

M.Tech. Second Semester (Chemical Engineering) (CBS)
13014 : Energy Technology & Conservation : 2 CE 4

P. Pages : 2

Time : Three Hours



AV - 3393

Max. Marks : 80

- Notes :
1. All question carry marks as indicated.
 2. Answer **six** questions.
 3. Question No. **1** is compulsory.
 4. Due credit will be given to neatness and adequate dimensions.
 5. Assume suitable data wherever necessary.
 6. Diagrams and chemical equations should be given wherever necessary.
 7. Illustrate your answer necessary with the help of neat sketches.
 8. Use of slide rule logarithmic tables, Steam tables, Moller's Chart, Drawing instrument, Thermodynamic table for moist air, Psychrometric Charts and Refrigeration charts is permitted.
 9. Discuss the reaction, mechanism wherever necessary.
 10. Use of pen Blue/Black ink/refill only for writing the answer book.

1. a) An engine develop 25kW by consuming 7kg fuel/hr. The heating value of the fuel is 40000kJ/kg. Calculate the 10
 - i) Thermal efficiency of engine
 - ii) The specific fuel consumption express as kJ/kW.hr
 - iii) Work done by the engine in 15min.
b) Explain in brief the different sources of power generation. 5
2. a) A Refrigerator is given 2kW of power input. The heat rejected is 2.8 times the work input. Refrigerator uses 2 kW.hr/day and the heat rejected is 3 times of work done. Calculate the cooling effect and coefficient of performance. 9

b) What are the essential elements of a thermal energy producing device and explain how its performance can be evaluated? 4
3. 0.02 m³ of air is expanded from 1.75mPa and 313K to 103kPa. Calculate final temperature, final volume, work transfer, heat transfer, change in internal energy, change in enthalpy, change in entropy, if expansion is carried out. 13
Data:-
 $C_p = 1.006$, $C_v = 0.718 \text{ kJ/kg}$
 $r = 1.4$, $n = 1.3$
4. A furnace is fired with 250 kg/hr coal. The efficiency of coal contain 80% Carbon and rest ash. The efficiency of furnace is such that only 85% of the carbon charged burns, remaining 15% giving as residue and unburnt carbon of the carbon which burns 90% goes to CO₂ and rest to CO 40% excess air is used. 13
Calculate the percentage composition by volume of the gases leaving the furnace and the volumetric flow rate of flue gases in m³/min i.e. if the gases leave the chimney at 350°C & 100kPa Pressure.

5. The following information are available for a steam power plant: 13
Cycle work: 681 kJ/kg, cycle efficiency : 23.63%, Feed pump inlet and exit velocity: 10m/sec, Exit enthalpy of steam from boiler: 3000 kJ/kg with an exit velocity of 50 m/sec, Heat removed by cooling water: 2000 kJ/kg; Exit velocity of steam from turbine: 250m/sec with an enthalpy of 2286.8 kJ/kg. Based on 1kg of steam as working substance, calculate the heat supplied to the steam generator, feed pump work, liquid enthalpy at inlet and exit of pump.
6. An evaporator is to concentrate a 5% solution to 10% solution in a food industry while run was carried out for a period of 5 hours and variation in input and output over the period of 5 hours is shown in table below:- 13
- | Time (Hour) | Input (Tonns) | Output (Tonns) |
|-------------|---------------|----------------|
| 0 | 64.8 | 147.6 |
| 5 | 75.6 | 152.64 |
- The mixing inside evaporator is so intense than outlet concentration leaving evaporator is almost same is that the solution within evaporator.
Assume specific gravity of solution as 1. The evaporator body diameter 1.5m. Calculate the amount of concentrate and water evaporated to raise in hour of liquid level within the evaporate due to accumulation.
7. A vessel is divided into two equal compartments having a volume of 0.5m^3 each. One compartment has air at 2 bar and the other has air at 5 bar 100kJ of energy is supplied and the separation plate is punctured. Find the final pressure in the vessel. 13
8. Heat is supplied to a working substance at constant volume of 0.0035m^3 and at a temperature of 535°C which increases the pressure from 2.4mPa to 4.25mPa. Same amount of heat is transferred at constant pressure of 4.25 mPa. Calculate the total heat transferred, final volume and final temperature. 13
 $C_p = 1.25\text{kJ/kg}^\circ\text{K}$; $R = 0.290\text{kJ/kg}^\circ\text{K}$.
9. What are the basics of biodiesel production? Give an over-view. What precautions would you take while producing bio-diesel. 13
10. Explain the followings:- 13
- Adiabatic and Actual flame temperature.
 - Development of power generation.
