Hall Ticket No | | | | | | | | | | | Question Paper Code:AAE551

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

B.Tech VI Semester End Examinations (Supplementary) - July, 2019

Regulation: IARE – R16

AEROSPACE PROPULSION AND COMBUSTION

Time: 3 Hours **(ME)** **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) Explain with a neat sketch the principles of operation of a turbojet engine and state its advantages and disadvantages. **[7M]**

   (b) A Turbojet engine operates at M=1.2 at an altitude of 6500m. The diameter of inlet diffuser at entry is 50cm and the stagnation temperature at the nozzle entry is 1500K. The calorific value of the fuel used is 40MJ/kg. The properties of the combustion gases are san=me those of air ($\gamma = 1.4$, R = 287 J/kg). The velocity of the air at the diffuser exit is negligible, calculate:
   i) The efficiency of ideal cycle ii) Flight speed iii) Air flow rate **[7M]**

2. (a) Compare the constructional features and operating performance of turbofan and turbojet engines. **[7M]**

   (b) A turbojet engine takes in 50 kg/s of air and propels an aircraft with uniform flight speed of 880km/hr. Isentropic enthalpy change for nozzle is 188 kJ/kg and velocity coefficient is 0.96. The fuel air ratio is 1.2%. Combustion efficiency is 95%. Calorific value of fuel is 44,000kJ/kg, Find out: i) Thermal efficiency ii) Fuel flow in kg/hr iii) Propulsive efficiency **[7M]**

UNIT – II

3. (a) Explain Momentum theory with a neat sketch? **[7M]**

   (b) An aircraft while cruising at 724 km/hr is expected to encounter 5927 N of drag. The propeller flying this aircraft is of diameter 3.657 m and is designed with NACA 5868-9 3-bladed propeller blades. The engine delivers 1491.4 kW while the propeller runs at 1300 rpm. Check if the aircraft propeller matching for cruise flight is achieved. Compute any extra power or power shortfall that may be found. **[7M]**

4. (a) With a suitable diagram explain the working principle of impulse turbine. **[7M]**

   (b) With a neat sketch explain the effect of turbine blade speed on velocity triangle. **[7M]**

UNIT – III

5. (a) Describe the behavior of flow in a convergent divergent nozzle. **[7M]**

   (b) A turbojet engine powering an aircraft flying at an altitude of 11,000m where Ta = 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 is 1.4 and 4/3. The nozzle efficiency is 0.98. Determine the thrust per inlet frontal area for C-D nozzle. **[7M]**

6. (a) What is the need for variable area nozzle and explain the methods used to attain in with a neat diagram. **[7M]**

   (b) Describe about subsonic inlet function and modes of operation with neat sketch. What is nacelle? Explain the subsonic inlet nomenclature with neat sketch. **[7M]**

UNIT – IV

7. (a) Explain in detail about the affect chemical equilibrium with respect to change in volume pressure, temperature and catalyst? **[7M]**

   (b) Define stochiometric ratio. Explain in detail about different flame holders used inside a combustion chamber with a neat diagram. **[7M]**

8. (a) Explain in detail about factors affecting combustion chamber design. **[7M]**

   (b) What are basic requirements of a combustion chamber? Explain. **[7M]**

UNIT – V

9. (a) What is minimum ignition energy? What are the basis to estimate its valve for a particular fuel-air mixture **[7M]**

   (b) What are the different flammability limits to obtain the assured flame? **[7M]**

10. (a) Define the laminar burning velocity? Why is it used for characterization of premixed flame? **[7M]**

    (b) Explain in brief about droplet combustion and write down the advantages and disadvantages over generalized combustion. **[7M]**

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