No. of Printed Pages : 4

BIMEE-029

DMEVI

01315

Term-End Examination

June, 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 allowed.*

1. (a) What is a chemical fuel ? How does it differ from a nuclear fuel ? How are chemical fuels classified ? **7+7**

   (b) The volumetric analysis of a fuel gas is : $CO_2 = 14\%$; $CO = 1\%$; $O_2 = 5\%$, and $N_2 = 80\%$, Calculate the fuel gas composition by weight.

2. (a) Describe the different operations of Rankine-cycle. Derive also the expression for its efficiency. **7+7**

   (b) A steam power plant working on Rankine cycle has the range of operation from 40 bar dry saturated to 0.05 bar. Determine :

   (i) The cycle efficiency

   (ii) Work ratio

   (iii) Specific fuel consumption.

3. (a) The efficiency of an Otto cycle is 60% and $\gamma = 1.5$. What is the compression ratio ? 7+7

(b) The steam used by the turbine is 5.4 kg/kWh at a pressure of 50 bar and a temperature of 350°C. The efficiency of boiler is 82 percent with feed water at 150°C.

(i) How much kg of 28100 kg coal are required /kWh ?

(ii) If the cost of coal / tonne is Rs 5000, what is fuel cost / kWh ?

4. (a) What factors should be taken into consideration while selecting the site for steam power plant ? 7+7

(b) In an impulse turbine (with a single row wheel) the mean diameter of the blades is 1.05 m and the speed is 3000 rpm. The nozzle angle is 18°, the ratio of blade speed to steam speed is 0.42 and the ratio of the relative velocity at outlet from the blades to that at inlet is 0.84. The outlet angle of the blade is to be made 3° less than the inlet angle. The steam flow is 10 kg/s. Draw the velocity diagram for the blades and derive the following :

(i) Tangential thrust on the blades

(ii) Axial thrust on the blades.

(iii) Resultant thrust on the blades.

(iv) Power developed in the blades

(v) Blading efficiency.

5. (a) Enumerate and explain various modern ash - handling systems in steam power plant. Explain with the help of a diagram the working of a 'cyclone separator'. 7+7

(b) In a steam nozzle, dry and saturated steam is expanded from 10 bar to 0.1 bar. Calculate :

(i) Dryness fraction of steam at exit.

(ii) Heat drop

(iii) The velocity of steam at exit from the nozzle when initial velocity is 135 m/s.

6. (a) Explain briefly ***any two*** of the following boiler accessories : 7+7

(i) Economiser

(ii) Air preheater

(iii) Superheater.

(b) Explain briefly the following lubrication system :

(i) Wet sump lubrication system.

(ii) Dry sump lubrication systems.

7. (a) Define a steam condenser and state its functions. Explain the reasons for inefficiency in surface condenser. 7+7

(b) List the advantages and disadvantages of steam power plants.

8. (a) Describe the advantages of pulverised coal firing in a steam power plant. What are the different methods used for supplying pulverised fuel to combustion chamber ? 7+7

(b) A hydro - turbine is required to give 25 MW at 50 m head and 90 rpm runner speed. The laboratory facilities available, permit testing of 20 kW model at 5 m head. What should be the model runner speed and model to prototype scale ratio.