Time: 3 Hours   **Total Marks: 80**

N.B.: (1) Question No.1 is compulsory.
      (2) Attempt any **Three** out of remaining questions.
      (3) Assume any suitable data if necessary and indicate it clearly.
      (4) Draw neat sketches wherever required.

Q.1   (a)   What are the measures of the effectiveness of safety programs?   (05)

     (b)   Explain MSDS.   (05)

     (c)   Explain types of boilers.   (05)

     (d)   Give different devices used for efficient distribution of steam.   (05)

Q.2   (a)   The following accident report has been filed.   (10)

Failure of a threaded 1.5 inch drain connection on a rich oil line at the base of an absorber tower in a large (1.35 MCF/D) gas producing plant allowed the release of rich oil and gas at 850 psi and -40°F. The resulting vapor cloud probably ignited from the ignition system of engine driven recompressors. The 75 inch high and 10 inch diameter absorber tower eventually collapsed across the pipe rack and on two exchanger trains. Breaking pipelines added more fuel to the fire. Severe flame impingement on an 11,000-horsepower gas turbine-driven compressor, waste heat recovery, and super-heater train resulted in its near total destruction.

Identify the initiation, propagation, and termination steps for this accident.

     (b)   Explain the working of spring loaded safety valve as a boiler mounting.   (10)

Q.3   (a)   Explain the treatment of air used for pneumatic control.   (10)

     (b)   A reactor contains the equivalent of 10,000 lb of TNT. If it explodes, estimate the injury to people and the damage to structures 500 ft away.   (10)
Data:-
for $z_e = 9.20$ m/kg$^{1/3}$, Scaled overpressure=0.21
for deaths resulting from lung hemorrhage, $Y = -77.1 + 6.91 \ln P$
for ear drum rupture, $Y = -15.6 + 1.93 \ln P$

Q.4   (a)   Estimate the UOL for methane. UFL=15 % volume fuel in air, $C_{UOL}=1.87$ and $UFL_0=17.85\%$.   (10)

     (b)   Draw the temperature-entropy diagram representing vapor-compression refrigeration cycle when the outlet of compressor is saturated vapor and the outlet of condenser is subcooled liquid.   (10)

E60CFC45F2172FDF02888C8F249C6B26

Q.5 (a) Methanol has a flash point of 54 °F, and its vapor pressure at this (10) temperature is 62 mm Hg. What is the flash point of a solution containing 75 % methanol and 25 % water?

Antoine Equation Parameters (P in mmHg, T in °C) are:-
A= 8.08097, B=1582.27, C=239.7

$$P = 10^{A-\frac{B}{C+T}}$$

(b) Draw and explain a typical steam and condensate circuit. (10)

Q.6 (a) Explain major advantages and disadvantages of spring operated relief valve (10) and rupture disc.

(b) Compare vapor absorption and vapor compression refrigeration cycle. (10)

****