

Seat  
No.

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CBI1329

## Turbo Machinery (New) (1100)

P. Pages : 3

Time : Three Hours

Max. Marks : 100

Instructions to Candidates :

1. Do not write anything on question paper except Seat No.
2. Answersheet should be written with blue ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. Use of steam table, Mollier chart and non programmable calculator is allowed.
5. Assume suitable data if necessary & Draw sketches wherever necessary.
6. Solve **any two** subquestion from each unit.

### UNIT - I

1. a) Explain the following. 10
  - i) Pass out turbine.
  - ii) Disc friction loss of steam turbine.
  - iii) Labyrinth Glands.
- b) Steam flows from the nozzles of a single row impulse turbine with a velocity 450m/sec at a direction which is inclined at an angle of 16 degree to the peripheral velocity. Steam comes out of the moving blades with an absolute velocity of 100 m/sec in the direction 110 degree with the direction of blade motion. The blades are equiangular and steam flow rate is 6 kg/sec. Determine the power produced and power loss due to friction of turbine. 10
- c) A steam turbine plant works between the limit of 150 bar, 600 °C and 0.1 bar. The mean blade velocity is 200 m/sec. The average nozzle efficiency is 0.92. The Nozzle (fixed blade) is 20 degree. All stages operate at the condition of maximum efficiency. Determine the number of stages required for the following cases.
  - i) All simple impulse stages.
  - ii) All 50% impulse - reaction stages.
  - iii) A two row curtis stage followed by simple impulse stages.
  - iv) A two row curtis stage followed by 50% impulse-reaction stages. 10

### UNIT - II

2. a) Explain the following. 10
  - i) Gas turbine Blade cooling.
  - ii) Semi closed Gas turbine.

- b) A gas turbine set draws in atmospheric air at 1 bar and 15 °C, there are two pressure stages with perfect intercooler, and the total pressure ratio is 25:1. The maximum temperature of the cycle is 1300 °C as there is one turbine for expansion. A regenerator is used and recover 70% of the available heat. Determine the efficiency of plant and work ratio. The turbine and compressor efficiencies may be taken as 0.87 and 0.86 respectively. Assume mechanical efficiency of whole assembly equal to 0.96 and generator efficiency as 0.98. **10**
- c) i) A gas turbine plant operates on the Brayton cycle between  $T_{\min} = 300\text{ K}$  and  $T_{\max} = 1073\text{ K}$ . Find the maximum work done per Kg of air, and the corresponding cycle efficiency. How does this efficiency compare with the carnot efficiency operating between the same two temperature ? **5**
- ii) Write the assumptions for ideal Brayton's cycle. **5**

### UNIT - III

3. a) Explain with a neat sketch the operation of a centrifugal compressor. What is prewhirl ? Why is it provided ? **10**
- b) i) Discuss the factors which are mainly affect the performance of turbo jet engine. **5**
- ii) Method of thrust augmentation of turbo jet engine. **5**
- c) For the consumption of 430 kg of petrol, a flying Bomb had a range of 260km, an average speed 174 m/sec and a thrust of 2678 Newton. Assuming the calorific value of fuel 42676 kJ/kgk' the maximum temperature rise in the combustion chamber as 820°C, the diameter of the discharge nozzle as 0.304 meter, the altitude of the flight as 606 meter, and the Cp of exhaust gases as 1.05 kJ/kgk calculate : **10**
- i) The fuel-air ratio.
- ii) Temperature of exhaust gases and their relative velocity to the bomb.
- iii) The propulsive efficiency and overall efficiency of the power unit.

### UNIT - IV

4. a) i) What are the reasons to provide splitter in between the two hemispherical shape bucket of pelton wheel. **4**
- ii) A 7.5 cm diameter jet having a velocity of 30 m/sec strikes a flat plate, the normal of which is inclined at 45 degree to the axis of the jet. Find the normal pressure on the plate. **6**
- i) When the plate is stationary and
- ii) when the plate is moving with a velocity of 15 m/sec and away from the jet. Also determine power and efficiency of the jet when plate is moving.

- b) The following data is related to a pelton wheel  
 Head at the base of nozzle = 80 meter  
 Diameter of the jet = 100 mm  
 Discharge of the nozzle =  $0.30 \text{ m}^3/\text{sec}$   
 Power at the shaft = 206 kw.  
 Power absorbed in mechanical resistance = 4.5 kw  
 Determine  
 i) Power lost in nozzle  
 ii) Power lost due to hydraulic resistance in the runner. 10
- c) i) The number of buckets in a pelton wheel is a function of the jet ratio.  
 Explain. 4
- ii) Write the short notes on the following : 6  
 i) Servo-motor.  
 ii) Spear and deflector plate in a pelton wheel.

### UNIT - V

5. a) How is the governing of a reaction turbine carried out ? Explain with a neat sketch. 10
- b) A kaplan turbine runner is to be designed to develop 7357.5 kw shaft power. The net available head is 5.50 meter. Assume that the speed ratio is 2.09 and flow ratio is 0.68 and the overall efficiency is 60%. The diameter of the boss is  $\frac{1}{3}$ rd of the diameter of the runner. Find the diameter of the runner, its speed and its specific speed. 10
- c) i) The available discharge and head at a proposed site of hydroelectric plant is  $400 \text{ m}^3/\text{sec}$  and 45 meter respectively. The overall turbine efficiency is 90%. The generator coupled directly to the turbine has 24 poles and generates electricity at 50 cycles/sec. Calculate the least number of machines required if  
 a) A Francis turbine with specific speed of 350 is used.  
 b) A Kaplan turbine with specific speed of 700 is used. 4
- ii) Draw the velocity triangle diagram for slow speed, Medium speed and high speed runner of Francis turbine. 6

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