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| **An-Najah National University**  **Engineering College** |  | | **جامعة النجاح الوطنية**  **كلية الهندسة** |
| **Energy Engineering and Environment**  **Energy Management (65521)** | | | |
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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: 50** | | **Credit Hours: 3** | |
|  | | **Date: 11/05/2017** | |
|  | | **Exam Duration: 120 minutes** | |

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| **Question** | **Points** | **ILO’s** | **Question Grade** |
| **Q1** | **20** |  |  |
| **Q2** | **15** |  |  |
| **Q3** | **10** |  |  |
| **Q4** | **10** |  |  |
| **Q5** | **10** |  |  |
| **Student Grade** | | |  |

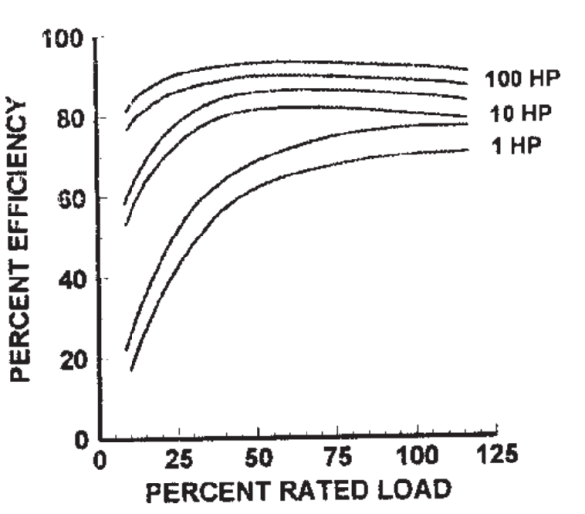
**Note**: it is an open book exam.

**Q1 (20 points):**

1. An energy saving device will save $25,000 per year for 8 years. How much can the company pay (at maximum) if they want the SPBP to be less than 2 years?
2. A 2000 m2 building consumed the following amounts of energy last year. What is the Energy Use Index of the building per year? Natural Gas 150,000 kWh/year, Electricity 60,000 kWh/year
3. A boiler is rated at 30 boiler horsepower and 80% efficient. What is the input rating?
4. Calculate the group relamping interval for T12 lamp fixtures that annually operate for 4,160 hrs with rated life of 15,000 hrs (assuming replacements at 70% of rated life).
5. A company has an electric boiler with 32 kW rated capacity which operates 2000 hours per year. If the boiler is 0.97 efficient, estimate the annual cost. Assume energy price to be 0.5 Nis/kWh.

**Q2 (15 points):**

1. 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. 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.

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.

**Q3 (10 points):** In a hospital, the current lighting system is 300 fixture, 268 W/fixture including ballast. The system operates 2400 hour/year. The proposed system consumes 180 W/fixture including the ballast. If the hospital pays 12$/kW/month as a demand charge and 0.1$/kWh as energy charge, calculate:

1. The annual savings.
2. The effect on the summer HVAC system if it’s COP equals to 3.2, and it operates 250 hour per year.

**Q4 (10 points):** An industrial facility is about to install steam boiler to heat water from 20 oC and atmospheric pressure (84 kJ/kg enthalpy) to 180 oC and 18.5 psi (2824.6 kJ/kg enthalpy). Two options are available, oil #2 burner with efficiency equals to 0.87, 36 MJ/L caloric heat value and costs 5.34 Nis/L. the second option is a natural gas burner with 0.82 efficiency, 37 MJ/m3 caloric heat value, 4.6 Nis/m3.

1. Which burner is cheaper to operate?
2. Based on the burner you chose in (a), if there is a steam leak in one distribution line with a mass flow rate equals to 30 kg/hr. estimate its costs.

**Q5: (10 points):** A milk evaporator uses a steamjacketed kettle, in which milk is batch-processed at atmospheric pressure. The kettle has a 1500-lb per batch capacity. Milk is heated from a temperature of 80°F to 212°F, where 25% of its mass is then driven off as vapor. If the kettle weighs 200 lbm and has a specific heat equals to 0.11 Btu/lb.oF. Determine the amount of 15-psig steam required per batch including the kettle itself.

**Good Luck ☺**