May 24, 2024 10:30 am - 01:30 pm 1T00538 - B.E.(Chemical Engineering)(SEM-VIII)(Choice Base Credit Grading System ) (R- 19) (C Scheme) / 52572 - Engineering Stream : Energy System Design (DLOC - V) QP CODE: 10056284

**Time: 3 Hours** **Total Marks: 80**

**N.B.: (1) Question No 1 is compulsory**
**(2) Attempt any three questions out of remaining five questions**
**(3) Assume suitable data if necessary and indicate it clearly.**
**(4) Figures to the right indicate full marks.**

Q.1. Solve the following (Any Four) **20**

(a) Briefly discuss sources of electricity generation in India.
(b) Briefly explain two basic thermodynamic cycles used as basis for cogeneration.
(c) Discuss the applications of geothermal energy.
(d) Define ECO and explain how it is analyzed using simple payback period with any one suitable example.
(e) With suitable diagram, explain heat pumping in distillation column.
(f) Discuss any five energy efficient techniques for compressed air system.

Q.2. (a) Consider the process stream data given below. Find out MER target i.e. $Q_{H,min}$ and $Q_{C,min}$ as well as Pinch temperature for this data at $\Delta T_{min}$= 30 $^0$C. **08**

| Stream No. | Ts ($^0$C) | Tt ($^0$C) | mCp (kW/$^0$C) |
|---|---|---|---|
| 1 | 260 | 160 | 30 |
| 2 | 250 | 130 | 15 |
| 3 | 120 | 235 | 20 |
| 4 | 180 | 240 | 40 |

(b) For the process stream data given in Q.2 (a) above, design a feasible HEN to achieve MER target **12**

Q.3. (a) A steam is to be used for power generation of 20000 kW. Estimate the steam flow rate required if it is expanded in 5000 RPM multistage condensing turbine. **08**
Enthalpy of Inlet steam, $h_i$ = 1500 Btu/lb
Enthalpy of Outlet steam, $h_o$ = 1100 Btu/lb
Turbine efficiency = 90 %

(b) Explain in detail what is "energy benchmarking" and how energy performance is evaluated for any plant. Also briefly explain how should be energy management approach. **12**

Q.4. (a) Consider a process for which hot and cold stream data is given below: **15**

| Stream No. | Ts ($^0$C) | Tt ($^0$C) | mCp (kW/$^0$C) |
|---|---|---|---|
| 1 | 150 | 60 | 5 |
| 2 | 90 | 60 | 16 |
| 3 | 25 | 100 | 6 |
| 4 | 20 | 125 | 5 |

For this system, $Q_{H,min}$ = 155 kW; $Q_{C,min}$ = 110 kW; $\Delta T_{min}$= 20 $^0$C; Hot Pinch temperature = 90 $^0$C
(i) Design a feasible HEN for this system to satisfy $Q_{H,min}$ and $Q_{C,min}$ target.
(ii) Calculate $NHx_{,min}$.
(iii) Further redesign feasible HEN with $NHx_{,min}$ by using breaking loop method

(b) Write the general rules of heat exchanger networking. **05**

Q.5 (a) Briefly explain the following waste heat recovery equipments: **10**
(i) Waste heat boiler (ii) Heat Wheel

(b) Explain working, advantages, disadvantages and applications of Diesel engine cogeneration system. **10**

Q.6. Write short notes on any four of the following **20**
(a) Difference in primary and secondary energy sources
(b) Post energy audit analysis
(c) Energy efficient steps to improve cooling tower operation
(d) Quality and classification of waste heat
(e) Method of energy generation using Biomass
(f) Pros and Cons of solar energy

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