Form No. T611

Philadelphia University
Faculty of Engineering

Student Name:
Student Number:

Dept. of Renewable Energy Engineering
Final Exam, Second Semester: 2021/2022

Course Title: Energy Economics and Management	**Date: 26/6/2022**
Course No: (611312)	**Time Allowed: 2 Hours**
Lecturer: Dr. Mohammad Abu-Naser	**No. of Pages: 5**

Question 1: ***(5Mark)***

Objectives: This question is related to Net Present Value

A project has an initial investment of 30000 JD. If the life of the project is 30 years. And revenue for each year is 3000 JD and the cost of each year is 1000 JD. At a discount rate of d = 10%. What is the NPV of the project? Is this project feasible?

$$NPV = \sum_{n=1}^{30} \frac{(R_n - C_n)}{(1+d)^n} - I$$

$$= \sum_{n=1}^{30} \frac{3000 - 1000}{(1+0.1)^n} - 30000$$

$$= 2000 \times \frac{1.1^{30} - 1}{0.1(1.1)^{30}} - 30000$$

$$= 2000 \times 9.427 - 30000$$

$$= 18854 - 30000 = -11146 \text{ JD}$$

The project is not feasible

Question 2: ***(2Mark)***

Objectives: This question is related to economics of fossil fuels

Mention the four main activities that affect the price fossil fuels

1) Exploration
2) Extraction
3) Transportation
4) Processing

Question 3: ***(8Mark)***

Objectives: This question is related to Levelized Cost of Electricity

A PV system has a size of 1 MW. The system life is 25 years. If the system costs 1 JD/Wp. The utilization factor is 20%. The operation and maintenance cost of the system is 10000 JD/year. Assume 5% discount rate. What is the LCOE?

Capital Cost $1\text{MW} \times \frac{1\text{JD}}{\text{W}} = 1{,}000{,}000 \text{ JD}$

Yearly energy produced $= 1\text{MW} \times 365 \text{ day} \times 24 \frac{\text{hrs}}{\text{day}} \times 0.2$

$= 1{,}752{,}000 \text{ kWhr}$

$$LCOE = \frac{I + \sum_{n=1}^{N} \frac{C_n}{(1+d)^n}}{\sum_{n=1}^{N} \frac{(kWhr)_n}{(1+d)^n}}$$

$$= \frac{1{,}000{,}000 + \sum_{n=1}^{25} \frac{10{,}000}{(1.05)^n}}{\sum_{n=1}^{25} \frac{1{,}752{,}000}{(1.05)^n}}$$

$$= \frac{1{,}000{,}000 + 10{,}000 \frac{1.05^{25} - 1}{.05(1.05)^{25}}}{1{,}752{,}000 \frac{1.05^{25} - 1}{.05(1.05)^{25}}}$$

$$= \frac{1{,}000{,}000 + 10{,}000 \times 14.09}{1{,}752{,}000 \times 14.09}$$

$$= \frac{1{,}140{,}939}{24{,}692{,}591}$$

$= .046 \text{ JD/kWhr}$

Question 4: ***(6Mark)***

Objectives: This question is related to terms and their definitions

Connect the term on the left column with its correct definition on the right column

R/P ratio	Maximum energy a storage can hold
P/R ratio	Maximum rate of energy charge/discharge
Utilization factor	Duration oil will last at current production level
Round trip efficiency	Fraction of oil reserve that has been produced
Power Capacity of ESS	Net ratio of retrieved power to input power
Energy Capacity of ESS	Ratio of actual energy generated to rated energy potential of RE systems

Electricity pricing Program	**Goal**
Time of Use	Encourage customer to reduce consumption during peak hours only
Peak time saving	Encourage customers to conserve energy
Tiered	Encourage customers to shift consumption from peak hours to off-peak hours

Demand Response Objective	**Reason**
Peak clipping	Utilize power that would otherwise be wasted
Load building	Avoid overloading the system which causes power outage
Valley filling	Approach a load factor = 1

Question 5: ***(4Mark)***

Objectives: This question is related to the electric grid

A) What are the three most important advantages of the electric grid for energy transport?

1) Small losses (high efficiency)

2) Low cost

3) Many machines/applications have been electrified

B) What is the main limitation of using conventional electric grid for energy transport?

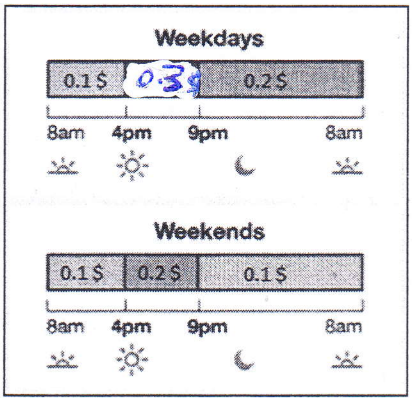
Doesn't provide energy storage (buffer) of electricity

Question 6: ***(5Mark)***

Objectives: This question is related to Time of Use Electricity Billing

The chart below represents the rates of each kWhr of electricity consumption during different times. One month electricity consumption is given by the following table

Weekdays		
Day	Evening	Night
100 kWhr	75 kWhr	50 kWhr
Weekends		
Day	Evening	Night
80 kWhr	20 kWhr	40 kWhr



What is the total cost of electricity consumption?

Weekdays

$100 \times 0.1 + 75 \times 0.3 + 50 \times 0.2 = 42.5$ \$

Weekends

$80 \times 0.1 + 20 \times 0.2 + 40 \times 0.1 = 16$ \$

Total Cost $= 42.5 + 16 = 58.5$ \$

Question 7: ***(4Mark)***

Objectives: This question is related to load variations

1) Mention three factors that contributes to the yearly variations of loads
   - population growth
   - increased electrification of loads
   - increased efficiency of loads

2) Mention two factors that contributes to the seasonal variations of loads
   - climate
   - tourism

3) Mention three factors that contributes to the daily variations of loads
   - lighting
   - working hours
   - returning to home

Question 8: ***(3Mark)***

Objectives: This question is related to flexible loads

Mention the three types of flexible loads and define each one of them

Dimmable: their energy consumption can be changed and reduced

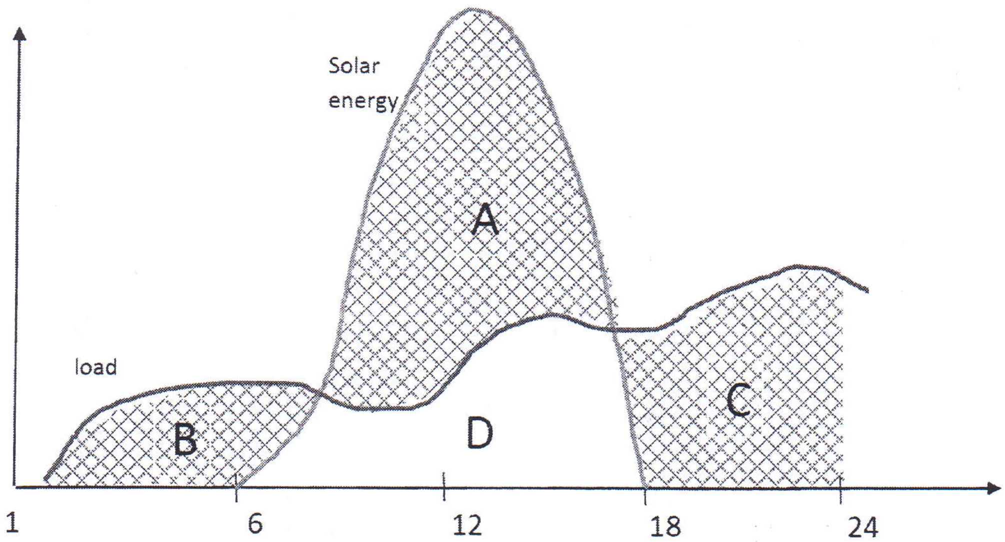
Shiftable: not required to run at certain time (can be delayed)

Interruptible: can be disconnected without negative effect on customers

Question 9: ***(3Mark)***

Objectives: This question is related to storage sizing

In the figure below, the daily load curve is given such that: area B = 10 kWhr, area D = 15 kWhr, area C = 12 Kwhr. What is the storage size required to supply the load for one day without interruption?



Battery size = Area A = Area B + Area C

= 10 + 12 = 22 Kwhr