

Reg No.: \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

Fourth semester B.Tech examinations (S), September 2020

**Course Code: AO206****Course Name: PROPULSION I (AN)**

Max. Marks: 100

Duration: 3 Hours

**PART A***Answer any three full questions, each carries 10 marks*

Marks

- 1 a) Write a short note on the classification of piston engines. Mention at least 4 types of classification. (4)
- b) Explain the ideal momentum theory of propellers and derive an expression for the efficiency of a propeller. (6)
- 2 Explain the working of a turbojet engine with the help of a schematic diagram and also derive the expression for the thrust developed. (10)
- 3 Derive the relation between minimum area ratio and external deceleration ratio in a subsonic inlet. (10)
- 4 a) What is frozen flow and equilibrium flow with respect to flow in nozzles? (5)
- b) Discuss the concept of flame stabilization in combustion chambers. (5)

**PART B***Answer any three full questions, each carries 10 marks*

- 5 Discuss the performance characteristics of a single stage axial flow compressor. (10)
- 6 An axial compressor stage has the following data: (10)
- Temperature and pressure at entry= 300 K and 1.0 bar
- Degree of reaction =50%
- Mean blade ring diameter= 36 cm
- Rotational speed = 18000 rpm
- Blade height at entry= 6 cm
- Air angles at rotor and stator exit =  $25^\circ$
- Axial velocity= 180 m/s
- Work-done factor = 0.88
- Stage efficiency= 85%
- Mechanical efficiency= 96.7%.

Determine:

- i) Air angles at the rotor and stator entry.
  - ii) Mass flow rate of air
  - iii) Power required to drive the compressor
  - iv) Stage loading coefficient
  - v) Pressure ratio developed by the stage.
- 7 a) Explain the principle of operation of a centrifugal compressor with the help of a neat sketch. (7)
- b) Explain the phenomenon of slip in a centrifugal compressor. (3)
- 8 a) Derive an expression for the degree of reaction of a centrifugal compressor. (6)
- b) Why is pre-whirl required in a centrifugal compressor? (4)

**PART C**

*Answer any four full questions, each carries 10 marks*

- 9 a) With the aid of a schematic diagram, explain the principle of operation of axial flow turbines. (7)
- b) Define: (i) blade loading coefficient and (ii) stage loading coefficient with respect to axial flow turbines (3)
- 10 Derive an expression for the degree of reaction of an axial turbine. Also derive an expression for a 50% reaction turbine. (10)
- 11 Explain clearly how the matching of compressor and turbine is carried out. (10)
- 12 a) With a schematic, explain the operating principle of a ramjet engine. (5)
- b) How are ramjets different from turbojets? Explain at least 2 major points of comparison. (5)
- 13 Explain the different modes of operation of a ramjet engine. (10)
- 14 a) Give a brief on the working of a turboprop engine. (5)
- b) Explain the working of an integral ram rocket. (5)

\*\*\*\*