Second Semester M.Tech. Degree Examination, Dec.2013/Jan.2014
Advanced Power Plant Cycles

Time: 3 hrs.   Max. Marks:100

Note: *1. Answer any FIVE full questions.*
        2. Use of steam tables and Mollier chart is permitted.

1   a. Explain Rankine cycle with a neat flow diagram and show the cycle plotted on P-V, T-S and h-s coordinates? **(10 Marks)**

     b. Draw a block diagram to represent a power plant which converts energy in fuel to electricity? Also explain the efficiencies in a steam power plant. **(10 Marks)**

2   a. What are the advantages of combined cycle power generation? **(06 Marks)**

     b. List the different combined cycle plants available for power generation and explain Brayton/Rankine combined cycle plant coupled in series. **(10 Marks)**

     c. For a mercury-steam-sulphur dioxide cycle, the heat rejected in the mercury cycle is given to the steam cycle and the heat rejected in the steam cycle is given to the steam cycle and the heat rejected in the steam cycle is utilized in the SO_2 cycle. If the efficiencies of the mercury, steam and SO_2 cycles are 0.5., 0.4 and 0.25 respectively, find the overall efficiency of the composite cycle. **(04 Marks)**

3   a. Explain the heat of combustion by open system and closed system. **(10 Marks)**

     b. An unknown hydrocarbon fuel C_xH_y, was allowed to react with air. An orsat analysis was made of a representative sample of the product gases with the following result:
       CO_2 12.1%, O_2 3.8% and CO 0.9%. Determine :
       i) The chemical equation for the actual reaction.
       ii) The composition of the fuel.
       iii) The air fuel ratio during the test and
       iv) The excess or deficiency of air used. **(10 Marks)**

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

     b. Mention the two conditions important to satisfy in burning pulverized coal successfully. **(04 Marks)**

     c. Fluidized bed is required to operate at atmospheric pressure and a bed 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/m³. Find the plan form area required if
       i) The firing rate is 2 MW/m² and   ii) The fluidizing velocity is 2.7 m/s. **(08 Marks)**

5   a. Explain with a neat sketch the basic elements of an electrostatic precipitator. **(10 Marks)**

     b. Explain the following: i) Evaporation; ii) Deacration. **(06 Marks)**

     c. What are the functions of the drum in a water-tube boiler? **(04 Marks)**

6   a. How do you classify the types of condenser? Explain with neat sketches the direct contact condensers. **(10 Marks)**

     b. What do you mean by circulating water system? Explain with neat sketches the once through system and closed loop system of circulating water system. **(10 Marks)**

7   a. Explain nuclear fission and chain reaction. **(06 Marks)**

     b. Explain with a schematic diagram the pressurized water reactor. Also mention merits and demerits. **(08 Marks)**

     c. The half-life of radium 226 (atomic mass = 226.095) is 1620 yrs. Compute:
  i) The decay constant and
  ii) The initial activity of 1g of radium 226. **(06 Marks)**

8   a. Explain with a neat sketch a hydrological cycle. **(06 Marks)**

     b. Give the classification of hydraulic turbines. **(06 Marks)**

     c. The following data refers to a proposed hydroelectric power plant:
Available head = 27m, catchment area 430 sq. km, rainfall = 150 cm/year, percentage of total rainfall utilized = 65%, penstock efficiency = 95%, turbine efficiency = 80%, generator efficiency = 86% and load factor = 0.45. Calculate the power developed and suggest suitable turbines for the plant. **(08 Marks)**

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