# Energy Resources & Utilization

Session: 2k9 - 6th term | Open Book Paper | Max. Marks = 60

Note: ***Attach Excel Work Sheet with your answer book. Submit the Answer Book on-line by writing Paper-09-ME-ABC in subject of your e-mail. Use Winzip/Winrar to zip all your answers in one folder and name it as 09-ME-ABC. You have 72 hours to do this work. Try to solve with clarity and also be precise. Each Paper consists of 4 Questions and accommodates 24 students (06 groups). Try to solve the paper individually as copying is strictly forbidden and may liable to cancel the paper. You must follow the announced 'Layout' and 'rules' as information were provided in advance.***

**Question#01**

ABC Company of power generation started production by newly built biomass plant of 12 MWe. The Company faces generation cost of C (q) = $3q^2$ + 60q + 80. The power price for each MWh sold of electricity is P = $80.

Which output level q* does the firm choose to maximize profit?

Derive the first and second order conditions.

What is the firm's marginal revenue?

What are the firm's marginal and average cost functions?

What is the producer's profit and his revenue?

**Graphical representation:**

1) Plot profit in one graph;

2) Plot marginal cost, price and average cost in 2nd graph;

3) Plot total cost and revenue in a third graph

Use Excel to plot the graph. Also attach the excel sheet containing the data and graph in your answer book.

**Question#02**

An electricity generation company faces overall cost of C (q) = 0.35 $q^2$. The electricity provider acts as a monopolist, i.e., there are no competitors in the market. The monopolist faces demand, given by the inverse demand function p (q) = 115 – 1.5q.

Which output level q* does the firm choose to maximize profit?

Derive the first and second order conditions.

What is the firm's marginal revenue?

What are the firm's marginal and average cost functions?

What is the producer's profit and his revenue?

**Graphical representation:**

1) Plot profit in one graph;

2) Plot marginal cost, price and average cost in 2nd graph;

3) Plot total cost and revenue in a third graph

Use Excel to plot the graph. Also attach the excel sheet containing the data and graph in your answer book.

## Question#03

The following Table presents the energy service of cooling required / year, taken by two types of coolers (Standard & Improved form) used for Urban Residential Households of Pakistan. Assume the total electrified homes in Pakistan are 9 million and household growth rate 1.8% per annum. Check the validity of data upon the basis of any published source or educational guess. Analyze the data for sensitivity analysis of improved technology penetration rate about 2% per year and 5% per year for next 10 years (2012-2022). How much GWh may be saved by adopting the changeover strategies? Use Excel spreadsheet for the analysis and attach it with your answer book.

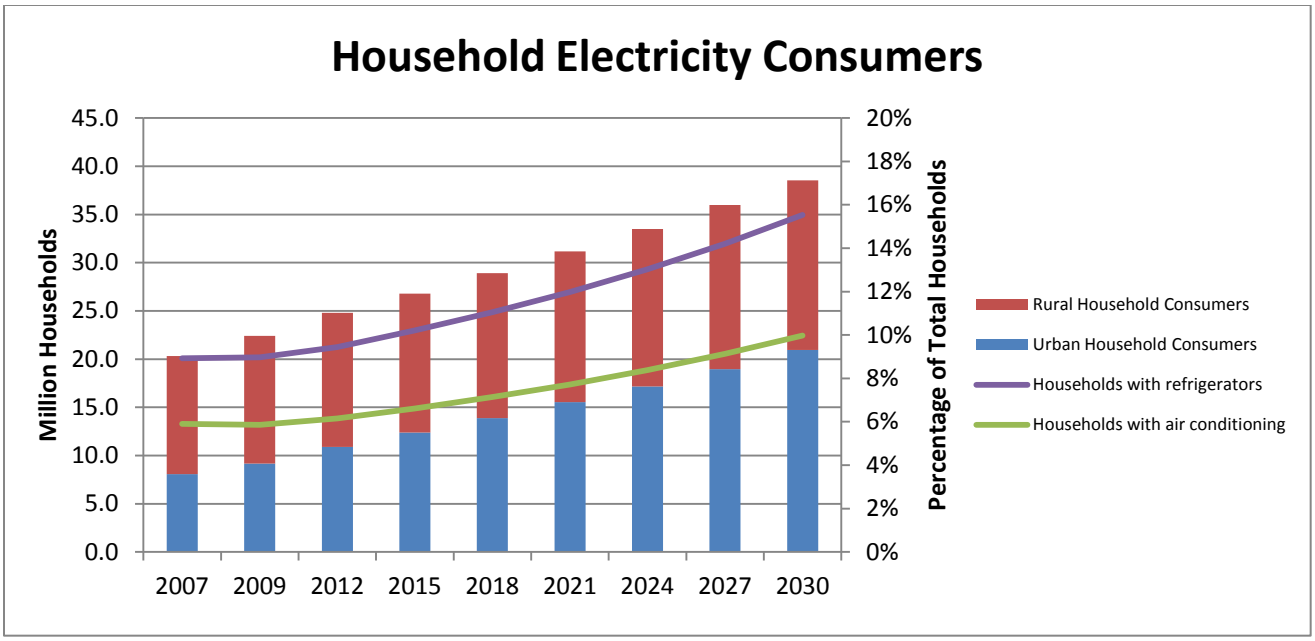
| Energy Service | Technology | % stock | % households | % households with appliance | Input Fuel | Power Rating (W) | Derived EFF | Life | Hours used | Days used | AF | Price (Rp) | Price ($) | $M/PJa | Lifetime Main. Cost ($) | Ann. Main. Cost ($) | $M/PJa | Derived Energy Cons. (GWh) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cooling (AC) | Air cooler Standard - Metal Body | 0.7 | 0.32 | 0.22 | ELC | 400 | 1 | 12 | 11 | 120 | 0.15 | 7000 | 87.5 | 6.94 | 50 | 4.17 | 0.33 | 1043.16 |
| | Air cooler Improved - Plastic Body | 0.3 | 0.32 | 0.10 | ELC | 330 | 1.21 | 12 | 11 | 120 | 0.15 | 8200 | 102.5 | 9.85 | 40 | 3.33 | 0.32 | 368.83 |

## Question#04

The graph below shows the households electricity consumers for urban and rural base in Pakistan. Interpret the information given in integrated column chart and penetration level of refrigeration and air conditioner technologies in residential sector.

Summarize the information by selecting and reporting the main features and make comparisons where relevant**.**

You should write at least 250 words.


Household Electricity Consumers
Million Households
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Percentage of Total Households
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
2007
2009
2012
2015
2018
2021
2024
2027
2030
Rural Household Consumers
Urban Household Consumers
Households with refrigerators
Households with air conditioning