

# EFFECTIVE TEACHING METHODOLOGIES IN ELECTRICAL ENGINEERING

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**Abstract**—With due advancement in the state-of- the art of teaching technology, one has to adopt multimedia such as animation and movie based teaching methods for the students to make the lectures more interesting and memorable. The subject of Electrical Engineering is very abstract. It may be hard for the students to comprehend. Hence certain innovative methods of teaching are needed to help the students to understand, retain, retrieve and apply the fundamental concepts as and when needed. The use of analogy as a teaching tool to promote better understanding of the behavior of some electrical components such as Resistance (R), Inductance (L), capacitance (C) is well explained in this paper. The terminologies such as Active power (P), Reactive power(Q), Basic Insulation Level (BIL), electric potential etc. are well depicted in an understandable way. Innovative methods of teaching are explained. The students are motivated to take up thought provoking projects under the guidance of expert teachers so as to create in them the flair for research. Students have received a number of awards and medals for the models developed by them. The technical knowledge on the fundamental concepts helped them a lot and also benefited in getting selection in placements

**KEY WORDS:** *Effective Teaching, Model Room, Research element, Thought Provoking Projects, Basic impulse level.*

## I. INTRODUCTION

The Paper describes the innovative methods adopted for conducting effective teaching/learning process in Elec. Engineering. The methods adopted for inculcating research aptitude among the students at under graduate (UG) level are described with illustration of some working projects developed by the students of EEE department under the guidance of competent teaching staff.

Swami Vivekananda insisted on Value Based Education. It is hardly possible now-a-days to induct moral science as a subject in the Engineering college curriculum for obvious reasons. However we may plan to have a few lecture classes on ethics by eminent personalities from

time to time to improve the discipline, punctuality and character building of the students. This aspect is being followed in Vidya Jyothi Institute of Technology in letter & spirit. Indian education system is churning lakhs of students every year with little skills. The cost of professional education is sky rocketing but only limited numbers of students are seen employable. Teaching factories are mushrooming but quality of education is lacking. Therefore there is a basic need to reorient the method of teaching in the class room so as to generate interest among the students and inculcate in them the practical concepts of the subject.

## II. ANALOGY BASED TEACHING

The teacher should correlate with the day-to-day real time examples and explain the topic effectively in a more meaningful way. The subject can be made more interesting by citing suitable examples with analysis as illustrated below. The students need to be aware of the usefulness and purpose of the subject they learn and where exactly the knowledge they acquired would be applicable in their real life. Analogies help to provide a powerful tool for the students to learn about the abstract concepts and increase their retentivity.

### A. Analogy of Resistance, Inductance and Capacitance

The resistance tends to oppose the flow of free electrons. It is analogous to the friction of the wall of a vessel while pouring the sand. The Inductance does the same but in a different way. The choked throat of the vessel will restrict the flow of sand. This is analogous to inductance. A capacitor makes up the voltage levels as per the need of the circuit. Temporary storage of water in a surge tank and releasing it as and when needed is an analogy of a capacitance. These are self explanatory as illustrated in the figures given below:

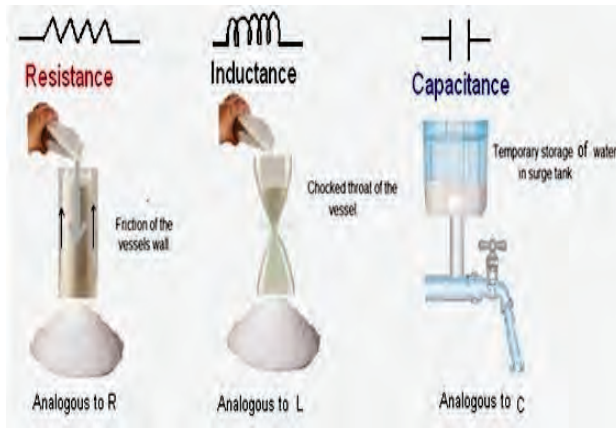


Fig.1(a)

Fig.1 (b)

Fig.1(c)

#### B. Active power/ Reactive power concept

Effervescence: lagging reactive power (Q wattless power) ---- 25%

Actual Pepsi in a glass: Real power (P wattful power) ---- 75%

Total quantity of the glass (Apparent power) ----100%

If lemon drops (leading reactive power) are added while pouring the Pepsi in the glass the effervescence (lagging Reactive power) is instantaneously neutralized making the Pepsi 100% in the glass.

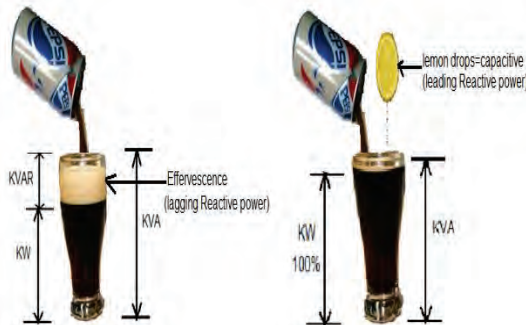


Fig.2 (a)

Fig.2 (b)

$$\text{Power factor} = \frac{75\%}{100\%} = 0.75 \text{ in fig.2(a)}$$

$$\text{Power factor} = \frac{100\%}{100\%} = 1 \text{ (unity) in fig.2(b)}$$

#### C. Basic Insulation level (B.I.L)

It is the crest value of the impulse voltage for which the given equipment is required to withstand without failure. This may be from 2 to 3 ½ times of the

normal operating voltage (V) depending on the degree of the reliability desired. This is illustrated through the Fig.3 as shown below. The height of the dam will represent the Basic Insulation Level (BIL). The surge of the flood is analogous to the lightning / switching surges of the Power System. If the dam is not strong enough to withstand the surges of the flood it will be washed away. So also if the insulation level of the electrical equipment is not strong enough the equipment will get damaged.

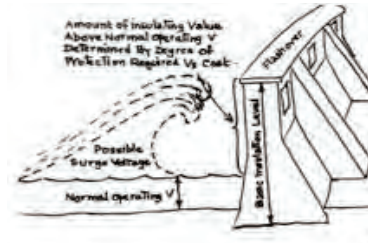


Fig.3

#### D. Electric Potential

It is the work done in moving a unit positive charge from one point to the other point against the Electric field. This can be illustrated through the following Fig.4. The moment disk valve of the penstock is opened water starts flowing from the upstream reservoir to the down stream side because of the acceleration due to gravity. To send the water from the down stream side to the up stream side, against the gravity we have to do work in pumping the same back into the reservoir. Consequently the potential energy of the water in the reservoir will rise.

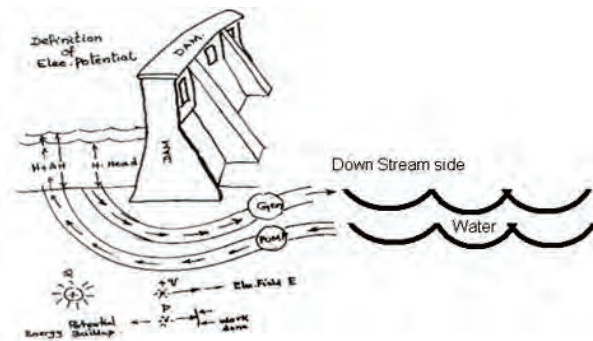


Fig.4

#### E. Forces created due to Short Circuits in a Transformer

During the operation of a transformer electromagnetic forces are generated in both radial and axial directions. Under short circuit conditions these forces can become substantial enough

to cause axial displacement of the High Voltage (HV) and Low Voltage (LV) windings relative to each other.

The abnormal forces created due to short circuits in a transformer will disrupt the winding as shown in the figure. This is similar to a person meeting with a severe accident losing the original capacity despite medical treatment (even after repairs the transformer is derated)

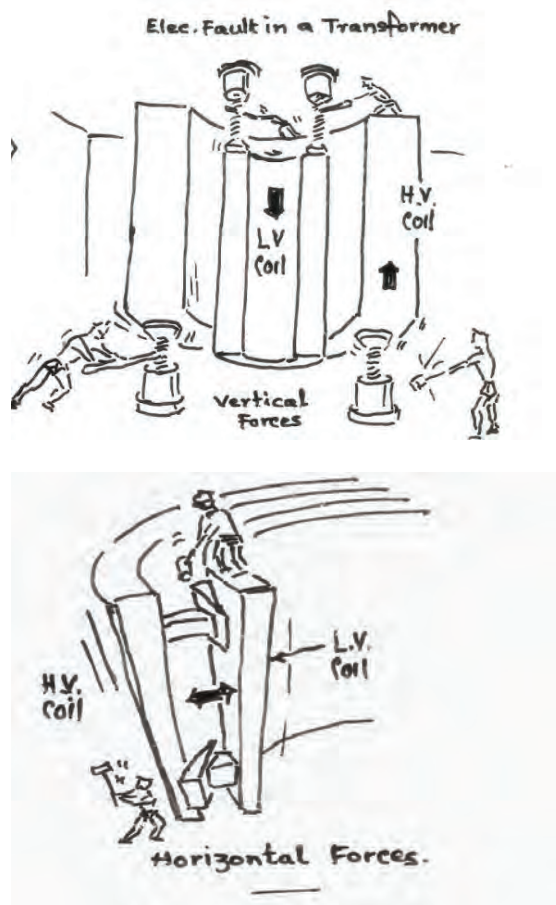


Fig.5

*The Vertical forces created, try to shear off the HV and LV windings whereas the horizontal forces try to deform them as shown in the figure.*

### III. INNOVATIVE METHODS OF TEACHING

Good teaching should be rewarded and poor teaching should be remedied through training and frequent Faculty Development Programmes (FDP). Frequent FDPs are being conducted in each semester in Vidya Jyothi Institute Of Technology (VJIT) invariably

- The teacher often talks continuously for hours together without knowing students' response or feedback. If the students assume only a passive

role, their concentration gets faded away soon. The teaching should be of interactive type. Interactive methods of teaching are being adopted and students' feedback is being taken from time to time in VJIT.

- Education should become a fun and thrill to the students rather than a burden or boredom. A person will enjoy an interesting movie for 3 hours continuously without getting distracted or bored because it is creating interest in his mind appealing to his senses, engendering in him "Navarasas" (Nine mental sensational feelings) such as happiness, humor, surprise, emotion sympathy etc. Hence a movie based teaching through multimedia tools will be an effective method of teaching.
- Animation through relevant pictures along with explanation would be thought provoking.
- The art of remembrance depicts that, a student will never forget (a) If he understands the subject well (b) If he evinces interest in the subject (c) If he changes the subject/ topic from time to time and studies. The above theory was put forth by Ebingos, a German Scientist.
- Teaching should be from macro to micro. A Teacher should give a bird's eye-view of the entire syllabus of the subject in the beginning, and then unit wise description. He has to come to the actual point of discussion finally.
- The usefulness of the subject under study and its importance should be discussed in the beginning to create interest among the students for the subject.
- The students should be motivated to present papers on the topics which they learn in the class room every semester. They should be encouraged by giving merit certificates and prizes.
- The students should be sent to the field visits to places viz EHV Substations, Power Stations, Railway Tracking & SCADA System, Transformer Manufacturing companies etc., as frequently as possible
- Guest Lectures from the distinguished speakers are to be arranged to impart practical knowledge to the students.

### IV. RESEARCH PROJECTS FOR STUDENTS

Study by seeing and doing makes an indelible impression in the mind of a student and he can't forget. A teacher should inspire the student and ignite his mind. In a nutshell the student should have a practical outlook of whatever he studies in the class. It is the duty of the institution to make the student worthy and employable, by adopting suitable teaching techniques.



As a matter of fact, research activity can only be taken up after Post Graduation in view of the fact that the grasp of the subject, mental makeup and maturity of the mind of the student will be reasonably adequate at this level. The under graduate students are normally in the stage of infancy and immaturity for tackling the research activity. But needless to say that it is essential to inculcate the culture of elementary research ideology in the minds of the students while developing the Project works at Under Graduate level.

In the process of accomplishing the mini as well as main project works the Undergraduate students may come across numerous problems. They may commit mistakes and at times fail to get the results. It is a good symptom in as much as the student is improving his creativity. Creativity is allowing a student to commit mistakes and learn thereby. It is the grief which develops the mind more than the happiness. Under the guidance of the teachers the students should do the projects independently. The students have to pursue their work till they get the results. A collection and display of such projects duly accomplished by the students will constitute a Model Room which will be a treasure of the Department. A good number of projects are available in the Model Room in the EEE Dept. of VJIT. Projects like Solar Fencing for the entire college, Working Model of Synchronous Machine, Vertical Shaft Hydro Generator, Magnetic Levitation, Van de Graff Generator, Thermal Power Plant, Gas Power Plant, Power Generation through speed breakers etc., have been designed by the students under the guidance of the faculty at VJIT. Photos of some models are shown below.

#### EXPLANATION OF THE MODELS

The Fig.6 depicts the model of a Gas power station where combined cycle operation is illustrated.

Fig.7 shows a cut section of the Hydro generator wherein the thrust bearing, upper guide bearing, lower guide bearing, turbine guide bearing, slipring with brush gear, the rotor along with the armature windings, stator air coolers and spiral casing are shown. It is a working model exhibiting all the relevant accessories.

Fig.8 shows a model of Linear Induction Motor depicting the Magnetic Levitation.

Fig.9 shows a Vertical Shaft Synchronous Generator. The rotor winding and armature windings are designed and manufactured in the college. DC excitation system with the slipring and brush gear are also configured. A Prime mover is also provided on the top of the shaft. It is a working model depicting all the accessories. When the prime mover reaches the synchronous speed, three phase voltage of 415v will be generated at the armature terminals and displayed through three different coloured LEDs.



Fig.6

*Gas Power Plant*



Fig.7

*Hydro Generator cut- section*



Fig.8

*Magnetic Levitation*



Fig.9

*Synchronous machine*

#### V. CONCLUSION

By adapting the innovative methods of teaching as cited above, the EEE B.Tech students of VJIT gained a lot of skill and confidence. The level of understanding of the students increased considerably. They developed the team spirit and leadership qualities. The students got a number of awards and medals instituted by the Ministry of non-conventional energy, Govt. of Andhra Pradesh, Jana Vignana Vedika affiliated to NCSTC Network, Agastya International Foundation etc for the models developed by them. The morale and creativity of the EEE students increased by leaps and bounds. The percentage pass of the students increased and the employment opportunities picked up.

The technical skills, the knowledge and the behaviour that the students acquire in their graduation will go a long way in shaping their career, transforming them into responsible citizens of our country.

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