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12MTP23

Second Semester M.Tech. Degree Examination, June/July 2013
Advanced Power Plant Cycles

Time: 3 hrs. Max. Marks:100

Note: ***1. Answer any FIVE full questions.***
2. Use of steam tables and charts are permitted.

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

1 a. With a neat circuit diagram, explain the "Carnotization of Rankine cycle" and also explain with "T – S" diagram. **(12 Marks)**

b. A textile factory requires 10 t/h of steam for process of heating at 3 bar saturated and 1000 KW of power, for which a back pressure turbine of 70% internal efficiency is to be used. Find the steam condition required at inlet of the turbine. **(08 Marks)**

2 a. What are the flows of steam as the working fluid in a power cycle? **(04 Marks)**

b. Explain the characteristics of an ideal working fluid in a power cycle. **(04 Marks)**

c. A thermionic generator designed at its maximum thermal efficiency has the cathode and anode temperatures of 1250°C and 500°C, respectively. Determine : i) out put voltage ii) the current densities in the cathode and the anode iii) the power out put per unit area iv) the thermal efficiency. **(12 Marks)**

3 a. Explain the coal gasification process, with a neat sketch. **(08 Marks)**

b. In an oil fired boiler the fuel had an analysis by mass : carbon 84%, hydrogen 10%, sulphur 3.2%, oxygen 1.6%, remainder incombustible. The analysis of dry flue gases by volume gave : combined $CO_2 + SO_2$ – 15 .72%, O_2 – 1%, there being no CO or SO_3. Calculate per kg of fuel

i) Mass of air supplied
ii) Percentage air supplied
iii) Mass of dry flue gas formed
iv) Mass of water vapour formed. **(12 Marks)**

4 a. What are the advantages and disadvantages of pulverized coal firing? **(08 Marks)**

b. What is a stoker? What are the different types of stockers? **(04 Marks)**

c. Fluidized bed is required to operate at atmospheric pressure and a bcd temperature of 850°C. The fuel has a calorific value of 25 MJ/kg. The stoichiometric air fuel ratio is 9.5 by mass and 20% excess air is used. The total fueling rate is 4.8 MW. The density of air at 850°C is 0.3145 kg/m^3. Find the plat form area required if

i) The firing rate is 2 MW/m^2
ii) The fluidizing velocity in 2.7 m/sec. **(08 Marks)**

5 a. Mention the merits and demerits of fire – tube boiler. **(08 Marks)**

b. Explain the operation of a spray – type desuper heater, with a neat sketch. **(06 Marks)**

c. A spray type desuper heater is supplied with water at 60°C. It is connected in a stream line carrying 200 t/h of steam at 35 bar. Calculate the amount of water that must be sprayed per hour to maintain steam at 400°C. when the boiler load causes steam to leave at 450°C. **(06 Marks)**

6 a. Explain an indirect dry cooling tower where a direct contact spray type [open] condenser is used. **(08 Marks)**

OR

Explain an indirect dry cooling tower where ammonia is used as the coolant in the condenser. **(08 Marks)**

b. Water at 30°C flows into a cooling tower at the rate of 1.15 kg per kg air. Air enters the tower at the dbt of 20°C [dry bulb temperature] and a relative humidity of 60% and leaves it at a dbt of 28°C and 90% relative humidity. Make up water is supplied at 20°C. Determine :

i) The temperature of water leaving the tower
ii) The fraction of water evaporated
iii) The approach and range of the cooling lower.

The properties of air from psychometric chart are twb_1 = 15.2°C, twb_2 = 26.7°C, h_1 = 43 kJ/kg dry air h_2 = 83.5 kJ/kg dry air, w_1 = 0.0088 kg water vapour/ kg dry air w_2 = 0.0213 kg water vapour/ kg dry air. **(12 Marks)**

7 a. Sketch and explain the liquid metal fast breeder reactors. **(08 Marks)**

b. Sketch and explain the fusion power reactors and write significant advantages. **(08 Marks)**

c. Calculate the mass defect and binding energy per nucleon of oxygen. Given, m_p = 1.007277 amu, m_n = 1.008665 amu, m_e = 0.00055 amu, atomic mass of oxygen ≃ 16 = 15.99491 amu. **(04 Marks)**

8 a. Sketch and explain the Deriaz turbine. **(06 Marks)**

b. Sketch and explain the bulb turbine and for which type of power plants it is suitable. **(06 Marks)**

c. A Slaton wheel has to be designed for the following specification. Power to be developed 6000 KW. Net head available = 300 m ; speed = 550 rpm ; ratio of jet diameter to wheel diameter = 1/10 Hydraulic efficiency = 0.85 assuming the velocity coefficient C_v = 0.98 and speed ratio ϕ = 0.46, find

i) The number of jets
ii) Diameter of each jet
iii) Diameter of wheel
iv) The quality of water required. **(08 Marks)**

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