Paper-1(Boiler Engineering-1)

Time: 3 Hours   Full Marks: 100

PART - A

1. **Answer all the questions.**   **(2 x 10)**
   a) What is the advantage of using tubes and flues in a boiler and mention the difference between tubes and flues.
   b) What are passes of the gases of combustion?
   c) Why do water tube boilers generate steam more quickly from a cold start and respond more quickly to load changes than firetube boilers?
   d) What keeps boiler metal from being destroyed by the intense furnace heat?
   e) Why is steel preferred over cast iron for boiler fittings?
   f) What is a drip leg and dirt pocket in a boiler?
   g) How does oxygen get into the boiler and pipes?
   h) What is a line desuperheater?
   i) Why must leaks of very high pressure or superheated steam be quickly repaired?
   j) Why is it important to maintain a constant water level in a steam boiler?

PART - B

2. **Answer any five from the given questions.**   **(4 x 5)**
   a) Describe the issues to be considered when piping a main steam line from the boiler to a major piece of steam-using equipment. Why should branches from steam mains always be taken from the top of the main?
   b) Can a boiler be operated with a broken gauge glass? What provisions must be made if the boiler operator does not have direct visual contact with the gauge glass on the boiler when making control changes? Explain the purpose of sheet mica in flat, high pressure gauge glasses. Why are gauge glasses fitted with hand valves at the top and bottom?
   c) What is water hammer? Where does water hammer damage a steam line first?
   d) What is the lift of a safety valve? What type of safety valve is used on modern boilers?
   e) What is a package boiler and miniature boiler? Explain their working principle.
   f) What is the primary concern if a water tube boiler experiences a tube leak and what should be done if the water in a boiler is foaming badly?
   g) How may the benefits of adding insulation to piping be quantified?

3. **Answer any four of the following questions.**   **(10 x 4)**
   a) A proximate analysis of coal shows fixed carbon (FC) 45%, volatile matter (VM) 25%, ash 12% and total moisture (TM) 23%, then calculate percentage of Carbon, Hydrogen and Oxygen present in the coal. Take percentage of nitrogen (N_2) in fuel 1.7.
   b) In a process plant, 35,000 lb/hr of flue gas having a composition N_2 = 75%, O_2 = 2%, CO_2 = 15%, and H_2O = 8%, all by volume, flows through a duct of cross section 3 ft^2 at a temperature of 350 °F. Estimate the gas density and velocity. Since the gas pressure is only a few inches of water column, for quick estimates the gas pressure may be taken as atmospheric.
   c) A 70% efficient Travelling grate Boiler consumes 40 TPH of Bagasse, by incorporating CR system the unburnt level in the fly ash is reduced from 22% to 18%, then calculate the total bagasse saved in a day. The ash percentage in bagasse is 1.5% and GCV of bagasse is 2250 kcal/kg and GCV of fly ash at 22% and 18% unburnt are 550 and 425 kcal/kg respectively.
   d) A 6-meter OD X 10-meter height condensate storage tank has surface metal temperature 75 °C calculate the heat loss per year in terms of tons of coal, take coal GCV 5000 kcal/kg and ambient temperature 30 °C.
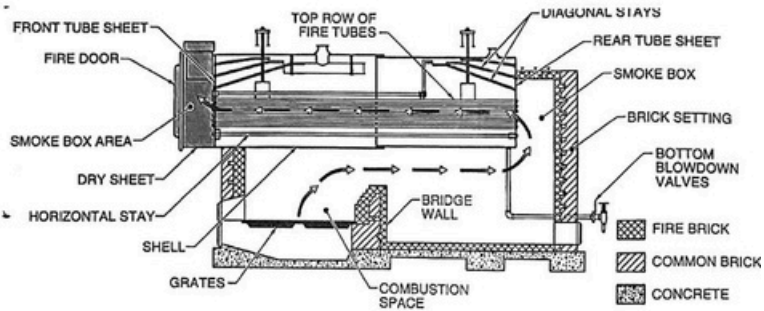
PART – C

4. Elaborate and mention which figure is given below and write a short note about their principle of working.
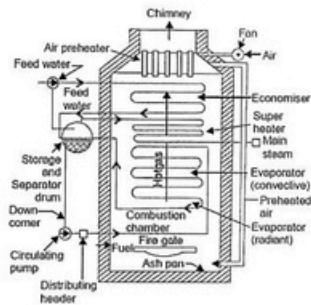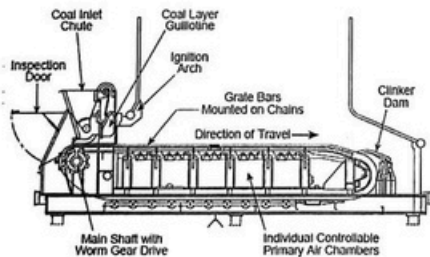
    (5 x 4)

a)
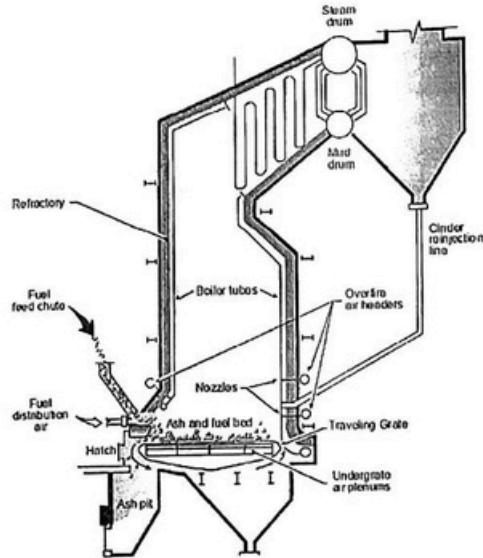
b)

c)

d)

Paper-2(Boiler Engineering-2)

Time: 3 Hours   Full Marks: 100

PART - A

1. **Answer all the questions.**   (2 x 10)
   a) What is total heat, latent heat, sensible heat and specific heat?
   b) Water enters a boiler at 225 °F and 100 psig. The heat of the steam (total heat) at these conditions is 1190.6 Btu. Assuming that there is no moisture in the steam, what is the factor of evaporation?
   c) What is steam blanketing of boiler heating surfaces?
   d) Why do scale deposits form in a boiler?
   e) What is the required accuracy of mechanical pressure gauges compared to the working pressure?
   f) What is an evaporative condenser?
   g) What is ORP and its Importance?
   h) What are the different types of cooling tower?
   i) Can a furnace explosion occur under a banked boiler?
   j) Where is the forced draft fan and induced draft fan located in the boiler setting?

PART – B

2. **Answer any five from the given questions.**   (4 x 5)

   a) What are the different schemes for condensate system?
   b) How acid and alkali requirement for pH correction can be calculated?
   c) When using an induced draft fan, where is the strongest negative draft found? How is the damper on a large fan controlled from a remote location?
   d) How energy can be saved in steam, feed water and condensate cycle for power plant operation?
   e) Why are soot blowers provided in the regenerative air preheaters used in solid fuel-fired boilers?
   f) How does an open loop control work? What are Set Point (SP) & Process Value (PV)?
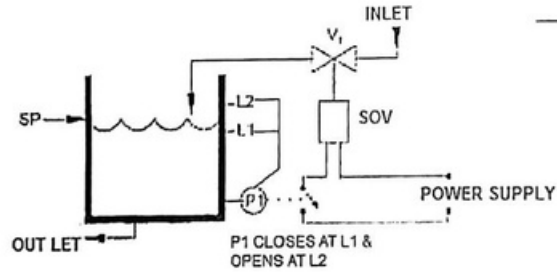   g) What is flue gas scrubber? What is the difference between a dry flue gas scrubber and a wet flue gas scrubber?

3. **Answer all of the following questions.**
   a) In a rankine cycle, the steam flows to turbine as saturated steam at a pressure of 35 bar and the exhaust pressure is 0.2 bar. Determine (using steam table only) (i) pump work (ii) the turbine work (iii) the rankine efficiency (iv) the condenser heat flow (v) the dryness fraction at the end of expansion. The mass flow rate of steam is 9.5 kg/sec.   (10)
   b) A chimney of inside diameter 3 meter has flue gas velocity 12 m/sec., calculate the mass of flue gas passing through the chimney at temperature 150 °C.   (5)
   c) Estimate the pounds of water vapor to pounds of dry air when the dry bulb temperature is 80°F and the relative humidity is 65%.   (5)
   d) In a boiler trial, the following observations were made.
   Atmospheric pressure = 0.998 bar
   Boiler gauge pressure = 8.58 bar
   Hot well temperature = 50 °C
   Temperature of boiler house = 28°C
   Steam condensed per hour = 480 kg
   Moisture in fuel = 2.1 % by mass
   Mass of flue gases per kg of fuel = 18 kg
   Coal used per hour = 58 kg
   L.C.V of coal = 33700 kJ/kg
   Brake power of engine = 40 kW
   Temperature of flue gases = 325°C
   Mean specific heat of flue gases = 1.005 kJ/kgK
   Condition of steam = 0.95 dry
   Draw up the heat balance sheet for the boiler and find the boiler efficiency and the overall efficiency of the plant.   (20)
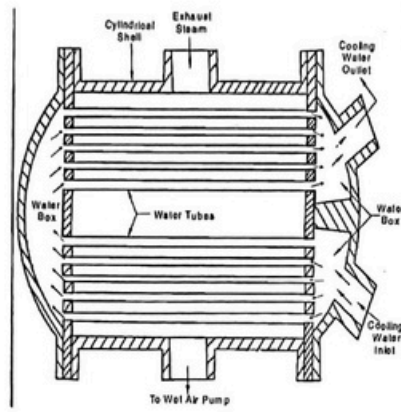
PART – C

4. Elaborate and mention which figure is given below and write a short note about their principle of working. (5 x 4)
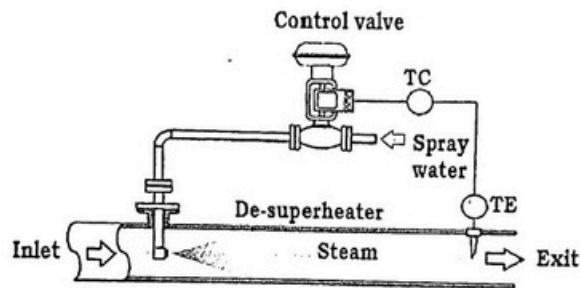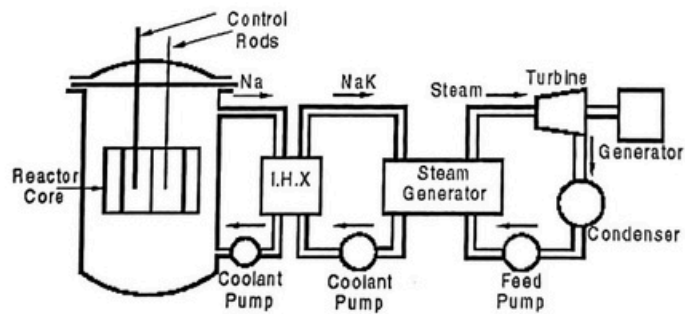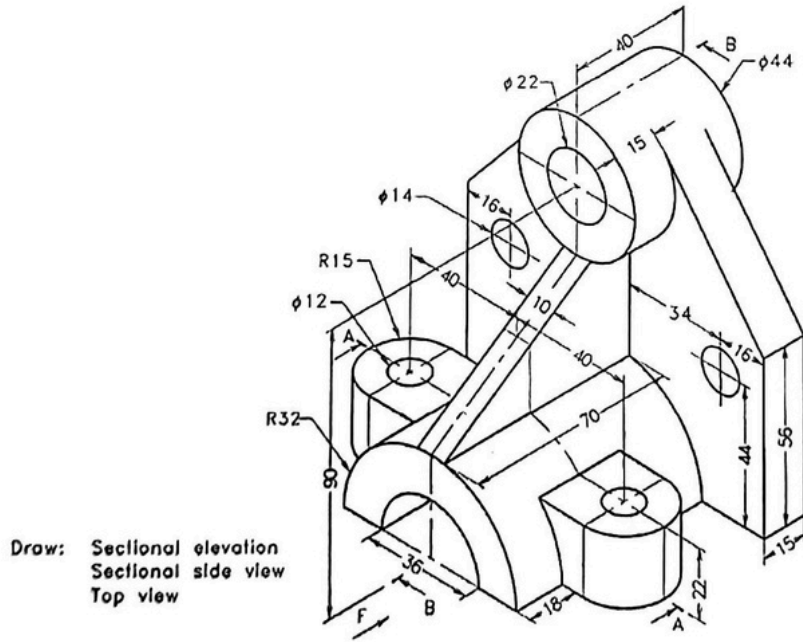
a)

b)

c)

d)

Paper-3(Engineering Drawing)

Time: 3 Hours   Full Marks: 100

Missing dimensions, if any, may be suitably assumed.

PART - A

1. **Answer any one from the given two questions.**   **(10 x 2)**

   a) Sketch sectional elevation and end view of the assembly of shaft and collar fitted with the following types of keys.

   (i) Taper sunk key

   (ii) Taper sunk key with gib head

   (iii) Feather sunk key

   The diameter of the shaft is 30 mm and that of the collar is 50 mm for a length of 60 mm. Indicate the dimensions on the keys as per the standard practice.

   b) Figure below gives orthographic views of parts of a sleeve and cotter joint. Assemble them and draw:

   (i)   Elevation top half in section

   (ii) End view from left side

   ① Rod end (2 Nos.–Steel)

   ② Sleeve (1No.–Steel)

   ③ Cotter (2 Nos.–Steel)

PART – B

   c) Draw orthographic views (multi views) of the machine part given in pictorial form. Name the views and dimension them as per BIS.   **(40)**

   Draw: Elevation
   Plan
   Right side view

d) Draw the elevation top half in section and plan bottom half in section. Avoid hidden lines in the sectioned areas. (40)

Draw: Sectional elevation
        Sectional side view
        Top view