## Fifth Semester B.E. Degree Examination, June/July 2019 Aircraft Propulsion

Time: 3 hrs.

Max. Marks:100

Note: Answer any FIVE full questions, selecting at least TWO questions from each part.

PART - A

- 1 a. What are the different types of jet engines used in airplane? Write the limitations of each.
  - b. On what basis compressor and turbines are classified? Explain them. (08 Marks)
    (06 Marks)
  - c. The exit velocity from a jet unit is 650 M/sec for an air flow of 40 kg/sec through the unit. The aircraft is flying at 250 km/hour. Calculate the thrust developed, the thrust power and propulsive efficiency. (Neglect the mass of fuel).

    (06 Marks)
- 2 a. Explain the parameters affecting the performance of the propulsion cycle of a jet engine.
  - b. What are the ways of augumenting the thrust of a jet engine? (06 Marks) (06 Marks)
  - c. A simple turbojet unit operates with a maximum turbine inlet temperature of  $1200^{\circ}$ K, a pressure ratio of 4.25:1 and a mass flow of 25 kg/sec under design conditions. The isentropic efficiency of compressor is 87%, isentropic efficiency of turbine is 91.5%, propelling nozzle efficiency is 96.5%, transmission efficiency is 98.5%. combustion chamber pressure loss is 0.21 bar. Calculate the total design thrust. Assume  $C_{P_a} = 1.005$  kJ/kgK and  $\gamma = 1.4$ ,

 $C_{P_g} = 1.147 \text{ kJ/kgK} \text{ and } \gamma = 1.33.$  (08 Marks)

- 3 a. List the major design variables for the inlet and nacelle of a jet engine. (08 Marks)
  - b. Describe the function of the vortex generator in a diffuser. (06 Marks)
  - c. Describe the various classification of a supersonic air inlet. (06 Marks)
- 4 a. What are the various requirements of a combustion chamber in a jet engine? (08 Marks)
  - b. What is meant by engine Back Pressure Control? Explain how it is controlled. (06 Marks)
  - c. Write short notes on: (i) Gross Thrust coefficient (ii) Discharge coefficient (06 Marks)

PART - B

- 5 a. Name the performance parameters used to assess the centrifugal compressor. (06 Marks)
  - b. Describe the various flow losses in an axial compressor. (06 Marks)
    - c. The ideal and actual flow process occurring in a diffuser blade row is shown in Fig.Q5(c). Derive the efficiency in terms of diffuser stagnation pressure loss coefficient.

1 of 2

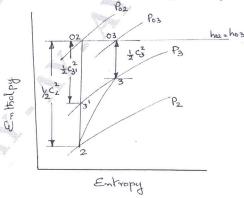


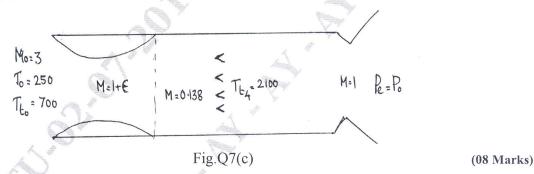
Fig.Q5(c)

(08 Marks)

Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice. compulsorily draw diagonal cross lines on the remaining blank pages. Important Note: 1. On completing your answers,

- 6 a. In a single stage impulse turbine the nozzle discharges the fluid on to the blades at an angle of 65° to the axial direction and the fluid leaves the blades with an absolute velocity of 300 M/S at an angle of 30° to the axial direction. If the blades have equal inlet and outlet angles and there is no axial thrust. Estimate the blade angle and power produced per kg/s of the fluid.

  (12 Marks)
  - b. Draw the velocity triangles of a single stage turbine and mark the velocities. (08 Marks)
- 7 a. Describe the principle of operation of a ram jet with the help of a neat sketch. (06 Marks)
  - b. What are the advantages and disadvantages of ram jet? (06 Marks)
  - c. What is the thrust of an ideal ram jet with a fully expanded nozzle for the data given in Fig.Q7(c)?



- 8 a. Explain ion-rocket propulsion with a neat sketch. (08 Marks)
  - b. What is the principle of rocket propulsion and write the equation for thrust and power required to produce exhaust jet? (06 Marks)
  - c. Write short notes on:
    - i) Requirements of liquid propellant in a rocket
    - ii) Performance differences of the air breathing engine and the rocket engine. (06 Marks)

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