Code No: 45048 **R07** **Set No - 1**

III B.Tech I Semester Regular Examinations,Nov/Dec 2009
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 are carbon deposits? Explain crucial role played by it on the performance of combustors. [16]
2. Air at 1.032 bar and 288 K enters an axial flow compressor stage with an axial velocity 150 m/s. There are no inlet guide vanes. The rotor stage has tip diameter of 60 cm and hub diameter of 50 cm and rotates at 100 rps. The air enters the rotor and leaves the stator in the axial direction with no change in velocity or radius. The air is turned through 30.2^0 as it passes through rotor. Assume a stage pressure ratio of 1.2. Assuming the constant specific heats and that the air enters and leaves the blade at the blade angles.
   (a) Construct the velocity at mean dia for this stage,
   (b) Mass flow rate,
   (c) Power required and.
   (d) Degree of reaction. [16]
3. Differentiate between impulse and reaction blading of an axial flow turbine. [16]
4. Discuss the nozzle performance with reference to nozzle performance variables and useful correlations. [16]
5. What is ram recovery point and enumerate its significance in subsonic inlets. [16]
6. A centrifugal compressor of 40.6 cm diameter revolving at 18000 rpm delivers air at an isentropic efficiency of)0.78. what would be the approximate pressure ratio expected if the machine was at 6000 m altitude where $P_0 = 35$ cm of Hg and $T_0 = 248$ K. Calculate the actual delivery temperature and the power required to deliver air at the rate of 0.5 kg/s. Neglect effects of inlet and exit velocities. [16]
7. Explain in detail the steps involved in the combustion of a liquid fuel in a gas turbine combustor. [16]
8. A diffuser on a Mach 2 aircraft operates with a standing normal shock outside of the inlet at STP. If the internal diffuser recovery factor is 0.90, what are the diffuser exit total pressure and total pressure recovery from the free stream to the diffuser exit? [16]

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Code No: 45048 **R07** **Set No - 2**

III B.Tech I Semester Regular Examinations,Nov/Dec 2009
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) Determine the pressure ratio of a single sided centrifugal compressor and the power required to drive it, assuming that the velocity of air at inlet is axial, with the help of following data:
Rotational speed = 270rev/s
Overall diameter of impeller = 0.45m
Air mass flow = 8kg/s
Inlet stagnation temperature = 290K
Isentropic efficiency = 0.79
Slip factor = 0.9

   (b) Derive the relationship for work done and pressure ratio of a centrifugal compressor. [8+8]

2. Explain the significance of combustion efficiency with respect to the actual and theoretical total temperature rise across a gas turbine combustor. [16]

3. Discuss significance of capture area ratio (mass flow ratio) characteristic on the performance of supersonic inlet. [16]

4. (a) Derive an expression for work input to the compressor and explain.
   (b) What is meant by work done factor? [8+8]

5. State the various laws used in designing turbo-machines and the relationship between enthalpy and internal energy for a gas turbine? [16]

6. What do you understand by the term diffusion? Explain its significance with reference to static pressure rise across divergent inlets. [16]

7. (a) Describe the exhaust mechanism in a convergent nozzle of fixed area with a neat sketch.
   (b) Discuss the airflow mechanism in a convergent-divergent nozzle of variable area with a schematic. [8+8]

8. 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]

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Code No: 45048 **R07** **Set No - 3**

III B.Tech I Semester Regular Examinations,Nov/Dec 2009
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 centrifugal compressor has an inlet eye 15 cm diameter. The impeller revolves at 20,00 rpm and the inlet air has an axial velocity of 107 m/s, inlet stagnation temperature 294 K and inlet pressure 1.03 kg/cm^2 . Determine:
   (a) Theoretical angle of the blade at this point and.
   (b) Mach number of the flow at the tip of eye. [16]

2. Enumerate and discuss various types of drag that play a significant role in the design of inlets. [16]

3. What are different types of nozzles used in aircraft engine? Briefly explain them. [16]

4. Find the polytropic efficiency of an axial flow compressor from the following data:
   The total head pressure ratio: 4
   Overall total head isentropic efficiency: 85 Total head inlet temperature: 290k
   The inlet and outlet air angles from the rotor blades of the above compressor are 10^0 and 45^0 respectively. The rotor and stator blades are symmetrical. The mean blade speed and axial velocity remains constant throughout the compressor. Assuming a value of 220 m/s for blade speed and the work done factor as 0.86, find the number of stages required. Also find the inlet Mach number relative to rotor at the mean blade height of the first stage.
   Assume R=284.6 KJ/Kg K. [16]

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

6. Why is it desirable for a high speed supersonic inlet to produce a series of weak oblique shocks? Explain in detail. [16]

7. (a) Explain advantages, disadvantages, basic characteristics and applications of a Ramjet engine.
   (b) Show that a turbofan with all of its bypassed air mixed into the core flow, results in same thrust equation as for a turbojet. [8+8]

8. Explain in detail various forms of combustion systems used in aircraft engines with appropriate sketches. [16]

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Code No: 45048 **R07** **Set No - 4**

III B.Tech I Semester Regular Examinations,Nov/Dec 2009
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) Discuss significance of starting and stability characteristics on the performance of an inlet.
   (b) Discuss significance of life, cost and reliability characteristics on the performance of inlets. [8+8]
2. Discuss significance of boundary layer bleed flow on the performance of supersonic inlet. [16]
3. Enumerate and discuss briefly the effect of four operating variables on burner performance. [16]
4. Explain in detail the process of ignition occurring inside a combustion chamber. [16]
5. Discuss in detail fluid flow through a rotor blade and the nomenclature associated with it? [16]
6. Enumerate the significance of local angularity coefficient on the performance of nozzle with suitable plot. [16]
7. (a) Determine the slip factor in a single-sided centrifugal compressor fitted in the aircraft flying with a speed of 230 m/s at an altitude where the pressure is 0.25 bar and the static temperature is 22o K. the mean dia of the eye is 25.5 cm and the impeller tip dia is 54 cm. rotational speed of the compressor is 16,000 rpm and the inlet duct of impeller eye contains fixed vanes which gives the air pre-whirl of $65^0$with respect to the pre-whirl speed at allradii. Stagnation pressure at compressor outlet is 1.75 bar. Take the power input factor as 1.04 and isentropic efficiency as 0.8.
   (b) Derive Stanitz's formula for slip factor. [8+8]
8. Explain the three-dimensional flow in axial flow compressor and derive the free-vortex condition. What does free vortex condition signify? [16]

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