

**B.Tech. AEROSPACE ENGINEERING
(BTAE)****Term-End Examination****December, 2015****BAS-016 : PROPULSION – II***Time : 3 hours**Maximum Marks : 70*

*Note : Attempt any **five** questions. All questions carry equal marks. Use of scientific calculator is permitted. Use of Steam table and Mollier chart is allowed.*

1. (a) Discuss the aerodynamic design process of axial flow compressor. 7
(b) Explain the working principle of Ramjet engine, with the help of a neat diagram. 7
2. (a) Describe the ignition system of a jet engine, with a neat sketch. 7
(b) Explain the principle of jet propulsion. Describe how the jet propulsion engines are classified. 7
3. (a) What is meant by thrust ? Derive the expression of thrust for a general propulsion system. 7

- (b) Prove that for a one-dimensional steady isentropic flow through nozzle 7

$$\frac{dA}{A} = (M^2 - 1) \frac{dV}{V},$$

where symbols carry usual meaning.

4. (a) Explain the characteristics of a good fuel of a jet engine. 7

- (b) Derive an expression for C_L and C_D with and without friction in case of axial compressor. 7

5. An axial compressor stage has the following data : 14

Degree of reaction : 50%, mean blade dia : 36 cm, rotational speed : 18000 rpm, blade height at entry : 6 cm, air angles at rotor and stator exit : 25° , axial velocity : 180 m/s, work done factor : 0.88, stage efficiency : 0.85, mechanical efficiency : 96.7%.

Determine :

- (a) Air angles at rotor and stator entry
- (b) Mass flow rate
- (c) Power required
- (d) Stage loading coefficient
- (e) Pressure ratio developed by stage
- (f) Relative Mach number at rotor entry

6. A turbojet is flying with a velocity of 320 m/s at an altitude of 9150 m, where the ambient conditions are 32 kPa and -32°C . The pressure ratio across the compressor is 12, and the temperature at the turbine inlet is 1400 K. Air enters the compressor at a rate of 40 kg/s, and the jet fuel has a heating value of 42,700 kJ/kg. Assuming ideal operation for all components and constant specific heats for air at room temperature, determine :

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- (a) the temperature and pressure at inlet turbine exit,
- (b) the velocity of the exhaust gases,
- (c) the propulsive power developed,
- (d) the propulsive efficiency, and
- (e) the rate of fuel consumption.

7. Write short notes on any *four* of following :

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- (a) Air cooling system
- (b) Turbojet with after burner
- (c) Diffuser in subsonic flow
- (d) Fuel injection system
- (e) Pollution in combustion system
- (f) Knocking