

VIRTUAL LAB: KEEP AWAY PHYSICALLY BUT NOT TECHNICALLY

Rangarajan J¹, Saravanakumar U², Sabitha J³ Pooja J⁴

¹Professor, Department of ECE, Muthayammal Engineering College, Rasipuram, Tamilnadu, India

²Professor & Head, Department of ECE, Muthayammal Engineering College, Rasipuram, Tamilnadu, India

^{3,4}UG First year Students, Department of ECE, Muthayammal Engineering College, Rasipuram, Tamilnadu, India

Abstract - An Entire academic world is now talking about online learning to ensure that the threat posed by the growing pandemic of COVID 19 – the Corona Virus will not stop the learners at any cost. Focusing on educationist specifically faculty and students, many of the online teaching institutes or companies now provide an opportunity to learn new technology courses free of cost which are chargeable earlier. Government authorities are also supporting this in many ways. Learning from home is one way of working from home for faculty and students. Younger generation always interested in learning by doing. That is, they want to learn by doing experiments. Learning by doing at home involves a lot of critical factors. This paper presents the avenue to gain practical knowledge in the circuit branch engineering courses through virtual labs instead of getting only theoretical knowledge.

Key Words: Virtual Lab, Online learning, E-learning, Covid-19, Social distance

1. INTRODUCTION

Entire world is now working from home to avoid infection from the Covid-19, the Corona virus disease. The virus is mainly spread during close contact and by small droplets produced when people cough, sneeze or talk. Recommended measures to prevent infection include frequent hand washing and social distancing. To ensure social distancing, the entire educational institutes around the world closed their campus. However, to ensure the continuous learning process during the lock down period, the faculty and students are advised to work from home. Learning from home is one of the best of working from home.

In this modern age, lots of resources for learning are available through internet and other media. To facilitate and encourage learners, many of the online teaching institutes or companies now provide an opportunity to learn new courses free of cost which are chargeable earlier. Government authorities and management of educational institute are also supporting this in many ways. The learners can use stay at home time effectively to enrich their knowledge with this type of opportunity provided to them. In addition to this, lots of e-books are available for learning.

The learners, specifically students may get bored by continuously learning through theoretical concepts. Younger generation always interested in learning by doing. That is, they want to learn by doing some experiments. Learning by doing in home involves a lot of critical factors. The learners

have to establish lab in their home and it is not always possible to invest on high cost equipment. A good solution for this is Virtual Lab [1]. In addition to this, open source software are also available to carryout experiments. In this work, some of the experiments included in the academic syllabus are carried out using virtual lab and it shows that the learners can enrich their practical knowledge [2].

2. VIRTUAL LABS

In the most general terms, a virtual laboratory is a computer-based activity where students interact with an experimental apparatus or other activity via a computer interface[3]. With the present day internet and computer technologies the limitations such as unavailability of experimental apparatus or lab setup can no more slowdown the learners in enhancing their practical skills and knowledge[4].

Web enabled experiments for remote operation and viewing will increase the curiosity and innovation into students. This would help in learning basic and advanced concepts through remote experimentation[5]. It is possible to design good experiments around some of this equipment which would enhance the technical skills of learners[6]. Some of the advantages of using Virtual labs are:

- The virtual lab can be taken during the learners own time.
- Significant improvements in learning can be demonstrated.
- Available 24X7. So learners can learn difficult concepts at their own pace.
- Real looking components, to give the user a feel of the real laboratory.
- Before the real time implementation, learners can troubleshoot all errors occurred in their designed circuits / projects.

3. EXPERIMENTS UNDERTAKEN

Two experiments that come under the undergraduate engineering course of circuit branch are considered in this work. They are:

1. Characteristics of Transistor and
2. Half wave rectifier

The physical components such as power supply, breadboard, CRO, capacitor, resistor, ammeter, voltmeter, transistor and diode are required to do these experiments in Lab. With the aid of virtual lab it is possible to do these experiments

without any of these physical components. It is the main advantage and power of virtual lab.

4. RESULTS AND DISCUSSION

Two experiments undertaken in this work are carried out using different virtual labs and simulators. It shows that plenty on online tools are available for the learners to work from home to enrich their knowledge.

4.1 Characteristics of Transistor

The experimental setup of virtual lab used for learning and doing this experiment is shown in figure 1. The procedure to carry out this experiment along with the theoretical background is clearly given[7]. Therefore, without the aid of anyone, the learners can understand and develop their practical knowledge. The output graph is also drawn automatically.



Fig -1: Characteristics of Transistor

Some of the online resources provide 3D view of the physical equipments as shown in figure 2, in which the learners have to select the component and make the wiring connection[8]. In this type of virtual lab, the output voltage is varied and output current is noted and tabulate. Then, the characteristic curve is plotted on a graph sheet. This will give an experience similar to doing in physical lab.

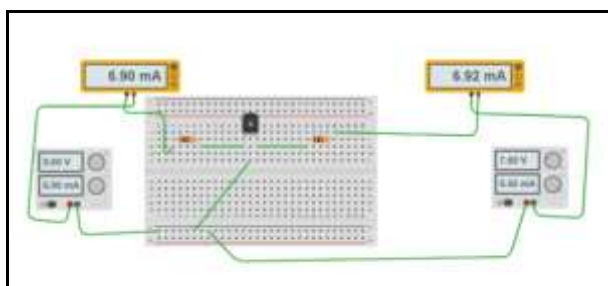


Fig -2: Characteristics of Transistor (3D view)

It is to be noted that without having any physical components the characteristics of a transistor is learned.

4.2 Half Wave Rectifier

Figure 3 shows the circuit setup to conduct this experiment and is constructed using open source software [9].

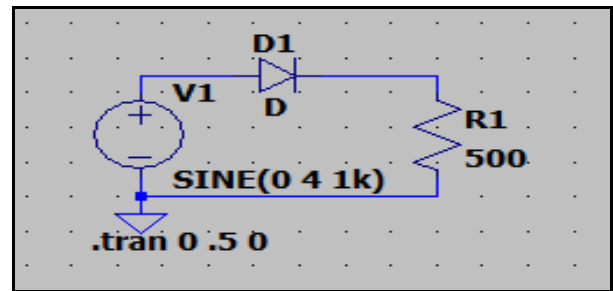


Fig -3: Half wave rectifier

After making the connection and setting the values to each element, the waveforms at different points can be obtained by just clicking the run button. The outputs obtained after simulation is shown in figure 4 and it is noted that output is not a pure dc and large amount of ripple are occurring.

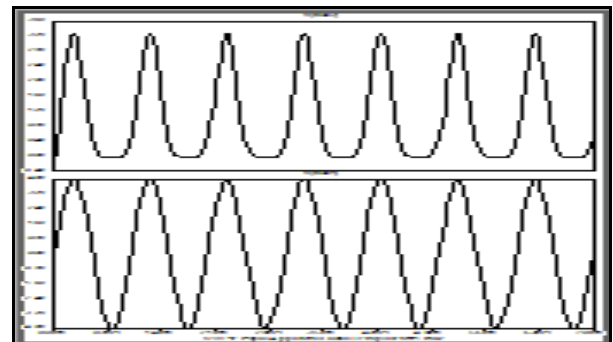


Fig -4: Input and output of Half wave rectifier

To reduce the ripple, a capacitor which acts as a filter is connected across the load. The circuit with capacitor of value $C = 100 \mu\text{F}$ connected across the load is shown in figure 5 and the output waveform is shown in figure 6.

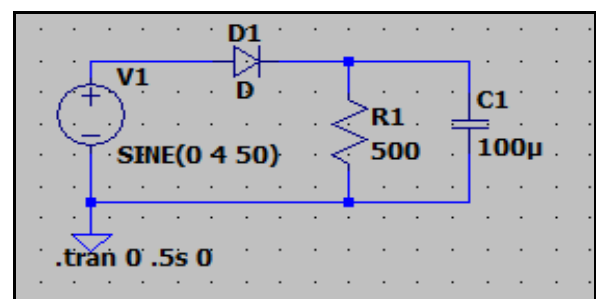


Fig -5: Half wave rectifier with filter ($C = 100 \mu\text{F}$)

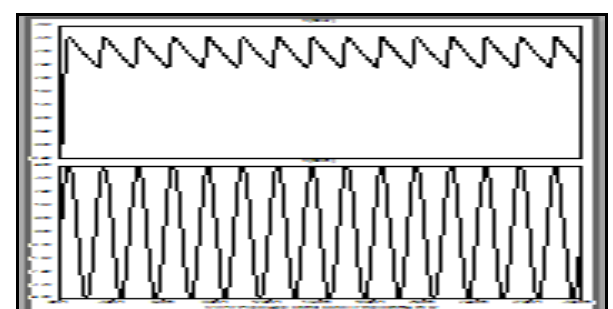


Fig -6: Input and output with filter ($C = 100 \mu\text{F}$)

To have better response, the value of capacitor is changed to $C = 500 \mu\text{F}$ as shown in figure 7 and the output waveform thus obtained is shown in figure 8.

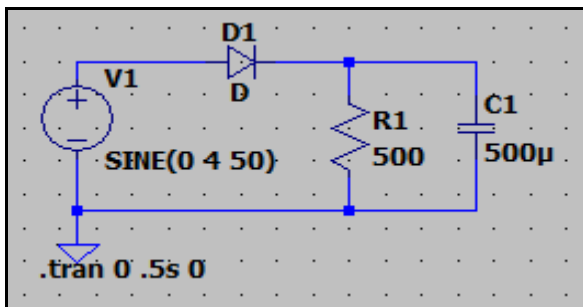


Fig -7: Half wave rectifier with filter ($C = 100 \mu\text{F}$)

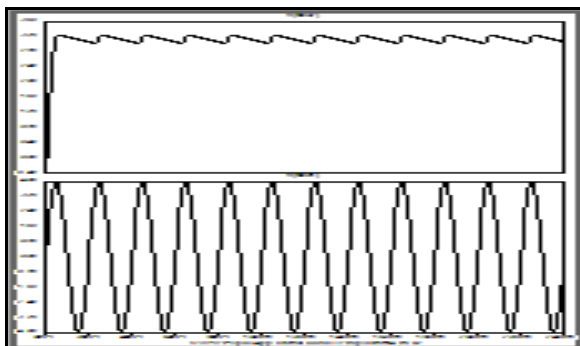


Fig-8: Input and output with filter ($C = 100 \mu\text{F}$)

It is interesting to note that, just by changing the value mentioned against the capacitor, it is possible to connect a capacitor with new value. However, it not possible in physical lab, where the old valued capacitor has to be replaced by new valued capacitor. By changing the value of resistor, capacitor or value of any other electrical and electronic components it is possible to get the output immediately.

By this way, the performance and behavior of the components used in the circuit can be analyzed. This will definitely increase the learning capacity. The learners need not worry about the damage of components in the circuit due to wrong connection. Because, it is a virtual or simulation lab and such things will not happen.

5. CONCLUSION

Virtual laboratory is a computer-based activity where students interact with an experimental apparatus or do other activity without having physical components. A virtual circuit can be created to help the learners in preparing for their physical labs without using any physical component or equipments. Learners can utilize the stay at home time effectively to enrich their knowledge with this type of opportunity provided to them. New electrical or electronic circuit ideas can be created, constructed and tested to enrich their technical practical knowledge during this lock down period.

ACKNOWLEDGEMENT

The author's wishes to thank the Management, Principal, Deans and HoDs of Muthayammal Engineering College for the moral support and encouragement given to the Faculty and Students to learn and enhance their skills during the Covid-19 lock down period.

REFERENCES

- [1] Ankita Dumbre, Sayali Manjare, Priyanka Shinde, C.S. Arya, "Survey Paper on Virtual Laboratory To Improve Learning", International Journal of Advanced Research in Computer Engineering & Technology, Vol. 6, No. 10, October 2017.
- [2] R. Lavanya, V. Ramachandran, J. Divya, "A study on the effectiveness of virtual lab in E- learning", International Journal on Computer Science and Engineering Vol. 02, No. 06, 2010, pp. 2173-2175.
- [3] S. Shweta, M.D.Katkar, "Survey paper on Virtual Lab for ELearners", International Journal of Application or Innovation in Engineering & Management, Vol. 3, No, 1, January 2014.
- [4] K. Rebecca. Scheckler, "Virtual labs: a substitute for traditional labs?", Int. J. Dev. Biol. 2003, Vol. 47, pp. 231-236.
- [5] Diwakar, S. Anita, Noronha, B. Santosh. "The Effectiveness of Virtual Labs in Engineering Education- what do we Measure?", Journal of Engineering Education Transformations, July 2016, pp. 73-81.
- [6] Dongfeng Liu et al. , "Integration of Virtual Labs into Science E-learning", Procedia Computer Science, International Conference on Virtual and Augmented Reality in Education, 2015, Vol. 75, pp. 95 – 102.
- [7] <http://vlabs.iitkgp.ernet.in/be/exp11/index.html>
- [8] <http://tinkercad.com/circuits>
- [9] <https://www.analog.com/en/design-center/design-tools-and-calculators/ltspice-simulator.html#>