B.E. POWER ENGG. 4TH YEAR 1st SEMESTAR SUPPLEMENRTARY EXAM-2024
SUBJECT: *High Pressure Boiler*

Time: Three Hours   **Full Marks 100**

Sl No.	Use of steam Table is allowed	Marks
	CO1(25 Marks)	
1 (a)	What do you mean by high pressure boiler? Classify boiler based on a) heating surface characteristics b) end use of steam c) circulation d) number of drums.	8
(b)	What is the importance of proximate analysis of coal in a power plant, though ultimate analysis is available?	5
(c)	Calculate Equivalent Evaporation from following parameters. Main steam flow from boiler 680 Tons/ Hour at Pressure of 130.0 bar and at 500° C; Feed water temperature 240°C Cold reheat steam flow rate is 600 Tons/ Hour at 30 bar, 300° C and reheat outlet Temperature is 500° C	12
OR (c)	Sketch and label a π-shaped steam generator showing all the heat transfer surfaces and other major equipment.	12
	CO2(25 Marks)	
2.(a)	State, the difference between i) header and drum, ii) Pipe and tube.	6
(b)	(i)Why high pressure boilers are fire tube boiler?	3
	(ii) What is the maximum carbon percentage in low alloy steel? Why carbon percentage is kept low?	4
(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 =315 N / mm^2 and at 350° C =306 N / mm^2 R = Minimum tensile stress at room temperature = 595 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)	What is the importance of residence time of the coal particle in boiler. Explain, how residence time can be increased?	5
(b)	Describe condensate polishing process.	5
(c).	A steam generator operates on following condition. A steam generator operates under following condition. (Composition by wt %): Carbon-48.4%, Hydrogen -3.7%, Oxygen- 8.6%, Nitrogen -1.1%, Sulfur- 0.3%, Moisture- 11.5% and ash-26.4%. GCV of coal = 4670 KCal/kg, Air Moisture = 0.014 Kg/Kg of dry air Excess Air = 20%, backend temp.- 125°C, backend gas pressure- 0.07 bar, Air inlet temperature - 25°. Consider 2% of heat is lost due to unburnt carbon Determine dry flue gas loss and moisture loss.	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

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	CO4 (25 Marks)	
4.(a)	Certain coal having GCV of 25 MJ/KG contain 3% Hydrogen and 9% moisture is to be fired in a furnace at a rate of 30 kg per second. If net heat input per unit of plan area= 5.0 MW/m ^{2}, width: depth = 6:5 and volumetric Heat Release Rate = 125 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. Why steam separator is used in supercritical boiler?	4+4+2
(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 strait tube construction over spiral tube?	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 = 400^0 C. t_s = Cladding temperature or cold surface temperature= 60^{0}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/m2, determine the thickness of wool and temperature at the layer interface.	8