

USN

--	--	--	--	--	--	--	--	--	--

18AE43

Fourth Semester B.E. Degree Examination, July/August 2022 Aircraft Propulsion

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. With the help of a neat schematic and P-V diagram, explain the working principle of a four stroke diesel engine. (10 Marks)
- b. Explain the principle of aircraft propulsion and the types of fluid suitable for aircraft propulsion. (10 Marks)

OR

- 2 a. With the help of a neat schematic and P-V diagram, explain the working principle of a four stroke petrol engine. (10 Marks)
- b. List the advantages of gas turbine engine over reciprocating engines and explain. (10 Marks)

Module-2

- 3 a. With the help of a neat schematic diagram, explain the working of a Turbo-prop engine. Write the thrust equations, its advantages and disadvantages. (12 Marks)
- b. List the theories used in the design of propellers and describe Blade Momentum theory. (08 Marks)

OR

- 4 a. An aircraft flies at 960 kmph. One of its turbojet engines takes in 40 kg/s of air and expand the gases to the ambient pressure. The air fuel ratio is 50 and the lower calorific value of the fuel is 43 MJ/kg. For maximum thrust power, determine (i) Jet velocity (ii) Thrust (iii) Specific thrust (iv) thrust power (v) Propulsive, thermal and overall efficiencies (vi) TSFC. (12 Marks)
- b. List the methods of thrust augmentation and describe the after burner with relevant sketches. (08 Marks)

Module-3

- 5 a. List the purpose of inlets in gas turbine engines. Briefly explain supersonic inlets. (10 Marks)
- b. With the help of relevant sketches, describe the process of shock swallowing by area variation. (10 Marks)

OR

- 6 a. With the help of neat sketches, explain under-expanded and over-expanded nozzles. (10 Marks)
- b. Air flowing in a duct has a velocity of 300 m/s, pressure 1.0 bar and temperature 290 K. Taking $\gamma = 1.4$ and $R = 287 \text{ J/kgK}$. Determine (i) Stagnation pressure and temperature (ii) Velocity of flow in the dynamic and stagnation conditions. (iii) Stagnation pressure assuming constant density. (10 Marks)

Module-4

- 7 a. Describe the essential parts of a centrifugal compressor with a neat sketch. Explain the principle of operation. (10 Marks)
- b. Define degree of reaction of an axial flow compressor and obtain an expression for 50% degree of reaction. (10 Marks)

OR

- 8 a. Describe the following with relevant sketches:
- (i) Surging and stall of axial flow compressor.
 - (ii) Vaneless and Vaned Diffuser. (10 Marks)
- b. A centrifugal compressor under test gave the following data :
- Speed – 11,500 rpm, Inlet total head temperature - 21°C,
Outlet and inlet total head pressure – 4 bar and 1 bar,
Impeller diameter – 75 cm
If the slip factor is 0.92. What is the compressor efficiency? (10 Marks)

Module-5

- 9 a. With suitable sketches, explain the difference between impulse and reaction turbine. (10 Marks)
- b. Describe external and internal cooling of turbine blades, with relevant sketches. (10 Marks)
- OR
- 10 a. Explain different types of combustion chambers used in gas turbine engines. List their advantages and disadvantages. (10 Marks)
- b. Explain the factors affecting combustion chamber performance with relevant sketches. (10 Marks)
