Code: 15A03501 **R15**

B.Tech III Year I Semester (R15) Regular Examinations November/December 2017

THERMAL ENGINEERING – II

(Mechanical Engineering)

(Steam tables and Mollier charts is permitted in the examination hall)

Time: 3 hours Max. Marks: 70

PART – A

(Compulsory Question)

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1 Answer the following: (10 X 02 = 20 Marks)

(a) Define work ratio.
(b) What is the function of deaerator?
(c) Define equivalent evaporation.
(d) What is draught.
(e) Define critical pressure ratio.
(f) Define Wilson line.
(g) What is carry-over coefficient?
(h) Define gross stage efficiency.
(i) What is flow coefficient?
(j) Define ramming effect.

PART – B

(Answer all five units, 5 X 10 = 50 Marks)

UNIT – I

2 (a) Explain the effect of maximum pressure and mean temperature heat addition on thermal efficiency.

(b) A steam turbine receives steam at pressure 20 bar and superheated to 88.6^{o}C. The exhaust pressure is 0.07 bar and the expansion of steam takes place isentropically. Using steam table only, calculate the following: (i) Heat supplied, assuming that the feed pump supplies water to the boiler at 20 bar. (ii) Heat rejected. (iii) Net work done. (iv) Work done by the turbine. (v) Thermal efficiency. (vi) Theoretical steam consumption.

OR

3 (a) Explain with neat sketch reheating cycle and derive the thermal efficiency equation for the same

(b) A steam turbine plant equipped with a single regenerative feed heater operates under the following conditions: Initial steam pressure = 16.5 bar, initial superheat = 93^{o}C, extraction pressure = 2 bar, exhaust pressure = 0.05 bar. Compare the regenerative and non-regenerative cycle with respect to the following: (i) Thermal efficiency. (ii) Steam consumption in kg per kWh. (iii) Condenser duty (steam condensed per kWh). It may be assumed that the expansion is isentropic; that the feed water is heated to the steam saturation temperature in the heater.

UNIT – II

4 (a) Explain the unique features of the high pressure boilers and also explain Loeffler boiler with neat sketch.

(b) What are the boiler mounting and accessories? Explain with neat sketch tabular type air preheater.

OR

5 (a) Define chimney efficiency and find out expression for the same.

(b) Calculate the mass of flue gases flowing through the chimney when the draught produced is equal to 1.9 cm of water. Temperature of flue gases is 290^{o}C and ambient temperature is 20^{o}C. The flue gases formed per kg of fuel burnt are 23 kg. Neglect the losses and take the diameter of the chimney as 1.8 m.

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UNIT – III

6 (a) Derive an expression for mass of discharge through nozzle.

(b) A nozzle expands steam from 14 bar and 300°C to 6 bar. If the flow rate is 1 kg/s, find the throat and exit area. What should be the coefficient of velocity if the exit velocity is 550 m/s?

OR

7 (a) What is super saturation flow and explain with neat sketch?

(b) Classify the condenser and explain the effects of air leakage in condenser.

UNIT – IV

8 (a) Derive an expression condition for maximum blade efficiency.

(b) The mean diameter of the blades of an impulse turbine with a single row wheel is 105 cm and the speed is 3000 r.p.m. The nozzle angle is 18°, the ratio of blade velocity to steam velocity is 0.42 and the ratio of the relative velocity at outlet from the blades to that at inlet is 0.84. The outlet angle of the blade is to be made 3° less than the inlet blade angle. The steam flow is 8 kg/s. Draw the velocity diagram for the blades and calculate the following: (i) Tangential thrust on the blades. (ii) Axial thrust on the blades. (iii) Power developed by the blades. (iv) Blading efficiency. (v) Resultant thrust on the blades.

OR

9 (a) Derive an expression condition for maximum gross stage efficiency

(b) Steam flow into the nozzles of an impulse-reaction turbine stage from the blades of the preceding stage with a velocity of 100 m/s and issues from the nozzles with a velocity of 325 m/s at an angle of 20° to the wheel plane. Calculate the gross stage efficiency for the following data: Mean blade velocity = 180 m/s, expansion efficiency for the nozzle and blades = 0.9, carry-over factor for nozzles and blades = 0.9, degree of reaction = 0.26 and blade outlet angle = 28°.

UNIT – V

10 (a) Explain with neat sketch closed cycle gas turbine and draw T-S diagram. What are the advantages over open cycle gas turbine?

(b) A gas turbine cycle has a perfect heat exchanger. Air enters the compressor at a temperature and pressure of 300 K and 1 bar and discharges at 475 K and 5 bar. After passing through the heat exchanger the air temperature increases to 665 K. The temperature of air entering and leaving the turbine are 870°C and 450°C. Assuming no pressure drop through the heat exchanger, compute: (i) The output per kg of air. (ii) The efficiency of the cycle. (iii) The work required to drive the compressor.

OR

11 (a) Explain with neat sketch pulse jet engine. List the advantages and disadvantages.

(b) In a theoretical cycle for a jet propulsion unit both the compression and the expansion are considered isentropic, and that heat at constant pressure. Show that the thrust developed per kg of air per second when the velocity of approach is neglected is:

$$[2CpT(q-1)r_p^{(\gamma-1)/\gamma}-1]^{1/}2.$$

Where q is the ratio of the absolute temperature after and before combustion, r_p is the compression ratio and T is the absolute atmospheric temperature.

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