M.Tech-Heat Power Engineering (Old Scheme + CBCS Pattern) Sem I

918 - Thermal Engineering - I

P. Pages : 2 **GUG/S/18/3837**

Time : Three Hours * 0 9 7 4 * Max. Marks : 70

Notes :
1. All questions carry equal marks.
2. Due credit will be given to neatness and adequate dimensions.
3. Assume suitable data wherever necessary.
4. Diagrams and Chemical equation should be given wherever necessary.
5. Illustrate your answers wherever necessary with the help of neat sketches.
6. Use of slide rule, Logarithmic tables, Steam tables, Mollier's chart, Drawing instruments, Thermodynamic tables for moist air, Psychrometric charts and Refrigeration charts is permitted.
7. Answer **any five** questions.

1. a) Give chemical reaction & numerical values for estimating the air requirement for complete combustion of coal. **7**

b) A producer gas, used as a fuel has the following volumetric compositions → **7**

$H_2 = 28\%$

$CO = 12\%$

$CH_4 = 2\%$

$CO_2 = 16\%$ &

$N_2 = 42\%$

Find the volume of air required for complete combustion of $1m^3$ of this gas. Air contains 21% by volume of oxygen.

2. a) Derive an equation for theoretical or minimum volume of air required for an complete combustion. **7**

b) A fuel has the following compositions by mass. Carbon = 86%, Hydrogen = 11.75%, oxygen = 2.25% calculate the theoretical air supply per kg of fuel & mass of the products of combustion per kg of fuel. **7**

3. a) A bed of a particles of mean size 478 μm is fluidized by air under the ambient condition where the air density is 1.22 kg/m^3 & the viscosity is $1.87 * 10^{-5}$ kg/ms. The bulk density of the loosely packed bed is 1680 kg/m^3. If the density of solids is 2800 kg/m^3. Estimates → **7**

i) The Voidage of the bed

ii) The minimum fluidization velocity.

iii) The sphericity of particles.

b) Explain with the help of neat sketch pressurized fluidized bed combustion (PFBC) Boiler. **7**

4. a) Explain with neat sketch continuous reheating furnaces along with its advantages & drawbacks. **7**

b) Compare various fluidized bed combustion system on the following basis → **7**

i) Principle

ii) Constructional features

iii) Combustion efficiency.

iv) Applications.

v) Refracting & insulations.

5. a) In a co-generation system, Rankine cycle is operated with steam being supplied to the turbine at 50 bar & 380ºC & the condenser pressure of 12 bar. The isentropic turbine efficiency is 85%. Energy rejected by the condensing steam is transferred to a separated process steam of water entering 120ºC & 9.6 bar & leaving as saturated vapour at 9.6 bar. Compute the mass flow rate in kg/hr for the working fluid of the Rankine cycle, if the main flow rate of process steam is 25,000 kg/hr. Also compute the power developed. **7**

b) Explain the various methods to improve the thermal efficiency of gas turbine. **7**

6. a) Discuss the part load behaviour of combined cycle power plant. Compare it with conventional gas turbine power plant. **7**

b) Discuss the working principle of heat pipe with the help of neat sketch along with its applications, advantages & drawbacks. **7**

7. a) Explain the following terms → **6**

i) Ceramic recuperator.

ii) Convective radiative recuperator.

b) Compare binary vapour cycle & combined gas steam power cycle (T.S. diagram is must) **8**

8. a) Classify waste heat recovery system & explain any one type with neat sketch. **6**

b) Write short notes → **any two.** **8**

i) Different methods of energy conservation

ii) Combustion equations of solid & gaseous fuels.

iii) Pass out turbine, Back pressure turbine & Exhaust turbine.

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