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| **An-Najah National University**  **Engineering College** |  | | **جامعة النجاح الوطنية**  **كلية الهندسة** |
| **Energy Engineering and Environment**  **Energy Management (1/463610)** | | | |
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| **Student Name:………………………...** | | **Instructor Name: Dr. Mohammed Alsayed** | |
| **Registration Number:** | | **Academic Year:2016/2017** | |
| **Total Exam Mark: 50** | | **Semester: second** | |
| **Exam Weight: 40** | | **Credit Hours: 3** | |
|  | | **Date: 02/08/2017** | |
|  | | **Exam Duration: 120 minutes** | |

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| **Question** | **Points** | **ILO’s** | **Question Grade** |
| **Q1** | **20** |  |  |
| **Q2** | **10** |  |  |
| **Q3** | **20** |  |  |
| **Student Grade** | | |  |

**Note**: it is an open book exam.

**Q1 (45 points):** Choose the best answer for the following statements and fill it in the table below:

1. Infrared camera can be used for:

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1. Explain Briefly with simple drawing the differences between fire-tube and water-tube boiler:

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1. Describe briefly the main types of energy audit based on ASHRAE categorization:

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1. Low power factor values will lead to the following problems:

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1. A steam pipe in which 100 psig saturated steam is flowing with 10 lb/min. mass flow rate. The energy flow rate in this pipe is:

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1. For 75 psia saturated steam, the available energy that can be utilized by condensing 1 lb equals to:

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1. For oil #2 boiler, if the percent flue gas oxygen equals to 9%, the stack rise gas temperature equals to 55 oF, then the estimated combustion efficiency equals to:

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1. A boiler that consumes 1,000,000 therme/year has 0.78 efficiency. If a good maintenance program will increase its efficiency to 0.83. the annual savings will be about:

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1. If you are buying oil #2 fuel for 5.3 Nis/L and each liter contains 36 MJ. The POU for a 0.878 efficiency boiler is:

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1. An audit for one firm showed that the power factor is almost always 70% and that the demand is 1000kW. What capacitor size is needed to correct power factor to 90%?

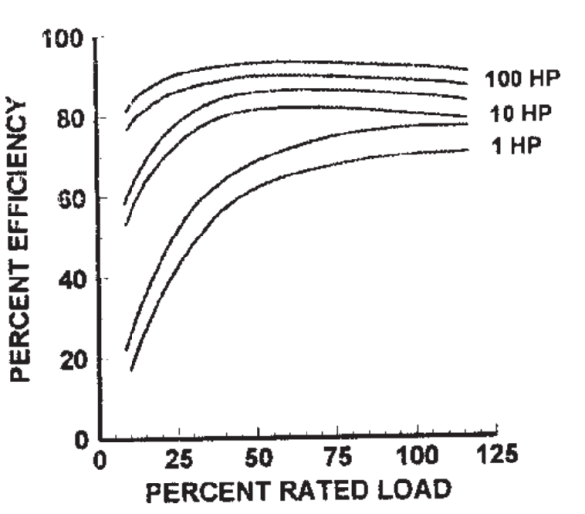
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**Q2 (10 points):** For the following HVAC cooling load profile.

1. Make the required analysis to design a leveling strategy thermal energy storage system (assume you are going to store ice).
2. If the applied tariff structure is $7.5/kW/month, on-peak (12:00-17:00) energy charge equals to $0.12/kWh, and off-peak energy charge equals to $0.07/kWh. Assume the chiller COP equals to 3.5 and the daily load is constant. Calculate the monthly savings.

**Q3 (20 points):**

1. For a centrifugal motor that runs on 2800 RPM, you found after an audit that the motor speed can be lowered to 2200 RPM. If the motor consumed power before modifying the speed equals to 10 hp. Find out the monthly savings if the motor runs 200 hr/month and the electric price equals to 0.1 $/kWh.
2. Consider a 100 HP, 1800 RPM Motor FLS = 1770 RPM, OLS = 1780 RPM. Find the motor efficiency if it is rated power is 746 W.



1. Assume an uncorrected 460 kVA demand, 480V, three-phase at 0.78 power factor. If your kVA demand charge is $1.91 / kVA / month, and your energy charge is:

$0.0286 / kWh (first 200 kWh / kVA of demand)

$0.0243 / kWh (next 300 kWh / kVA of demand)

$0.021 / kWh (all over 500 kWh / kVA of demand)

1. Find the current for the old PF.
2. Find the capacitor banks required to modify the power factor to 0.95.
3. Find the value of the new current (after correcting the power factor).
4. Calculate the bill (consumption = 1,350,000 kWh/month) before and after PF correction.
5. For the following motors alternatives:

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| --- | --- | --- |
|  | Standard | Energy efficient |
| Rated power | 110 hp | 100 hp |
| % load | 0.8 | 0.84 |
| Energy cost | 0.08 $/kWh | |
| Operating hours | 4000 per year | |
| Efficiency | 0.86 | 0.91 |

Calculate the expected annual savings.

**Good Luck**