Welcome

EE 111

Introduction to Electrical Systems

Instructor: Kishore Chatterjee
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Office: Electrical Engg. Bldg.
Room No. 032
Ground Floor

Lecture schedule:

Wed: 11:00 to 12:35 pm
Friday : 11:00 to 12:35 pm

Extra/Compensatory/Special lecture : Saturday 11:00 to 12:35 pm

Meeting the instructor outside the scheduled lecture hours:

Wednesday: 3:30 pm to 5:00 pm

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Passive elements, Sources, Review of Kirchhoff's Laws: KCL, KVL, Mesh and Nodal analysis, network theorems
Time domain analysis of simple first order circuits
Steady state ac circuit analysis, phasors,
Single phase, Power, Reactive power, Power factor improvement, 3 phase circuits
Magnetic circuits and Mutual inductance
Transformers, DC machines, Induction machines (1 and 3 phase), Synchronous machines, Stepper motor,
Introduction to Power Engineering

Text/References:

1. Vincent Del Toro, `Electrical Engineering Fundamental, Prentice Hall India
2. P.C.Sen, `Principles of Electrical Machines and Power Electronics', John Wiley and Sons (Indian Edition)
3. I.J.Nagrath, `Basic Electrical Engineering', Tata McGraw Hill, India. 1988
4. DeCarlo / Lin ‘Linear Circuit Analysis’ 2nd Edition, Oxford University Press (Oxford Indian Edition)

Evaluation Scheme:

- Attendance is compulsory
- Quizes : 15 %
- Assignments : 5 %
- Midsem : 30 %
- Endsem : 50 %

Why to do courses ?

Why to learn ?

How to learn ?

How knowledge is acquired ?

- the levels involved

1) What teacher knows students do not know.

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2) What teacher does not know, students do not know, but somebody else knows.

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2) What teacher does not know, students do not know, but somebody else knows.

3) What teacher does not know, students do not know, and nobody else knows.

Why to do science/technology/engineering ?

1) For betterment of life/society in general

2) To impart rationality

Modern Electrical Engineering resulted with the confluence of electricity and magnetism in the beginning of the eighteenth century

People new about of electricity : Lightning, polar lights (aurora borealis), electric eel, St. Elmo's fire, attraction of light objects by natural resins when rubbed

Magnetism: use of lodestone for navigation

2637 BC Hoang-ti's charriot had a female figure always pointing towards south

9th Century BC : Navigation on land and sea carried out with the aid of a floating needle after being rubbed by a lodestone

12th Century AD : Use of compass in sea navigation

Voyage of Columbus (1492)

Voyage of Vasco da Gama, Sebastian Cabot : led to the development of terrestrial magnetism

1544 : Hartman discovered the phenomenon of dip or inclination

1576 : Robert Norman set up a factory for manufacturing of compasses at Wapping

1600 : William Gilbert (physician of Elizabeth I) published the book ‘De Magnete’

1750 : Benjamin Franklin, experiments with kites, protection of buildings from lightning.

Shocks from fishes – torpedo, gymnotos – for curing ailments like gout, rheumatism

Static electricity: resin, amber. Gilbert's 'De Magnet' talked about electric force

1660 : Frictional electrical machine by Otto Von Guericke

1675 : Newton communicated to Royal Society than rubbed glasses also attract light bodies

1720 : Principle of conduction and insulation shown by Stephen Grey. By suspending a hempen line on silken threads he transmitted electric charges hundreds of feet.

1745 : Storing of charge in Leyden jar - Cunaeus

1761 : First public lecture on ‘electricity’ by Ebenezer Kinnersley in Boston – ‘ a subtle fluid which does not take perceptible time to pass’

The constraints of static charges

The next jump : The discovery of steady electric current

1762 : Sulzar : Placing Zn and Ag on either side of the tongue producing itching sensation – this discovery went unnoticed for 24 years i.e. up to 1786

1786 : Galvani (University of Bologna, Italy)

- Static charges produce similar convulsions in the limbs of dead frogs – the effect can be produced without any other external agency than a pair of dissimilar metals

- Inferred that the source of electricity lay in the nerves and muscles of frog.

Rivalry with Volta (University of Pavia, Italy)

Volta's inference : 'Continuous' electromotive force exists between two wet conductors.

- Increased the no. of pairs of wet conductors and the effect increases.

- Volta used Galvani's experiment of 'contraction of frog muscles' to evaluate the 'effect'

- Led to the development of 'Volta Pile' or 'Voltaic Pile' reported to Royal Society on 26th June 1800

Volta's contribution led to electrochemistry and electrical engineering

Humphry Davy : Son of a wood carver turned farmer

- carbon arc – for illumination and melting
- decomposition of water and other chemical compounds

In January 1801 he was offered a post of assistant lecturer with a prospect of becoming Professor in the following year at Royal Institution at a salary of 500 GBP

‘In a letter to his mother at this time he told her he was asking for the specific terms of the appointment “when I shall determine whether I accept it or not”, and says “ I will accept no appointment except upon the sacred terms of *Independence”* (History of Electrical Engineering by Percy Dunsheath, Faber and Faber, 1962)

Delivered first public lecture on the subject of Galvanism at the age of 23 on April 25 only few weeks after taking up the appointment.

Volta's pile led to Cu – Zn cells : 1800

Limitation :

- Local action
- Polarization

1820 : Emergence of Electromagnetism

1828 : Amalgamation of the Zn plate by Hg to overcome *local action* – Kemp and William Sturgeon

1836 : Adoption of two fluid principle to overcome *polarization* – Daniell

1839 : Grove Cell, Bunsen Cell

1840 : Single liquid cell – Smee, Bichromate Cell

1868 : Leclanche Cell (1.5 V)

- Employment of solid depolarizer (MnO_2)
- Zn and C electrode
- Electrolyte: Ammonium Chloride

1887 : Dry cell (Non spillable Leclanche Cell) manufactured by Hellesen

Emergence of Electromagnetism

Suspision was there that Electricity and magnetism are interelated

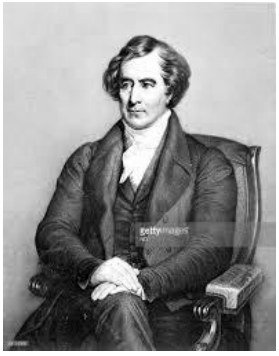
- both having two polarities
- both following law of inverse squares
- weakening of compass needle during lightning

Benjamin Franklin magnetized sewing needles from Leyden Jars (around 1745)

1820 : Hans Christian Oersted (1777-1851) son of an apothecary formed the basis of electromagnetism – current carrying conductors produces magnetism : the originator

Andre Marie Ampere : Within seven days he formulated how to determine the direction of the magnetic field : the thinker
(1775-1836)

French physicist, Arago : Arago's disc
(1786 – 1853)



Significance of Electromagnetism

1837 : Launching of commercial telegraph

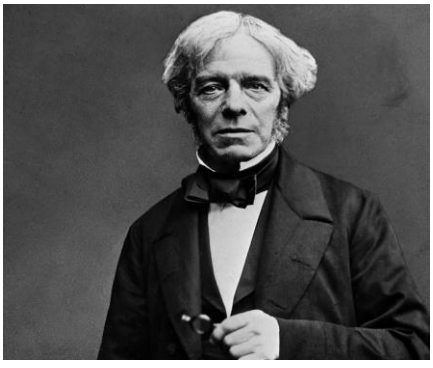
Electrical Engg. mainly dependent on voltaic current and continued for another 25 years or so based on it

Discovery of Steam engine in 1698 by Thomas Savery and its commercialization by James Watt between 1763 to 1775

Requirement of a new source of current of ‘large’ magnitude to match the mechanical drives

The man responsible for realizing it : Michael Faraday

Michael Faraday born in 1791, son of a black smith.



School drop out : Started working for a book seller named Riebau as a book binder

Started reading scientific books which he were given to bind and developed interest in chemistry, electrochemistry and Electricity in general

Carried out scientific experiments with limited resources. Made his own version of Volta's pile and started experimenting

The turning point:

Faraday attended four public lectures of Humphry Davy – the ticket bought by one of the shop's customers, Mr Dance

Faraday took notes, copied them in clear hand writing, bound them and presented them to Davy

Davy got impressed, met Faraday (aged 22 years) and appointed him as a laboratory assistant at 25 shillings per week. An association which lasted for almost 50 years

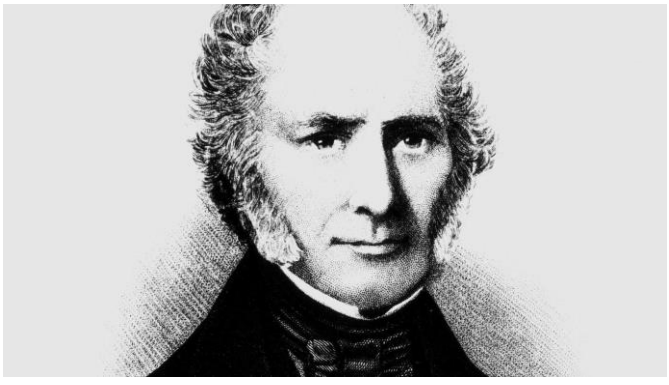
Initial work was on Chemistry/Electrochemistry

Came to know about Oersted's work (1820)

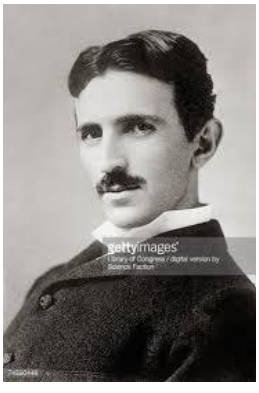
Electromagnetic rotation (1820)

Electromagnetic induction (1830)

DC Machine – William Sturgeon 1832



Induction Machine – Nichola Tesla 1887



Ohm’s Law: George Ohm in 1827

They called his work a "web of naked fancies"[10] and the German Minister of Education proclaimed that "a professor who preached such heresies was unworthy to teach science."[11] The prevailing scientific philosophy in Germany at the time asserted that experiments need not be performed to develop an understanding of nature because nature is so well ordered, and that scientific truths may be deduced through reasoning alone. (Source: Wikipedia)

Ohm’s Law: Ultimately got recognition in 1840