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RN-7463

B. E. - IV (Sem. VII) (Mechanical) Examination

May / June – 2010

Energy System

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

Instructions :

(1)

નીચે દર્શાવેલ ☛ નિશાનીવાળી વિગતો ઉત્તરવહી પર અવશ્ય લખવી.
Fillup strictly the details of ☛ signs on your answer book.

Name of the Examination :

☛ B. E. - 4 (Sem. 7) (Mech.)

Name of the Subject :

☛ Energy System

☛ Subject Code No. : 7 4 6 3 ☛ Section No. (1, 2,.....) : 1&2

Seat No. :

Student's Signature

(2) Answer **all** questions.

(3) Use **separate** answer book for each section.

(4) Figures to the right indicate full marks.

(5) Assume suitable data, if necessary.

(6) Use of steam table, moiler diagram, refrigeration charts are permitted.

(7) Location : 22.15° N, 72.85°E

SECTION - I

1 (a) Answer the following : **10**

(i) Define : The latitude angle, (φ)

(ii) Define : Power coefficient of wind machine.

(iii) What is biomass gasifies?

(iv) The longest day of the year is on _____ and equal day and night length on _____.

(v) Differentiate tidal and wave energy.

(b) Describe boiler efficiency by direct method. **10**

During trial of coal fire boiler following observations are made :

Quantity of steam generated is 10.50 TPH

Steam pressure and temperature observed 12 bar (g) and 188°C

Feed water temperature is 90°C

Enthalpy of steam (dry and Sat) at 12 bar (g) pressure is 2783 kJ/kg

Enthalpy of feed water is 372 kJ/kg

Gross calorific value of coal is 17000 kJ/kg

Quantity of coal consumed is 1.90 TPH

Calculate boiler efficiency and evaporation ratio using direct method.

2 (a) Explain solar flat plate collector with neat sketch. 8

OR

(a) Define solar constant. Find the solar altitude angle at 2 hour after local solar noon on June 1st for a city located at 26.75°N altitude. Also find the sunrise, sunset hours and the day length. 8

(b) Explain horizontal axis wind machine with neat sketch. 8

OR

(b) The following data are available for propeller wind turbine has diameter of 110 m. The rotor speed of 43 rpm. The wind available at standard atmospheric and 15°C has velocity of 17 m/s. Assuming 36% efficiency, calculate : 8

(1) The power density in wind
(2) The maximum power density obtained
(3) The total power
(4) The thrust and torque.

3 Answer any **two** : **14**

(1) Explain single basin arrangement type tidal plant
(2) Write short note on wave energy system
(3) Describe cross draft type gasifier with the help of neat sketch.
(4) Explain ocean thermal electric conversion (OTEC) system.

SECTION - II

4 (a) Answer the following short questions (any **ten**) **10**

(i) De-laval turbine is a single rotor impulse turbine. (True/False)

(ii) Define blade velocity coefficient (K).

(iii) What is the effect of nozzle friction?

(iv) Steam power plant follows Carnot cycle. (True/ False)

(v) Define diagram or Blade efficiency of steam turbine.

(vi) Define axial thrust of steam turbine.

(vii) Critical pressure P_c =0.546 P1, if the steam is initially _____.

(viii) The efficiency of rankine cycle lies between 40% to 50%. (True/False)

(ix) The reheat factor is ratio of _____.

(x) The ratio of total useful heat to the total isentropic heat drop is called _____.

(xi) For C-D nozzle, steam is initially dry and saturated, the index of expansion (n) = _____.

(xii) In case of impulse turbine, threre is enthalpy drop in

(a) Fix and moving blades

(b) Only in moving blades

(c) nozzle only

(d) None

(xiii) Correctly designd C-D nozzle is always chocked. (True/False)

(xiv) What are the various losses in steam turbine?

(xv) In steam turbine, reheat factor increase with increase in number of stages. (True/False)

(b) Steam is expanded in a set of nozzles from 10 bar and 200°C to 5 bar. What type of nozzle it is? Neglecting the initial velocity find minimum area of the nozzle required to allow a flow of 3 kg/s under the given conditions. Assume that expansion of steam to be isentropic. **10**

5 (a) In an impulse turbine with single raw wheel, the mean diameter of the blade is 1.05m and the speed is 3000 rpm. The nozzle angle is 18°, the ratio of blade speed to steam speed is 0.42 and the ratio of the relative velocity at outlet from the blades to that at inlet is 0.85. The outlet angle of the blade is 3° less than the inlet angle. The steam flow is 10 kg/s draw the velocity diagram for the blades and derive 8

(i) Tangential thrust on the blades

(ii) Power developed in the blades

(iii) Blade efficiency.

OR

(a) In a single stage impulse turbine, nozzle angle is 20° and blades angles are equal. The velocity efficient for blade is 0.85. Find maximum blade efficiency, possible. If the actual blade efficiency is 92% of he maximum blade efficiency find the possible ratio of blade speed to steam speed. 8

(b) 300 kg/min of steam (2 bar, 0.98 dry) flows through a given stage of a Parson's reaction turbine. The angle of fixed blades as well as moving blades is 20° and 3.68 kW power is developed. If the rotor speed is 360 rpm and tip leakage is 5 per cent, calculate the mean drum diameter and the blade height. The axial flow velocity is 0.8 times the blade velocity. 8

OR

(b) Write the equation of blade efficiency for Parson's reaction turbine and show that the maximum blade efficiency is given by $(\eta_{bl})_{max} = \frac{2\cos^2 \alpha}{1+\cos^2 \alpha}$ 8

6 Answer any **two** : 14

(a) What do you mean by supersaturated flow? Explain with the help of h-s diagram.

(b) What do you mean by compounding of steam turbines? Explain velocity compounding of impulse turbine.

(c) Define the term "Degree of reaction" as applied to a steam turbine. Show that for Parson's reaction turbine, a degree of reaction is 50%.
