AMATEUR RADIO LESSONS

For
Those who wish to become HAMs
But have little knowledge of the theory needed.

These Lessons are designed to be used as Home Study and not to be shown by projector in a class situation. It would not be effective as each slide contains far too much material, and the student might need to go back to previous slides.

Used by students independently on their own time it can supplement material studied in class. It probably will not present topics in the same order as the class instructor. It will include topics not usually included by instructors that may seem irrelevant. It will treat topics with a different approach than is usually done and in different order, but having taught basic electronics at the post high School level for over 15 years, and instructed students in High School Amateur Radio Clubs get their licence, I have some experience in the best way to make difficult topics such as sidebands, suppressed carrier, etc easy and obvious to the learner.

This is not an abbreviated course to rush a student to the exam through rote memorization, or recognition without understanding. How long it takes will depend upon the student. It emphasizes understanding not memorization.

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Teaching Experience

Grades 5 to 8 ---------- 3 yrs
Grades 9 to 12 ---------- 3 yrs
Grades 10 to 12 ---------- 15 yrs

Northern Alberta Institute of Technology
Electronics Engineering Technology--5 yrs
Westerra Institute of Technology
Computer Engineering Technology---5 yrs
Northern Alberta Institute of Technology
Computer Engineering Technology---5 yrs

Certificates

RCA Institute – Television
RCA Institute – Colour Television
RCA Institute – Electronics Engineering
Saskatchewan Journeyman Cert – TV rep
Alberta Journeyman Certificate – TV rep
Saskatchewan Teaching Certificates
Alberta Permanent Teaching Certificates
RCAF – Air Radio Officer Diploma (Wings)

Related Experience:

McCaslin Radio & TV Ltd.---------- 5 years
Orthon Computers Ltd ---------- 5 Years
Rybet Electronics Research & Development Ltd. -2 years

NOTICES

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DISCLAIMER

1. No gender bias is intended by the use of the words “he”, “person”, “his”, etc. unless it is clear such words are referring to an identifiable real male person such Edison, Einstein, etc.. I feel it is a waste of time and space to do such things as write “he/she” etc. or to alternate between using “he” and “she” and keep count to make sure that each has been used the exact same number of times! Every person has his (or her) own abilities, and differing experiences, and learning in life. Some people excel at mathematics while others excel at music. That does not make one more superior than the other. In my many years of teaching I found that male students tend to find Physics easier to understand than female students, while female students tend to find Chemistry easier to understand, but either could **master** both if they wanted to.

2. I do not claim that everything contained in these lessons is 100% right. There are several reasons why this may be the case.

a. I may be completely wrong! This problem happens to me more often than I would like to admit. When I am wrong I would really like to be informed of the right facts. That's why I have provided my Email address. But don't just tell me I am wrong but include what is right so I can correct the next version of the lesson.

As an excuse:

I am going to be 80 in a few months. I have forgotten more than I knew when I was 20. So jog my memory by Email.

Electronics has changed a lot since the late '20s. Detectors for radio no longer have to be wound up to make them work! I have tried to keep up.

Just a couple of days ago I heard on the radio that the “god” particle has just been discovered in Switzerland, the Higgs Bosun. My study of particles at University was in the 1960's. The last I knew anything about the Higgs Bosun was it had been predicted but there was no equipment yet in existence that could actually produce a collision that could produce it.

So maybe I am wrong because what I learned has been superseded by new information. Please bring me up to date.

b. I may be simplifying the explanation to make it easier to understand. I may be leaving out things that are not needed at the level of understanding required. I may go into it in more depth in a later lesson. For example I taught a grade six class of 8 students one year. Everyone of the students had skipped at least one year of school. The lowest IQ student in the class had an IQ of 140. This meant they were all classified as geniuses (How there were 8 in one age group in one small school, I will never figure out!).

I had to watch out for everything I said in class. As an example if I said 6 and 7 added together give 13. A hand would shoot in the air and the student would say "But Mr. McCaslin in the Octal system of numbers the answer would be 15". Then another student would pipe up with "In the hexadecimal system the answer would be D" What I should have said, to be absolutely correct, would have been "In the decimal system of number if you add 6 and 7 the answer is 13."

In these lessons I will only be correct enough to give simple explanations, and not be 100% right all the time.

LESSON NUMBER 1

BASIC RADIO RECEIVER THEORY

DIRECT CURRENT

Radio Receiver Theory

- We need to start with the basics
- Combined with some of the Jargon
- Basics learned in this lesson apply to more than radio receivers
- Learning the jargon will help with future lessons
-

When we start studying a new field we run across what may seem like a new language!

When we learn to cook, knit, play hockey, use a computer, or play a musical instrument, we have to know the jargon.

This is true when we begin classes to Become a HAM radio operator.

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LET'S GET STARTED
BY
LEARNING SOME BASICS
ABOUT RADIO RECEIVERS
AND
HAM RADIO JARGON

Electrical Currents

Electrical Currents come in a number of different forms, such as AC, as Square Wave, Complex, etc. and DC, as Pulse.etc.

Let's start with DC

DC or Direct Current flows always in one direction. A **Battery** produces DC in a conductor. Long before they understood what electric current was they gave names to the poles of the battery.

One connection on the battery was called the **anode** and the other the **cathode.**

The anode was called the **+** or the **positive terminal** or **pole.**

The cathode was called the – or the **negative terminal or pole.**

DC Currents (continued)

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- Since they did not know what an electric current was, only that something was moving through the wire, and had no idea in the direction, they arbitrarily decided it moved from anode to cathode in the wire or positive to negative.

DC Currents

- Much later it was discovered that what was moving were **free electrons** moving through the wire, and they travelled out the cathode the –ve **(negative pole of the Battery)** into the wire and then back into the **+ (positive pole).**
- Unfortunately the scientists had guessed wrong.

This was just opposite to what the Electrical trade had been teaching and using for years. As all the text books, scientific journals, physical laws, etc. were based on the error it was decided to just continue using the wrong choice so new text books wouldn't be required and the old ones destroyed.

But that ran into a problem when Edison discovered the Edison Effect and DeForest and others developed Vacuum Tubes.(Often called Radio tubes, or just tubes, or as in England, Radio Valves.)

To make sense of how tubes worked and to understand the **circuits** that used them, we had to have electric flow to be from -ve to +ve.

So the Electronics profession had their books and teaching corrected but the Electrical trade continued in the traditional way using the wrong direction. This of course caused lots of confusion.

Thus most Electricians and others still use the old direction while Electronics Technicians Use the correct.

The old flow was renamed Traditional or Conventional Flow And the correct flow was named Electron Flow

Then Bardeen and others at Bell Labs Discovered SEMI-CONDUCTOR TRANSISTORS

Although the flow of electrical current through a transistor
is by the motion of electrons
they are not free electrons but ones bound in the atom.

Instead a flowing freely as they do in a copper conductor
they move by jumping from one atom to another one that is missing an electron.

Then either that electron or another one jumps to a hole in completely different atom.

This is repeated over and over again.

We could thus explain current flow as the electron absences (or **holes**) in the atoms moving in the opposite direction to the electron motion.

Why would we want to do that?

Since the moving electrons are bound in atoms most of the time, the effect of their movement is different than that of moving free electrons .

Thus what we learned how 'free electron flow' causes certain results in a circuit, cannot be applied that to their 'bound in atom" flow.

In fact, it is easier to explain what is happening by talking about the hole flow instead!

And of course the hole flow is from +ve to -ve just as the traditional flow is.

So when electricians and some schools are starting to use electron flow, electronic technicians use Hole Flow in semi-conductor circuits!

So now there are three ways of talking about electrical current flow.

1. Traditional flow from positive to negative in a conductor
2. Electron Flow from negative to positive in a conductor
3. Hole Flow from positive to negative in a semi-conductor

HOW DOES ALL THAT CONCERN ME AS FAR AS BECOMING A HAM RADIO OPERATOR.?

Only so you will not become confused when talking with different people. If one person you talk to says electricity goes from positive to negative and the next person says the other way, and yet another starts talking about hole flow don't panic.

The first person was probably an Electrician, the second was probably getting on in age who learned about and used vacuum tubes, while the last one is heavy into semi-conductors and transistors.

Its just like three veterans talking about the Second World War. If one is a Canadian, he says the battles Canadians fought was what decided the war. If one is French it was the French underground that decided it, and if one is American, they won the war almost single handed.

Its all in looking at it from different view points.

A Canadian Sailor, Army tank driver, and Air Force Pilot Will each see see the war from different view points. Yet they are all talking about the same war.

1. To learn about Amateur Radio electronics learn from a HAM, Not a nuclear reactor electronics technician!

2. If things appear confusing it may be caused by different ways of looking at things, not because you are dumb.

3. Each field speaks a different language, (called a jargon). To understand one another you both must use the same jargon.

TAKE TIME TO LEARN IT! Then things will be much simpler.

WHAT WAS IT THIS LESSON WANTED YOU TO LEARN?

1. TO MAKE LEARNING EASIER YOU MUST UNDERSTAND THE JARGON.

2. EVEN USING USING THE SAME JARGON THERE MAY BE DIFFERENT VIEWPOINTS.

3. LEARNING MAY BE FASTER BY MEMORIZING BARE FACTS, BUT BY KNOWING HOW THEY WERE OBTAINED, WHERE THEY APPLY, ETC. MAKE THEM EASIER TO REMEMBER. ANALOGIES MAKE THEM EASIER TO LEARN.

4. ALTHOUGH YOU MAY BE IN A HURRY TO GET TO THE FINAL GOAL, TAKING TIME TO RELEARN THE BASICS IN THE NEW JARGON GETS YOU THERE MUCH FASTER! THIS COURSE WILL MIX BASICS WITH JARGON.

5. YOU WON'T BE TESTED ON EVERYTHING MENTIONED IN EACH LESSON.

WHAT FACTS DO I NEED TO REMEMBER?

1. An electric current in wire conductor is actually a flow of free electrons (not bound in atoms). From this you might conclude that the more free electrons in a material (conductor) the easier it is to get them to flow.

2. There are two ways to describe the flow. Electricians usually use the conventional flow, i.e. from positive to negative. Electronic technicians normally use the electron flow, i.e negative to positive.

3. It does not really matter which you use unless you want to use vacuum tube circuits in which case electron flow is needed. However when you pick you should stay consistent, as some laws are like mirror images.

4. When dealing with semi-conductor circuits and the current flow in them it is usually easier to think in terms of hole flow. (+ to -)

6. There are many different modes of current flow in conductors. They can be divided into two main groups. Those that run in the same direction all the time called direct current (DC) and those where the direction keeps changing. (AC).

7. This lesson talks about one kind of direct current, one that does not change value. There are other DC types such as **pulse** used in digital circuits. These can be understood as an unvarying DC with one or more alternating currents mixed in. So we need to understand AC circuits before we study these. They will be covered in future lessons, after we study AC.

8.Unfortunately when we mention AC, because of previous learning, most people think it always has a wave shape of a sine wave.

9. AC can be in any shape such as **square**, **rectangular**, **triangular**, **saw tooth**, **complex** (such as that produced by a person's voice or orchestra). But don't worry, they can all be broken down to be some number of sine waves all added together. So it important we understand sine waves before we get to the others.

Jargon used in Lesson 1

- The following is a list of Jargon Words used in this Lesson.
- Some are not explained here as almost everyone is familiar enough to deduce their meaning for this lesson.
- Some are only explained enough for this lesson, and more explanation will come in future lessons.
- Some may be important enough for a whole future lesson to explain them.
- Be sure you understand them as used here as they will occur in future lessons. Some will be used in the exam questions as well.

Words in approximate order found in the lesson

AC
DC
Battery
Positive Terminal
Negative Terminal
Cathode
Anode
Tube
Valve
Traditional flow
Conventional flow
Electron flow
Semi-conductor
Free electrons
Bound electrons
Holes
HAM
Amateur Radio
Conductor
Sine wave
Square wave
Saw Tooth wave
Complex wave

Looking Forward to Lesson 2 on Radio Receivers

Block Diagrams
Electro-Magnetic Waves
Light waves
Two ways of looking at things
Fields
Sine waves
Frequency
Wave length
Radio Bands

End of Lesson 1

Radio Receivers