|  |  |  |  |
| --- | --- | --- | --- |
| **An-Najah National University**  **Faculty of graduate Studies** |  | | **جامعة النجاح الوطنية**  **كلية الدراسات العليا** |
| **Clean Energy and Energy Conservation Engineering**  **Energy Conservation and Auditing (**[**1/463601**](https://zajelbs.najah.edu/servlet/regstudent?cou=45&num=463601&sec=1)**)** | | | |
|  | | | |
| **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: 16/05/2019** | |
|  | | **Exam Duration: 120 minutes** | |

|  |  |  |  |
| --- | --- | --- | --- |
| **Question** | **Points** | **ILO’s** | **Question Grade** |
| **Q1** | **30** |  |  |
| **Q2** | **10** |  |  |
| **Q3** | **10** |  |  |
| **Q4** | **10** |  |  |
| **Q5** | **15** |  |  |
| **Q6** | **15** |  |  |
| **Q7** | **10** |  |  |
| **Student Grade** | | |  |

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

**Q1 (30 points):** Choose the best answer for the following statements and fill it in the table below:

1. Energy management and conservation programs are suitable for:
2. Industrial & commercial facilities.
3. Residential buildings.
4. Transportation.
5. Everywhere.
6. Combustion analyzer can be used for measuring:
7. Combustion efficiency only.
8. Combustion efficiency and net efficiency.
9. Combustion efficiency and gross efficiency.
10. All of the above.
11. Measuring devices which are used without stopping the measured equipment and/or making any modifications are called:
12. Destructive measuring devices.
13. Non-destructive measuring devices.
14. Sweet measuring devices.
15. None of the above.
16. The most used boiler type in the Palestinian industrial sector is:
17. Fluidized bed.
18. Fire tube.
19. Water tube.
20. None of the above.
21. In cases of lighting system audits, savings opportunities are:
22. Challenging.
23. Can be achieved in energy cost only.
24. Can be achieved in power cost only.
25. Easy to obtain in energy and power costs.
26. The most important issue (key point) in making a successful energy audit study is:
27. Detailed data availability over period of time (at least one year).
28. High bill value.
29. Steam generation equipment low efficiency.
30. The production quantity.
31. The degree day method.
32. Low power factor values will lead to:
33. Higher current.
34. More wires losses.
35. Overheating.
36. Shorter equipment life time.
37. All the above.
38. None of the above.
39. A steam pipe in which 200 psig saturated steam is flowing with 10 lb/min. mass flow rate. The energy flow rate in this pipe is:
40. 837 Btu/min.
41. 1199 Btu/min.
42. 11993 Btu/min.
43. 199.9 Btu/min.
44. For 105 psia saturated steam, the available energy that can be utilized by condensing 1 lb equals to:
45. 877.5 Btu/lb.
46. 1180 Btu/lb.
47. 886 Btu/lb.
48. 1188 Btu/lb.
49. For oil #2 boiler, if the percent flue gas of carbon dioxide equals to 10%, the stack rise gas temperature equals to 550 oF, then the estimated combustion efficiency equals to:
50. 75%.
51. 78.5%.
52. 81%.
53. 84%.
54. Adjusting excess air level (constant value) in combustion boilers will always lead to higher efficiency:
55. True in all cases.
56. True in relatively constant load boilers.
57. True in variable load boilers only.
58. None of the above.
59. A boiler that consumes (input) 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:
60. 60240 therme/year.
61. 66240 therme/year.
62. 55000 therme/year.
63. 55240 therme/year.
64. When combustion boilers stack gas temperature is very high, the following device can be used to improve its efficiency:
65. Softener for water treatment.
66. Excess air controller.
67. Flue gas to air preheater or economizer.
68. None of the above.
69. If you are buying oil #2 fuel for 5.3 Nis/L and each liter contains 36 MJ. The energy cost for a 0.878 efficiency boiler is:
70. 0.12 Nis/MJ.
71. 0.15 Nis/MJ.
72. 0.17 Nis/MJ.
73. 0.21 Nis/MJ.
74. Power factor correcting capacitors may be located:
75. At the inductive load
76. At load control centers
77. At the customer side of the service transformer
78. At the utility side of the service transformer
79. a, b, & c.
80. a, b, & d.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

**Q2 (10 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).

**Q3 (10 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. Write clearly the assumptions you built your analysis on (a & b).

**Q4 (10 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).

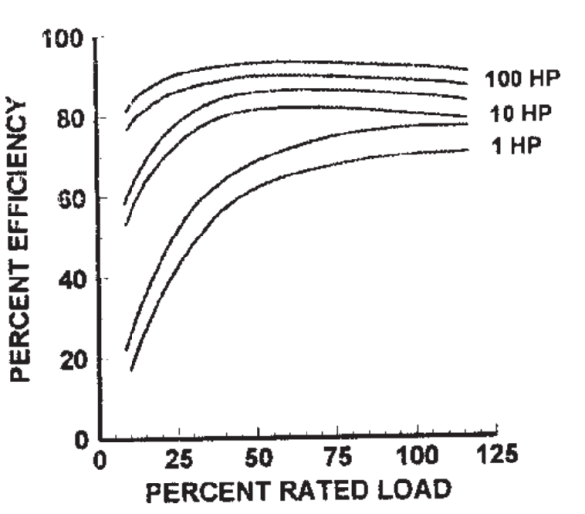
**Q5 (15 point):** A typical apartment (150 m2) in Tulkarem city got an offer of installing roof top on-grid PV system. The PV company **claimed** that the 5 kW system:

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.

**Q6 (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.

**Q7 (10 point):** You find that you can replace a 20 HP motor with a 5 HP motor by cutting the total air flow requirements. Both motors operate at 80% load. Calculate the total dollar savings, given that: runtime equal to 8,760 hours/year, motor efficiency equal to 90% (both motors), electrical rate equal to $9.00/kW/month, energy price equals to $0.05/kWh. Moreover, if the new motor costs $12,000, find the SPP.



**Good Luck**