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| **An-Najah National University**  **Engineering College** |  | | **جامعة النجاح الوطنية**  **كلية الهندسة** |
| **Energy Engineering and Environment**  **Energy Conservation and Auditing (1/10656301)** | | | |
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| **Student Name:………………………...** | | **Instructor Name: Dr. Mohammed Alsayed** | |
| **Registration Number:** | | **Academic Year:2017/2018** | |
| **Total Exam Mark: 30** | | **Semester: second** | |
| **Exam Weight: 25** | | **Credit Hours: 3** | |
|  | | **Date: 16, April, 2018** | |
|  | | **Exam Duration: 60 minutes** | |

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

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

**Q1 (20 points):** A factory owns a boiler that operates 2000 hours per year. It consumes 250,000 liters of oil #2 fuel (37037 Btu/L, 0.886 kg/L, 5.2 Nis/L). The boiler takes return liquid water at 198 oF and produces saturated steam at 55 psia. An energy engineer checked the boiler and suggested the following energy management opportunities. Estimate the savings for all opportunities, if the boiler exhaust temperature is about 600 oF while the surrounding ambient temperature equals to 77 oF.

1. Boiler deliver steam to the factory load (demand) which is 1200 kg/hour, and this demand can be reduced at least 10%.
2. Excess air test show the O2% is about 9%, and there is an opportunity to reduce it to 3%.
3. Exhaust temperature can be utilized to preheat intake air; in this boiler case exhaust temperature can be lowered to 400 oF.
4. Boiler body insulation can be improved to reduce its losses by 30%.
5. If all of the above opportunities will cost 200000 Nis, do you recommend it or not?

**Q2 (10 points):** Oil #2 (37037 Btu/L, 0.886 kg/L, 5.2 Nis/L) boiler (82% efficient) generates saturated steam at 275 oF and takes return water at 198 oF. Generated steam equals to 1500 kg/hr. If the steam distribution line heat transfer losses equal to 760000 Btu. Calculate steam cost in Nis/kg of steam. Moreover, if an insulation company suggested improving insulation and reducing distribution line heat losses by 50%, how much the steam cost (Nis/kg) will be?





