Code No: 07A52104 **R07** **Set No. 2**

III B.Tech I Semester Examinations,May 2011
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. What is inlet buzz? Explain its origin and the method to control it. [16]
2. What do you understand by the term combustion? Explain the significance of various types of pressure losses occurring in gas turbine combustors. [16]
3. Enumerate the purpose of an aircraft gas turbine nozzle. [16]
4. What is ram recovery point and enumerate its significance in subsonic inlets. [16]
5. A centrifugal compressor has a pressure ratio of 4:1 with an isentropic efficiency of 80% when running at 15,000 rpm and inducing air at 293 K. Curved vanes at inlet give the air at pre-whirl of 25^0 to the axial direction at all radii and the mean dia of eye is 250 mm. The absolute air velocity at inlet is 150 m/s. Impeller tip dia is 600 mm. Calculate the slip factor. [16]
6. Explain the process of cooling of combustion products with the air in a combustion chamber using an appropriate sketch. [16]
7. Enumerate three different methods of thrust augmentation and explain any two of them in detail with appropriate sketches. [16]
8. (a) Derive an expression to calculate the pressure ratio on a stage.
   (b) A 50% reaction, axial flow compressor runs at a mean blade speed of 250 m/s. The pressure ratio developed by the machine is 1.3. Determine the blade and air angle if the mean flow velocity is 200 m/s. Condition at inlet are4 1 bar and 300 K. [8+8]

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Code No: 07A52104 **R07** **Set No. 4**

III B.Tech I Semester Examinations,May 2011
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. List eight major functions of an exhaust nozzle. [16]
2. Enumerate the significance of temperature distribution at burner exit with suitable curve. [16]
3. What is a nacelle? Explain the subsonic inlet nomenclature with a neat sketch. [16]
4. Explain in detail the working of a typical GE combustor with a neat sketch. [16]
5. Explain briefly the following performance parameters:
   (a) Power input factor,
   (b) Pressure coefficients and
   (c) Compressor efficiency. [16]
6. What are the basic requirements of compressors for aircraft applications? Do axial flow compressors meet them? Explain. [16]
7. A turbofan (approximately same size as a commercial turbofan engine) operates at sea level and moves at 269.7 m/s. It ingests 121.1 kg/s of air into the core and five times this amount into the fan (the bypass ratio), which all exhausts through the fan exhaust. The fuel flow is negligible. The exit areas of the fan and core are 1.580 and 1.794 m^2, respectively. The exit pressures from the fan and core are 154.4 and 144.8 kPa, respectively. The exhaust velocities from the fan and core are 328.6 and 362.7 m/s, respectively. Find the thrust. [16]
8. Derive and explain significance of Prandtl relation obtained in the normal shock wave relations inside a supersonic inlet. [16]

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Code No: 07A52104 **R07** **Set No. 1**

III B.Tech I Semester Examinations,May 2011
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. Discuss significance of boundary layer bleed flow on the performance of supersonic inlet. [16]
2. What are different types of nozzles used in aircraft engine? Briefly explain them. [16]
3. Define degree of reaction and derive an expression for the same. [16]
4. Derive Euler's energy equation for a turbo-machine and explain its physical meaning with a velocity diagram at rotor blade exit?? [16]
5. Explain in detail the process of ignition occurring inside a combustion chamber. [16]
6. What do you understand by vortex generators? Explain its role played in the internal flow physics of inlets using a schematic diagram. [16]
7. (a) Discuss briefly the contingencies experienced due to fuel injection inside combustors.
   (b) What are atomizers? Explain their significance by enumerating the requirements of a good atomizer. [16]
8. Briefly explain the phenomena of surge and choking in centrifugal compressors. [16]

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Code No: 07A52104 **R07** **Set No. 3**

III B.Tech I Semester Examinations,May 2011
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. A three-stage axial flow compressor developing a pressure ratio of 3 delivers 10 Kg/s of air. The air enters the rotor with a velocity of 220 m/s and at an angle of 15^0. The velocity diagram is symmetrical. Determine the speed of compressor if the blade height is restricted to 25 mm at the inlet. Take inlet conditions, stagnation pressure and stagnation temperature are 1 bar and 300 K, degree of reaction = 0.5 and polytropic efficiency = 0.9. [16]

2. (a) Discuss the significance of total pressure recovery characteristic on the performance of supersonic inlets.
   (b) Discuss significance of cowl drag characteristic on the performance of supersonic inlet. [8+8]

3. A single-sided straight vaned centrifugal compressor is required to deliver 10kg/s of air with a total pressure ratio of 4:1 when operating at a speed of 16500rpm. The air inlet pressure and temperature are 1.013bar and 300K respectively. Calculate:
   (a) Tip speed of the impeller.
   (b) Actual rise in stagnation temperature.
   (c) Tip diameter.
   (d) Inlet eye annulus area.
   (e) Theoretical power required to drive the compressor. The air enters the eye axially with a velocity of 150m/s.

   [16]

4. Discuss briefly about different measures used for noise suppression in aircraft jet engines. [16]

5. Discuss briefly the contingencies experienced due to fuel injection inside combustors. [16]

6. Discuss in detail fluid flow through a rotor blade and the nomenclature associated with it? [16]

7. Consider Ear type air intakes for a subsonic airplane as that for Gnat / Ajit fighter plane. Show the internal layout for swallowed air to reach the engine. Explain its aerodynamics and thermodynamics in detail when the airplane takes a turn of about 10 in its yaw plane.

   [16]

8. (a) Balance the following equation and calculate the stoichiometric fuel to air ratio. $C_{10}\ H_{22} + Y\ 0_2 + 3.76\ Y\ N_2 \longrightarrow X\ H_20 + Z\ C0_2 + 3.76\ Y\ N$

   (b) Explain briefly the process of ignition occurring inside a combustion chamber. [10+6]

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Code No: 09A52104	R09	SET-1

B. Tech III Year I Semester Examinations, December - 2011
AEROSPACE PROPULSION - I
(AERONAUTICAL ENGINEERING)

Time: 3 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks

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1. In a Gas Turbine plant, working on the Brayton cycle with a regenerator of 75% effectiveness , the air at the inlet to the compressor is at 0.1 Mpa 30^oC , the pressure ratio is 6 , and the maximum cycle temperature is 900^oC . If the turbine and compressor have each an efficiency of 80%, find the percentage increase in the cycle efficiency due to regeneration. [15]

2. Define parametric cycle analysis and explain the engine performance parameters for ideal and real engines. [15]

3. Write a short notes on the following :
   a) Engine back pressure control, c) Exhaust Nozzle area ratio
   b) Thrust reversing and Thrust Vectoring, d) Nozzle coefficients. [15]

4. Explain the importance of following terms in deciding the performance of a combustion chamber:
   a) Combustion Efficiency c) Pressure Loss
   b) Combustion Intensity d) Stability Limits. [15]

5. Explain the following factors
   a) Gross thrust coefficient.
   b) Discharge coefficient.
   c) Angularity coefficient. [15]

6. Starting from the first principles and with the help of neatly drawn velocity triangles obtain the following relationship: $\Omega = [(\varphi/2) (\tan \beta_3 - \tan \beta_2)]$, Where Ω is the degree of reaction, `φ' is the flow coefficient; β_2 and β_3 are the air angles. [15]

7. How do you differentiate between an impulse and reaction type turbine? With the help of a neat sketch explain the working of an impulse and a reaction stage of a turbine. [15]

8. Define the significance of turbine and compressor components matching. Describe the method of matching them for a twin-spool engine. [15]

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Code No: 09A52104	R09	SET-2

B. Tech III Year I Semester Examinations, December - 2011
AEROSPACE PROPULSION - I
(AERONAUTICAL ENGINEERING)

Time: 3 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks

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1. Describe the flight regime for the suitability of a turbo-prop engine in aviation and explain with examples. Make a lay out sketch of this engine, explain its thermodynamic cycle and work out its efficiency. [15]

2. What are different types of air intakes for subsonic airplanes powered by turbo jets? Illustrate each of these categories with sketches and aerodynamic characteristics. [15]

3. Explain the concept of exhaust flow pattern across a convergent nozzle and a convergent-divergent nozzle with appropriate sketches. [15]

4. Explain its aerodynamics and thermodynamics in details when the airplane is in its flight at its near stalling speed in subsonic aircrafts and explain thrust reversing and Vectoring. [15]

5.a) What are the differences between Axial flow Compressor and centrifugal compressor? Explain in detail.

b) Explain the following with respect to axial flow compressor:
i) Cascade characteristics
ii) Reynolds and Mach number effects. [7+8]

6. A multi-stage gas turbine is to be designed with impulse stages, and is to be operated with an inlet pressure and temperature of 6 bar and 900 K respectively and an outlet pressure of 1 bar. The isentropic efficiency of the turbine is 85%. All the stages are required to have a nozzle outlet angle of 15^0. Also, they have equal outlet & inlet blade angles and equal inlet & outlet gas angles. Mean blade speed is equal to 250m/s. Assuming Cp = 1.15 kJ/kgs and $\gamma = 1.333$, estimate the number of stages required [15]

7.a) What are different types of flow losses in the compressor? Explain in detail.

b) What are the basic requirements of a fuel injection system? Explain the working of a typical fuel injection system of a turbine engine with the help of a sketch. [15]

8. Write short notes on the following:
a) Dimensional analysis and its application in generating turbine characteristics.
b) Equilibrium running lines. [15]

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Code No: 09A52104 | R09 | SET-3

B. Tech III Year I Semester Examinations, December - 2011
AEROSPACE PROPULSION - I
(AERONAUTICAL ENGINEERING)

Time: 3 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks

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1. Write the Steps involved in the parametric cycle analysis of the ideal Turbo prop engine with suitable diagram. [15]

2. Illustrate with neat sketches and plots various components of a gas turbine engine. What are its added advantages over a piston engine? Explain the thermodynamics of each component put on the same plot. [15]

3. What is the total thrust comprised of? Derive a general equation for the thrust developed in a jet engine? [15]

4. In a Gas Turbine plant, working on the Brayton cycle with a regenerator of 75% effectiveness, the air at the inlet to the compressor is at 0.1 Mpa 30 ^{o}c , the pressure ratio is 6, and the maximum cycle temperature is 900 $^{o}_{C}$. If the turbine & compressor have each an efficiency of 80%, find the percentage increase in the cycle efficiency due to regeneration. [15]

5. Making use of first principle, develop an expression for thrust developed by a jet Engine with inlet area of 0.45 sq. m .A turbojet engine is under static testing on a test bed. It develops a jet speed of 400 m /s at a pressure of 1 atm at 750 K at exit of the nozzle. Considering the location at sea level, calculate the static thrust.[15]

6. What do you mean by Rotating Stall and Surging? Explain their consequences. [15]

7. Explain the three-dimensional flow in axial flow compressor and derive the free vortex condition. What does free vortex condition signify? [15]

8.a) What are the types of turbine blade stages? Explain each.
b) Why turbine blade cooling is required? Explain the types of Turbine blade cooling methods and what are the materials required for the blade cooling? [7+8]

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Code No: 09A52104	R09	SET-4

B. Tech III Year I Semester Examinations, December - 2011
AEROSPACE PROPULSION - I
(AERONAUTICAL ENGINEERING)

Time: 3 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks

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1. Draw a Schematic diagram of Ramjet engine and describe its operation. What are its advantage and disadvantage? [15]

2. A turbo-prop driven airplane is flying at 600 Km / h at an altitude where the ambient conditions are 0.458 bar and -15 ^{o}C. The compressor pressure ratio is 9:1 and the turbine inlet temperature is 1200 K. The isentropic efficiencies of compressor and turbine are 0.89 and 0.93 respectively. Assuming that no thrust is generated by the jet exhaust from the engine; calculate the specific power input available to the propeller. [15]

3.a) Derive the expressions for thermal efficiency, propulsive efficiency and specific thrust for turbofan engine using parametric cycle analysis.

b) Write notes on:
i) Oswatitsch type oblique shock diffuser,
ii) Starting of an oblique shock inlet. [7+8]

4. Make use of a block diagram to illustrate the operation of a gas turbine engine and Explain its operation in details. Show the variation of pressure, temperature and Velocity along the engine. [15]

5. What are the various components of a flame tube type combustion chamber? Explain the combustion process in flame tube with the help of a neat and labeled sketch and define the terms Degree of reaction, Combustion loading parameter and Combustion efficiency. [15]

6. Draw the velocity triangle diagram for axial flow compressor? Derive the equation for it. [15]

7. The following particulars of a single stage turbine of free vortex are given below:
Total head inlet pressure = 4.6 bar, Total head inlet temperature = 700^{0}C, Static head pressure at mean radius = 1.6 bar , Mean blade diameter/blade height = 10, Nozzle loss coefficient = 0.10, Nozzle outlet angle = 28^{o}
Determine the gas temperature, velocities, and discharge angle at the blade root and tip radii. Take C_p = 1.147, γ = 1.33 and mass flow rate = 20 kg/s. [15]

8.a) Explain the significance and requirements for component matching.

b) Explain gas generator with neat sketches. [7+8]

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Code No: 07A52104 **R07** **Set No. 2**

III B.Tech I Semester Examinations,December 2011
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. What is meant by low degree of reaction and high degree of reaction? How do you differentiate these two? [16]

2. Explain about the limitations of the following in gas turbine combustors with their relative importance

   (a) Pressure.
   (b) Temperature.
   (c) Inlet air velocities.
   (d) Flame speeds.
   (e) Light gauge heat resistant sheets.

   [16]

3. (a) Enumerate four fundamental laws frequently used in dealing with problems and operation of rotary components like gas turbines.
   (b) Explain important thermodynamic properties used in the understanding of gas turbines. [8+8]

4. Discuss briefly the contingencies experienced due to ignition process inside combustors. [16]

5. (a) A centrifugal air compressor delivers 20 kg/s of air with a total head pressure ratio of 4:1. The speed of compressor is 12000 rpm. Inlet total temperature is 15^0C, slip factor 0.9, power inlet factor 1.04, and the total head isentropic efficiency as 80%. Calculate overall diameter of the impeller.
   (b) Briefly explain how a centrifugal compressor diffuser is designed. [8+8]

6. Explain the concept of thrust reversing using clamshell reverse type of arrangement with neat sketch. [16]

7. What are subsonic inlets? Explain the significance of nacelle in subsonic inlets. [16]

8. Derive normal shock wave relations for a calorifically perfect gas. [16]

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Code No: 07A52104 **R07** **Set No. 4**

III B.Tech I Semester Examinations,December 2011
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. Explain about the limitations of the following in gas turbine combustors with their relative importance
   (a) Pressure.
   (b) Temperature.
   (c) Inlet air velocities.
   (d) Flame speeds.
   (e) Light gauge heat resistant sheets.
   [16]
2. What is meant by low degree of reaction and high degree of reaction? How do you differentiate these two? [16]
3. Derive normal shock wave relations for a calorifically perfect gas. [16]
4. Explain the concept of thrust reversing using clamshell reverse type of arrangement with neat sketch.
   [16]
5. What are subsonic inlets? Explain the significance of nacelle in subsonic inlets.
   [16]
6. (a) Enumerate four fundamental laws frequently used in dealing with problems and operation of rotary components like gas turbines.
   (b) Explain important thermodynamic properties used in the understanding of gas turbines. [8+8]
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   (b) Briefly explain how a centrifugal compressor diffuser is designed. [8+8]
8. Discuss briefly the contingencies experienced due to ignition process inside combustors. [16]

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Code No: 07A52104 **R07** **Set No. 1**

III B.Tech I Semester Examinations,December 2011
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. Explain about the limitations of the following in gas turbine combustors with their relative importance
   (a) Pressure.
   (b) Temperature.
   (c) Inlet air velocities.
   (d) Flame speeds.
   (e) Light gauge heat resistant sheets.
   [16]
2. What is meant by low degree of reaction and high degree of reaction? How do you differentiate these two? [16]
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   (b) Briefly explain how a centrifugal compressor diffuser is designed. [8+8]
5. Explain the concept of thrust reversing using clamshell reverse type of arrangement with neat sketch. [16]
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   (b) Explain important thermodynamic properties used in the understanding of gas turbines. [8+8]
8. Discuss briefly the contingencies experienced due to ignition process inside combustors. [16]

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Code No: 07A52104 **R07** **Set No. 3**

III B.Tech I Semester Examinations,December 2011
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. Explain the concept of thrust reversing using clamshell reverse type of arrangement with neat sketch. [16]

2. (a) A centrifugal air compressor delivers 20 kg/s of air with a total head pressure ratio of 4:1. The speed of compressor is 12000 rpm. Inlet total temperature is 15^0C, slip factor 0.9, power inlet factor 1.04, and the total head isentropic efficiency as 80%. Calculate overall diameter of the impeller.
   (b) Briefly explain how a centrifugal compressor diffuser is designed. [8+8]

3. Explain about the limitations of the following in gas turbine combustors with their relative importance
   (a) Pressure.
   (b) Temperature.
   (c) Inlet air velocities.
   (d) Flame speeds.
   (e) Light gauge heat resistant sheets. [16]

4. What is meant by low degree of reaction and high degree of reaction? How do you differentiate these two? [16]

5. Discuss briefly the contingencies experienced due to ignition process inside combustors. [16]

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   (b) Explain important thermodynamic properties used in the understanding of gas turbines. [8+8]

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