USN ☐☐☐☐☐☐☐☐☐☐ **18AE43**

Fourth Semester B.E. Degree Examination, July/August 2021
Aircraft Propulsion

Time: 3 hrs.   Max. Marks: 100

Note: *Answer any FIVE full questions.*

1 a. Define and explain Mach number, Reynolds's number, compressible flow, incompressible flow and stagnation pressure. **(10 Marks)**
   b. With a neat sketch, explain the working principle of four stroke CI engine. **(10 Marks)**

2 a. What is meant by boundary layer? Explain Boundary Layer separation with Figure. **(08 Marks)**
   b. With a schematic diagram, explain the working principle of Turbojet engine. Also mention their advantages. **(12 Marks)**

3 a. Mention the types of propellers used for aircraft. Explain momentum theory of propellers. **(10 Marks)**
   b. With a neat graph, discuss the performance characteristics of Turbojet and turboprop engines. **(10 Marks)**

4 a. What is Thrust? Derive an equation of thrust for a propulsive device. **(08 Marks)**
   b. Define with relevant equations
      (i) Thrust power
      (ii) Propulsive efficiency. **(06 Marks)**
   c. The effective jet exit velocity from a jet engine is 13,320 km/hr. The forward flight velocity is 8460km/hr and the air flow rate is 86.5kg/s. Calculate :
      i)   Thrust
      ii) Thrust power and
      iii) Propulsive efficiency. **(06 Marks)**

5 a. Derive a relation for minimum area ratio (A_{max}/A_i) min in terms of external deceleration (V_i/u_a) and also explain with relevant graphs. **(10 Marks)**
   b. Define the working principle of supersonic inlets, explain its types. **(10 Marks)**

6 a. What do you mean by Thrust Reversal? Explain the types of thrust reversals with figures. **(10 Marks)**
   b. List the major design considerations for the inlets. **(06 Marks)**
   c. What are over expanded and under expanded nozzle? **(04 Marks)**

7 a. Explain the principle of operation of centrifugal compressors. **(10 Marks)**
   b. A centrifugal compressor has to deliver 35kg of air per second. The impeller is 76cm diameter revolving at 11500rpm with an adiabatic efficiency of 80%. If the pressure ratio as 4.2:1. Estimate the probable axial width of the impeller at the impeller tip if the radial velocity is 120m/s. The inlet conditions are 1 bar and 47°C. **(10 Marks)**

8 a. Explain the performance characteristics of axial flow compressor. **(10 Marks)**

b. An axial flow air compressor of 50% reaction design has blades with inlet and outlet angles of 45º and 10º respectively. The compressor is to produce a pressure ratio of 6:1 with an overall isentropic efficiency of 0.85 when inlet static temperature is out the compressor. Assuming a valve of 200m/s for blade speed fluid the number of stages require if the work done factor is i) Unity ii) 0.87 for all stages.

(10 Marks)

9 a. Describe the process of combustion in a gas turbine and explain classification of combustion chambers with neat diagrams. **(10 Marks)**

b. Explain the effect of operating variables on burner performance. **(10 Marks)**

10 a. Discuss various cooling techniques in a turbine blade with neat sketches. **(10 Marks)**

b. Define various losses in the turbine. **(07 Marks)**

c. What is a Turbine? Mention its classification. **(03 Marks)**

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