

Ref. No. Ex/PE/PE/B/T/413B/2024

B.E. POWER ENGG. 4TH YEAR 1ST SEMESTAR EXAMINATION, 2024

SUBJECT: **High Pressure Boiler**

Time: Three Hours

Full Marks 100

SI No.	Use of steam Table is allowed	Marks
CO1(25 Marks)		
1 (a)	State the differences among natural circulation, force circulation and once through boiler.	6
(b)	What is the importance of proximate analysis of coal in a power plant, though ultimate analysis is available?	5
(c)	With block diagram show (i) water—steam cycle and (ii) air—flue gas path of a high pressure boiler. (Consider Cold primary air fan)	7+7
OR (c)	Sketch and label a π -shaped steam generator showing all the heat transfer surfaces and other major equipment.	14
CO2(25 Marks)		
2.(a)	State, the difference between longitudinal stress and hoop stress? Which one is used for design of boiler drum?.	5
(b)	(i) Why high pressure boilers are fire tube boiler?	3
	(ii) Draw the creep curve to show the different zone.	3
	(iii) How creep failure differs from fatigue failure	2
(c)	Write a short note on the constituent of boiler tube material and their properties	12
OR (c)	An alloy steel steam drum works under 75 Kg/ cm ² g pressure. Drum inside diameter is 1524 mm, tube hole diameter- 57.2 mm, longitudinal pitch of tube hole-101.6 mm, circumferential pitch of tube hole 7.15°, Corrosion allowance as per code – 0.762 mm Et =Yield point stress (0.2 % proof stress) at temperature 300°C =310 N / mm ² and at 350° C =301 N / mm ² R = Minimum tensile stress at room temperature = 590 N / mm ² Calculate: i) design stress value to be adopted ii) ligament efficiency in longitudinal and circumferential direction, iii) desired drum thickness before and after stress value correction	12
CO3 (25 Marks)		
3 (a)	Kolaghat TPS and Budgebudge TPS both are coal fired. Explain why boilers at Kolaghat TPS Unit 1 coal is front fired while in Budgebudge it is double downshot.	5
(b)	What do you mean by hard water? State the processes of removing the hardness.	5
(c)	A steam generator operates on following condition. Coal composition (% weight): Carbon-50, Hydrogen- 2.75, Oxygen-6.2, Nitrogen-1.2, Sulfur-0.50, Moisture-3.75, Ash-35.60, GCV-4730 kCal/kg. Other parameters: Moisture in air-0.015 kg/kg of dry air, Ambient temperature – 25°, Back end Temperature- 145°, Sp. Heat of the flue gas-1.01 kJ/kg K. GCV of carbon-33800 kJ/kg, Unburnt carbon loss- 1.8% of GCV of coal. Excess air –20%. Determine dry gas loss and moisture losses of the unit.	15
OR (c)	(i) State factors those needs to consider for selection of boiler tube material.	7
	(ii) What measures are taken to minimise scale formation and corrosion in boiler tubes?	8

[Turn over

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Sl No	Use of steam Table is allowed	Marks
	CO4 (25 Marks)	
4.(a)	Certain coal having GCV of 20 MJ/KG contain 4% Hydrogen and 5% moisture is to be fired in a furnace at a rate of 32 kg per second. If net heat input per unit of plan area= 4.8 MW/m^2 , width: depth = 6:5 and volumetric Heat Release Rate = 120 KW/m^3 , estimate plan area, width depth and height of the furnace. (neglect other losses and heat credit)	5
(b)	What are the main difference between a subcritical and a super critical boiler? Show the cycles of both in T-s diagram. What are the other differences?	6+4
(c).	With diagram show the difference between straight tube and spiral tube furnace construction of a once through supercritical boiler. What are major advantages and disadvantages of spiral tube construction?	10
OR (c)	What is the purpose of boiler insulation?	2
	The wall of a boiler consists of a 300 mm thick insulating brick layer and a slag wool insulation layer. t_w = Wall temperature i.e. hot surface temperature = 400°C . t_s = Cladding temperature or cold surface temperature = 60°C . Thermal conductivity of fire bricks and wool are 1.0 w/m.K and 0.05 w/m.K respectively. If heat loss through the insulating surface is 130 W/m^2 , determine the thickness of wool and temperature at the layer interface.	8