Code No: RR322103 **RR** **Set No. 2**

III B.Tech II Semester Examinations,December 2010
AEROSPACE PROPULSION - II
Aeronautical Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

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1. The following particulars relate to a single stage turbine of free vortex design:

   Inlet temperature T_{01}= 1050 K

   Inlet pressure p_{01} = 3.8 bar

   Pressure ratio (p_{01}/p_{03}) = 2.0

   Outlet velocity C_3 = 275 m/s

   Blade speed at root radius = 300 m/s

   Isentropic efficiency η_t = 0.88

   The above data yields the following results for the gas angles:

	α_2	β_2	α_3	β_3
Tip	$54^0 56'$	0^0	$8^0 31'$	$58^0 20'$
Mean	$58^0 23'$	$20^0 29'$	10^0	$54^0 57'$
Root	$62^0 9'$	$39^0 19'$	$12^0 7'$	$51^0 8'$

   The values of radius ratio in plane 2 were $(r_m/r_r)_2 = 1.164$ and $(r_m/r_t)_2 = 0.877$.

   Using the same mean diameter angles, calculate β_2 at tip and root for constant nozzle angle design in which α_2 and C_{w2}. $r^{(sin\alpha 2)*(sin\alpha 2)}$ are constant over the annulus.

   Compare the two designs by sketching the velocity diagrams and commenting qualitatively on such aspects as the radial variation of degree of reaction and blade inlet Mach number. [16]

2. What do you understand by electrostatic thrusters? Explain the working principle and various types with the help of suitable diagrams. [16]

3. (a) Define 'effective jet Mach number' for a ramjet engine and derive the relationship for it.

   (b) Write a short note on 'external drag' of a ramjet engine. [8+8]

4. (a) What do you understand by burning rate of solid propellant? Explain the various factors affecting the burning rate in a full scale rocket motor.

   (b) Distinguish between composite and double base solid propellant. What are their merits and demerits? [10+6]

5. A preliminary performance analysis is to be made of a two dimensional ramjet engine which is to be installed in the wing of a supersonic airplane. The design flight

Mach number is $M_0 = 3.0$ at 50000 ft altitude and the maximum total temperature due to combustion is 4000^0R. The ramjet engine is to be equipped with a diverging diffuser. Calculate

(a) the area ratio of the diffuser A_2/A_1,

(b) the area ratio for converging exhaust nozzle A_6/A_7,

(c) the weight ratio of air flow into the engine,

(d) the pressure ratio P_6/P_0,

(e) The gross thrust coefficient C_{Fg} and

(f) the TSFC.

Assume that the Mach number M_2 at the entrance to the constant area combustion chamber is 0.2, k=1.4=constant, the lower heating value of the fuel is 19300 Btu/lb, A_1= 10ft^2 and the flow is frictionless and neglect the effect of the fuel flow on the thrust. [16]

6. (a) Derive the equation for thrust of a rocket motor.

   (b) Differentiate between a rocket and a missile. [9+7]

7. Define loss coefficient for nozzle and rotor blade of an axial turbine stage and derive relationship for stage isentropic efficiency relating nozzle and rotor loss coefficient. [16]

8. What is the need of cooling in liquid rockets? Explain the various methods of cooling. [16]

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Code No: RR322103 **RR** **Set No. 4**

III B.Tech II Semester Examinations,December 2010
AEROSPACE PROPULSION - II
Aeronautical Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Derive the equation for thrust of a rocket motor.
   (b) Differentiate between a rocket and a missile. [9+7]
2. (a) What do you understand by burning rate of solid propellant? Explain the various factors affecting the burning rate in a full scale rocket motor.
   (b) Distinguish between composite and double base solid propellant. What are their merits and demerits? [10+6]
3. (a) Define 'effective jet Mach number' for a ramjet engine and derive the relationship for it.
   (b) Write a short note on 'external drag' of a ramjet engine. [8+8]
4. What do you understand by electrostatic thrusters? Explain the working principle and various types with the help of suitable diagrams. [16]
5. What is the need of cooling in liquid rockets? Explain the various methods of cooling. [16]
6. A preliminary performance analysis is to be made of a two dimensional ramjet engine which is to be installed in the wing of a supersonic airplane. The design flight Mach number is $M_0 = 3.0$ at 50000 ft altitude and the maximum total temperature due to combustion is 4000^0R. The ramjet engine is to be equipped with a diverging diffuser. Calculate
   (a) the area ratio of the diffuser A_2/A_1,
   (b) the area ratio for converging exhaust nozzle A_6/A_7,
   (c) the weight ratio of air flow into the engine,
   (d) the pressure ratio P_6/P_0,
   (e) The gross thrust coefficient C_{Fg} and
   (f) the TSFC.

   Assume that the Mach number M_2 at the entrance to the constant area combustion chamber is 0.2, k=1.4=constant, the lower heating value of the fuel is 19300 Btu/lb, A_1= 10ft^2 and the flow is frictionless and neglect the effect of the fuel flow on the thrust. [16]

7. The following particulars relate to a single stage turbine of free vortex design:

   Inlet temperature T_{01}= 1050 K

   Inlet pressure p_{01} = 3.8 bar

   Pressure ratio (p_{01}/p_{03}) = 2.0

   Outlet velocity C_3 = 275 m/s

   Blade speed at root radius = 300 m/s

   Isentropic efficiency η_t = 0.88

   The above data yields the following results for the gas angles:

	α_2	β_2	α_3	β_3
Tip	$54^0$56'	0^0	$8^0$31'	$58^0$20'
Mean	$58^0$23'	$20^0$29'	10^0	$54^0$57'
Root	$62^0$9'	$39^0$19'	$12^0$7'	$51^0$8'

   The values of radius ratio in plane 2 were $(r_m/r_r)_2$ = 1.164 and $(r_m/r_t)_2$ = 0.877.

   Using the same mean diameter angles, calculate β_2 at tip and root for constant nozzle angle design in which α_2 and C_{w2}. $r^{(sin\alpha 2)*(sin\alpha 2)}$ are constant over the annulus.

   Compare the two designs by sketching the velocity diagrams and commenting qualitatively on such aspects as the radial variation of degree of reaction and blade inlet Mach number. [16]

8. Define loss coefficient for nozzle and rotor blade of an axial turbine stage and derive relationship for stage isentropic efficiency relating nozzle and rotor loss coefficient. [16]

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Code No: RR322103 **RR** **Set No. 1**

III B.Tech II Semester Examinations,December 2010
AEROSPACE PROPULSION - II
Aeronautical Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) What do you understand by burning rate of solid propellant? Explain the various factors affecting the burning rate in a full scale rocket motor.
   (b) Distinguish between composite and double base solid propellant. What are their merits and demerits? [10+6]

2. The following particulars relate to a single stage turbine of free vortex design:

   Inlet temperature T_{01}= 1050 K

   Inlet pressure p_{01} = 3.8 bar

   Pressure ratio (p_{01}/p_{03}) = 2.0

   Outlet velocity C_3 = 275 m/s

   Blade speed at root radius = 300 m/s

   Isentropic efficiency η_t = 0.88

   The above data yields the following results for the gas angles:

	α_2	β_2	α_3	β_3
Tip	$54^0 56'$	0^0	$8^0 31'$	$58^0 20'$
Mean	$58^0 23'$	$20^0 29'$	10^0	$54^0 57'$
Root	$62^0 9'$	$39^0 19'$	$12^0 7'$	$51^0 8'$

   The values of radius ratio in plane 2 were $(r_m/r_r)_2 = 1.164$ and $(r_m/r_t)_2 = 0.877$.

   Using the same mean diameter angles, calculate β_2 at tip and root for constant nozzle angle design in which α_2 and C_{w2}. $r^{(sin\alpha 2)*(sin\alpha 2)}$ are constant over the annulus.

   Compare the two designs by sketching the velocity diagrams and commenting qualitatively on such aspects as the radial variation of degree of reaction and blade inlet Mach number. [16]

3. What do you understand by electrostatic thrusters? Explain the working principle and various types with the help of suitable diagrams. [16]

4. A preliminary performance analysis is to be made of a two dimensional ramjet engine which is to be installed in the wing of a supersonic airplane. The design flight Mach number is M_0 = 3.0 at 50000 ft altitude and the maximum total temperature due to combustion is 4000^0R. The ramjet engine is to be equipped with a diverging diffuser. Calculate

   (a) the area ratio of the diffuser A_2/A_1,

(b) the area ratio for converging exhaust nozzle A_6/A_7,

(c) the weight ratio of air flow into the engine,

(d) the pressure ratio P_6/P_0,

(e) The gross thrust coefficient C_{Fg} and

(f) the TSFC.

Assume that the Mach number M_2 at the entrance to the constant area combustion chamber is 0.2, k=1.4=constant, the lower heating value of the fuel is 19300 Btu/lb, A_1= 10ft^2 and the flow is frictionless and neglect the effect of the fuel flow on the thrust. [16]

5. What is the need of cooling in liquid rockets? Explain the various methods of cooling. [16]

6. (a) Derive the equation for thrust of a rocket motor.

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7. (a) Define 'effective jet Mach number' for a ramjet engine and derive the relationship for it.

   (b) Write a short note on 'external drag' of a ramjet engine. [8+8]

8. Define loss coefficient for nozzle and rotor blade of an axial turbine stage and derive relationship for stage isentropic efficiency relating nozzle and rotor loss coefficient. [16]

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Code No: RR322103 **RR** **Set No. 3**

III B.Tech II Semester Examinations,December 2010
AEROSPACE PROPULSION - II
Aeronautical Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

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1. A preliminary performance analysis is to be made of a two dimensional ramjet engine which is to be installed in the wing of a supersonic airplane. The design flight Mach number is $M_0 = 3.0$ at 50000 ft altitude and the maximum total temperature due to combustion is 4000^0R. The ramjet engine is to be equipped with a diverging diffuser. Calculate
   (a) the area ratio of the diffuser A_2/A_1,
   (b) the area ratio for converging exhaust nozzle A_6/A_7,
   (c) the weight ratio of air flow into the engine,
   (d) the pressure ratio P_6/P_0,
   (e) The gross thrust coefficient C_{Fg} and
   (f) the TSFC.

   Assume that the Mach number M_2 at the entrance to the constant area combustion chamber is 0.2, k=1.4=constant, the lower heating value of the fuel is 19300 Btu/lb, A_1= 10ft^2 and the flow is frictionless and neglect the effect of the fuel flow on the thrust. [16]

2. What do you understand by electrostatic thrusters? Explain the working principle and various types with the help of suitable diagrams. [16]

3. (a) What do you understand by burning rate of solid propellant? Explain the various factors affecting the burning rate in a full scale rocket motor.
   (b) Distinguish between composite and double base solid propellant. What are their merits and demerits? [10+6]

4. What is the need of cooling in liquid rockets? Explain the various methods of cooling. [16]

5. Define loss coefficient for nozzle and rotor blade of an axial turbine stage and derive relationship for stage isentropic efficiency relating nozzle and rotor loss coefficient. [16]

6. (a) Define 'effective jet Mach number' for a ramjet engine and derive the relationship for it.
   (b) Write a short note on 'external drag' of a ramjet engine. [8+8]

7. The following particulars relate to a single stage turbine of free vortex design:

   Inlet temperature T_{01}= 1050 K

   Inlet pressure p_{01} = 3.8 bar

   Pressure ratio (p_{01}/p_{03}) = 2.0

   Outlet velocity C_3 = 275 m/s

   Blade speed at root radius = 300 m/s

   Isentropic efficiency η_t = 0.88

   The above data yields the following results for the gas angles:

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   The values of radius ratio in plane 2 were $(r_m/r_r)_2$ = 1.164 and $(r_m/r_t)_2$ = 0.877.

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8. (a) Derive the equation for thrust of a rocket motor.

   (b) Differentiate between a rocket and a missile. [9+7]

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