(ii) What is bleeding and how does it affect the cycle efficiency ?

(b) Draw the layout of a steam power plant operating on Rankine cycle with three bleed heaters and one reheater reheating the steam to boiler temperature. Reheater being used between II and III stage of the turbine whereas reheaters are used with each and every stage.

(c) Explain the terms 'State Point Locus' and 'Reheat Factor'. For six-stage turbine find out the reheat factor with the help of H-S plot and prove that Internal efficiency = Stage efficiency × Reheat factor of the turbine

$(i.e.\ \eta_i = \eta_s \times R.F.)$

5 You are required to attempt only **two** parts of the following : 10×2

(a) Draw schematic and T-S diagrams of an open cycle gas turbine plant which has been provided with perfect intercooling, reheating and regeneration arrangements.

(b) Prove that optimum pressure ratio for maximum specific out for a gas turbine plant is given by

$$\gamma_p = \left[\eta_{turbine} \times \eta_{compressor} \times \frac{T_3}{T_1}\right]^{\frac{\gamma}{2(\gamma-1)}}$$

(c) With the help of Enthalpy-entropy and schematic diagrams explain the difference between the working of a propeller turbine and a jet turbine. Derive the expressions for specific thrust, thermal efficiency, propulsive efficiency for a jet plane.

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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, 2007-08

APPLIED THERMODYNAMICS

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

Note : *(i) Attempt all the **five** questions.*
*(ii) All questions carry **equal** marks.*
(iii) Use of steam tables and mollier charts is permitted.
(iv) Assume missing data suitably, if any.

1 Attempt any **four** of the following : 5×4

(a) What are the mathematical conditions for exact differentials ? Show that $\int\left(\frac{dT}{T} - \frac{vdp}{T}\right)$ can be used as property of the system.

(b) State the Zeroth Law of thermodynamics. How is mercury in thermometer able to find the temperature of a body using the zeroth law of thermodynamics ?

(c) Derive Maxwell's equations and give its application.

(d) What do you understand by inversion curve ? Define Joule's coeff. How these can be used for refrigeration ?

(e) Derive the expression for Clausius inequality for a power cycle. It must be supported by logics for any statement you would like to give.

(f) In a certain flow process, the fluid is taken in from 10 bar and 500 °C to 2 bar and 250 °C while 220 kJ/kg of useful work is realised. The properties of fluid are given below :

Pressure,p (bar)	*Temperature,t (°c)*	*Enthalphy,h (kJ/kg)*	*Entropy,S (kJ/kg-°K)*
10	500	3478.3	7.7627
2	250	2971.2	7.7096

If the ambient atmospheric conditions are 1.013 bar and 20°C, determine :

(i) degree of effectiveness of the process, and

(ii) irreversibility of the process.

2 Attempt any **four** of the following : **5×4**

(a) Sketch and explain the construction and working of a water tube boiler.

(b) (i) What do you understand by the degree of superheat and degree of subcooling.

(ii) Write down the values of critical pressure, critical temperature and sp-volume at critical point for water.

(c) Name two mountings of a water tube boiler plant. With neat sketches explain their working.

(d) What are the advantages and disadvantages of Artificial over Natural Draught ?

(e) Discuss the different methods to express the boilder performance.

(f) A boiler produces 2000 kg of dry and saturated steam per hour at 10 bar and feed water is heated by an economiser from 20°C to a temperature of 110°C. 225 kg of coal of a calorific value of 30100 kJ/kg is fired per hour. If 10% of coal remains unburnt, find the thermal efficiency of the boiler.

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

(a) Define the term indicator diagram and explain why actual indicator diagram differs from hypothetical one. Define diagram factor.

(b) Find out the condition for maximum rate of discharge for the flow of steam through a nozzle in terms of intake pressure, pressure at throat and constant as isentropic index of expansion.

(c) A steam turbine working on Rankine cycle is supplied with dry satuated steam at 25 bar and the exhaust takes place at 0.2 bar. For a steam flow rate of 10 kg/sec, determine for a theoretical cycle :

(a) quality of steam at end of expansion,

(b) turbine shaft work

(c) power required to drive the pump,

(d) work ratio

(e) Rankine efficiency.

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

(a) (i) Why modified Rankine cycle is not used in steam turbines ?