

--	--	--	--	--	--	--	--	--	--

Second Semester M.Tech. Degree Examination, December 2012

Advanced Power Plant Cycles

Time: 3 hrs.

Max. Marks:100

**Note: 1. Answer any FIVE full questions.
2. Use of steam tables, thermodynamics data handbook
and Mollier chart are permitted.**

1.
 - a. With the help of a schematic diagram, explain the application of Rankine cycle in steam power plant. (05 Marks)
 - b. What is a supercritical steam cycle? Draw the T-S diagram of a supercritical steam cycle with double reheat. Mention its advantages and disadvantages. (06 Marks)
 - c. In a single-heater regenerative cycle the steam enters the turbine at 30 bar, 400°C and the exhaust pressure is 0.10 bar. The feed water heater is a direct contact type which operates at 5 bar. Find:
 - i) The efficiency and the steam rate of the cycle.
 - ii) The increase in mean temperature of heat addition, efficiency and steam rate as compared to the Rankine cycle (without regeneration). Pump work may be neglected. (09 Marks)

2.
 - a. With the help of a line diagram and a T-S diagram, explain the working of binary vapour cycle. (08 Marks)
 - b. Show with simple notations that, when two cyclic plants operate in parallel, the overall efficiency lies between the efficiencies of these plants. (06 Marks)
 - c. A mercury cycle is superposed on the steam cycle operating between the boiler outlet condition at 40 bar, 400°C and the condenser temperature of 40°C. The heat released by mercury condensing at 0.2 bar is used to impart the latent heat of vaporization to the water in the steam cycle. Mercury enters the mercury turbine as saturated vapour at 10 bar. Compute:
 - i) kg of mercury circulated per kg of water
 - ii) the efficiency of the combined cycle.

The property values of saturated mercury are given below:

p (bar)	t(°C)	h _f (kJ/kg)	h _g (kJ/kg)	s _f (kJ/kg)	s _g (kJ/kg)	v _t (m ³ /kg)	v _g (m ³ /kg)
10	515.5	72.23	363.0	0.1478	0.5167	80.9 × 10 ⁻⁶	0.0333
0.2	277.3	38.35	336.55	0.0967	0.6385	77.4 × 10 ⁻⁶	1.163

(06 Marks)

3.
 - a. Explain the two types of coal analysis. What are their advantages? (06 Marks)
 - b. What is biomass? Explain different forms of bioconversion methods. (08 Marks)
 - c. The volumetric analysis of a fuel gas is given as:
C₂H₆ 22.6%, CH₄ 73.6%, CO₂ 2.4% and N₂ 1.4%.
Assuming combustion air to be dry and in 25% excess, find:
 - i) The molecular weight of the combustion products
 - ii) The total gas volume for complete combustion at 260°C, 1.013 bar
 - iii) The dry flue gas analysis based on CO₂, O₂ and N₂. (06 Marks)

- 4** a. With the help of simple sketches, explain the three types of gasifiers, classified depending on the flow patterns in gasifiers. (09 Marks)
b. What are the advantages and disadvantages of pulverized coal firing (write five each)? (05 Marks)
c. Explain with the help of a neat diagram, the working of fluidized bed combustion (FBC). (06 Marks)
- 5** a. Write short notes on the following:
i) Boiler blow down
ii) Steam purity (06 Marks)
b. With the help of a neat sketch, explain the working of high pressure hydraulic ash handling system. What are its advantages? (08 Marks)
c. What are the needs of feed water treatment in boiler? Explain any two methods of feed water treatment. (06 Marks)
- 6** a. With the help of T-S diagram, explain how the use of condenser increases the specific work output of a turbine. (06 Marks)
b. Sketch and explain the construction and working of forced draught mechanical cooling tower. What are its disadvantages? (08 Marks)
c. A prime mover uses 15000 kg of steam per hour and develop 2450 kW. The steam is supplied at 30 bar and 350°C. The exhaust from the prime mover is condensed at 0.0399 bar. The condensate temperature from the condenser is 31°C and the rise of temperature of circulating water is from 8°C to 18°C. Determine:
i) The quality of steam entering the condenser
ii) The quantity of circulating cooling water and the ratio of cooling.
Assume that no air is present in the condenser and all mechanical drive losses are negligible. (06 Marks)
- 7** a. Sketch and explain working of pressurized water reactor (PWR). (08 Marks)
b. What do you understand by radio active decay? With the help of examples, explain the various naturally occurring radioisotope emissions. (08 Marks)
c. Explain the difference between chemical and nuclear reactions. (04 Marks)
- 8** a. Explain the advantages and disadvantages of water power (four each). (04 Marks)
b. Explain with a sketch the importance of surge tank in a hydro-plant. (04 Marks)
c. With the help of a sketch, explain the pumped storage hydroelectric power plant. (06 Marks)
d. A single jet impulse turbine of 10 MW capacity is to work under a head of 500 m. If the specific speed of the turbine is 10 SI unit, the overall efficiency is 80% and the coefficient of velocity is 0.98, find the diameters of the jet and the bucket wheel. Assume the speed of the bucket wheel as 0.46 of the velocity of jet. (06 Marks)

* * * * *