CBCS SCHEME

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15AE43

# Fourth Semester B.E. Degree Examination, Jan./Feb. 2021
## Aircraft Propulsion

Time: 3 hrs. Max. Marks: 80

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



### Module-1

1 a. Explain the principles of Jet propulsion and list the general classification of Aircraft Power plants. **(08 Marks)**

b. With the help of a neat schematic diagram, explain the working of a four stroke Diesel engine. Also drawn the P-V diagram of the cycle. **(08 Marks)**

**OR**

2 a. Show that for a simple gas turbine engine working on an Ideal Brayton cycle the specific power output and the cycle efficiency will be only a function of pressure ratio (r) and maximum cycle temperature. Also illustrate the same on appropriate graph. **(08 Marks)**

b. List the advantages of Gas Turbine engine over reciprocating engine. **(04 Marks)**

c. Differentiate Petrol and Diesel engine. **(04 Marks)**

### Module-2

3 a. Explain the propeller nomenclature and describe the different types of propeller. **(08 Marks)**

b. List and explain the three theories used in the design of propellers. **(08 Marks)**

**OR**

4 a. With the help of a schematic diagram, explain the working principle and performance characteristics of a Turbojet engine. List its advantages and disadvantages. **(08 Marks)**

b. The effective jet exit velocity from a jet engine is 2700m/s. The forward flight velocity is 1350 m/s and the air flow rate is 78.6 kg/s. Calculate :
   i) Thrust
   ii) Thrust power and
   iii) Propulsive efficiency. **(04 Marks)**

c. List the different methods of thrust augmentation, with the help of a relevant sketch explain an Afterburner. **(04 Marks)**

### Module-3

5 a. List the characteristics and explain supersonic inlets with relevant sketches. **(04 Marks)**

b. With the help of relevant sketches describe different modes of inlet operation. **(06 Marks)**

c. An aircraft flies at 800nm/hr at an altitude of 10,000 meters (T = 223.15K, P = 0.264 bar). The air is reversibly compressed in an inlet diffuser. If the mach number at the exit of the diffuser is 0.36 determine:
   i) entry mach number
   ii) velocity pressure and temperature of air at the diffuser exit. **(06 Marks)**

**OR**

6 a. With the help of relevant sketches, explain :
   i) Thrust reversing and thrust vectoring
   ii) Under expanded and Over expanded nozzles. **(12 Marks)**

   b. Illustrate the working of convergent Divergent nozzle with relevant sketches. **(04 Marks)**

## Module-4

7 a. Illustrate the essential parts of a centrifugal compressor, and explain its principle of operation with a neat sketch. **(06 Marks)**

   b. A centrifugal compressor under test gas the following data :
   Speed = 11,500 rpm, Inlet total heat temperature 21°C, outlet and inlet total head pressure - 4 bar, and 1 bar respectively. If the slip factor is 0.92, what is the compressor efficiency? **(06 Marks)**

   c. Derive an expression for work done with usual notation for a radial vaned impeller list the assumption made. **(04 Marks)**

**OR**

8 a. Define Degree of Reaction and derive an expression for the same with usual notations for an axial flow compressor. **(06 Marks)**

   b. List the advantages of centrifugal compressors and Axial flow compressor. **(04 Marks)**

   c. A 10 stage axial flow compressor provides an overall pressure ratio of 5:1 with an overall isentropic efficiency of 87%. When the temperature of air at inlet is 15°C. The work is equally divided between the stages. A 50% reaction is used with a blade speed of 210m/s and constant axial velocity of 170m/s. Estimate the blade angles. Assume a work done factor of 1. **(06 Marks)**

## Module-5

9 a. List the classification of combustion chambers used in gas turbine engines. Explain the types based an geometry and their advantages and disadvantages. **(08 Marks)**

   b. Write short notes on :
   i) Flame tube cooling
   ii) Fuel Injection **(08 Marks)**

**OR**

10 a. Draw the variation of pressure and velocity in a Reaction Turbine and explain the operating principle. **(04 Marks)**

   b. With the help of relevant sketches explain the different method of fixing turbine blades. **(06 Marks)**

   c. A multistage gas turbine is to be designed with impulse stages and is to operate with an inlet pressure and temperature of 6 bar and 900K and an outlet pressure bar of 1 bar. The isentropic efficiency of the turbine is 85%. All the stages are to have a nozzle outlet angle of 75° and equal outlet and inlet blade angles. Mean baled speed of 250 m/s and equal inlet and outlet gas velocities. Estimate the maximum number of stages required. Assume Cp = 1.15 kJ/kg.K, $\gamma = 1.333$, and optimum blade speed ratio. **(06 Marks)**

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