UNIVERSITY OF GUJRAT

Electrical Engineering Department, Hafiz Hayat Campus

Assignment # 01

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Subject: Smart Grid System Operation (EE – 625)

Program: MS Electrical Engineering

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Q. No. 1:

What is the Smart Grid? Why implement the Smart Grid now?

Smart Grid:

An electricity supply network that uses digital communications technology to detect and react to local changes in usage.

Reason of smart Grid implementation:

The basic concept of Smart Grid is to add monitoring, analysis, control, and communication capabilities to the national electrical delivery system to maximize the throughput of the system while reducing the energy consumption.

Adding new transmission lines will help the utilities get more power from the power plants to your home. However, many communities don't want new power lines in their areas. In addition, adding new capacity, although needed, will not increase the reliability of all the old electrical equipment reaching the end of its useful life. What is needed is a new approach that significantly increases the efficiency of the entire electrical delivery system. This approach will not only increase reliability but will also reduce energy in the delivery process and thereby reduce greenhouse house emissions. We call this new approach Smart Grid.

Q. No. 2:

Discuss the many national governments (Pakistan, China, The European Union, Japan, The UK and The USA) who are encouraging Smart Grid initiatives as a cost-effective way to modernize their power system infrastructure while enabling the integration of low-carbon energy resources. Also discuss the Early Smart Grid initiatives.

Many governments are taking early smart grid initiatives I shall discuss one by one from Pakistan to USA.

Pakistan:

Currently major of Electrical Distribution network is out dated due to which power companies bear so much loses. There are problems of theft and tempering. There is a very good article on smart Grid named as Opportunities and challenges in control of smart grids–Pakistani perspective. In year 2009–2010, line losses in Pakistan were 22% while in 2013–2014, it was around 16%. According to the statistics provided by Water and Power Development Authority (WAPDA) of Pakistan, the total power generation capacity is 15,764 MW from renewable as well as from traditional sources. The peak energy demand for 2016-17 are 26,249 MW and 27,572 MW respectively. This leads to the fact that there is an annual increase of 8.77% in peak energy demand in the country. The gap between electricity supply and usage is enhancing due to population increase, expansion of cities, line losses and urban life style.

At the moment, the country is experiencing numerous challenges due to shortage of generated electricity, distribution losses and electricity theft issues. Also with increase in electricity demands in commercial and household sectors, electricity prices are soaring. Pakistan has a lot to learn from other highly populated and developed countries, which are moving towards smart grid solutions to explore benefits of renewable energy. The concept of smart grid can also be successfully applied in Pakistani energy sector to realize a viable, cheap and environmental friendly solution

China:

Due to large size of china and specially its population smart grid concept is very important to be implement there. During 2011 SGCC took bids for 44 million smart meter units. In total, 65 companies received bids for smart meters from SGCC. The total smart meter market in China is estimated to be 330 million smart meter units worth approximately US$7.7 billion. By 2011, SGCC had deployed 45 million smart meter units. All SGCC users are expected to be equipped with smart meters by 2014.

They have divided the implementation into three phases

1) **2009–2010 –Phase 1 – Planning and Pilot Projects Phase**
2) **2011–2015– Phase 2 – Comprehensive Construction Phase**

3) 2016–2020– Phase 3 – Leadership Phase

Japan:

Japan choose to be at the boundary at some time in the duration of the smart grid revolution because they already have had a reliable grid system. Recently the Japanese association is bringing up large-scale grids that deal with the power like how the internet does with the information data.

Japan is currently focusing on last mile and demand-side management and home solar power. Researchers have started to address challenges caused by large-scale solar power generation connected to the power grid as well as information security issues. Because the smart grid remains a novel field of study in Japan, it has great potential for further research.

UK and The USA:

Europe is currently working on security issue which can face by smart Grid. Government's specially intention is IoT industry for cyber security. One of the instances of government initiatives that can potently drive the IoT utilities market is the US Department of Energy's pursuit of a smart grid that is investing in the utilisation of technologies which can lower power costs and transmit electricity more efficiently.A manifestation of the initiative is evident in the installation of smart meters in Bellevue, Washington. In December 2018, the Washington City Council approved a $20.2 million contract to install smart water meters at homes in the city.

Q. No. 3:

Illustrate the different Switching Techniques, Communication Channels and Communication Technologies.

Switching Techniques

There are three switching techniques

1. Circuit Switching

   Physically switching by circuits.

2. Packet Switching

   Advance switching technique than circuit switching. But no physical switching.

3. Message Switching

   It is a form of switching in which packages are sent through multiple nodes

Communication Channels

- Digital (discrete) or analog (continuous) channel
- Transmission medium, for example a fibre channel•
- Multiplexed channel
- Computer network virtual channel
- Simplex communication, duplex communication or half duplex communication channel•

Communication Technologies.

Types of communication technology include: email, texting, instant messaging, social networking, tweeting, blogging and video conferencing.

Q. No. 4:

Explain the evolution of electricity metering, Compare the Conventional and Smart Metering.

As commercial use of electric energy spread in the 1880s**.**

The first specimen of the AC kilowatt-hour meter produced on the basis of Hungarian Ottó Bláthy's patent and named after him was presented by the Ganz Works at the Frankfurt Fair in the autumn of 1889,

1922 E.B. Moullin create the first real vacuum tube voltmeters using improved triodes.

1957 Rosewell Gilbert (of Weston) developed the dual slope analog-to-digital conversion circuit was developed and allowed for stable noise-reduced measurement by digital means.

1970s Digital multimeters begin to appear as the cost of solid state devices drops1970s Vacuum tube meters finally kill off moving coil galvanometers which were still in use by large companies. Many employees take the older meters home and these enter collections including the Edison Tech Center's collection later on.

1990s Digital multimeters outnumber tube-based or magnetic multimeters

2000s Digital multimeters are produced by many companies,

Q. No. 5:

Discuss all the benefits of advanced metering. Illustrate the key components of Smart Metering.

Smart meters can provide quick, accurate measurements of electricity use while eliminating the need for estimated monthly bills or home visits from meter readers. While this seems like the smart thing to do, there are concerns that smart meters are collecting unnecessary information about hourly electricity use. This collection of data could, potentially, be a violation of users' privacy.

- raising awareness and empowering the consumer through delivery of actual consumption data
- improving Customer Relationship Management (CRM) and services, including automated billing/invoicing based on detailed metering data
- managing energy networks/grids better by shifting or reducing energy consumption, e.g. through Demand Side Management (DSM)
- enabling new energy services for improving energy-efficiency
- encouraging decentralised, micro-generation of energy, thus transforming the consumer into a energy producer (“Prosumer”).

Q. No. 6:

Draw and discuss the functional block diagram of a Smart Meter. Describe Communications infrastructure and protocols for Smart Metering.