Turbo Machinery
(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. Answer sheet 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** sub question from each unit.

UNIT – I

1. a) Explain the following. **10**

i) Regenerative turbine.

ii) Back pressure or topping turbine.

iii) Reversed flow turbine.

b) Steam expands in a set of nozzles from 10 bar, 300 ºC to 1 bar. The convergent parts of the nozzles are sharp and frictionless. In the divergent parts, the friction loss may be taken as 0.15 of the isentropic enthalpy drop. If the steam flow rate is 1 kg/s and initial velocity of steam is negligible, find the minimum area of the nozzles. If the exit diameter of nozzles is 25 mm, find the no. of nozzles. **10**

c) In a stage of an inpulse turbine, provided with a single row wheel, the mean diameter of the blade ring is 80 cm and the speed of rotation is 3000 rpm. The steam issues from the nozzles with a velocity of 300 m/s and the nozzle angle is 20º. The rotor blades are equi-angular and due to friction in the blade channels the relative velocity of steam at outlet from the blades is 0.86 times the relative velocity of the steam entering the blades. What is the power developed in the blades when the axial thrust on the blades is 140N? **10**

UNIT - II

2. a) Give the advantages and disadvantages of Gas turbine plant. **10**

b) In a gas turbine plant, the air at 10ºC and 1 bar is compressed to 12 bar with compression efficiency of 80%. The air is heated in the regenerator and the combustion chamber till its temperature is raised to 1400 ºC and during the process the pressure falls by 0.2 bar. The air then expanded in the turbine and passes to regenerator which has 75% effect issues and causes a pressure drop of 0.2 bar. If the isentropic efficiency of the turbine is 85%, determine the thermal efficiency of the plant. **10**

c) An open cycle gas turbine plant operates with a pressure ratio of 4.5 while using 82 kg/min of air and 1.4 kg/min of fuel. The net output of the plant is 200 kw when 230 kw is needed to drive the compressor. Air enters the compressor at 1 bar and 15ºC and combustion gases enters the turbine at 765ºC. Assuming specific heats of air and combustion gases as 1.005 and 1.128 respectively, the index of compression 1.4, the index of expansion 1.34 and mechanical efficiency for both the compressor and the turbine 0.98 each, estimate **10**

a) The isentropic compressor efficiency
b) The isentropic turbine efficiency
c) Overall thermal efficiency of the plant.

UNIT – III

3. a) Explain the following. **10**

i) Thrust
ii) Thrust power
iii) Propulsive efficiency.
iv) Thermal efficiency.
v) Overall efficiency.

b) i) What are the requirements of an ideal rocket propellants ? **5**

ii) Method of thrust augmentation of turbo jet engine. **5**

c) Explain with a neat sketch, the operation of a centrifugal compressor. What is prewhirl ? Why is it provided ? **10**

UNIT - IV

4. a) Derive an expression for work done by a jet of water on an unsymmetrical moving curved plate when jet strikes tangentially at one of the tips. **10**

b) A pelton wheel has to be designed for the following data. Power to be developed = 6000 kw net head available = 300m, speed = 550 rpm ratio of jet diameter to wheel diameter = $\frac{1}{10}$ and overall efficiency = 85%. **10**
Find the no. of jets, diameter of the jet, diameter of the wheel and the quantity of water required.

c) i) Enlist the four efficiencies of turbine and explain them. **8**

ii) Why breaking jet is provided in pelton wheel turbine. **2**

UNIT - V

5. a) Define specific speed. Derive an expression for specific speed of a turbine. **10**

b) A turbine is to operate under a head of 25 m at 200 rpm. The discharge is 9 cumec. If the efficiency is 90%, determine **10**
i) specific speed of machine.
ii) power generated
iii) type of turbine.

c) i) What is cavitation ? How it is minimized ? **6**

ii) Why draft tube is provided at exit of turbine. **4**

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