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| **An-Najah National University**  **Engineering College** |  | | **جامعة النجاح الوطنية**  **كلية الهندسة** |
| **Energy Engineering and Environmen**  **Energy Management (65521)** | | | |
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| **Student Name:………………………...** | | **Instructor Name: Dr. Mohammed Alsayed** | |
| **Registration Number:** | | **Academic Year:2018/2019** | |
| **Total Exam Mark: 100** | | **Semester: second** | |
| **Exam Weight: 50** | | **Credit Hours: 3** | |
|  | | **Date: 12/05/2019** | |
|  | | **Exam Duration: 120 minutes** | |

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| **Question** | **Points** | **ILO’s** | **Question Grade** |
| **Q1** | **15** |  |  |
| **Q2** | **15** |  |  |
| **Q3** | **15** |  |  |
| **Q4** | **15** |  |  |
| **Q5** | **15** |  |  |
| **Q6** | **10** |  |  |
| **Q7** | **10** |  |  |
| **Q8** | **5** |  |  |
| **Student Grade** | | |  |

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

**Q1 (15 point):** A hospital has 40 kW electric load (pf = 1), and another 75 kW electric load which (pf = 0.65).

1. Calculate the overall power factor for the hospital.
2. Calculate the required capacitor bank size (target pf = 0.92).
3. How much your answer in (b) will change if an additional 30 kW (pf =1) load was added to the hospital before correcting the power factor.

**Q2 (15 point):** For a residential on-grid 5 kW PV system, knowing that it will cost $ 1,450 per kW, and according to the net metering Palestinian law, it will be injected energy to the gird at a price of $ 0.17 per kWh.

1. Estimate system feasibility using SPBP.
2. Knowing that energy levelized cost equals to $/kWh, estimate it for this system.
3. Write clearly the assumptions you built your analysis on (a & b).

**Q3 (15 point):** A furniture showroom contains 150 incandescent spot lights (20 W per lamp), which are turned on when customers are moving inside the showroom (8 hours per day, six days per weeks, 50 week per year). Assume electricity costs 0.6 Nis/kWh.

1. Calculate the savings if you have an alternative to install fluorescent lights (9 W per lamp).
2. Estimate the alternative feasibility knowing that new fluorescent lights will cost (15 Nis per lamps including the fixture).
3. Discuss the benefits of reducing lighting systems energy consumption (on investor (user) scale and national scale).

**Q4 (15 point):** A typical apartment (150 m2) in Tulkarem city got an offer of installing roof top on-grid PV system. The PV company **claimed** that the 5 kW system:

1. Will be enough to electrify the apartment in case of municipal power supply shortage. Do you agree? And why?
2. The feed in energy is enough to compensate the grid consumed power for 4 ton HVAC units (3.52 kW/refrigeration ton). The HVAC system SEER equals to 12.6 kJ/Wh, it operates 8 hours per day for three continuous months on 0.8 average load and 0.5 utilization factor. Analyze their claim?
3. Discuss the offer from technical point of view based on company claims.

**Q5 (15 point):** Municipal solid waste in Palestine is a serious challenge. Current disposal sites are over loaded, and converting waste to electric energy is a good choice that deserves consideration. Establishing a waste to energy plant near Tulkarem city is one of the alternatives. Where a transfer station processes 143 ton/day for Tulkarem and Qalqylia governorates, Salfeet governorate can also participate in the idea and transfer additional 66 ton/day. Knowing that each kilogram of solid waste contains around 11.5 MJ, and the efficiency of waste to electricity generation is around 23%.

1. Calculate the potential energy that can be generated per day, and per year.
2. If the electric generation power plant will compensate on peak power shortage for 8 hours per day. Calculate the plant capacity in kW.
3. Knowing that building plant in Tulkarem will save 60 Nis/ton which is paid for transfer and final disposal to Jenin (Zahrit Finjan dump). How these savings should be included in understanding the waste to energy plant feasibility.

**Q6 (10 point):** Local supermarket fridges consume 10 kW and are turned on for 8760 hours per year. With proper controller, insulation, and maintenance that will cost 3000 USD, 70% savings can be achieved. If energy costs 0.2 $/kWh and power costs 10 $/kW/month:

1. Calculate the annual savings.
2. Calculate the SPBP.

**Q7 (10 point):** 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 SEER equals to 12.6 and the daily load is constant. Calculate the monthly savings.

**Q8 (5 point):** 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?

**Good Luck**