(c) In a multistage reaction turbine at one of the stage the rotor diameter is 1250 mm and speed ratio 0.72. The speed of the rotor is 3000 rpm. Determine :

(i) The blade inlet-angle if the blade outlet angle is 22°C.

(ii) Diagram efficiency.

5 Attempt any **two** parts of the following : 2×10=20

(a) Draw the flow, T-S diagrams of open and closed gas turbine cycle. Discuss the relative merit and demerits of closed cycle over open cycle.

(b) Explain in brief the various methods of improving the efficiency of a gas turbine working on a simple Brayton cycle with the help of neat sketches.

(c) Explain the difference between a turbojet and turbopropeller unit by drawing sketches.

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(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 4069 Roll No.

B. Tech.

(SEM. III) EXAMINATION, 2008-09

APPLIED THERMODYNAMICS

Time : 3 Hours] *[Total Marks : 100*

Note : *(i) Answer **all** questions. Each question carries **equal** marks.*

(ii) The steam tables, mollier charts may be used.

1 Attempt any two parts of the following : 2×10=20

(a) Explain inversion cure. With the help of thin define Joule-Thomson coefficient. What are the application of inversion cure and Joule Thomson coefficient ?

(b) Using Maxwell relation derive the following equations :

(i) $$\left(\frac{\partial T}{\partial P}\right)_s = \frac{T v \beta}{C_p}$$

(ii) $$\left(\frac{\partial T}{\partial v}\right)_s = -\frac{T}{C_v K}$$

where,

β = coefficient of cubical expansion and

K = isothermal compressibility.

(c) An ice skate is able to glide over the ice because the skate blade exerts sufficient pressure on ice that a thin layer of ice is melted. The skate blade then glides over this thin melted water layer. Using the clausis claperyon equation, find the pressure an ice skate blade must exert to allow smooth ice skate at -10°C.

Take $h_{fg(ice)} = 334\ kJ/kg$,

$v_{liq} = 1 \times 10^3\ gm^3/kg$,

$v_{ice} = 1.01 \times 10^3\ m^3/kg$ applicable for this problem.

2 Attempt any two parts of the following : **2×10=20**

(a) 2 kg of steam initially at a pressure of 15 bar and a temperature of 250°C expands reversibly and polytropically to 1.5 bar. Calculate the final temperature, work done, heat transferred and change of entropy.

(b) (i) Discuss the comparison between 'fire tube' and 'water tube' boilers.

(ii) Give the name of various boiler mountings and explain the working of any one of them.

(c) To provide a natural draft a chimney of height 32 m is used. calculate (i) the draught in mm of water when temperature of chimney gases is such that the mass of the gases discharged is maximum. (ii) If the temperature of flue gases does not exceed 350°C find air supplied per kg of fuel. When discharge is maximum. Tube ambient temperature as 20°C ?

3 Attempt any two parts of the following : **2×10=20**

(a) A single cylinder double acting steam engine is supplied with dry and saturated steam of 11.5 bar and exhaust occurs at 1.1 bar. The cut off occurs at 40% of the stroke. if the stroke equals 1.25 times the cylinder bore and engine develops 60 kW at 90 rpm, determine the bore and stroke.

Assume hyperbolic expansion and a diagram factor of 0.70.

Also calculate theoretical steam consumption per hour.

(b) Dry saturated steam is expanded in a nozzle from pressure of 10 bar to pressure 4 bar. If the expansion is super saturated, calculate

(i) The degree of under cooling

(ii) The degree of super saturation

(c) Define critical pressure ratio for nozzle of the steam turbine. Obtain analytically its value in terms of the index of expansion.

4 Attempt any two parts of the following : **2×10=20**

(a) Discuss the effect of inlet pressure and temperature of steam of Ronkine cycle. Write the advantages of reheating of the steam and at what pressure (interms of initial pressure) reheating is generally done to obtain best results.

(b) (i) Explain the difference between impulse and reaction turbines.

(ii) Define the stage efficiency and speed ratio of the steam turbine.