*Seat No.: _____* *Enrolment No._____*

# GUJARAT TECHNOLOGICAL UNIVERSITY

**M. E. - SEMESTER – I • EXAMINATION – SUMMER • 2014**

**Subject code: 713903N** **Date: 19-06-2014**

**Subject Name: Optimum Utilization of Heat and Power**

**Time: 02:30 pm - 05:00 pm** **Total Marks: 70**

**Instructions:**

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

**Q.1** **(a)** Explain Gas Turbine Topic Cycle, Steam Turbine topic cycle, Combined Cycle and Bottoming Cycle in context of Co-generation. **07**

**(b)** Heat exchange stream data for a process are given. Draw the combined composite curve for æ$T_{min}$. = $10^0$C **07**

| Stream | Type | Supply Temp.$T_s{}^0$C | Target Temp. $T_T{}^0$C | æH (MW) | Heat Capacity flow rate CP(MWK-1) |
|---|---|---|---|---|---|
| $C_1$ | Cold | 20 | 180 | 32.0 | 0.2 |
| $H_1$ | Hot | 250 | 40 | -31.5 | 0.15 |
| $C_2$ | Cold | 140 | 230 | 27.0 | 0.3 |
| $H_2$ | Hot | 200 | 80 | -30.0 | 0.25 |

**Q.2** **(a)** The stream data for a heat recovery problem are given. **07**

| Stream | | $T_s(^0C)$ | $T_T(^0C)$ | Heat Capacity Flowrate (MW.K-1) |
|---|---|---|---|---|
| No. | Type | | | |
| 1 | Hot | 450 | 50 | 0.25 |
| 2 | Hot | 50 | 40 | 1.5 |
| 3 | Cold | 30 | 400 | 0.22 |
| 4 | Cold | 30 | 400 | 0.05 |
| 5 | Cold | 120 | 121 | 22.0 |

The process has also requirement of 7 MW of Power. Following cogeneration scheme is available. A steam turbine with its exhaust saturated at $150^0$C used for process heating. Superheated steam is generated in the central boiler house at 41 bar with a temperature of $300^0$C.This superheated steam can be expanded in a single stage turbine with an isentropic efficiency of 85%. Take æT min = $20^0$C and Calculate the maximum generation of power possible by matching the exhaust steam against the process

**(b)** Explain the concept of combined heat and power with suitable example **07**

**OR**

**(b)** Differentiate heat engines and heat pumps with example of each. **07**

**Q.3** **(a)** Discuss the Heat integration of compression Refrigeration process. **07**

**(b)** Consider Triple Effect Evaporator system. Show how heat integration can be done. If increase in pressure cause unacceptably high levels of fouling and decomposition suggest how integration can be done. **07**

**OR**

**Q.3** **(a)** What is stream splitting? Explain how stream splitting can help to reduce the number of heat exchangers in the heat exchanger network. **07**

**(b)** A problem table analysis for part of a high temperature process revels that for æ$T_{min}$= $20^0$C the process requires 9.2MW of hot utility, 6.4 MW of cold utility and the pinch is located at $520^0$C for hot streams and $500^0$C for cold streams. The process stream data are given below. Design a heat exchanger network for maximum energy recovery that features the minimum number of units. **07**

| Stream | | $T_s$($^0$C) | $T_T$($^0$C) | Heat Capacity Flowrate (MW.K-1) |
|---|---|---|---|---|
| No. | Type | | | |
| 1 | Hot | 720 | 320 | 0.045 |
| 2 | Hot | 520 | 220 | 0.04 |
| 3 | Cold | 300 | 900 | 0.043 |
| 4 | Cold | 200 | 550 | 0.02 |

**Q.4** **(a)** Show the sequencing of distillation columns for separating minimum boiling azeotrope and maximum boiling azeotrope merely by pressure change. Show how there can be optimum utilization of energy by choosing correct pressures. **07**

**(b)** Explain Distillation sequencing using simple columns for separation of four product mixture. **07**

**OR**

**Q.4** **(a)** Explain energy losses and waste heat recovery in recuperative heat exchanger. **07**

**(b)** Write note on Steam System Configuration. **07**

**Q.5** **(a)** Compare combined cycles and Rankine cycle. **07**

**(b)** Discuss Kalina Cycle giving practical limitations and benefits. **07**

**OR**

**Q.5** **(a)** Discuss major aspects to be considered for selection of insulating material and design of insulating system to reduce energy losses. **07**

**(b)** Write short notes on Prime movers. **07**

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