00771

DIPLOMA IN MECHANICAL ENGINEERING (DMEVI)

Term-End Examination

December, 2012

BIMEE-029 : POWER PLANT ENGINEERING

Time : 3 hours   *Maximum Marks : 70*

*Note :   Attempt **any five** questions. All questions carry **equal** marks. Use of steam tables and scientific calculator are* **permitted.**

1.   (a)   Describe the following gaseous fuels :   **7+7**
            (i)   Coal gas
            (ii)   Coke-oven gas
            (iii) Blast furnace gas and
            (iv)   Producer gas.

     (b)   During a trial in a boiler, the dry flue gas analysis by volume was obtained as $CO_2=13\%$, $CO=0.3\%$, $O_2=6\%$, $N_2=80.7\%$. The coal analysis by weight was reported as $C=62.4\%$, $H_2=4.2\%$, $O_2=4.5\%$, moisture=15%, and ash=13.9%. Estimate.
            (i)   Theoretical air required to burn 1 kg of coal.
            (ii)   Weight of air actually supplied per kg of coal, and
            (iii) The amount of excess air supplied per kg of coal burnt.

2. (a) State the methods of increasing the thermal   7+7
      efficiency of a Rankine cycle.

   (b) In a Rankine cycle, the steam at inlet to
       turbine is saturated at a presure of 30 bar
       and the exhaust pressure is 0.25 bar.
       Determine.

       (i)   The pump work

       (ii) Turbine work.

       (iii) Rankine efficiency

       (iv) Dryness fraction at the end of
             expansion. Assume steam flow rate of
             10 kg/s.

3. (a) A diesel engine has a compression ratio of   7+7
      15 and heat addition at constant pressure
      takes place at 6% of stroke. Find the air
      standard efficiency of the engine. Take γ for
      air as 1.4.

   (b) Dry saturated steam at a pressure of 11 bar
       enters a convergent-divergent nozzle and
       leaves at a pressure of 2 bar. If the flow is
       adiabatic and frictionless, determine:

       (i)   The exit velocity of steam

       (ii) Ratio of cross-section at exit and that
             at throat.

             Assume the index of adiabatic
             expansion to be 1.135.

4. (a) Enumerate and explain the steps involved 7+7
in handling of the coal in a steam power
plant.

(b) In a reaction turbine, the fixed blades and
moving blades are of the same shape, but
reversed in direction. The angles of the
. receiving tips are 35° and of the discharging
tips 20°. Find the power developed per pair
of blades for a steam consumption of
2.5 kg/sec, when the blade speed is
50 m/s. If the heat drop per pair is
10.04 KJ/kg. Find the efficiency of the pair.

5. (a) Explain with neat sketches the construction 7+7
and working of any two of the following
high pressure boilers.

(i) Lamont boiler

(ii) Loeffer boiler

(iii) Benson boiler

(iv) Velox boiler.

(b) The inlet conditions of steam to a
convergent-divergent nozzle is 22 bar and
260 °C. The exit pressure is 4 bar. Assuming
frictionless flow upto the throat and a
nozzle efficiency of 85%, determine :

(i) The flow rate for a throat area of
32.2 cm^2.

(ii) The exit area.

6. (a) Define the term "Steam nozzle". Explain the 7+7
various types of nozzles. What is the effect
of friction on the flow through a steam
nozzle ?

   (b) 5400 mg steam is produced per hour at a
pressure of 7.5 bar in a boiler with feed
water at 41.5 °C. The dryness fraction of
steam at exit is 0.98. The amount of coal
burnt per hour is 670 kg. Calorific value of
coal is 31000 KJ/kg. Determine.
   (i) The boiler efficiency,
   (ii) Equivalent evaporation.

7. (a) What is a cooling tower ? How are cooling 7+7
towers classified ? Explain any one of them
with a neat sketch.

   (b) What are the advantages and disadvantages
of Diesel power plants ? State the
applications of Diesel Power plants.

8. (a) Explain with the help of a neat diagram the 7+7
construction and working of a nuclear
power plant.

   (b) The following data relate to a hydro-electric
power station :
   Head = 400 m ; Discharge = 4.5 m^3/s ;
   Turbine efficiency = 82% ; Generator
   frequency = 50 Hz.
   Determine :
   (i) Power developed
   (ii) Type of turbine
   (iii) Speed of turbine.

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