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Plant Engg.

CHEM / VI / CBGS / PE

QP Code : 5158

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(3 Hours)

[ Total Marks : 80

- N.B. : (1) Questions No. 1 is compulsory.  
 (2) Attempt any three out of remaining five questions.

1. Answer the following

- (a) Explain Detonation and Deflagration. 20  
 (b) Compare spring-operated (conventional) relief valve with spring-operated (balanced bellows) relief valve.  
 (c) Give advantages of high pressure boiler.  
 (d) How is compressed air distributed in a chemical plant?

2. (a) The free air delivered by a single stage double acting reciprocating compressor measured at 1 bar and 15°C of free air is 16m<sup>3</sup> / min. The pressure and temperature of air inside the cylinder during suction are 0.96 bar and 30°C respectively and delivery pressure is 6 bar. The compressor has a clearance of 4% of the swept volume and the mean piston speed is limited to 300 m/min. Determine 10

- (i) Power input to the compressor if mechanical efficiency is 90% and compression efficiency 85%.  
 (ii) Stroke and bore if the compressor runs at 500 rpm. Take index of compression and expansion as 1.3

(b) Define the following terms :-

- (i) Lost workdays 10  
 (ii) TLV-TWA  
 (iii) BLEVE  
 (iv) Set pressure (with reference to relief)  
 (v) Coding (with reference to data processing)

3. (a) Setup an analysis of variance table for the following per acre production data for three varieties of wheat each grown on 4 plots and state if the variety difference are significant. 10

Plot of land	Per acre production data		
	Variety of wheat		
	A	B	C
1	6	5	5
2	7	5	4
3	3	3	3
4	8	7	4

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3. (b) Explain the construction and working of a Babcock and wilcox boiler. 10
4. (a) A boiler generates steam at the rate of 10 kg/kg coal at a pressure of 12 bar with a dryness fn of 0.9. The boiler receives its feed water at 110°C from an economiser which receives it at 30°C. The steam raised by the boiler then passes through a super heater where its temperature is raised to 300°C at constant pressure 10
- Cv of coal = 34000 kJ/kg.  
 Cp (SH) = 2.1 kJ / kgk  
 Cp (water) = 4.18 kJ / kg k  
 At 12 bar  
 Enthalpy of saturated water = 798.65 KJ/Kg. (at 187.99°C)  
 Evaporation enthalpy = 1986.2 KJ/ kg.
- Determine :-
- Equivalent Evaporation at standard conditions.
  - Efficiency of combined plant
  - % of available heat in 1 kg coal utilized in boiler, economiser and superheater.

- (b) What are the LFL and UFL of a gas mixture composed of 0.8% hexane, 2.0 % methane and 0.5% ethylene by volume? 10

Data :-	Compound	(Vol % fuel in air)	
		LFL	UFL
	Methane	5	15
	Hexane	1.2	7.5
	Ethylene	2.7	36.0

5. (a) A storage tank system is used to store process feed stock. Overfilling of storage tanks is a common problem in the process industries. To prevent overfilling, the storage tank is equipped with a high-level alarm and a high-level shutdown system. The high-level shutdown system is connected to a solenoid valve that stops the flow of input stock. Develop an event tree for this system using the "Failure of level indicator" as the initiating event. 10
- (b) Explain the following technologies 10
- Volumetric efficiency
  - Tons of refrigeration
  - Factor of evaporation
  - MSDS
  - OSHA incidence rate

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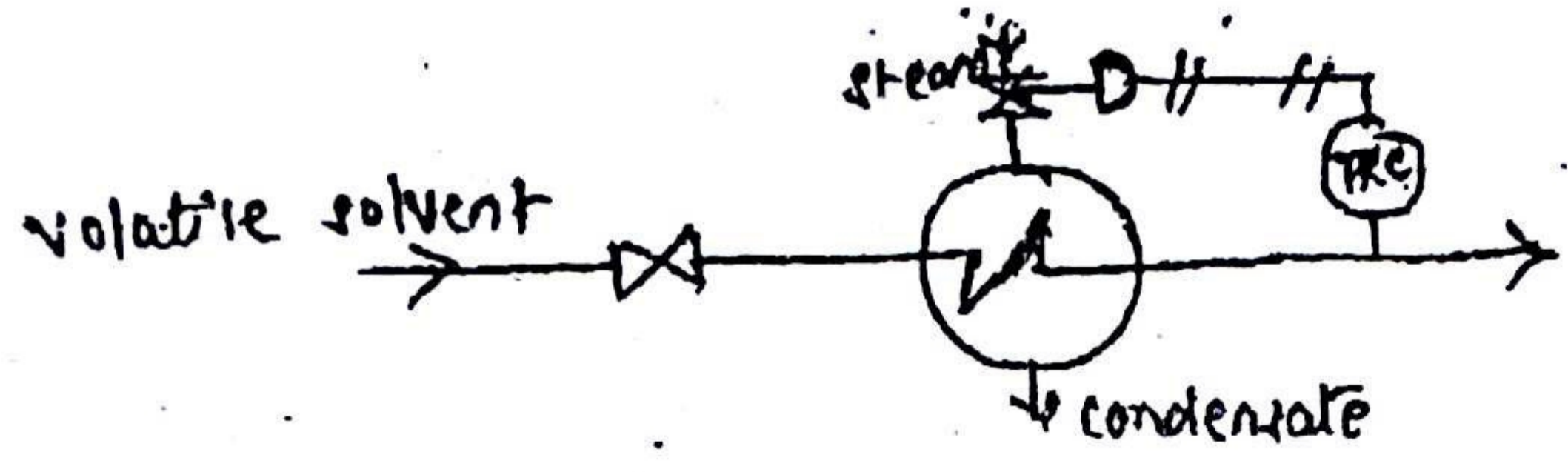
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6. (a) A heat exchanger is used to heat flammable, volatile solvents as shown. The temperature of the outlet stream is measured by a thermocouple, and a controller valve manipulates the amount of steam to the heat exchanger to achieve the desired set point temperature. Perform a HAZOP Study on the intention " hot Solvent from heat exchanger". 10



- (b) The capacity of a refrigerator is 300 tonnes when working between  $-4^{\circ}\text{C}$  and  $+15^{\circ}\text{C}$ . Determine the mass of ice produced per day (24 hours) at  $0^{\circ}\text{C}$  from water at  $15^{\circ}\text{C}$ . Also find the power required to drive the unit. Assume that the cycle operates on reversed carnot cycle and latent enthalpy of ice = 335 KJ/ kg. 10