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10AE55

**Fifth Semester B.E. Degree Examination, Dec.2018/Jan.2019**  
**Aircraft Propulsion**

Time: 3 hrs.

Max. Marks:100

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

**PART – A**

- 1 a. What is meant by jet propulsion? What are the classifications of power plants used in aircrafts? (06 Marks)
- b. Define stagnation enthalpy, stagnation temperature, stagnation pressure, stagnation density. (08 Marks)
- c. Explain Fourier's law of heat conduction, Newton law of cooling and Stefan Boltzmann law. (06 Marks)
- 2 a. With a neat sketch, explain the working principle of Turbofan engine. Indicate the advantages and disadvantages of Turbojet engine. (08 Marks)
- b. What are the various factors affecting thrust based on operating characteristics of the engine? (06 Marks)
- c. The effective jet exit velocity from a jet engine is 2700 m/s. The forward flight velocity is 1350 m/s and the air flow rate is 78.6 kg/s calculate thrust, thrust power and propulsive efficiency. (06 Marks)
- 3 a. Derive a relation for minimum area ratio  $\left(\frac{A_{max}}{A_i}\right)_{min}$  in terms of external deceleration ratio  $\frac{u_i}{u_a}$  and explain with relevant graphs. (10 Marks)
- b. Explain the following with suitable sketches: i) Vortex generators ii) Supersonic inlets. (10 Marks)
- 4 a. What are the various factors affecting combustor design? (06 Marks)
- b. Explain different types of combustion chambers used in gas turbine engines with suitable sketches. (06 Marks)
- c. Write short notes on: i) Thrust vectoring ii) Thrust reversing. (08 Marks)

**PART – B**

- 5 a. With a neat sketch, explain the essential parts of a centrifugal compressor. (06 Marks)
- b. Define degree of reaction of axial flow compressor and derive an expression for 50% degree of reaction. (06 Marks)
- c. A centrifugal compressor compresses 30kg of air per second at a rotational speed of 15000 rpm. The air enters the compressor axially and the conditions at the exit sections are radius = 0.3m, relative velocity of air at the tip = 100 m/s at an angle of 80° with respect to plane of rotation. Take  $P_{01} = 1$  bar and  $T_{01} = 300$  K. Find the torque and power required to drive the compressor, work done and head developed. (08 Marks)

- 6 a. Explain with a neat sketch the principle of operation of single stage reaction turbine. (06 Marks)
- b. Write a neat sketch of velocity triangle of single stage axial turbine and derive its expression. (06 Marks)
- c. Discuss the various types of losses in a turbine. (08 Marks)
- 7 a. Discuss the operation of Ramjet engines mention its advantages and disadvantages characteristics. (10 Marks)
- b. Explain critical, subcritical and supercritical operation of combustion in ramjet engine. (10 Marks)
- 8 a. With a help of a schematic diagram explain the principle of operation of liquid propellant rocket. Indicate its advantages over solid propellant rockets. (10 Marks)
- b. Explain ion rocket propulsion with a relevant sketch. (06 Marks)
- c. Write a short note on multistage rocket. (04 Marks)

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