Hall Ticket No | | | | | | | | | | | Question Paper Code: AAE007

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

B.Tech V Semester End Examinations (Supplementary) - January, 2019

Regulation: IARE – R16

AIRCRAFT PROPULSION

Time: 3 Hours **(AE)** **Max Marks: 70**

Answer ONE Question from each Unit
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

UNIT – I

1. (a) Construct a simple line diagram of gas turbine and explain with p-V, T-s diagram how it functions? **[7M]**

   (b) A gas turbine operating at a pressure ratio of 11.314 produces zero net work output when 473.35 kJ of heat is added per kg of air. If the inlet air temperature is 300 K and the turbine efficiency if 71%, find the compressor efficiency? **[7M]**

2. (a) Derive the thrust equation for gas turbine engine. **[7M]**

   (b) The effective jet exit velocity from a jet engine is 2700 m/s. the forward flight velocity is 1350 m/s and the air flow rate is78.6 kg/s. Calculate thrust, thrust power and propulsive efficiency. **[7M]**

UNIT – II

3. (a) Discuss the following: **[7M]**
   i) Supersonic inlets
   ii) Factors affecting diffuser performance.

   (b) Differentiate between internal compression and external compression in a supersonic inlet. **[7M]**

4. (a) State the main factors which are effecting combustion chamber performance? and explain in detail? **[7M]**

   (b) Differentiate between Can-type and Cannular-type combustor in gas turbine with a neat sketch? **[7M]**

UNIT – III

5. (a) Explain in detail about different operating conditions in CD nozzle. **[7M]**

   (b) Write brief notes on thrust vectoring and various methods of thrust vectoring. **[7M]**

6. (a) Derive the equation for nozzle efficiency and explain the losses in nozzle. **[7M]**

   (b) A turbojet engine powering an aircraft flying at an altitude of 11,000m where T_a = 216.7 K and Pa = 24.444 kPa. The flight Mach number is 0.9. The inlet conditions to the nozzle are 1000 K and 60 kPa. The specific heat ratio of air and gases at nozzle are 1.4 and 4/3. The nozzle efficiency is 0.98. Determine the thrust per inlet frontal area for C-D nozzle **[7M]**

UNIT – IV

7. (a) Explain the various components of typical centrifugal compressors with the help of a schematic diagram. Discuss the actual pressure and velocity variations of flow across the impeller and diffuser **[7M]**

   (b) A centrifugal compressor compresses 30kg of air per second at a rotational speed of 15000 rpm. The air enters the compressor axially, and the conditions at the exit sections are radius =0.3m, relative velocity of air at tip=100m/s at an angle of 80^0 with respect to the plane of rotation take p_{01}=1 bar and T_{01}=300K. Find the torque and power required to drive the compressor and also the ideal head developed. **[7M]**

8. (a) Write short notes on performance characteristics of axial compressors **[7M]**

   (b) Explain the operating principle of centrifugal compressor with neat diagram. **[7M]**

UNIT – V

9. (a) Write short notes on work done and pressure rise by radial flow turbine and derive the equations. **[7M]**

   (b) Combustion gases enter the first stage of a gas turbine at a stagnation temperature and pressure of 1200 K and 4.0 bar. The rotor blade tip diameter is 0.75m, the blade height is 0.12 m and the shaft speed is 10,500 rpm. At the mean radius the stage operates with a reaction of 50%, a flow coefficient of 0.7and a stage loading coefficient of 2.5. Determine (a) the relative and absolute flow angles for the stage; (b) the velocity at nozzle exit; (c) the static temperature and pressure at nozzle exit assuming a nozzle efficiency of 0.96 and the mass flow **[7M]**

10. (a) What is axial and radial flow turbine? What are the limitations of axial and radial flow turbine? **[7M]**

    (b) A single stage gas turbine operates at its design condition with an axial absolute flow at entry and exit from the stage. The absolute flow angle at the nozzle exit is 70 deg. At stage entry, the total pressure and temperature are 311 kPa and 850^0C respectively. 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 axial velocity through the stage, determine **[7M]**

    (i) the specific work done

    (ii)the Mach number leaving the nozzle

    iii)the axial velocity

    (iv) total to total efficiency

    (v) stage reaction.

– ∘ ∘ ◯ ∘ ∘ –