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| **An-Najah National University**  **Engineering College** |  | | **جامعة النجاح الوطنية**  **كلية الهندسة** |
| **Energy Engineering and Environment (make up)**  **Energy Management (65521)** | | | |
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| **Student Name:………………………...** | | **Instructor Name: Dr. Mohammed Alsayed** | |
| **Registration Number:** | | **Academic Year:2016/2017** | |
| **Total Exam Mark: 100** | | **Semester: second** | |
| **Exam Weight: 50** | | **Credit Hours: 3** | |
|  | | **Date: 06/07/2017** | |
|  | | **Exam Duration: 120 minutes** | |

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| **Question** | **Points** | **ILO’s** | **Question Grade** |
| **Q1** | **30** |  |  |
| **Q2** | **10** |  |  |
| **Q3** | **10** |  |  |
| **Q4** | **10** |  |  |
| **Student Grade** | | |  |

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

**Q1 (30 points):** Answer the following questions and show clearly you solution details:

1. Energy management and conservation programs can be applied in:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
2. Infrared camera can be used for:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
3. When measuring voltages in three phase system, it is found that V1 = 400 V, V2 = 381 V, and V3 = 350 V. The voltage imbalance is this case is:
4. 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:
5. 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 equals to:
6. If electricity is selling for $0.06 per kilowatt-our and is used for electric heating with an efficiency of 90%, what is the equivalent price of natural gas per therm if it can be burned with an efficiency of 80%?
7. Estimate the seasonal energy consumption for a building if its design-heating load has been determined to be 350,000 BTU/hr for a design temperature difference of 70 F if the heating season has 3,500-degree days. The heating unit efficiency is 80%. Assume 1 MCF = 106 BTU.
8. A wall has a total R -value of 15. Determine the annual cost of the heat loss per square foot in a climate having 5,000 heating degree-days. The heating unit efficiency is 70% and the fuel cost is $5.00/million BTUs.
9. Assuming that adding 2 inches of fiberglass insulation drops the U-value of a building from 0.24 to 0.098, calculate the annual cooling savings per square foot from the data given below:

2,000 cooling degree days; Cooling COP = 2.5; Electrical cost $0.05/kWh

1. How much fuel is wasted if 100 pounds per hour of condensate at 30 psia saturated liquid is drained to the sewer and is made up with water at 60 F. Assume the boiler is 80% efficient and ignore blowdown effects.

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| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
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**Q2 (10 points):**

1. How energy management can be related to renewable energy, engineering safety, and engineering maintenance approaches.
2. A small facility has 20 kW of fluorescent lights that has 0.88 power factor, and a 25 kW motor load that has a power factor of 80%. Calculate the factory combined power factor value.

**Q3 (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.

**Q4 (10 points):**

1. During an energy audit at the Orange and Blue Plastics Company you saw a 75-kW electric motor that had the following information on the nameplate: 460 Volt, 114 Amp, 3 phase 95% efficient. What is the power factor of this motor?
2. A rule of thumb for an air compressor is that only 10% of the energy the air compressor uses is transferred into the compressed air. The remaining 90% becomes waste heat. You have seen a 35-kW air compressor on an audit of a facility, but you do not have any measurements of air flow rates or temperatures. Assume that the motor efficiency is 91.5%, the compressor motor load factor is 0.6, and 80% of the waste heat can be recovered. Calculate the amount of waste heat available as GJ/year.

**Good Luck**