

GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER-VI • EXAMINATION – WINTER • 2014

Subject Code: 160102**Date: 28-11-2014****Subject Name: Fundamentals of Jet Propulsion****Time: 02:30 pm - 05:00 pm****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1** (a) The following data refers to a gas turbine set employing a regenerator and reheater. The high pressure turbine drives the compressor and the low pressure turbine generates the power. Pressure ratio of the compressor 4, isentropic efficiency of the compressor and both the turbines is 86%, 900K, temperature of gases entering the low pressure turbine is 825K, heat exchanger effectiveness 75%, ambient temperature and pressure 288K and 1 bar. Calculate the pressure ratio of the Low pressure turbine, work developed by the cycle and the efficiency of the cycle. **10**
- (b) Write a short note on pulse jet engine. **04**
- Q.2** (a) Derive the Mach-Area relation for the flow through variable area ducts and give your comments. **07**
- (b) A turbojet engine has the following data: speed of aircraft 810Km/h, compressor pressure ratio 4:1, combustion chamber pressure loss 0.21bar, turbine inlet temperature 1100K, efficiency of compressor, turbine and nozzle are 85%, 90% and 95% respectively, nozzle outlet area 0.094m^2 , ambient conditions are 0.458 bar and 248K. Calculate the thrust, specific fuel consumption, mass of air, mass of fuel and engine efficiencies. **07**
- OR**
- (b) Write a short note on propellant feed systems for rocket engine. **07**
- Q.3** (a) The following data refers to a gas turbine set employing a regenerator. Isentropic efficiency of the compressor and the turbine are 85%, mechanical efficiency of transmission 98%, compressor pressure ratio 7, maximum cycle temperature 1000K, combustion efficiency 97%, air mass flow rate 20Kg/s, regenerator effectiveness 80%, regenerator gas side and air side pressure loss 0.15 bar, ambient temperature and pressure 327K and 1 bar. Calculate the output, mass of fuel, specific fuel consumption and overall thermal efficiency. **07**
- (b) List out advantages and disadvantages of liquid and solid propellant engines. **07**
- OR**
- Q.3** (a) The turbojet engine inducts 40Kg/s of air and propels an aircraft with an uniform flight speed of 912Km/h. Thrust power developed by the turbojet engine is 7876KW, the fuel air ratio is 0.0119, combustion efficiency is 0.96, the calorific value of the fuel is 42 MJ/kg, calculate, mass of fuel required, enthalpy drop through the nozzle, thermal efficiency of the engine, TSFC, propulsive efficiency, overall efficiency and the specific impulse. Neglect the pressure thrust. **07**
- (b) With a neat sketch explain the zones of combustion chamber. **07**
- Q.4** (a) Write a short note on liquid propellant engine. **07**
- (b) Explain in detail the requirements of good combustion chamber. **07**
- OR**
- Q.4** (a) Write a short note on scram jet engine. List out its applications. **07**
- (b) The pressure ratio of the nozzle is 3, the static conditions at the entry to the nozzle are 750K and 6 bar, the velocity of gases at the entry to the nozzle is 20m/s, **07**

calculate: the Mach numbers at nozzle entry and exit, static and stagnation properties at the exit to the nozzle and area ratio of the nozzle.

- Q.5** (a) Derive the maximum mass flow condition for the flow through variable ducts. **07**
(b) With neat sketches explain effect of back pressure in convergent and divergent duct. **07**

OR

- Q.5** (a) With neat sketch explain the subsonic and supersonic inlets. **07**
(b) Write a short note on boundary layer separation and concepts to delay boundary layer separation. **07**
