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Production of a Video Tape Recorded Supplement for Use in Teaching Electrical Tuned Circuit Theory

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PRODUCTION OF A VIDEO TAPE RECORDED SUPPLEMENT FOR USE IN TEACHING ELECTRICAL TUNED CIRCUIT THEORY

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Master of Education

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by

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PRODUCTION OF A VIDEO TAPE RECORDED SUPPLIMENT FOR USE IN TEACHING ELECTRICAL TUNED CIRCUIT THEORY

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This paper presents a sample of the proceedures utilized to produce a video tape recorded suppliment for use in teaching electrical tuned circuit theory. It is designed so that it could be used as a ready reference for anyone desiring to make a video tape recorded teaching aid.

A recomendation is that, with the advent of the simplified video tape recorder, every teacher should become as practiced in its operation and utilization as he now is with the film projector.

Chapter 1

THE PROBLEM AND DEFINITIONS OF THE TERMS USED

In discussing the teaching of electrical theory with other instructors, it was found that many of their students have trouble understanding tuned circuit theory. The major difficulty seems to lie in the time that it takes to repeat demonstrations to many individuals or small groups. Many of the instructors lacked the instruments necessary to give an actual demonstration. They have to resort to charts and graphs. Many students fail to understand the theory presented in this manner. These students must resort to rote memory or else give up this important section of theory.

THE PROBLEM

Statement of the Problem

The purpose of this study is to prepare a video tape supplement which would be used in the teaching of electrical tuned circuit theory. It is designed so that it could be used as a ready reference for anyone desiring to make a video tape recorded aid.

Importance of the Study

The utilization of teacher time is a problem that presents itself in almost every teaching situation. Many times this shortage of teacher time means that some questions remain unanswered and many questions remain unasked.

Teachers must utilize every means at their disposal to reach every student in their class. The introduction of the video tape recorder to the classroom has done a great deal to free the teacher to work with special groups. Many electricity/electronics teachers have mentioned the availability of a video tape recorder, but have admitted to only limited use of the machine. The reasons given are mainly lack of familiarity with the equipment and a poor understanding of its versatility.

There are many aspects of the video tape recording that make it especially suited to the school situation. The importance of video tape recordings, the ease of utilization and the extreme versatility have merely to be recognized. The use of video tape recordings could possibly greatly supplement and expand the methods of demonstration that are available to the educator. By utilizing the video tape recorder the teacher can have the students who do not understand repeat the lesson via video tape. This lesson may be repeated as often as necessary for comprehension. Being able to repeat the lesson at the student's discretion, frees the teacher to help other students with more unique problems.

Specific sections of a video tape recording may be replaced or removed. Selected sections may be rearranged within the tape itself or replaced with a new section recorded by the educator at a later time. Each video tape may be reproduced much like audio tape recordings with very little loss in quality.

Many video tape recordings are on the market which take little more technical skill to operate than a standard audio tape recorder. For most production purposes the video tape can be recorded without any special supplementary equipment. Many video tape recorders are compatible with any standard television receiver for the purpose of playback. Video tape can be re-recorded and edited many times without any appreciable expenditures other than time.

With the predicted marketing of video tape in cassette form, the simplicity of playback operation will be like that of the standard audio tape playback. Given about five minutes of instruction, even an elementary school child is capable of operating the video tape recorder. The author predicts that the introduction of cassette tape recorders will mean the introduction of commercially produced tapes, just as the introduction of 8 millimeter film cassettes was followed by commercially produced films. Even these tapes could be modified by the educator to fit his particular situation when necessary.

DEFINITIONS OF TERMS USED

This section presents a glossary of the terms used in the script of the video tape. Because of the technical nature of the materials dealt with on this video tape, a glossary of the terms used in the demonstration have been included to enable a non-technical person to understand and follow the script.

This glossary is designed so that it could be used as a vocabulary list.

1. A.C.- abbreviation for alternating current.

2. Alternating current- that which flows in two directions, constantly changing in amplitude and usually reversing direction at a constant rate.

3. Amplify- to enlarge; as music in a phonograph.

4. B+- the positive direct current voltage applied to the plate of a tube.

5. Capacitance- that property of a condenser which determines how much charge can be stored at for a given potential difference.

6. Capacitor- that device consisting of two or more conductor plates separated by a dielectric and used to block direct current while impeding alternating current to a lesser degree.

7. Circuit- a complete or partial path through which electricity will flow.

8. Conductor- a material that allows current flow.

9. Counter electromotive force- voltage generated by electron current flow through a coil that apposes that voltage applied.

10. Current- electron flow through a conductor.

11. D.C.- abbreviation for direct current.

12. Direct current- current which flows only one direction, usually at constant values.

13. Electron- any of the non-nuclear, negatively charged particles that form part of all atoms.

14. Electron current- the flow of electrons through a conductor.

15. Filter- a device that passes electric currents of certain frequencies or frequency ranges while obstructing the passage of others.

16. Frequency- the number of times alternating waveform completes one cycle in one second.

17. Generate- to cause electron movement through a conductor.

18. Grid- the element in a vacuum tube that is used to control the amount of electrons flowing through that tube.

19. Ground- the point in an electrical circuit that is considered common. Voltage is usually measured with reference to this point.

20. Impedance- the apparent resistance to alternating current, corresponding to the true resistance to a direct current.

21. Inductance- the property of an electric circuit by which a varying current in it produces a varying magnetic field that induces voltages in the same circuit or a nearby circuit.

22. Inject- to introduce into a circuit.

23. Insulator- a very poor conductor.

24. Load resistance- a resistor sometimes inserted into the circuit under test to simulate additional circuitry.

25. Magnetism- power of attraction between opposite charges and repulsion of like charges.

26. Oscilloscope- an instrument which visually displays amounts of electrical voltage on a fluorescent screen, as of a cathode ray tube.

27. Parallel- a hookup of lights, cells, or other components, in which all positive poles or terminals are connected to one conductor and all negatives to another.

28. Plates- in a capacitor, conductive material formed so as to have large surface area, usually foil.

29. Resonance- the condition of adjustment of a circuit that allows the greatest flow of current of a certain frequency.

30. Resonant frequency- the frequency at which a circuit is designed or adjusted to operate.

31. Series- a hookup of lights, cells, or other components, in which the positive pole or terminal of one is connected to the negative pole or terminal of the next, all current flows through all components in succession.

32. Short circuit- a side circuit of relatively low resistance connecting two points of higher resistance so most of the current by-passes the higher resistance.

33. Shunt- a conductor connecting two points in a circuit and serving to divert part of the current from the main circuit.

34. Signal- electrical impulses which make up the intelligence received or transmitted.

35. Stage- a tube with its accessory apparatus in an electronic device made up of a number of tubes.

36. Sweep generator- an instrument that produces a signal which progresses through a selected range of frequencies and at a repetitive rate.

37. Tuned circuit- a circuit adjusted or designed to pass specific frequencies or bands of frequencies best.

38. Voltage- electromotive force, or difference in electrical potential, expressed in volts.

Chapter 2

PROCEDURE

The following steps were taken in the planning and production of the video tape recording, Understanding Series and Parallel L.C. Circuits. These same steps could be used for the production of any video tape presentation and they only take the standard lesson plan one step farther, i.e. the camera directions. Thus the procedures were broken down from two basic steps, (1) planning the demonstration, (2) planning the recording.

I. Planning the demonstration:

- A. Decide upon a topic to be demonstrated.
- B. Limit the topic to a convenient time allowance.
- C. Decide upon the best way to get the subject across.
  1. drawings
  2. machines
- D. Outline the main points of the topic.
- E. Write the audio portion of the script.
- F. Make the hod cards to be used.
- G. Gather the materials and equipment needed.
- H. Set up equipment and run through the script to be sure that what you intend to cover is covered adequately.

II. Planning the recording:

- A. Inventory the equipment available.

B. Gain some understanding of the capabilities and limitations of the equipment.

C. Select the shooting sites.

D. Write camera directions on the script.

E. Obtain approval of the technical personnel.

F. Reserve the recording equipment.

G. Make a video tape recording of your demonstration.

H. Preview your recording.

I. Do any editing, re-recording, cutting if necessary.

J. View the finished product.

Chapter 3

THE VIDEO TAPE

SCENARIO:

UNDERSTANDING SERIES AND PARALLEL L.C. CIRCUITS

Visual	Audio
Open on oscilloscope	Bring in background music
Super main title card: Understanding Series and Parallel L.C. Circuits	
FADE TITLE OUT FADE CREDIT CARD (1) IN INST. W. A. CARLSON FADE CREDIT CARD (1) OUT FADE IN CREDIT CARD (2) PRODUCED AT C.W.S.C. FADE OUT CREDIT CARD (2) FADE IN COVER SHOT INSTRUCTOR AND APPARATUS	Fade music out
CUE TALENT	NARRATION: There are many different kinds of filter circuits used to select specific frequencies. Those frequencies selected may be amplified or shunted to ground. Because of this variety of circuits, people have great difficulty understanding just how they work. In this lesson we are going to examine two of the basic types of filter circuits.

HOD CARD #1

1. Series LC
2. Parallel LC

MS TALENT

By examining the current flow through the load resistance one can observe the effects of any filter circuit while applying a range of frequencies that extend, both above and below the resonant frequency of the tuned circuit. First, before we combine the capacitance and the inductance, let us review the effects of these component individually. What do we know about a capacitor? Basically we know that a capacitor consists of any two conductors, usually called plates, separated by some type of insulator. The capacitor operates on the basic principles of electron magnetism. The amount of capacitance is determined by the size of the plates, the distance between the plates, and the type of insulation separating the plates. A capacitor has the greatest opposition to current flow at low

frequencies and very little reactance at high frequencies. It is for these reasons that, in an amplifier, a capacitor may be used to block the high voltage B+, which is D.C. from the grid of the next stage while at the same time, this capacitor allows the signal, which is A.C., to pass.

This D.C. isolation is called capacitive coupling.

Inductance reacts in the opposite way, with very little reactance to direct current, only the resistance of the wire itself, and a high opposition to current flow at high frequencies. This high frequency reactance is caused by the counter electromotive force that is generated by the electron current flowing through the coils of the conductor.

HOD #2 TOP
GRAPHIC CU
SERIES SCHEMATIC

Let's take a look at a circuit. This is a circuit containing a coil and a capacitor in series. The coil and capacitor are also

in series with a resistor which is used to simulate a load.

CU GENERATOR

For a signal source we are using a sweep frequency generator set to sweep those frequencies that range above and below as well as at the resonant frequency of the circuit.

The generator does this at a re-

CU OSCILLOSCOPE

curring rate so that we can observe the resultant effect on an oscilloscope.

When one plugs the output signal from the sweep generator directly

ECU OSCILLOSCOPE SCREEN UPPER RIGHT QUARTER

into the oscilloscope, we can see how our unfiltered signal looks. The low frequency end of the sweep is here on the right of the

MS INSTRUCTOR

screen ... The high frequency end appears here on the left ... Now let us inject the signal into the circuit.

What do you suppose is going to be seen when we connect the oscilloscope across the load resistor?...

Look to see if you were right... Were you?...

ECU OSCILLOSCOPE SCREEN — One can see from the oscilloscope presentation when the signal frequency is at the low end, where it is acted upon by the capacitor, and then as it approaches the higher frequency end of the sweep, where it is acted upon by the coil.

This leaves the center range of frequencies to be acted upon in lesser amounts by the capacitor and inductor in this configuration. This means that there will be maximum current flow at resonance, and therefore maximum voltage drop across the load resistor.

MS INSTRUCTOR — When discussing filter circuits we refer to ranges or bands of frequencies. For example, a high pass filter permits those frequencies in the high frequency range of an amplifier to pass more easily than those in the low end. A band pass filter allows only those frequencies directly

adjacent to a resonant frequency to pass easily. We can see that this series arrangement of circuit components allows for maximum current flow at resonant frequency, so we can call this circuit a band pass filter.

HOD #2
CU SCHEMATIC
PARALLEL (BOTTOM)

Now let's find out what happens when we arrange the capacitor and the coil in parallel with each other but still in series with our load resistor.

CU SCHEMATIC

What do you think is going to happen to the current flowing through the load resistor, when the sweep generator signal passes that range of frequencies adjacent to the resonant frequency?...

MS TALENT

Again we will monitor the circuit with an oscilloscope.

ECU SCREEN

When the signal is at the low frequency end of the sweep, the capacitor will have a high reactance, but the coil in parallel, having only a small amount of reactance at low frequencies, will prove to have provided a

path for the current around the capacitor. At the high frequency end of the sweep, the inductor will develop a high reactance, but then the capacitor will act as the shunt. As a result of this interacting, the opposition to current flow at resonance will be maximum, leaving little current flow to cause a voltage drop across our load resistor.

For this reason we can call this

MS INSTRUCTOR

circuit a band reject filter.

What we have seen displayed are two of the common basic filter circuits, band pass and band reject, connected in series with a load. They may also be connected in parallel with the load to shunt signal to, or block signal from, ground.

Many times they are combined in various manners to increase their effectiveness. This same process of analysis may be applied to most any type of filter circuit to determine its function

within a complex circuit

CHANGE CAMERAS

structure.

The main things that you must keep in mind when analyzing a

MS INSTRUCTOR

filter circuit are that capacitors block direct current and inductors are essentially a short circuit to direct current, and the fact that these characteristics reverse with increased frequency.

HOD

SUPER PRODUCED BY
C.W.S.C. TV
FADE TO BLACK
THE END

Bring up music----

Music down and out

Chapter 4

SUMMARY AND CONCLUSIONS

A twenty-minute, video tape recorded, supplementary demonstration was made. This video tape recording is designed to be used in conjunction with a discussion of tuned circuit theory. The subject matter is applicable in junior high, senior high, and college electricity or electronics classes. Although fairly comprehensive, the video tape recording is not designed as a unit in itself, but to fill a supplementary need.

Students that fail to understand tuned circuit theory can review the video tape recording on their own time. This reviewing can be either in small group or on an individual basis. There is almost no limit to the number of times that a student can review this tape.

A glossary of the technical terms used in the video tape is included so that a person so desiring could use it as a vocabulary list in conjunction with his lesson. If the students are familiar with these terms before viewing the video tape recording it will be most beneficial.

TECHNICAL OBSERVATIONS

Due to the nature of this video tape recording, some technical operations and facilities were used that are not ordinarily necessary. A television studio was used which

proved to be a drawback rather than an advantage. This drawback was actually unique in some ways to this particular demonstration. It would have been an advantage to set up the equipment needed right in the laboratory normally used. Everything needed would have been handy. Having the instructor in familiar surroundings would have put him more at ease. Another advantage to utilizing the classroom laboratory would be the availability of a small, interested group of students to help put the instructor at ease. The author has found a group of interested students quite preferable to two television cameras.

In contrast to unfamiliar surroundings the studio had the advantages of adjustable lighting, two television cameras, and their related controlling circuitry. These advantages, however, are not necessary. A very acceptable video tape recording may be made utilizing ambient light and only one camera.

The one camera becomes immensely more versatile when fitted with a zoom lens. This zoom lens is continually adjustable from close-up to wide angle. It allows the smooth adjustment of framing of just the picture desired.

The script for the video tape recording was written out verbatim and then camera directions were added. This method of scripting is highly undesirable because it necessitates reading during the presentation. This author would recommend the same type of outline used in regular lesson plans. Important points to be photographed should be

reviewed with the cameraman beforehand. When coming to a special point, just call particular attention to it both verbally and visually. Many professional cameramen have even less to go on.

Production in the classroom laboratory is an advantage in that any drawings or lettering may be put on the chalkboard. This virtually eliminates the time-consuming production of individual hod cards. Many of these drawings may be drawn as the instructor is talking about them, thus putting the students into a more familiar area.

Students many times have interest in these areas and can be persuaded to make the video tape recording from start to finish. Many students will learn more quickly if put into an area of special attention. This production may be just what they need for motivation to learn.

A more advanced group of students may be challenged by allowing them to go on ahead and produce a video tape recording to be used with the next unit to be studied.

The author went to a great deal of extra effort to produce this video tape recording. Straining to an exacting detail is not necessary to produce video tape recordings which are efficient and quite adequately fill the need in the classroom laboratory.