

**DIPLOMA IN MECHANICAL ENGINEERING  
(DMEVI)****Term-End Examination****December, 2013****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, Mollier chart and calculator are permitted.*

1. (a) Discuss the specific advantages of liquid fuels over solid and gaseous fuels. 6
- (b) A sample of coal supplied to a boiler has the following composition by mass : 8  
C → 88%  
H<sub>2</sub> → 5%  
O<sub>2</sub> → 3%  
S → 0.5%  
N<sub>2</sub> → 1%  
Incombustible matter 2.5%  
Calculate the theoretical air supply per kg of fuel and the mass of products of combustion per kg of fuel.
2. (a) Draw a block diagram of a steam thermal power plant, show all important components and discuss functions of each part. 7

- (b) Consider a steam power plant operating on the simple ideal Rankine cycle. The steam enters the turbine at 30 bar and 600°C and condensed at a pressure of 10kPa. Determine the thermal efficiency of the cycle. 7
3. (a) Describe with a neat sketch, the construction and working of a Lancashire boiler. Show the positions of different mounting and accessories . 7
- (b) Explain briefly following boiler mountings and accessories (Any two) : 7
- (i) High steam low water safety valve
  - (ii) Blow off cock
  - (iii) Economiser
4. (a) What do you understand by the term "boiler draught" ? What are the various methods of producing draught ? 4
- (b) List the merits of mechanical draught over natural draught. 3
- (c) A coal fired boiler plant consumed 400kg of coal per hour. The boiler evaporates 3200kg/hr of water from 44.5°C to superheated steam at a pressure of 12 bar and 274.5°C. If the calorific value of the fuel is 32760kJ/kg of fuel, determine : 7
- (i) Equivalent evaporation
  - (ii) Thermal efficiency of boiler
- Take  $C_p$  of superheated steam = 2.1kJ/kg/K

5. (a) Show that the maximum discharge of steam through the nozzle takes place when the ratio of steam pressure at the throat to the inlet pressure is given by : 7

$$\frac{p_2}{p_1} = \left( \frac{2}{n+1} \right)^{\frac{n}{n-1}}$$

Where n is the index of expansion

- (b) Dry saturated steam at a pressure of 10 bar is expanded in a nozzle to a pressure of 0.7 bar. Find the velocity and dryness fraction of steam issuing from the nozzle, if friction is neglected. Also find the velocity and dryness fraction of steam if 15% of the heat drop is lost in friction. 7
6. (a) Describe with the neat sketches the operation of the following types of condensers : 7
- (i) Jet condenser
  - (ii) Surface condenser
- (b) Outlet and inlet temperature of cooling water to a condenser are 37.5°C and 30°C respectively. If the vacuum in the condenser is 706mm of mercury with barometer reading 760mm, find out condenser efficiency. 7

7. (a) What are the different losses in steam turbines. Discuss briefly. 4
- (b) Discuss the advantages of steam turbine over steam engines. 3
- (c) The velocity of steam at inlet to the simple impulse turbine is 1000m/s and the nozzle angle is  $20^\circ$ . The mean blade speed is 400m/s and the blades are symmetrical. The mass flow rate of steam is 0.75kg/s. The frictional effects on the blade are negligible. Estimate : 7
- (i) Blade angles
- (ii) The tangential force on the blades
- (iii) The diagram efficiency.
8. (a) What is the objective of supercharging ? Why it is more beneficial in a CI engine compared to a SI engine ? 4
- (b) What is surge tank ? Why is it important in a hydro-electric plant ? 3
- (c) Draw a neat sketch of a CANDU type reactor and explain its working. Also enlist the advantages of this reactor over others. 7
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