Student Exam No._____

GANPAT UNIVERSITY

B. TECH. SEMESTER: VII MECHANICAL ENGINEERING

CBCS REGULAR EXAMINATION NOVEMBER – DECEMBER 2014

2ME701 TURBO MACHINERY

Time: 3 Hours **Total Marks:** 70

Instruction:
(1) Attempt all questions.
(2) Figure to the right indicates full marks.
(3) Assume required data if necessary

Section - I

Que. – 1 **Attempt any two**

(a) Is it possible theoretically to achieve the thermal efficiency of rankine cycle with that of carnot? Also discuss regenerative feed heating cycle. **[6]**

(b) What do you mean by reheating of steam? Draw and discuss reheating cycle of steam turbine. **[6]**

(c) Discuss nozzle governing for steam turbine. **[6]**

OR

Que. – 1 **Attempt any two**

(a) Why is water used as working fluid in steam turbine? What are the advantage and dis-advantage of mercury as a working fluid? **[6]**

(b) Write short not on waste heat recovery. **[6]**

(c) Discuss throttle governing for steam turbine. **[6]**

Que. – 2 **Attempt all**

(a) Give the advantage and dis-advantage of jet propulsion over the other system. **[5]**

(b) In a jet propulsion unit, the total pressure and total temperature at intake to compressor are 0.6 bar and 0°C. The speed of jet propulsion unit is 190 m/s. the total temperature and total pressure of gases after the combustion entering the turbine are 750°C and 3.1 bar. The isentropic efficiencies of compressor and turbine are 85% and 80% respectively. The static back pressure of propulsion nozzle is 0.52 bar and efficiency of nozzle based on total pressure drop available is 90%. Determine (a) power consumed by the compressor per kg of air (b) the air fuel ratio if calorific value of fuel is 41840kj/kg of air(c) the total pressure of gas leaving the turbine. **[6]**

Assume c_p of gas = 1.1296 kJ/kg K, γ_g = 1.33, c_{pa}= 1.005, γ_a=1.4

OR

Que. – 2 Attempt all

(a) Describe turbojet engine with neat sketch. [5]

(b) In jet propulsion unit, the air is compressed in a axial compressor from atmospheric pressure 1 bar and temperature 10°C to 3.4 bar. The final temperature is 1.14 times that of isentropic compression. The air is then led to combustion chamber where combustion takes place at constant pressure and products of combustion at 475°C pass through turbine which drives the compressor. The exhaust gases from the turbine are expanded in a nozzle down to atmospheric pressure. [6]

Assume the velocity of approach is negligible, the gases expanded isentropically in both turbines and nozzle and value of R and γ of gases are same as that of air, calculate (a) the power required to drive the compressor per kg of air per second; (b) the air – fuel ratio if calorific value of fuel is 43095kJ/kg and (c) static thrust developed per kg of air per second.

Que. – 3 Write short note on any three.

(a) Pass out turbine [4]

(b) Turboprop engine [4]

(c) Mixed pressure turbine [4]

(d) Liquid propellant Rocket engine. [4]

Section – II

Que. – 4 **Attempt any two**

(a) Define following terms. [6]

i) stagnation property
ii) static property
iii) critical property
iv) Mach number

(b) Effect of variation of back pressure on convergent-divergent nozzle. [6]

(c) Derive equation for mass of discharge through nozzle. [6]

OR

Que. – 4 Attempt any two

(a) Why compounding is required? Describe pressure compounded impulse turbine. [6]

(b) Gives difference between reaction and impulse turbine. [6]

(c) Discuss "Ram jet" with neat sketch and T-S diagram. [6]

Que. – 5 **Attempt all**

(a) Discuss Open cycle gas turbine with intercooling. **[5]**

(b) Open gas turbine is equipped with intercooling, regeneration and reheat arrangements. The H.P turbine used for compressor drive and L.P turbine for output. The specific output of installation is 132 kW/kg/s and overall thermal efficiency of 32%. The following data refer to this installation. Pressure ratio in each compressor stage = 2.5, isentropic efficiency in each compressor stage = 0.86 isentropic efficiency in H.P turbine = 0.87, isentropic efficiency in L.P turbine = 0.84, pressure loss in heat exchanger side = 6% of entry pressure, pressure loss in intercooler = 3% of entry pressure, pressure loss in reheater = 6% of entry pressure, Turbine inlet temperature (for both) = 1020K, atmospheric temperature = 288K, atmospheric pressure = 1.013bar, H.P compressor inlet temperature = 298K, **[6]**

Calculate the permissible pressure drop on gas side and effectiveness of heat exchanger.

OR

Que. – 5 **Attempt all**

(a) Discuss open gas turbine cycle with intercooling, reheating and regeneration **[5]**

(b) An open gas turbine plant works between the fixed absolute temperature limit 300K and 1500K, the absolute pressure limits being 1 bar and 14 bar. The isentropic efficiency of compressor is 0.85 and that of turbine is 0.86. Estimate the actual thermal efficiency of the plant and power developed. The calorific value of fuel is 4200kJ/kg. assume, η_{comb}=0.99, η_m = 0.98 for whole assembly, η_{gen}=0.985 and m_a=500 kg/s. **[6]**

Que. – 6 **Attempt any three.**

(a) What do you mean by turbo machinery? And classify it. **[4]**

(b) Advantage and dis-advantage of jet propulsion engine over other types of engine. **[4]**

(c) Derive general relationship between area, velocity and pressure for flow through nozzle. **[4]**

(d) Short not on back pressure turbine **[4]**

END OF PAPER