THERMAL ENGINEERING - II

MODEL QUESTION PAPER – I

Time: 3 Hrs. Max Marks : 100

[N.B: *(1) Answer all 10 questions from PART – A. Each question carries 3 marks.*

(2) Answer division (a) or division (b) of each question in PART – B. Each question carries 14 marks.]

PART – A

1. State the advantages of superheated steam.
2. Define dryness fraction.
3. State the difference between fire tube and water tube boilers.
4. Mention the common external treatments given to boiler feed water?
5. Name any three devices used to remove dust particles from the flue gas in thermal power plants.
6. What is the necessity of compounding?
7. Differentiate between nuclear fission and nuclear fusion.
8. State the main functions of control rods in nuclear reactor.
9. List out the uses of compressed air.
10. What is bi-propellant?

PART – B

11.(a) Two boilers A and B discharge equal amounts of steam into same main. Both the boilers operate at a pressure of 14 bar absolute, which is also the pressure of steam in the main. The boiler A delivers steam at 300°C. For a temperature of 235°C in the main, estimate the quality of steam supplied by the boiler. Also determine the net increase or decrease of entropy. Take C_p = 2.1 kJ/kgK for superheated steam.

(Or)

(b) One kg of steam at a pressure of 1 bar absolute and 0.85 dry is compressed according to the law $p.v^{1.25} = \text{constant}$. The final pressure is 2 bar. Find the final condition of steam and heat which passes through the cylinder walls.

12.(a) Explain the working of BHEL high pressure boiler with a line sketch.

(Or)

(b) (i) Write the procedure for starting the boiler from cold condition.

(ii) Following observations refer to a boiler trial :

Mean temperature of feed water =13°C;
Water evaporated per hour = 2155 kg
Boiler pressure = 11.25 bar;
Quality of steam = 0.95;
Coal burnt per hour = 250 kg
Calorific value of coal = 33400 kJ/kg

Calculate : 1) Actual evaporation per kg of coal, 2) Equivalent evaporation per kg of coal, 3) Thermal efficiency

13.(a) (i) Explain the following in a thermal power plant :
1) Fuel and ash circuit 2) Water and steam circuit

(ii) A surface condenser having an absolute pressure of 0.10 bar is supplied with cooling water at the rate of 40 kg/kg of steam condensed. The rise in temperature of cooling water is 14°C. Find the dryness fraction of steam entering the condenser. The condensate leaves at 44°C. Calculate also the amount of heat to be removed from 1 kg of steam.

(Or)

(b) (i) Explain the method of removal of dust particles using an electrostatic precipitator.

(ii) Explain the working of bleeder turbine with a line sketch.

14.(a) Draw the layout of a diesel power plant and explain the principle of working.

(Or)

(b) Explain the construction and working of pressurised water reactor with a line sketch.

15.(a) (i) A single cylinder reciprocating air compressor has a volume of 0.1 m^3 . The intake condition of air is one bar and 15 °C. The air after compression attains a pressure of 8 bar. It is delivered to the receiver at a constant pressure. The compression takes place according to the law $p.V^{1.3} = C$. Determine :

(i) Temperature at the end of compression, (ii) Net work done on air per cycle.

(ii) Explain the working of liquid propellant rocket engine with a neat sketch.

(Or)

(b) (i) A single acting two stage compressor with complete inter cooling delivers 5 kg/min of air at 15 bar pressure. Assume an intake state of 1 bar and 15 °C and that the compression and expansion processes are polytrophic with n=1.3. Calculate the power required.

(ii) With a neat sketch explain the closed cycle gas turbine.

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PART – A

1. What do you mean by external work of evaporation?
2. What is the use of calorimeter? State its types.
3. List out the advantages of high pressure boilers.
4. How will you compare the performance of boilers?
5. What is the main function of wet scrubber?
6. Why vacuum is maintained in condenser?
7. What is uranium enrichment?
8. Mention any three nuclear power plants in India.
9. Define volumetric efficiency of compressor. Give its expression.
10. List out the applications of rocket.

PART – B

11.(a) Determine the specific volume and internal energy of 1 kg of steam at a pressure of 8 bar when steam is 90% dry, saturated and superheated, the temperature of superheated steam being 200°C. Assume C_p for superheated steam as 2.25 k/kgK.

(Or)

(b) Explain the method of finding dryness fraction of steam using separating and throttling calorimeter with a neat sketch.

12.(a) In a boiler test, the following data were recorded : Mean temperature of feed water=50°C; Mean boiler pressure = 5 bar; Dryness fraction of steam = 0.95; Coal consumption = 600 kg/hr.; Calorific value of coal = 30400 kJ/kg; Feed water supplied to boiler = 4800 kg/hr. Taking boiler house temperature of 20°C, draw up an energy balance per kg of steam generated. Assume that 25% of heat energy supplied by coal is being carried away by flue gases. Determine also the equivalent evaporation from and at 100°C per kg of coal and the boiler efficiency.

(Or)

(b) (i) Briefly explain the important clauses of Indian boiler act.

(ii) A boiler produces 2267 kg of dry saturated steam per hour at a pressure of 11.5 bar absolute from feed water which is at a temperature of 121°C. The coal fired in 3 hours is 750 kg and has calorific value of 32000 kJ/kg. It is found that 10% of the coal is unburnt. Calculate: 1) Equivalent evaporation from and at 100°C per kg of coal fired, 2) Efficiency of the boiler, 3) Efficiency of the boiler and grate combined.

13.(a) (i) Explain the factors to be considered for the selection of site for thermal power plant.

(ii) What is the necessity of compounding? Explain any one type of compounding in impulse steam turbines.

(Or)

(b) (i) Explain the operation of cyclone separator with a neat sketch.

(ii) A surface condenser is designed to handle 10,000 kg of steam per hour. The steam enters at 0.08 bar and 0.9 dry. The condensate leaves at the corresponding

saturation temperature. The pressure is constant throughout the condenser. Estimate the cooling water flow rate per hour, if the cooling water temperature rise is limited to 10°C.

14.(a) Draw the layout of hydel power plant and explain the working principle.

(Or)

(b) Explain the construction and working of CANDU type nuclear reactor with a line sketch.

15.(a) (i) A single stage single acting reciprocating air compressor has a bore of 200mm and a stroke of 300mm. It receives air at 1 bar and $20\,^{o}C$ and delivers it at 5.5 bar. If the compression follows the law $p.V^{1.3} = C$ and clearance volume is 5 percent of the stroke volume, determine the power required to drive the compressor if it runs at 500 rpm.

(ii) Explain the working of a turbo propeller engine with a simple sketch.

(Or)

(b) (i) A two stage compressor works between 1 bar and 16 bar. The inlet temperature is $30\,^{o}C$. Determine the exit temperature, if intercooling is perfect and compression is isentropic. Also find the work done per kg of air with and without intercooling.

(ii) With a neat sketch, explain the working of a gas turbine with intercooler.