Assignment 1

Q.1 Explain the different thermodynamic approach to increase the thermal efficiency of Rankine Cycle.

Q.2 In a reheat cycle, the initial steam pressure and the maximum temperature are 150 bar and 550^0C respectively. If the condenser pressure is 0.1 bar and the moisture at the condenser inlet is 5%,and assuming ideal processes, determine i) the reheat pressure ii) the cycle efficiency, and iii) the steam rate.

Q.3 A simple steam power cycle uses solar energy for the heat input. Water in the cycle enters the pump as a saturated liquid at 40°C, and is pumped to 2 bar. It then evaporates in the boiler at this pressure, and enters the turbine as saturated vapour. At the turbine exhaust the conditions are 40°C and 10% moisture. The flow rate is 150 kg/h. determine (a) the turbine isentropic efficiency, (b) the net-work output (c) the cycle efficiency, and (d) the area of solar collector needed if the collectors pick up 0.58 kW/m^2.

Q.4 A cyclic steam power plant is to be designed for steam temperature at turbine inlet of 3600C and an exhaust pressure of 0.08 bar. After isentropic expansion of steam in the turbine, the moisture content at the turbine exhaust is not to exceed 15%. Determine the greatest allowable steam pressure at the turbine inlet, and calculate the Rankine cycle efficiency for these steam conditions. Estimate also the mean temperature of heat addition.

Q.5 In a reheat cycle, steam at 500°C expands in a H.P. turbine till it is saturated vapour. It is reheated at constant pressure to 400°C and then expands in a L.P. turbine to 40°C. If the maximum moisture content at the turbine exhaust is limited to 15%, find (a) the reheat pressure, (b) the pressure of steam at the inlet to the H.P. turbine, (c) the net specific work output, (d) the cycle efficiency, and (e) the steam rate. Assume all ideal processes.

What would have been the quality, the work output, and the cycle efficiency without the reheating of steam? Assume that the other conditions remain the same.

Q.6 An oil fired steam generator uses fuel whose analysis by mass gives: C=85%, H_2=9%, S=3%, O_2= 1.5% and remainder uncombustible. The analysis of dry flue gases by volume gives: combined (CO_2 +SO_2) =16.5%, O_2=2%. Evaluate per kg of fuel a) mass of air supplied b) percentage excess air supplied in kg mass of dry flue gas forced and c) mass of water vapour formed due to combustion.

Q.7 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%, 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 air or deficiency of air used.

Q.8 The percentage composition of a sample of coal was found to be: C=89.3%, H2 = 5% , O2 = 4.2% , N2 = 1.5% , and remainder ash. Calculate the stoichiometric air-fuel ratio by mass. If 30% excess air is supplied, calculate the percentage composition of dry gases by mass.

Assignment 2

Q.1 Describe the characteristics and advantages of modern high pressure water tube boilers?

Q.2 Define "Circulation Ratio". For boiler pressure more than 100 bar which internals are used in the boiler drum

Q.3 Show that for isentropic flow of steam through a convergent – divergent nozzle, the throat velocity is the local acoustic velocity. A nozzle expands steam from 14 bar and 300^0 C to 6 bar. If the flow rate is 1kg/s, find the throat and exit area. What should be the coefficient of velocity if the exit velocity is 550 m/s?

Q.4 Calculate the throat and exit diameter of a convergent- divergent nozzle which will discharge 820 kg of steam per hour from a pressure of 8 bar superheated to 220°C into a chamber having a pressure of 1.05 bar. Friction loss in the diverging part of the nozzle may be taken as 0.15 of the total isentropic enthalpy drop.

Q.5 Steam flows from the nozzles of a single row impulse turbine with a velocity 450m/s at a direction which is inclined at an angle of 160 to the peripheral velocity. Steam comes out of the moving blades with an absolute velocity of 100m/s in the direction at 1100 with the direction of blade motion. The blades are equiangular and steam flow rate is 6 kg/s. Determine the power loss due to friction.

Assignment 3

Q.1Why condenser is required in a steam power plant?

Q.2Why compounding of turbine is required? Differentiate between Impulse turbine and Impulse- Reaction turbine. Draw the velocity diagram at the inlet and exit of impulse turbine blade and find out the expression of power.

Q.3Why negative pressure is maintained in condenser? Explain with a neat sketch diagram the construction and the working principle of Surface Condenser.

Q.4What is the function of cooling tower? Differentiate between wet and dry type of cooling tower.