

**Birla Institute of Technology and Science, Pilani**  
 I Semester, 2022-23 Dated: 02/11/2022 Open Book  
 ME F420 Power Plant Engineering

Time: 90 Minutes Mid semester examinations Weightage: 30% Total Marks: 60

Q1) Coal blending is practiced in many coal based thermal power plants in India to optimize the specific coal consumption and cost. While the Indian coal is relatively cheaper, the calorific value is less and ash content is more whereas the imported coal has higher calorific value and low ash content but they are costly. A 800MW power plant having NPHR of 12000kJ/kWh. As a technical consultant, you need to compare three options available for the coal to be used in the power plant i) Indian Coal ii) Imported coal and iii) Perfectly blending of the two coal by 50: 50 ratio. Compare the three options in terms of a) SCC b) Cost/kWh c) Size of the coal handling system and iv) release of emission. Also suggest which option will you recommend with suitable recommendation. Ultimate analysis of Indian and Imported coal in mass percentage and cost is given below. Also find the A:F ratio for all the three options if 15% excess air is to be supplied to ensure complete combustion. **(20 Marks)**

Coal	C (%)	M(%)	A (%)	S (%)	H(%)	O(%)	V(%)	N(%)	Cost of Coal
Indian	34.5	11.14	40.88	0.5	2.98	9.56	20.96	0.27	Rs.2500/T
Imported	58.96	9.43	5.99	0.56	4.16	11.88	8.0	1.02	Rs.4000/T

Q2) Find the number of tubes and length of each tube required for the economizer and convective super heater of a power plant having SSC of 4.0kg/kWh generating 800MW having boiler pressure of 180bar and condenser pressure of 50kPa. Neglect pump work. Take flow rate of the flue gas as 1400kg/s with specific heat of 1.1kJ/kgK. **(20 marks)**

Device	ID/ thickness	Velocity	T <sub>gi</sub>	T <sub>go</sub>	U (W/m <sup>2</sup> K)
Economiser	50mm/ 5mm	1.5m/s	600°C	450°C	150
CSH	50mm/5mm	5m/s	800°C	600°C	140.

P <sub>(Sat)</sub>	T <sub>(Sat)</sub> °C	V <sub>f</sub> (m <sup>3</sup> /kg)	V <sub>g</sub> (m <sup>3</sup> /kg)	h <sub>f</sub> (kJ/kg)	h <sub>g</sub> (kJ/kg)	S <sub>f</sub> (kJ/kgK)	S <sub>g</sub> (kJ/kgK)
50kPa	81.32	0.001030	3.2403	340.54	2645.2	1.0912	7.5931
180 bar	356.99	0.001840	0.007504	1732.2	2510.0	3.872	5.1064

Q3) Condenser of a 660MW power plant is operating at a pressure of 50kPa taking saturated steam from the turbine. During winter the inlet water temperature to the condenser is 10°C and the range of cooling tower is 10°C. But during summer the inlet water temperature increases to 25°C and the range of the cooling tower decreases to 5°C. Specific steam consumption in the turbine is 4 kg/kWh. Find 1) Steam flow rate 2) Water flow rate in the condenser 3) Surface area of the condenser U=1500W/m<sup>2</sup>K 4) reduction in the condenser capacity during summer. 5) Reduction in power output from the turbine in summer. **(20 Marks)**