Student Exam No._____

GANPAT UNIVERSITY

B. Tech. Semester: VII (Mechanical Engineering)

CBCS Regular Examination Nov-Dec 2016

2ME701: Turbo-Machinery

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

Instruction:
1. Attempt Both Sections in separate answer sheet.
2. Use of Steam Table is permitted.
3. Be precise with your answer.
4. Assume suitable data if missing.

Section – I

Que. – 1 **(a)** What is turbo-machinery? Derive Euler's Equation. **6**

(b) A gas turbine plant consist of 1 turbine for compressor derive and another for output and both are having their own combustion chamber which are serves by air directly from the compressor. Air enters the compressor at 11 bar and 15^0C and compressed with isentropic efficiency 0.86. gas inlet temperature and pressure in both turbine are 1300^0C and 30 bar. The isentropic efficiency of the turbine is 0.86. mass flow rate of air at the compressor inlet is 130 kg/s. CV of the fuel is 42000 kJ/kg. Calculate output of the plant and thermal efficiency, assuming C_P (gas) = 1.128 kJ/kg-K and γ =1.34. assume $\eta_{Mechanical}$ = 0.99 for turbine and compressor each. $\eta_{combustion}$ = 0.995. **6**

OR

Que. – 1 **(a)** In open gas turbine plant, pressure ratio through which air at 15^0C is compressed is 14. The same air is than heated to maximum permissible temperature of 1300^0C. first in heat exchanger which is 75% efficient than in combustion chamber. The same air at 1300^0C is expended in two stages such that expansion work is maximum. Air is reheated to 1300^0C after the high pressure stage. Determine **6**

(i) the cycle thermal efficiency

(ii) work ratio and net shaft work per kg of air,

The isentropic efficiency may be assume to be 85% and 86% for compressor and turbine respectively. Calculate flow rate of air for output of 240MW, assume mechanical for compressor and turbine is and generator efficiencies are 99% each.

(b) Describe open gas turbine cycle with reheating with neat sketch and TS diagram. **6**

Que. – 2 **(a)** A jet propelled unit travels at 180 m/s in air at 0.65 bar and -6^0C. air first enters a diffuser in which it is brought to raise relative to the unit and it is then compressed in the compressor through pressure ratio of 5.8 and fit to a turbine at 925^0C. the gas expends through turbine and then through the nozzle to atmospheric pressure (0.65 bar). The efficiencies of diffuser and nozzle are 0.9. the compressor and turbine efficiencies are 0.8. pressure drop in combustion chamber is 0.14 bar. Find the fuel air ratio and specific thrust of the unit, if the inlet cross-section of the diffuser is 0.1 m^2, calculate total thrust. Assume CV of the fuel is 44141 kJ/kg **6**

(b) Write a short note on solid propellant rocket engine with neat sketch. **5**

OR

Que. – 2 (a) A gas turbine set draws in atmospheric air at 1 bat and 15^0C. there are two pressure stages with perfect intercooler, and the total pressure ratio is 25:1. The maximum temperature of the cycle is 1300^0C as there is 1 turbine for expansion. A regenerator is used and recovers 70% of the available heat. Determine the efficiency of the plant and the work ratio. Turbine and compressor efficiency may be taken as 0.87 and 0.86 respectively. Assume mechanical efficiency of whole assembly is 0.96, generator efficiency as 0.98. 6

(b) Write a short note on Ramjet engine with TS diagram. 5

Que. – 3 (a) Explain Binary Vapour cycle with TS diagram. 6

(b) What are the requirements of ideal working fluid in steam turbine? What do you mean critical temperature and pressure of water? 6

Section – II

Que. – 4 (a) Write a short note on back-pressure turbine with neat sketch. 6

(b) Discuss Nozzle governing for the steam turbine with neat sketch. 6

OR

Que. – 4 (a) Discuss throttle governing for the steam turbine with neat sketch. 6

(b) Describe mixed pressure turbine with neat sketch. 6

Que. – 5 (a) Effect of the variation of back pressure on CD Nozzle with proper diagram. 5

(b) Differentiate Nozzle and diffuser with proper figures. 6

OR

Que. – 5 (a) Derive the maximum condition of discharge though Steam Nozzle. 5

(b) Dry saturated steam enters a steam nozzle at a pressure of 15 bar and is discharge at a pressure of 2 bar. If the dryness fraction of discharge steam is 0.96, what will be the final velocity of the steam, neglect initial velocity of steam? 6
If the 10% of the heat drop is lost in friction, find the percentage reduction in the final velocity.

Que. – 6 (a) Describe pressure compounding for the steam turbine. 6

(b) Derive an expression for general relationship between area, velocity and pressure in nozzle flow. 6

END OF PAPER