BACHELOR OF ENGINEERING (MECHANICAL ENGINEERING) FIFTH YEAR SECOND SEMESTER - 2025

STEAM GENERATORS

Time: 3 hours | Full Marks: 100

Answer any five questions. *Different parts of the same question should be answered together. Assume any relevant data if necessary. Use of Steam tables and charts are allowed.*

1. *Answer the following questions*: 4x5=20
   a) What are the main functions of steam drum?
   b) Why indirect method of determining boiler efficiency is more useful than direct method?
   c) List the boiler mounting and accessories.
   d) Describe the function of Fusible plug?
   e) Explain the function of air-preheater in a steam boiler installation. Discuss its location.

2. a) Explain the working of a locomotive boiler with the help of a neat sketch. 10
   b) Explain the working of a water-level indicator with a neat diagram. 10

3. The following data were obtained during a boiler trial:

   Mass of steam = 700 kg/h
   Temperature of feed water = 60°C
   Steam pressure = 10 bar
   Oil consumption = 55 kg/h
   CV of oil = 44000 kJ/kg
   Dryness fraction of steam = 0.98
   Percentage composition of oil by mass:
   C = 85%, H_2 = 14%, Ash = 1%
   Analysis of dry flue gases by volume:
   CO_2 = 12.5%, O_2 = 4.5%, N_2 = 83%
   Temp. of flue gases leaving the boiler = 350°C
   Boiler room temperature = 25°C
   Specific heat of flue gases = 1.02 kJ/kg-K
   Partial pressure of steam = 0.08 bar
   Heating surface area = 21.4 m^2
   Find
   (a) Equivalent evaporation per kg of fuel from and at 100°C,
   (b) Equivalent evaporation per sq. m of heating area,
   (c) Thermal efficiency of the boiler,
   (d) Heat balance sheet on the basis of 1 kg of fuel and on the percentage basis. 20

4. a) Calculate the equivalent evaporation from and at 100°C for a boiler, which receives water at 60°C and produces steam at 1.5 MPa and 300°C.The steam generation rate is 16000kg/h. Coal is burnt at the rate of 1800 kg/h. The calorific value of coal is 34750 kJ/kg. Also calculate the thermal efficiency of the boiler.
   If the thermal efficiency of the boiler increases by 5% due to use of an economiser, find the saving in coal consumption per hour. 10

   (b) Why are superheaters used on boilers? Explain their working. 10

5. a) Derive an expression for maximum discharge through a chimney. 10

   b) Draw the basic Layout and explain the working of a thermal power plant. 10

6. a) What is the harmful effect of silica in water? How it is removed? 6
   b) Explain a steam jet draught with its features. 8

   b) State the advantages of artificial draught over natural draught. 6

7. a) What is Fluidization? 2+9+9
   b) Describe the followings: i) Atmospheric fluidized Bed Combustion (AFBC) ii) Pressurized Fluidized Bed Combustion (PFBC)