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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)** | | | |
|  | | | |
| **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: 07, March, 2018** | |
|  | | **Exam Duration: 60 minutes** | |

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| **Question** | **Points** | **ILO’s** | **Question Grade** |
| **Q1** | **20** |  |  |
| **Q2** | **5** |  |  |
| **Q3** | **5** |  |  |
| **Student Grade** | | |  |

**Note**: it is a closed book exam.

**Q1 (20 points):** For the following factory lighting system data. If it is time to replace the lamps (the factory adopts group re-lamping strategy):

|  |  |  |
| --- | --- | --- |
|  | Present system | Proposed system |
| Lamps / fixture | 4 | 3 |
| Type | mercury vapor light fixtures | high pressure sodium fixtures |
| Number of fixtures | 196 | 141 |
| Size | 285 watt/fixture, including ballast | 185 watt/fixture |
| Lamp life | 20,000 hours/lamp | 24,000 hours/lamps |
| Fixture cost | $44/fixture (including lamps) | $80/fixture (including lamps) |
| Lamp cost | $5/lamp | $7/lamp |
| Replacement labor cost | $0.8/lamp | |
| Output | 10,000 lumens/lamp | 12,000 lumens/lamp |
| Operating time | 5000 hr/year | |
| Tariff | 7 $/kW/month and 0.1 $/kWh | |

1. Calculate the annual energy savings.
2. Calculate the annual dollar savings from the lighting system.
3. If the air conditioning system has a COP equals to 3.5, and it operates 1000 hr/year, determine the **energy** cost difference due to light replacement.
4. Calculate the system payback period.

**Q2 (5 points):** A bank use central HVAC system during summer where thermostat is always at 18 oC. Use the following temperature profile to estimate the possible savings by setting the thermostat at 22 oC.

|  |  |
| --- | --- |
| Time | Temp. oC |
| 08:00 – 9:00 am | 22 |
| 09:00-10:00 am | 24 |
| 10:00-11:00 am | 28 |
| 11:00-12:00 am | 34 |
| 12:00-13:00 pm | 36 |
| 13:00-14:00 pm | 35 |
| 14:00-15:00 pm | 31 |
| 15:00-16:00 pm | 29 |

**Q3 (5 points):** Which is better, to heat your home using an HVAC (heat pump) unit with 3 COP, or to heat it using a gas heater with efficiency equals to 85%. Assume the electricity cost equals to 0.7 Nis/kWh, the gas cost equals to 4.4 Nis/m3, and the gas caloric heat value equals to 37 MJ/L.