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SE-7463

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

May / June – 2011

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)**

Name of the Subject :

☛ **Energy System**

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

Seat No. :

Student's Signature

(2) Answer **all** questions.

(3) Use of steam table, molier diagram and Solar data book is permitted.

(4) Assume suitable data if required.

(5) Use of calculator is permitted.

1 (a) (1) Draw the graph of stage efficiency and speed ratio for single, two and three row rotor. **3**

(2) Define following terms : **5**

(a) Heat rate

(b) Speed ratio

(c) Reheat factor

(d) Nozzle efficiency

(e) Stage efficiency

(3) If steam is initially dry and saturated then critical pressure ratio for C-D nozzle is _____. (0.545/0.5775/0.582) **1**

(4) De-laval turbine is also known as _____ impulse turbine. **1**

(b) Steam is supplied to a turbine at 30 bar, 350°C. The turbine exhaust pressure 0.08 bar, main condensate is heated regeneratively in two stages by steam **10**

bleed from the turbine at 5 bar and 1 bar respectively. Calculate the masses of steam bleed off at each pressure per kg of steam entering, the turbine and cycle efficiency. Assume drain cooler is used. Feed heaters are non conducting type.

2 Attempt any **two** of following : **12**

(1) Derive the equation for critical pressure ratio for flow through C-D nozzle.

(2) Nozzle governing for turbine.

(3) Velocity compounding impulse turbine.

3 Attempt any **two** of following : **18**

(1) Calculate the throat and exit diameter of a C-D nozzle which will discharge 820 kg of steam per hour from a pressure of 8 bar, superheated to 220°C into a chamber having pressure of 1.05 bar. Friction loss in diverging part of nozzle may be taken as 0.15 of total isentropic enthalpy drop.

(2) The 1st stage of an impulse turbine is compounded for velocity and has 2 row of moving blade and 1 ring of fixed blade. The nozzle angle is 15°, leaving angle of blades respectively for 1st moving blade = 30°, fixed blade = 20, 2nd moving blade = 30°. The velocity of steam leaving the nozzle is 540 m/sec. Friction loss in each row is 10%. Steam leaves the second row of moving blade axially.

Determine blade speed, blade efficiency, specific steam consumption.

(3) The following particular's refer to a stage of a parson's steam turbine, comprising of one ring of fixed blade and one ring of moving blades.

- Mean diameter of blade ring = 700 mm
- Rotational speed = 3000 rpm
- Absolute steam velocity at the exit of moving blade = 160 m/sec
- Blade outlet angle = 20°
- Steam flow through blades = 7 kg/sec

Find :

(1) blade inlet angle

(2) tangential force on the ring of moving blade

(3) Power developed in the stage

4 (a) (1) Define following terms : **5**

(a) Power coefficient of wind machine

(b) Biomass

(c) Hour angle

(d) Latitude

(e) Nadir

(2) Explain biological and thermal conversion process. **2**

(3) Power generated by wind machine is proportional to _____ of wind speed. (square/cube/fourth power) **1**

(b) A boiler acceptance test was conducted on a lignite fired power boiler as per BS-2885 and following data was recorded. **12**

- Steam pressure = 93.28 kg/cm^2 (gauge)
- Steam generation = 45.71 tonne/hour
- Feed water temperature = 280°C
- Steam temperature = 502°C
- O_2 by zirconium sensor (wet basis) = 4.07%
- Temperature of flue gas at APH outlet = 158°C
- Unburnt in bottom Ash = 6.58%
- Unburnt in fly ash = 1.7%

Distribution of fly ash and bottom ash = 80 : 20.

Analysis of lignite :

C = 48.2%, H = 3.2%, O = 7.6%, N = 0.6%, S = 1.0%, Ash = 12.4%

Moisture content = 27.0%

GCV = 19.1 MJ/kg

Determine :

(1) Various losses

(2) Efficiency of boiler

5 Attempt any **three** of following : **18**

(1) Explain wind energy conversion system (WECS) with neat sketch.

(2) Explain modern steam power plant with layout.

(3) Explain with neat sketch working of solar water pump.

(4) Give brief explanation of "Solar pond".

6 Attempt any **two** of following : **12**

(a) It is required to design a savonious type rotor for loom machine whose net power requirement is 100 W. The following data may be used for design.

Mean wind speed = 25 km/hr

Mean air density = 1.17 kg/m^3

Transmission loss = 7%

Wind passage = open type

If the design is for optimum performance what will be the speed of wind machine.

(b) It is required to design a biogas plant based on following data :

Plant capacity = 30 m^3/day

Gas yield = 20 lit/kg

Retention period = 22 days

Roof area factor = 1.065

Roof volume factor = 1.04

Determine the basic dimension of bio-gas plant.

Assume fraction of daily gas production = 0.6

Charge density = 900 kg/m^3

(c) Determine the altitude and azimuth angle of 3 p.m. (IST) on June, 15 for Bombay (ϕ = 18°54' N, longitude = 72° 94' E). For above location determine the angle of incidence over a south facing surface with tilt angle of 15° with horizontal. Also calculate hour of sun rise and length of day.