An Instructor’s Guide for Using the Gordon West
2014-2018 Technician Class
Amateur Radio FCC Element 2 Study Manual
Including tips on how to use Gordo’s book to earn the
Boy Scouts BSA Radio Merit Badge
Welcome & Thank You!

This Instructor’s Guide for teaching the 2014-18 Technician class, Element 2, precisely parallels all of the REORGANIZED questions, answers, and descriptions in my Technician Class study manual. My reorganization of the entire question pool will cut your teaching time in half, and will help your students better understand and learn the material!

First of all – Thank you for teaching amateur radio. Whether you are teaching the entry-level Technician class Element 2, or are offering instruction for General class, Morse code, and Extra class, the entire amateur radio service will surely benefit from your decision to become an instructor. I estimate that there are fewer than 1,000 active ham radio instructors throughout the country. It is my hope that this Instructor’s Guide, which parallels my 2014-18 Technician Class book, will help you develop some lively sessions in your upcoming classes.

If you haven’t yet taught a class, using my Instructor’s Guide in parallel with the student Technician Class book will help you organize and begin teaching your first course. You do not need to be a technical expert to teach Technician class – and you’ll probably find your first class will have plenty of technical experts taking the course. With their help, everyone learns!

This Instructor’s Guide for Technician class is based on my 40 years of offering amateur radio training courses. This booklet will encourage you to offer classes as part of your local ham radio club, your local community college system, or perhaps as a park district class. The booklet provides lesson plans that can be used for a 12-week community college semester; your local club’s 10-week, 3-hour evening seminars; or my most-asked-for class format – a weekend course that runs from Saturday morning through Sunday afternoon. This booklet covers all three options.

This Instructor’s Guide parallels my completely reorganized Technician Class study manual for the Element 2 Question Pool, valid July 1, 2014 through June 30, 2018. This new Question Pool is a comprehensive update of the previous pool, with obsolete questions replaced with new Q&A on up-to-date operating techniques. Questions are written to the reading comprehension of middle school students, and the focus is on current ham radio techniques for the new operator. The entire pool now contains 426 questions.

I have completely reorganized the questions into 20 topics, bundling similar type questions into logical groups that can be taught as single “hot topics.” This reorganization of the pool will cut your teaching time in half, and give you more time for actual “on-the-air” practical demonstrations.
IMPORTANT: If your students are using an alternate book, the Q&A order will not be the same as they are in this Instructor’s Guide and in my own book. This guide parallels only the Gordon West Technician Class theory book.

My Technician Class study manual includes many web addresses for further student study after class. It has lots of “Ham Hints” – practical operating tips for the new operator. And it also presents keywords printed in blue that your students will review just before the exam.

You probably know, there’s nothing like “hands-on ham” to get beginners excited about our hobby. Demos are the key to lively classroom sessions that get your students talking on-the-air, learning about how radios work, or understanding the fundamentals of electronics. I want to recommend an excellent book to you that you can use as a “lab book” to help with your classroom demonstrations. It’s Getting Started in Electronics by Forrest M. Mims, III. You can obtain a copy from The W5YI Group, the same place where you can purchase copies of my Technician Class book for your students. You’ll see some of the nifty experiments from Forrest’s book here in my Instructor’s Guide, and it will help you put on memorable demonstrations in class that will bring understanding to your students of some of the electronics involved in our hobby.

Our thanks to Forrest Mims for his permission to use some of the illustrations from his book in this Instructor’s Guide. Please note, all of the material from Getting Started in Electronics is copyright © 1983 and 2000 by Forrest M. Mims, III, and may not be used without permission.

This Instructor’s Guide also tells you where you can purchase books at an instructor’s discount, and how to obtain free training materials like ham wall maps, frequency charts, manufacturer discount coupons, and graduation certificates.

So let’s get started to see what it takes to teach amateur radio.

Gordo
How This Instructor’s Guide Is Organized

After 40 years of teaching ham radio classes, I can tell you what works and what pitfalls to avoid. Some are real classics! In this *Instructor’s Guide* for the 2014-18 Element 2 Technician class question pool, I am going to share with you every teaching secret I know. Here’s how we are going to teach you, THE TEACHER:

- Weekday Evening Classes or Weekend Seminars? ................................................ page 5
- Go It Alone or Team Teaching? ........................................................................ page 7
- Advanced Promotion Before the Course Assures Big Class Size .................. page 8
- Classroom Tips for Teaching Success ............................................................... page 9
- Now It’s Time for Your Homework! ............................................................... page 11
- Technician Class Instructor Course Outline .................................................. page 14
- Demos & Props / Show & Tell Will Make Your Classroom Lively .......... page 16
- Nichol’s Nuggets: Hands-on Experiments for the Ham Instructor .......... page 23
- Using Gordo’s Book to Earn the BSA Radio Merit Badge ......................... page 28
- Resources ........................................................................................................ page 31
- An Invitation to Sit-In & See for Yourself .................................................... page 34
- 2014-18 Technician Class Student Pre-Study Q & A................................. Page 36

**THE REAL LEARNING STARTS HERE**

Do you know where the real learning of ham radio occurs? If you think it happens in your classroom, you are partially correct. But the real learning of amateur radio occurs ON THE AIR. That’s why the live demos in class are so very, very important. It exposes your students to the fun and excitement of live ham radio in action.

For your students, the real learning will occur when they buy their first radio and discover that they need to program it. The real ham radio learning occurs when they’re on the roof trying to recall what formula you taught them in ham class for building a quarter wavelength coffee can ground plane. The real learning occurs when the ham is ready to mount the antenna on their vehicle and discovers that it is just inches from the back of the passenger’s head.

*So remember, getting the Amateur radio license to operate on the air is really like getting a license to begin learning ham radio! You’re role is to help the students get started!*
Weekday Evenings, or Weekend Seminars?

What is the best time to have your amateur radio beginner course? A 12-week class gives you plenty of time, and 9-week classes fit well into community college curriculums. A weekend class is my ultimate favorite, but it only works when you use the tricks I’m going to share with you on how to get the students working their pre-study homework ahead of class. Let’s review the pros and cons of each approach to scheduling your classes:

**WEEKNIGHT CLASSES**

It takes about 20 hours to completely cover all 426 test questions in the new Element 2 question pool. This new pool concentrates on questions that new hams should know before going on the air with their VHF and UHF privileges.

When you review my book, you’ll see that I have taken the 426 total questions and reorganized them into 20 topic groups. By doing this, the question pool is now much more manageable, and all 426 Q & A’s can be covered during 8 to 12 classroom sessions, each about 3-hours long, meeting once-a-week in the evening. Good class hours are 7 to 10 pm, but students may vote for 6 to 9 pm as an alternative.

If you offer a weekly ham class course that may last up to 12 weeks, the first week’s session may be devoted to the ham radio introductory chapters, and the final week’s session for the actual Element 2 exam. Twelve classes held once a week for 3 hours will require minimal homework or pre-study on your student’s part. I’ve found that most students taking a 12-week course only do a minimal amount of homework before each class session, so the real learning only takes place in the classroom.

The 12-week class will result in an approximate 50 percent attrition rate. If you start with 30 students, you’ll be lucky to end up with 15 graduates. You can be the best instructor in the world, but keeping your students on a 12-week schedule is next to impossible with everything around them changing on a daily basis. So be prepared to lose half of your students if you decide to hold a 12-week course.

**WEEKEND SEMINARS, SATURDAY & SUNDAY**

The most popular courses I teach throughout the country continue to be my 2-day weekend seminars. They begin Saturday around 8 am and go ‘til 6 pm, and resume on Sunday from 8 am to test-taking around 4 pm, with graduation at 6 pm.

The big selling point for the weekend Technician class intro to ham radio seminar is your students think that in just one weekend they will end up with their license. And they do. But what they might not factor in for this weekend class will be the pre-study you begin to send them **before** class. Weeks before. Sometimes months before!

The pre-study is not hard, and you will see it in the back of this *Instructor’s Guide*. The pre-study gets the students to study ahead of time, and leads them by the hand and pencil through their regular Gordon West *Technician Class* book, looking over all of the 426 questions in a
reorganized 20-topic program. We give them the actual page number and sometimes the actual question number to fill in the blanks on their home-study. They think the home-study is so easy that they indeed get totally through it before the class begins. You have now successfully trained these students to pre-study ahead of time and get a big jump on classroom instruction.

The attrition rate you can expect in a weekend 2-day seminar-style course should be less than 10 percent. You also will draw much larger numbers of students to the weekend seminar compared to the 12-week community college or ham club format. I went from evening classes at 12 to 15 students per class all the way up to an average of 75 students for each weekend course for the entry-level Technician class license. Upgrade weekend classes for learning the Morse code and General class average more than 50 students. For the Extra class, now that there’s no longer an additional code test, I usually end up with 30 to 40 in the weekend class.

The biggest thing for you to promote about the weekend class is that the upcoming course is absolutely not a “cram class.” Make sure everyone knows that you are teaching ham radio, not just teaching the 426 Q&As in the scrambled Element 2 question pool. If you were to try to teach the 426 questions in numerical order as originally presented by the Question Pool Committee, it might take you THREE WEEKENDS to complete a successful seminar! But by following the 20 logical topic groups in my book, you can easily teach the entire 426 question pool in a weekend if you stick to the time line presented here in your Instructor’s Guide.

**PRE-STUDY FOR WEEKEND SUCCESS**

The popular weekend class should be preceded with student pre-study homework. Students are expected to sign up well before the class, and you will send them pre-study, fill-in-the-blank homework before the big weekend seminar. The students will fill in the correct answer from what they read in my 2014-2018 Technician Class book. The questions in the pre-study homework precisely follow the reorganized Q&As as presented in my Technician Class book.

Pre-Study Q&As that guide students using my Technician Class book and/or my exclusive audio theory course on 4 CDs is included at the end of this booklet, starting on page 29. *Feel free to copy these Pre-Study Q&As and pass it out to your students.* It is written for the weekend seminar, but can easily be adapted as homework for a weeknight 10 to 12 session course. The pre-study assures that students will open up the book ahead of time. The students will not need to search for any answers – almost all of the pre-study topics illustrate what pages the material may be found in my Tech book.

In addition to the fill-in-the-blanks home-study workbook, I also expect the students listen to the 4 audio CDs that I have recorded that cover Technician theory. While the audio course is “extra credit,” it increases their enthusiasm for the class, and tunes them in on what to expect when they begin operating on the air. When the students listen to the audio course, it really brings ham radio TO LIFE!

You may wish to have your students study the computer course that also is available from The W5YI Group. The computer course carries my same description of the correct answer, and some students prefer to study at their computer rather than simply read the book.
When your weekly or weekend students hit the classroom, you will know immediately which students will be passing the examination with flying colors because they are the ones who have worked their home study ahead of time. A few might not have any home study completed at all, so you may wish to reschedule them for a different class at a date in the future – or at least warn them that without home study the weekend class probably won’t be a success for them.

**WEEK NIGHTS, WEEKENDS, OR BOTH?**

So you need to make a decision – are you going to teach a relaxed 10- or 12-week evening series of ham classes, or are you going to do a one weekend seminar based on home study ahead of time? If you are looking to attract and graduate a larger number of students, I guarantee that the weekend seminar is a great way to go.

Or, do as I do, teach both – offer the traditional 12-week evening course with your local community college or ham club, and then have a few one-weekend licensing seminars for those who can’t take 10 or 12 weeks out of their busy schedule for a once-a-week evening class.

**GO IT ALONE OR TEAM TEACHING?**

To be a great instructor, you must have plenty of pizzazz and presence. It takes a lot more than in-depth knowledge of amateur radio to make you a good presenter. You need to learn how to read your students, and how to get them involved in the material. That’s why the props and demos we’re soon to talk about are so essential.

If you plan to do the weekend class all by yourself, you better be in great physical and mental shape. By the time Sunday evening rolls around, you’ll just about collapse from the frenetic effort required to teach so much material in so little time.

In this *Instructor’s Guide*, I will soon be showing you how to make the complex simple. We’ll talk about a light bulb beginning to glow, or getting two of your in-class engineers to figure out why in the world the magnet that you dropped through the hollow aluminum tube defies the law of gravity and makes an ever-so-slow exit.

I encourage you to have additional help in the classroom, especially if you’re doing one of the weekend marathon sessions. But team teaching is a lot like acting on stage, and you need a script to follow in order to keep the class on schedule and make sure you cover all the material. If you select a good teaching partner, make sure they use the course outline following the book as their guide. You can split up the topics to be covered between you. That way you each can devote more energies to fewer topics. The result will be a better course for your students, and less work for you! Also, you can recruit help from any one or two other hams to put on a couple of special demos that illustrate important material.

But a word of caution – you need to carefully choose your assistant instructors because even the most knowledgeable technical ham may not have the skill to “read” their audience and will put them into nod-off land. The well-meaning, overly-technical ham will go on and on and on.
on, and this zaps your teaching time line instantly, and it will take you the rest of the class session to catch up. Don’t let this happen! While it’s great to explore the fascinating world of PSK-31, and while it would be fun to do a one-hour presentation on this new frequency saving digital mode, keep in mind that there may be only one question out of 426 on this subject, and unfortunately, you can only give it a couple of minutes and encourage students to stick around after class and watch a live PSK-31 demo take place.

**Advanced Promotion Before the Course Assures Big Class Size**

It pays to advertise! You know that, of course. And if you want to attract enough students to your ham radio class, you need to get the word out.

Here’s a sample flyer that has been successful for me in promoting entry-level ham classes. Please feel free to use any of the wording that you like to help promote your upcoming class. If you have a local ham radio dealer near you, they will probably be more than happy to put your class flyers right up front. Remember, everybody who graduates from your class will be wanting to buy ham equipment, and I always recommend going to a local dealer that is helping support your class.

If you are teaching your class for a specific audience, such as boaters, emergency squads, pilots, RVers, or model airplane flyers, each of these organizations usually has specialty stores that would probably be more than happy to help promote the class. And don’t forget to put a notice on their websites or in their e-mail newsletters.

Once you set your class date, please contact The W5YI Group instructor program and let them know your schedule. Many times prospective hams call the W5YI-VEC asking where there might be a class, and they’ll recommend your class to students calling from your area.

Go to: [www.haminstructor.com](http://www.haminstructor.com)
To register your upcoming classes on the W5YI website

Let local amateur radio clubs know you are teaching a class for beginners. Often, they will have students to send you! Clubs also can help get the word out, and every ham club loves to see more members join up, and more newcomers get into our hobby. So regularly work the clubs, support what they are doing, and you’ll probably find they will support you in a big way!
Classroom Tips for Teaching Success

Where you hold your class depends on many factors. The organization that is sponsoring you may provide the space. You may have to ask the local school for a classroom. If you’re doing a weekend seminar and are attracting students from a wide area, you may want to find a hotel with meeting rooms, food service, and hotel rooms for those students who want to stay overnight.

SETTING-UP YOUR CLASSROOM

Try to select a classroom that will allow you to gain access to an outside area to set up some simple antennas. This allows you to go on the air during classroom sessions, which dramatically spices up your teaching with on-the-air demos.

I prefer to run the coax out windows where there’s absolutely no chance that someone might trip over the cable. Be careful to never create a hazard by running the coax where someone might trip. Make sure no one can get anywhere near any antennas that you plan to transmit on. Also, make sure that you don’t put up any antenna that has protruding metal spikes that could catch on clothing or cause injury to a student who doesn’t see it in the evening. SAFETY is your most important consideration when laying out your classroom demos.

Here’s a great trick I want to share with you. This is how I have the students seated within the classroom. I always prefer that students sit at a table. But if the 6-foot or 8-foot tables are horizontal to the instructor, this means you can only get a maximum of 3 students per table.

Turn the tables vertical to you, as shown, and put 3 chairs on one side and 2 on the other to accommodate 5 students. If you have 3 rows of 3 tables per row, try putting 3 chairs on one side, and 2 on the other for an 8-foot table, or 2 and 2 for a 6-foot table. You’ll be surprised how many more students you can pack into a very small room without them feeling overcrowded. Leave enough room in between the rows of tables so you can easily walk up and down between the tables, looking over their shoulder to see how well your students are doing.

I usually have three 8-foot tables up front for my demo gear. I call it my “show and tell” stuff, and it is one of my biggest successes for a class that everybody talks about. Bringing loads of demo gear allows you to pass around 2 or 3 small audio transformers at the same time. Then 2 or 3 resistors at the same time. Three coils, 3 transistors, 3 chips, 3 pieces of coax cable – you get the idea – every time you talk about something electronic in class, start the demo gear moving up and down the tables.
Now, beside the insides of a radio in a gazillion pieces all kept in plastic bags and marked so they can inspect everything, make sure you have a minimum of a dual-band radio in the classroom for 2 meters and one other UHF band, plus a worldwide radio to let your students listen in on all of the excitement that is out there. These radios go to live outside antennas, and this further adds to the excitement of your ham class. The more stuff you have, and the more live demos, the more students are going to hear about your technique of teaching, and they will be waiting in line to sign up for your next class!

In the Resources section of this Instructor’s Guide, I show you listings of web addresses where you might contact amateur radio manufacturers and bring in colorful wall charts. These wall charts will help dress up your classroom and allow you to point things out so everyone can see. In addition to the wall charts, The W5YI Group may include maps and frequency charts with each textbook you order from them. This way you can lay the charts out for each student when they first enter the classroom on day one. Visually, this adds excitement when they come in to take their class and see that they already have things waiting for them right at their seat.

NAME TAGS

Here’s a sample of a stick-on student name tag. This is another great icebreaker! In very large letters, print each student’s first name on their tag, and have them wear the tag for the first few class sessions. Remember that the first impression you make is always a lasting one, so you want to make your first class session a rousing success. This means make all students feel comfortable, and the big name tag certainly helps.

And I give out an inexpensive ribbon to those who successfully pass my course and get their license. It may seem “corny” but it works. Everyone relaxes and has a good time!

As you get close to your first class session, contact your students via e-mail, letter, or phone, and double check that they know exactly when the class is scheduled, and where the class is going to be held. Go over every detail including parking. Double check to see if you might have some handicapped students who may need a special parking spot, or special accommodations to the classroom.

Remember, that first impression on finding the classroom successfully puts your new students in a good mood to begin their studies. If they get lost and can’t locate the classroom immediately, you’ll have an uphill challenge to make those students happy. So its a good idea to put up some directional signs to help them find their way.
Now It’s Time for Your Homework!

Before I start you out with your class outline, we need to make sure you are absolutely up to date on all that has changed in ham radio over the last couple of years. In my Technician Class book, I bring everyone up to date on a little ham history, privileges your students will earn, preparing for the class, taking the class, and ultimately passing the final exam. So instructors, the following is YOUR homework assignment before we begin to teach ham radio in the classroom.

Your assignment:

READ & REVIEW PAGES vii AND viii – SKIM CHAPTERS 1 + 2

These first 2 pages will help motivate your students to follow a logical study plan to ultimately obtain their amateur license using their book and working with you, their instructor.

Next, skim Chapters 1 and 2 on pages 1 through 20. Chapter 1 briefly describes to your students the excitement awaiting them as ham radio operators, the need for an FCC license, and encourages them to join a club, read magazines, and get an Elmer to show them the ropes. Chapter 2 fully explains all of the frequencies they will earn with JUST the no-code Technician class license that they will achieve in your upcoming class. Chapter 2 has some excellent band plans that illustrate all of the excitement on the popular VHF and UHF bands. Since YOU have already been on the air, you can skim the privileges, but please note that on page 8 I show them all of the new frequencies they will earn in an easy-to-read table. Combine this with the frequency charts that accompany each book you are bringing in for your students, and you’ll have no problem showing them all of the “radio real estate” they will soon be acquiring.

Your assignment:

CHAPTER 3 IS IMPORTANT FOR YOU! A LITTLE HAM HISTORY

I suggest that you carefully read this important chapter to better understand all of the changes to our current amateur radio service. By thoroughly understanding the ham radio history you will get a broad perspective on how relatively easy it is for your new students to pass their first test and get on the air with VOICE. This chapter may help you better understand some of the resentment felt by our senior hams who complain the testing process is not tough enough – certainly not like the old days when they HAD to learn Morse code.

And this is why we suggest you teach a little bit of CW in the classroom – a little code instruction will satisfy some of our senior hams who might worry that we are simply teaching the test and skirting the code issue. Once they see the work that you’re putting in to your teaching in the classroom, and they hear the dits and dahs, they will probably join you as a guest instructor. This is good!
Chapter 4 – *Getting Ready for the Exam*, is another important chapter for you to know and understand before you start your class. In this chapter, I topically describe to the students the yearly update process of individual amateur radio question pools. I advise the students that an older book with the old question pool will not reflect the new updated Technician class question pool, valid 2014 through 2018. Let them know that the pool now includes 426, and many questions are asked two and three times over with slightly different wording. This means they are only studying around 150 question topics.

Page 28, *Table 4-1*, shows the new Element 2 syllabus, total questions in each sub-element, and the number of questions taken from each subelement to make up their 35-question exam. Many students will be worried that the electronics portion of the test will be tough for them – but if they look at subelement T5 in this Table, they’ll discover that only 4 test questions on their upcoming exam will be taken from this subelement. They’ll breathe a sigh of relief!

**Your assignment:** Turn to page 28

### WHY I REORGANIZED THE QUESTION POOL

Pay careful attention to pages 30-32. This explains why I decided to reorganize all of the Q&As in the new 2014-18 Element 2 pool into the 20 logical topic groups. Here’s some background.

Each of the three Amateur radio question pools is developed by the National Conference of Volunteer Examination Coordinators’ Question Pool Committee. The abbreviations are NCVEC and QPC. This new question pool is no longer a re-hash of the older pool. The NCVEC made the wise decision to “start fresh” with new technology Technician class entry pool questions, rather than using older questions that date back to the original Novice class exam. This allows you to teach relevant topics like repeater operation, Voice Over Internet Protocol communications, and practical radio concepts rather than abstract subjects like inductive reactance and near field/far field safety formulas.

This new 426 question pool is by no means a “dumbed down” examination for the new ham radio operator. Rather, this fresh new question pool was developed by professional educators to take the reading level down to the middle school level. Complicated diagrams have been omitted, and tricky answers with the last word incorrect have been eliminated. Fresh new topics have been added such as IRLP and repeater linking. On air operating courtesy has several questions, plus repeater programming in a new VHF/UHF handheld. Practical RF safety is always an important topic area with more meaningful questions on antenna safety around high voltage power lines and personal safety gear when taking part in an antenna party.

This new question pool eliminates the need for rote memorization of tough answers just to pass the exam. Rather, each test question has real relevance for the new ham radio operator starting off with a dual band transceiver on 2 meters and 440 MHz. Instead of asking a question about a moonbounce array of 4 long-beam Yagis, this new question pool talks about $\frac{1}{4}$
wavelength ground plane design, simple halfwave dipoles, and why a longer rubber duck is better than a shorter rubber duck! I have also rearranged the material in a logical teaching order. This arrangement follows the classroom syllabus I have used in teaching my weekend seminars. You won’t need to skip around in the book to keep things together!

All 426 questions are in my new Technician Class book, rearranged for logical learning and teaching. Refer to pages 234-235 for the cross reference. Then check our pages 48-49 and see the convenient listings of CEPT agreements, third-party agreements and reciprocal agreements. I also give you the Q codes on page 86, and with safety always in mind, Tables on pages 227 to 229 provide a simplified chart on Maximum Permissible Exposure limits. All this is in my new book just for you and your students!

**TEACH YOUR CLASS BY THESE TOPIC AREAS**

Don’t skip around in the book – I have completely minimized the need to do that in THIS book. Look again on page 32 and go with the flow of this logical instruction method. This is the same order that I use to present the material in my audio course, and our computer course includes my fun explanations from the book. My book, the audio course, and the software are available through The W5YI Group Instructor Division, and for a discount, too.

To further convince you that my rearrangement is on target, look at pages 73 to 75 and see the original topics T7A, T4B, T9A, and T2B all arranged together covering Your First Radio. You can imagine the amount of skipping around you would need to do to keepthese logical areas all together. I’ve done the work for you!

Now check out our cartoon friend Elmer, who provides numerous Ham Hints in shaded boxes surrounded by a CW border. This breaks up the copy and adds a smile to your instruction. Elmer and his Ham Hints add important substance to specific questions in the pool. Then check out WEBSITE RESOURCES, also in a shaded box, specifically for you and your students to obtain additional information with accurate www web locations. These web addresses will assist you in some simple homework assignments for once a week classroom sessions.

So please trust me on this one. I’m out there teaching these classes all over the country, and the reorganized questions are a much more logical way to instruct your students. Stay with the book, page by page, no jumping allowed!
Technician Class Instructor Course Outline

The course outline you are about to read works for both the weekend seminar as well as 10- and 12-week evening classes format. The course outline specifically parallels my Technician Class book for 2014-2018. I rearranged all of the Q&A in the new question pool into 20 topic groups based on how you should teach ham radio, presenting the material in a logical order and making it easier to learn!

If your students are using another book, the Q&A won’t be in the same order as they are presented in my topic groups, and the “other book” students will quickly get lost.

As a professional instructor yourself, I value your comments about where a couple of questions might be moved around to improve the presentation of the Q&A. We can do this easily when we next reprint our book, so let’s hear your suggestions. If your suggestions make the book, I will acknowledge you up front in the beginning of the book, too!

Here are the 20 topic areas grouped into class sessions based on a 12-week course. You should be able to cover all of the topics included in each group during a 3-hour session.

<table>
<thead>
<tr>
<th>Session Number</th>
<th>Topic Areas – Pages to Cover</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Introduction to Ham Radio – v through 32</td>
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<tr>
<td>2</td>
<td>About Ham Radio – 33 to 37</td>
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<td></td>
<td>Call Signs – 39 to 50</td>
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<tr>
<td>3</td>
<td>Control – 51 to 56</td>
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<td></td>
<td>Mind the Rules – 57 to 62</td>
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<tr>
<td></td>
<td>Tech Frequencies – 63 to 72</td>
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<tr>
<td>4</td>
<td>Your First Radio – 73 to 78</td>
</tr>
<tr>
<td></td>
<td>Going On the Air! – 79 to 90</td>
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<tr>
<td></td>
<td>Repeaters – 91 to 98</td>
</tr>
<tr>
<td>5</td>
<td>Emergency – 99 to 104</td>
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<tr>
<td></td>
<td>Weak Signal Propagation – 105 to 112</td>
</tr>
<tr>
<td>6</td>
<td>Talk to Outer Space! – 113 to 118</td>
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<tr>
<td></td>
<td>Your Computer Goes Ham Digital! – 119 to 126</td>
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<tr>
<td>7</td>
<td>Multi-Mode Radio Excitement – 127 to 136</td>
</tr>
<tr>
<td></td>
<td>Run Some Interference Protection – 137 to 144</td>
</tr>
<tr>
<td>8</td>
<td>Electrons – Go With the Flow! – 145 to 157</td>
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<tr>
<td></td>
<td>It’s the Law Per Mr. Ohm! – 159 to 162</td>
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<td></td>
<td>Picture This! – 163 to 174</td>
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<tr>
<td>9</td>
<td>Antennas – 175 to 182</td>
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<td></td>
<td>Feed Me with Some Good Coax! – 183 to 192</td>
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<tr>
<td>10</td>
<td>Safety First! – 193 to 206</td>
</tr>
<tr>
<td>11</td>
<td>Review and Chapter 5 – 207 to 216</td>
</tr>
<tr>
<td>12</td>
<td>Exam Prep, Session and Graduation</td>
</tr>
</tbody>
</table>

NOTE: For a shorter class schedule, combine sessions 1 + 2; 6+ 7; and 9 + 10.
DO SOME MORSE CODE

At every class session, I do a little bit of Morse code on my paddles and electronic keyer. This gives students a smooth intro to the code, and they won’t be afraid to get the code audio course after they successfully complete their Element 2 Technician no-code exam. By doing this, they will have a real feel for Morse code. Even though the FCC has eliminated the Morse Code test, in-class simple code practice is fun for most students and will give you a moment to relax your vocal cords! You will adapt quickly to sending with one hand and sloshing down something cool and wet with the other.

When you do the code in your classroom, you should try to use multiple speakers throughout the room to minimize echoes. Use an electronic key, and key-in the code yourself. This allows you to make dramatic pauses between hard letters, words, sentences, and allows you to re-enter any code character that you see your students might be missing. Don’t just play code cassettes or a computer code program. Do it live yourself for maximum effect.

I also recommend you do some code over the air, asking the other station to please QRS so that your students may write down what the other station is sending. This is another great way to keep excitement at its peak in your classroom.

See Chapter 6 on Learning the Code, pages 217 to 224, for tips on Morse code instruction.
DEMOS & PROPS / SHOW & TELL WILL MAKE YOUR CLASSROOM LIVELY

You know that a picture is worth a thousand words – and a hands-on demonstration is a lot more fun and memorable than a straight “talking heads” lecture. Now let’s take a look and see what graphics, demos, and props you can build into each of my 20 topic areas. Here’s a host of “show and tell” ideas to make your classroom session lively, memorable, and fun!

When you start to figure out your classroom demonstrations, review the Forrest Mims book *Getting Started in Electronics*. It is full of fun experiments that will help you get your points across, especially when it comes to helping your students understand the fundamentals of electricity, electronics, and how components work.

And...

*There’s an app for that!!*

Smart phone Apps have their ham radio uses – everything from repeater directories and FCC rules, to some useful teaching tools. Here, from Eric Nichols, KL7AJ, is a list of some nifty Apps for the Amateur Radio Instructor (that’s YOU!!):

1) A cool virtual slide rule: http://tinyurl.com/6tavubt
2) A great wave interference demonstration: http://tinyurl.com/qemuubn
3) A non-daunting Smith Chart app: http://tinyurl.com/qccm9wb
4) An Ohm’s Law app: http://tinyurl.com/ntulxab
5) All-in-one Electronics calculator app: http://tinyurl.com/qxr8zol
6) A resistor color code “figure-outer” app: http://tinyurl.com/nuuvelm
7) A versatile antenna calculator app: http://tinyurl.com/p36gbq5
8) A magnetic compass without the magnets: http://tinyurl.com/caxujgq
9) An RLC calculator: http://tinyurl.com/nlkgsqw
10) A great suite of electronics calculation tools: http://tinyurl.com/o7cltxv
**About Ham Radio (pages 33-38)**
- FCC Rulebook, CFR 47, Part 97 (*available at quantity discounts from The W5YI Group*)
- Live ham equipment for VHF/UHF.
- Copy of ham license.
- Old call book.
- Computer printout of FCC licensing database.
- NCVEC Form 605.
- Sample copy CSCE.

**Call Signs (pages 39-50)**
- Large call sign map of USA.
- Ham call sign license plate.
- On-air contact to illustrate saying call letters.
- NCVEC Form 605 for call sign change. (*available free from The W5YI-VEC*)
- Club call sign application. (*available free from The W5YI-VEC*)
- Special event call sign application.

**Control (pages 51-56)**
- Stand next to an on-air radio control point.
- Bring in second ham with higher/lower class license to operate.
- Enter room with 6 HT’s on your belt!
- Ham call sign prefix of the world map. (*available from W5YI Group when ordering books*)
- Toy cruise ship and toy airplane.
- Refer to Page 49 for reciprocal agreements.

**Mind the Rules (pages 57-62)**
- Pass around Part 80 of the FCC Rulebook. Give them a rule number, and have them look it up and explain.
- Have a student read a script, either a legitimate ham news announcement, or an illegal general broadcast to the public.
- Tune around the 2-meter band and identify proper and maybe some improper ham transmissions.

**Tech Frequencies (pages 63-72)**
- Start out by tossing 10 or 15 foam fuzz balls around the room, illustrating radio waves traveling through the air.
- Describe the velocity of radio waves, and then describe frequency and wavelength.
- Use a plastic slinky to better illustrate frequency and wavelength. Have a student pull it apart for longer wavelength, and have another student measure frequency by how many oscillations in one second.
- Use an adjustable tone generator to illustrate audio and radio frequencies.
- Use a guitar or other stringed instrument to illustrate frequencies.
- Review manufacturer color frequency privileges charts (*Available free from W5YI Group Instructor Program when ordering books*).
- Listen to signals on different bands.
Show HF, VHF, UHF on the board.

Make contacts on 1.25 or 70 cm band.

Have students identify wavelength when looking at a radio’s frequency.

Bring in guest in military uniform.

Bring in a radio-controlled model boat, car, or quad copter. Show them how the model turns and maneuvers via radio control. You don’t necessarily need to be on 6 meters to illustrate radio control, but have a separate receiver to tune into the actual sounds that the radio-control transmitter may send to the model airplane or boat.

**Your First Radio (pages 73-78)**

- Turn on your working radios and let them listen to phone and data.
- Illustrate CW with on and off of the telegraph key.
- Show off a typical FM mobile radio and identify stages within that radio.
- Use an inexpensive portable deviation meter and check out a radio that might be under or over modulated.
- Show off a dummy load.
- Tune in WWV for receiver calibration.
- On HF, click in different filters to show bandwidth.

**Going Solo! (pages 79-90)**

- Work your live classroom equipment to another station on 2 meters. *(Illustrate listening before transmit.)*
- Give signal reports on a repeater.
- Have students say their name and then spell their name phonetically.
- Have student read an HF RST report.
- Have the class listen to an incoming 2-meter simplex signal. You can illustrate full quieting to noisy by slightly unscrewing the antenna SMA connection. There is a point that the signal will drop off rapidly, and this allows you to show them full quieting, half quieting, and all noise on FM.
- Illustrate how to place a general call on FM.
- Illustrate how to place a general call on 10 meters SSB with the CQ.
- Pass around a list of ham abbreviations.

**Repeaters (pages 91-98)**

- Illustrate repeater on ceiling as silver foil-covered box with 2 antennas. Use a small laser pointer.
- Bring in a portion of a real repeater.
- Show a telephone handset for repeater RX and TX.
- Show dual-band handheld.
- Make an actual repeater call.
- Listen to CW repeater ID.
- Listen to a CTCSS received by an HT with a big external low-frequency-response speaker.
- Illustrate listening to the input of a repeater.
♦ Dial in a repeater and work politely into a conversation between the courtesy tone.
♦ Dial around and listen to different repeater conversations.
♦ Pass around a 35-watt HT power amp for mobile operation.
♦ Dial into a 440 MHz closed repeater system and monitor.
♦ Use a laser pointer to demonstrate simplex.
♦ Make a repeater autopatch phone call.
♦ Draw a typical 2-meter band plan from color frequency chart.
♦ Transmit a slow-scan picture on 2 meters.
♦ Use laser pointer again to demonstrate line of sight.
♦ Use thick but bendable Plexiglas to demonstrate refraction and ducting with a laser pointer.
♦ Play portions of my audio course on recorded record-breaking tropo contacts.

**Emergency (pages 99-104)**
♦ Play excerpt from my audio course of a station calling for help.
♦ Play excerpt of earthquake and hurricane emergency traffic.
♦ Give examples of non-emergency but priority calls over a repeater.
♦ Hand around rechargeable batteries and alkalines – describe battery life, battery natural decay for rechargeables, and small AA cell battery chargers.
♦ Show a RACES patch. Show an AREA patch.
♦ Conduct third-party traffic locally with student.
♦ Decline money payment.
♦ Review third-party list, Page 47.

**Weak Signal Propagation (pages 105-112)**
♦ Bring out those soft fuzz balls and start throwing them around the room. This will get everyone’s attention to what radio waves may be doing all around them.
♦ Bounce the fuzz ball off the ceiling to illustrate skywaves, and roll it on the floor to show groundwaves and ground-wave obstructions.
♦ Bring out a prism to illustrate refraction of wavelengths as seen in different colors of sunlight.
♦ Tune into WWV at 18 minutes past the hour for solar report.
♦ Tune into skywave comms on HF.
♦ Tune into groundwave signals on HF and 2 meters.
♦ Reverse binoculars held over a white sheet to show sunspots.
♦ Illustrate minimum ionospheric activity just like minimum temperatures just before dawn as you wear a very heavy coat.
♦ Tune into HF CW to illustrate what a beacon may sound like.
♦ Look for beacons on 10 meters and 6 meters.
♦ With a multimode VHF/UHF radio, tune into beacons on 2 meters in your area.

**Outer Space!  Ham Digital + Multi-Mode (pages 113-136)**
♦ Bring in your lap-top computer with a multimode VHF/UHF radio, or an HF radio on an outside antenna. Tie it in with a terminal node controller, my favorite is the SCS PTC2 Pro. Dial the radio around for incoming computer signals, watch the TNC decode it, and then watch the faces on your students!
♦ Illustrate simple data using CW and a flashing light.
♦ Tune around the band, best on HF, listening to RTTY, AMTOR, PACTOR II, PSK-31, CLOVER, and any other digital mode including CW.

♦ Log onto APRS and show them live positions coming up on local maps.

♦ Check into a repeater with IRLP and place a call to a ham in a different portion of the world. Be sure to set this up ahead of time to offer a no-problem, no-surprise connection. In other words, stage your operating well ahead of time to insure everything goes smoothly between your computer, your students, and the outside world of radio!

♦ Play audio recordings of actual space contacts – including satellite, space shuttle, and International Space Station (these are all on my audio course.)

♦ Show space station QSL cards.

♦ Play moon bounce audio.

♦ Show photos of giant quad of Yagis aimed at the moon.

♦ Show tiny ground plane that just won’t make it!

**Bandwidth & Interference (pages 137-144)**

♦ Tune around on HF and illustrate bandwidth of different emissions.

♦ Decode PSK-31. (Mims book, pages 22-23.)

♦ Use a mobile FM radio to demo bandwidth of FM voice, and then ATV video on 70 cm.

♦ Bring in an ATV demo.

♦ Illustrate overload by transmitting too close to a turned-on boom box.

♦ Show off various filters external to the radio or TV.

♦ Tune in SSB in AM mode to illustrate what SSB interference sounds like on a phone.

♦ Show off a low-pass filter for HF.

♦ Show off a cable TV box with a gazillion splitters in line!

♦ Show off a bandpass filter.

♦ Talk about decibels using audio.

**Volts & Amps and Components (145-174)**

This is the section of the course where the Mims book will be very helpful to you!

♦ Colored water and clear tubing makes for some great safe demos. The water is voltage; squeezing the bulb creates current; and a kink in the clear tubing illustrates resistance. Drive a little paddle wheel to show power. Here’s an illustration from page 14 of Mims’s book showing how you might build a model to demonstrate electricity fundamentals.

♦ A volt meter and an ammeter.

*Courtesy of Forrest M. Mims, III*
♦ Describe current and light up a 12-volt light bulb.
♦ Show off an inverter, and then show off a power supply.
♦ Show off / illustrate a multimeter – both digital and d’Arsonval (needle).
♦ Show fuses good and bad, and meter them in the resistance mode to check.
♦ Spark a fuse to blow it on purpose (Mims book, pages 24-31)
♦ Work with several needle-type multimeters (Mims book, page 26)
♦ Pass around DC power supply filters.
♦ Show current flow with a 12-volt bulb and a diode in series, passing and blocking current.
♦ Talk about the dangers of electrocution with current flowing from your fingers and out through your feet when doing the laundry in the garage (Mims book, page 19).
♦ Work the Ohm’s Law formulas on the board, and illustrate with a simple 12-volt DC light bulb.
♦ Pass around various resistors, and talk about resistor color code although it’s not needed for the exam (Mims book, page 28-31). Demo the effect of a fixed resistor and 12-volt lightbulb.
♦ Plenty of little batteries (Here’s an illustration from page 16 in Getting Started in Electronics for a lemon battery project that’ll get kids really excited!)
♦ Pass around schematic diagrams of equipment and have them identify components.
♦ Demo a variable resistor on the 12-volt light bulb with current flowing through both.
♦ Illustrate capacitors and spark a big electrolytic carefully. See Mims book, page 32, for how to make a capacitor with aluminum foil and waxed paper.
♦ Show off a variable capacitor.
♦ Show off coils. (Mims book, pages 38 – 39.)
♦ Demonstrate the power of a coil by dropping a rare earth magnet ball down the end of an aluminum tube, only to see the ball slowly float down as Lenz Law impedes the physical flow of the ball’s energy.
♦ Pass around transformers. (Mims book, pages 40-41.)
♦ Pass around diodes and illustrate diodes.
♦ Pass around transistors and large-scale integrated chips.
♦ Pass around switches.
♦ Have plenty of goodies to pass around. Instead of just talking about a component, show them what it looks like and feels by passing them around. When everybody has one component, go around the room and do a spot quiz to see if they can identify what that component is, and what it does!
♦ Buy Forrest Mims’s book Getting Started in Electronics! It’s a gold mine of ideas to demonstrate and teach electricity and electronics!!

![Image](getting_started_in_electronics.jpg)  Courtesy of Forrest M. Mims, III

![Image](variable_resistor.jpg)  Courtesy of Forrest M. Mims, III

Gordon West's Instructor's Guide for 2014-18 Technician Class - Page 21
Antennas and Coax (pages 175-192)

♦ Start by making a simple dipole.
♦ Have students build their own different dipole on different bands.
♦ Have students built a quarterwave ground plane using soda cans as a vertical, and then use an MFJ SWR analyzer to the results after the coax has been soldered.
♦ Use a soft, inflatable ball to demonstrate antenna radiation patterns.
♦ Bring in a guitar or ukulele to demonstrate resonance.
♦ Bring in parts of a multi-band vertical to demonstrate traps and capacity hats.
♦ Use a flood lamp to demonstrate directional antennas.
♦ Use a light bulb to demonstrate omni directional antennas.
♦ Bring in old TV antenna and demonstrate director, reflector, and driven element - CAUTION: PUT RUBBER BALL ON ALL ELEMENT ENDS TO PROTECT EVERYONE AROUND.
♦ Show off an automatic antenna coupler in action.
♦ Demonstrate a center-loaded, high-Q, mobile antenna system.
♦ Pass around a balun.
♦ Show a corroded antenna connection.
♦ Discuss and demonstrate safe soldering techniques (Mims book, page 98)
♦ Demonstrate directivity of a halfwave dipole.
♦ Show antenna modeling on your computer.
♦ Bring in a small cubical quad antenna.
♦ Illustrate polarization with wire.
♦ Talk about the little rubber duck antenna.
♦ Show off antenna adapters necessary for an HT on an outside antenna.
♦ Bring in a duplexer and triplexer.
♦ Show off various sizes of coaxial cable.
♦ Use a watt meter to illustrate coax cable losses.
♦ Show off parallel conductor and twin-lead.
♦ Illustrate standing waves with a rope.
♦ Show a standing wave ratio meter.
♦ Determine SWR on a student-built antenna.
♦ Show off hard hat and safety glasses and a climbing belt.
♦ Demonstrate grounding techniques and ground foil.
♦ Demonstrate green wire on a 3-blade plug.
♦ Show off component hit by lightning.
♦ Walk outside and spot high-voltage, unprotected power lines.
♦ Show off old unsafe leather climbing belt.
♦ Show off old rusted turn buckles.
♦ Show off one way to launch a non-conductive line over a tree.
Safety First! (pages 193-206)

- Turn on a flood lamp or auto headlamp and have a student come up and feel the warmth. If they touch it, they will get burned. This illustrates a basic principle of radiation.
- Talk about the handheld and show keeping the antenna away from your head.
- Go outside and examine a mobile vehicle installation for safe placement of the dual-band antenna.
- Talk about microwave ovens and what they do to food on the inside.
- Use the microwave oven to illustrate duty cycle.
- Work the charts in the book, going over controlled and uncontrolled environments.
- Give them questions on the charts in the book that are different than the actual book questions.
- Discuss safety when working with electricity.
- Reinforce all test questions dealing with personal operator safety around transmitting antennas.

Morse Code
(Chapter 6 - pages 217-224)

- Each class session should have a live Morse code oscillator – and both straight key as well as electronic key. Refer to page 218 – 219 in my book showing Morse code.
- Teach some simple CW characters and words: AT, EAT, SOS, TEAM, ANTENNA, and TEST are good ones to start with. Page 223 shows the order of learning on my CW CDs.
- Show on the student frequency sheet additional bands for Technician with CW privileges.
- Demonstrate 10 meters CW beacons and all that skywaves it might do!

Remember – kids (and adults, too) love the excitement of live ham radio demos! They are the key ingredient for a successful, memorable ham radio course!!
Nichols’ Nuggets:
Hands-on Experiments for the Ham Instructor

Our new contributor to the Technician Class study manual, Eric Nichols, KL7AJ, is an accomplished electronics instructor. Eric has a real knack for making complicated electronics simple to understand with his many demonstrations. Here are some that you can try in your Technician ham class to help your students better understand the science of radio and electronics.

Eric likes to “practice what he teaches!”
Here he is with his Q loop antenna – a project that began as a joke, but turned out to be an effective antenna design. He lives and works in North Pole, Alaska.

PLUMBING THE DEPTHS OF ELECTRIC CURRENTS
I like to use plumbing analogies to teach concepts like Ohm’s Law and especially Kirchhoff’s Current Law (KCL). Most students grasp the plumbing ideas quite intuitively, and it helps to emphasize that electric current is not much different; in fact, the math is identical!
Imagine a plumbing Tee, with three ports. It’s obvious that no more water can come out of the Tee than what you put into the Tee. The water coming out of any single port has to be exactly the sum of the water entering any of the other two ports. This is Kirchhoff’s Current Law… to a “Tee!”

MHO IS MO’ BETTER!
Figuring out parallel resistances can be daunting. Most of us learned how to memorize an awkward formula: \( R_t = \frac{1}{(1/r_1+1/r_2+1/r_3)} \) without any clue as to where this came from. If you use the CONDUCTANCES instead of the resistances of parallel resistors, things come into crystal clarity. The plumbing analogy works great here, too! If you have multiple parallel pipes you know that they can carry more water than a single pipe. When you have parallel resistances, you can simply ADD the individual conductances (\( Mho = \frac{1}{Ohm} \)). When you’re all done adding those conductances, you simply need to take the reciprocal to get the answer back into OHMS. (\( Ohm = \frac{1}{Mho} \)).

ENLIGHTENING YOUR ANTENNA UNDERSTANDING
One very cool experiment I’ve done for a number of years is to build a \( \frac{1}{2} \) wave dipole (preferably 40 meters) out of a string of miniature Christmas tree lights. (Be sure to remove any blinker lamps!) If you feed 20 watts or so of power into the string with your HF rig, you can see the RF current distribution! The lights near the center are brightest, and they become dimmer near the ends of the dipole. If you tune the rig to the second harmonic, you can see TWO standing waves, and with the third harmonic, you can see THREE standing waves.
RESISTANCE IS NOT FUTILE (Drawing an Interesting Conclusion!)

Build a potentiometer with a pencil and paper! You’ll need a good digital multimeter (in OHMS mode), or preferably a large scale VTVM in the OHMS mode to demonstrate this. Take a sheet of copier paper and draw a heavy dark line across it with a #2 pencil. Place one lead of your ohmmeter and touch it to one end of the pencil line. Take the other lead and place it on the other end of the line. Now move the probes closer together and see the resistance decrease! (Hams of yore used to use this method to create precision bias resistors for some tubes!) If your students want to get fancy, they can draw their “resistor” in a spiral or zigzag configuration. Experiment with different thicknesses and widths of the line, and see what conclusions they can “draw.”

TELL ME NO LIES

Another variation on the experiment above. With a DMM in the Megohm range, (it helps to use the Range Hold), have a student grab each probe between the thumb and index finger of each hand. Watch the resistance change as he or she squeezes the probes tighter… or answers an embarrassing question! This is fundamentally how lie detectors work; as you perspire more (as a result of your conscience being violated), your skin resistance goes down.

GIVE ‘EM SOME STATIC

If you still have some hair, here’s a neat experiment. You’ll also need a kitchen sink. Turn on the cold water faucet so a very thin stream flows from the spigot. (Just fast enough so the stream doesn’t break up until it falls 6 inches or so). Now, take a plastic comb, and come your hair vigorously. Bring the end of the comb near the stream of water, and watch it bend! If you really build a good charge, the stream can actually make a full U-turn! This demonstrates that water is made of polarized molecules… an important concept in a lot of more-advanced electronics.

A LITTLE LEVITATION… OR AT LEAST SOME LEVITY

This is one of my all-time favorite experiments; especially since it was utterly impossible to perform when I was a kid… we just didn’t have rare earth super magnets! All you need for this is a small rare earth magnet and a piece of ¾” copper pipe. Hold the copper pipe vertically and drop the magnet down the middle of the pipe. The magnet will very slowly drift downward through the tube! This is even more mystifying when you demonstrate that the magnet has NO attraction to the outside of the copper tube whatsoever! This demonstrates Lenz’s Law, a fundamental principle of all electric generators.

REGENERATE SOME INTEREST

It’s hard to find any amateur radio device with more bang for the buck than the REGENERATIVE RECEIVER. There are a number of kits available, and countless homebrew REGEN receiver projects for any skill level. Every semester I require my students to build a REGEN for their class project. It’s always educational, and the “kids” are always amazed at the performance of these gems.
CRYSTALIZING YOUR THOUGHTS

Even less daunting than the regenerative receiver is the CRYSTAL RADIO. No ham has an excuse NOT to build one! This used to be a rite of passage for every ham, and a lot of non-hams, a generation or two ago. Midnight Science www.midnightscience.com has all the parts and goodies you’ll ever need to build your first – or tenth – crystal radio. These fine folks usually show up at the Dayton Hamvention, too!

RUNNING INTERFERENCE

Antennas can be baffling, and explaining how antenna gain works can be even more so. The classic water tank experiment, where you create ripples by bouncing a couple of tennis balls on the surface of the water can clear up a lot of misunderstanding. Allow the students observer how waves crossing each other can either reinforce or cancel out the amplitudes. (Any good High School science book will describe this in some detail)

SOMETHING’S PHONE-Y HERE

Quick! – do this experiment while you can still find a land line telephone! Get one of those LONG curly telephone cords… 15 feet or so. Tie one end to a doorknob, grab the other end, and walk back till the middle is up off the floor but not too tight. Flap the cord back and forth and generate nice STANDING waves. By flapping at different speeds you can create some really nice HARMONIC waves as well. Point out the LOOPS and the NODES on the standing waves.

PONDER THE PENDULUM

The Three Rs of Radio are: Resistance, Reactance, and Resonance. The PENDULUM is a very intuitive demonstration of RESONANCE. A simple weight on a string is a great demonstration. Show how the resonant frequency is dependent ONLY on the length of the string. Show how you can ACCUMULATE energy by giving a tiny nudge every cycle… this is directly analogous to the Q of an electrical circuit.

THE MUSE WON’T CONFUSE

Undoubtedly, one or two of your students will have some musical ability or knowledge that transfers directly to electrical principles. Use their knowledge of vibrating strings and columns of air to explain the dipole antenna! Frequency, wavelength, interference, and a number of other principles are easily demonstrated using acoustic analogies. Explain that each OCTAVE is harmonically related to the fundamental. (The OCTAVE is somewhat infrequently used in basic electronics, but an important concept in more advanced electronics). Demonstrate BEAT frequencies on a piano and explain how you use the same concept in a radio frequency MIXER.

SPARKING FURTHER INTEREST

Of course a spark gap transmitter has long been illegal… but you can demonstrate how to create an actual radio wave using nothing more than a battery, a coil, and a couple of clip leads. If you have an oscilloscope, you can show a radio frequency damped oscillation, if you wind a coil to be self-resonant at some radio frequency. You might even want to duplicate Heinrich Hertz’ original experiment! (It’s also in the ARRL Handbook.)
WHO HAS’MA PLASMA?

Most of the Universe is made of plasma, but most folks think plasma physics is rocket science. Well, sometimes it is… but often it’s not. In this neat experiment, you can create your very own plasma. All you need is a glass of water, a microwave oven, and a BURNED OUT incandescent bulb – if you can still find one! Fill a glass with water. Float the bulb BASE DOWN in the glass of water. Place the glass of water with the bulb in the microwave, and turn it on to its highest setting. Observe what happens to the lamp! (Hint: Standard light bulbs are filled with Argon gas, supposedly to make them last longer. Obviously that never worked, so we have to conclude that there was always collusion between the light bulb manufacturers and the Argon distillers. Nevertheless, it’s a cool experiment).
Using Gordo’s Book and Audio CD Course to Earn the Boy Scouts Radio Merit Badge

Earning Merit Badges is an important pursuit for active Boy Scouts. Ham radio instructors involved with Scouting can use Gordo’s Technician Class book to help their Scouts earn their Radio Merit Badge. We have reviewed the latest Requirements for the Radio Merit Badge as posted on the BSA website. The following pages show the BSA Requirements related to Amateur Radio and provide a key for using the Gordon West Technician Class study manual and Audio Theory Course on CD for earning the Radio Merit Badge. (You can review the complete BSA requirements, including options for broadcast and shortwave listening activities, at: http://usscouts.org/mb/mb093.asp)

Boy Scout Radio Merit Badge Suggestions

Resources Found in Gordo’s Technician Class book and Audio Theory CD Course

Radio Merit Badge Requirements

1. Explain what radio is. Then discuss the following:
   A. The differences between broadcast radio and hobby radio.
   B. The differences between broadcasting and two-way communications.
   C. Radio call signs and how they are used in broadcast radio and amateur radio.
   D. The phonetic alphabet and how it is used to communicate clearly.

   Chapter 3, p. 21-26; CD 1 track 1
   About ham radio, pg 33-37; CD 1 track 2
   Call signs, pg 39-50; CD 1 track 2
   Call signs, pg 43 CHART; CD 1 track 2

2. Do the following:
   A. Sketch a diagram showing how radio waves travel locally and around the world. Explain how the broadcast radio stations, WWV and WWVH can be used to help determine what you will hear when you listen to a shortwave radio?

   Propagation, pg 108 CHART; CD 3 track 1
Radio Merit Badge Requirements

B. Explain the difference between a DX and a local station. Discuss what the Federal Communication Commission (FCC) does and how it is different from the International Telecommunication Union.

3. Do the following:
   A. Draw a chart of the electromagnetic spectrum covering 100 kilohertz (kHz) to 1000 megahertz (MHz).
   B. Label the MF, HF, VHF, UHF, and microwave portions of the spectrum on your diagram.
   C. Locate on your chart at least eight radio services such as AM and FM commercial broadcast, citizens band (CB), television, amateur radio (at least four amateur radio bands), and public service (police and fire).

4. Explain how radio waves carry information. Include in your explanation: transceiver, transmitter, amplifier, and antenna.

5. Do the following:
   A. Explain the differences between a block diagram and a schematic diagram.
   B. Draw a block diagram for a radio station that includes a transceiver, amplifier, microphone, antenna, and feed line.
   C. Explain the differences between an open circuit, a closed circuit, and a short circuit.
   D. Draw eight schematic symbols. Explain what three of the represented parts do. Find three electrical components to match to three of these symbols.

6. Explain the safety precautions for working with radio gear, including the concept of grounding for direct current circuits, power outlets, and antenna systems.

7. Visit a radio installation (an amateur radio station, broadcast station, or public communications center, for example) approved in advance by your counselor. Discuss what types of equipment you saw in use, how it was used, what types of licenses are required to operate and maintain the equipment, and the purpose of the station.

Resources

- Call signs, pg 45 map; CD 1 track 2
- Spectrum chart, pg 6; CD 1 track 1
- Frequency chart, pg 67; CD 1 track 1
- Charts of radio services, pg 6 and 67; CD 1 track 1
- Radio Communications System chart, pg 79; CD 2 track 2 – also pgs 119-126; CD 3 track 4
- CD 4 track 2; schematic diagrams, pgs 163-166; CD 4 track 2; Multi Mode radios, pg 134; transmitter, pg 127; receiver, pg 130; feed line and antennas, pg. 183-192, CD 3 track 4;
- Ohms Law, pg 136, electron flow CD 3 track 6 also pg 145-157. CD 4 track 1
- Electrons, pg 147 and schematic symbols pg 164; CD 3 track 6
- Safety , pgs 193-206; CD 4 track 5; also RF exposure levels pg 205; also Maximum Permissible Exposure limits pgs 227-229 W5YI Safety Charts
- VISIT A HAM OPERATOR AND TALK RADIO! Use list of Examiners to find a local ham , page 226; CD 1 track 1
Radio Merit Badge Requirements

8. Find out about three career opportunities in radio. Pick one and find out the education, training, and experience required for this profession. Discuss this with your counselor, and explain why this profession might interest you.

9. For Amateur Radio, Do the following:
   1. Tell why the FCC has an amateur radio service. Describe some of the activities that amateur radio operators can do on the air, once they have earned their FCC license.
   2. Using proper call signs, Q signals, and abbreviations, carry on a 10 minute real or simulated radio contact using voice, Morse code, or digital mode. (Licensed amateur radio operators may substitute five QSL cards as evidence of contacts with amateur radio operators from at least three different call districts.) Properly log the real or simulated ham radio contact and record the signal report.
   3. Explain at least five Q signals or amateur radio terms you hear while listening.
   4. Explain some of the differences between the Technician, General, and Extra Class license requirements and privileges. Explain who administers amateur radio exams.
   5. Explain how you would make an emergency call on voice or Morse code.
   6. Explain the differences between handheld transceivers and home “base” transceivers. Explain the uses of mobile amateur radio transceivers and amateur radio repeaters.

Resources

VISIT A HAM OPERATOR AND TALK RADIO! Use list of Examiners to find a local ham, page 226; CD 1 track 1

Chapter 1, pgs 1-19; CD 1 tracks 1 + 2

On The Air, pgs 79-90; CD 2 track 2

Q Signals, full page listing Page 86;
   CD 2 track 2

Emergency, pgs 99-104 voice, pg 119 for CW

Your First Radio, pgs 73-78; CD 2 track 1
   also, Repeaters and base stations, pgs 91-98 CD 2 track 3
Resources

So, where do we get all of these materials to put on a class and do these different demos? Chances are, you probably have a bin full of “stuff” that would make great demo items. If you invite your ham friends to help with the class, you will find each may have a specialized area of operation, and they would love to bring that particular demo into the classroom. You can’t do it all yourself – get your ham pals to bring in their specialty gear and talk about their operating modes!

GORDON WEST BOOKS, AUDIO TAPES, & W5YI SOFTWARE PACKAGES AT AN INSTRUCTOR DISCOUNT:

The W5YI Group (800-669-9594, or www.w5yi.org) distributes all of the Gordon West amateur radio study materials for the Technician, General, and Extra class licenses. They offer a special Instructor Discount Program to ham radio instructors registered with W5YI. Here’s a summary of the products:

Technician Class, General Class, and Extra Class study manuals. Each book contains the exact questions and answers used to make up the exams, plus explanations of the correct answers. The books also contain a great deal of additional information on ham radio, including frequency privileges, list of VECs, and much, much more.

Educational Book & Software Packages. W5YI also has each book packaged with Windows® software that allows students to study the Q & A at their PC and take practice exams. The software scores their exams showing where they are weak and need more study. Interactive explanations and keywords appear when a student answers incorrectly. Each package includes a free copy of W5YI’s FCC Part 97 rule booklet.

Audio Theory CDs for each license class recorded by Gordon West. Each set of CDs (4 each for Technician and General, and 6 for Extra) discusses the theory covered in each FCC exam element. They are a great way to get the students to pre-study and listen in on the excitement of ham radio for their upcoming class. All of the theory cassette tapes contain live sounds of radio, plenty of sound effects, and Gordo’s humor to keep students playing the cassettes over and over again.

Code CDs. Teaching the code? If you’re planning to teach Morse code, Gordo has an in-depth set of 6 audio CDs that students love because of the humor that is on them – they make learning the code fun. He also has a 2 CD code teacher. As an instructor, you may also use these CDs to play over the airwaves, especially on the 2-meter band. All of the code characters are sent Farnsworth method at 15 wpm character rate, slowed to 5 wpm word rate. Refer to Chapter 6 of Technician Class, “Learning Morse Code,” pages 217 through 224, on the progression of letters, lesson plans, and steps to make code learning FUN.
EXOTIC DEMO TOOLS & PROPS

If you are not into building your own plasma tube, or your own Tesla coil, a commercial educator/experimenter company called **Information Unlimited Amazing Devices** (800-221-1705, or www.amazing1.com) has you covered *big time!* They have assembled systems or kits for Tesla's, levitation, induction and conduction, spark gap, neon tube conductor analyzers, and a host of other “eyeshocking” devices that are relatively safe around your students, yet will have everyone coming back for a second look. One device, called the phaser tube, allows me to show conductivity by having students joining hands in series and watching the neon tube begin to glow further and further up as better contact is made. Another good prop is the Tesla coil, but keep in mind this device has plenty of high voltage around it. *Always* take your high-voltage demos off-line when teaching a class for kids – they are indeed curious!

**Free With Each Book Purchase:**

- **FREQUENCY CHARTS, WALL MAPS, GRADUATION CERTIFICATES, & MORE…**

Order your books through The W5YI Ham Instructor Program and they will include as much material that they may have on hand.

To order the Gordon West *Technician Class* book, go to

[www.w5yi.org](http://www.w5yi.org) or call 1-800-669-9594

To register as an instructor or to have your class posted on our website, go to:

[www.haminstructor.com](http://www.haminstructor.com)

In addition, here is a listing of various manufactures, dealers, and others that may supply you with materials that contain excellent illustrations and simplified technical explanations to help with your demonstrations.

- **Alinco**
  - radio catalogs
  - www.alinco.com
- **Aluma Towers**
  - lightweight tower catalogs
  - www.alumatower.com
- **Amateur Electronic Supply**
  - 160-page full ham catalog
  - www.aesham.com
- **American Radio Relay League**
  - ARRL materials
  - www.arrl.org
- **Batteries America**
  - battery catalog
  - www.batteriesamerica.com
- **CQ Communications**
  - promotional copies of CQ
  - www.cq-amateur-radio.com
- **Gap Antenna Products**
  - catalog on vertical antennas
  - www.gapantenna.com
- **Gordon West Radio School**
  - contact Gordo
  - wb6noa@arrl.net
- **Ham Radio Outlet**
  - 120-page full ham catalog
  - www.hamradio.com
- **ICOM America**
  - band charts
  - www.icomamerica.com
- **KB3IFH QSL Cards**
  - sample QSL cards
  - www.kb3ifh.homestad.com
- **Kenwood USA**
  - frequency charts, maps, catalogs
  - www.kenwoodusa.net
- **LDG Electronics**
  - automatic antenna tuner charts
  - www.ldgelectronics.com
- **MFJ Enterprises**
  - catalogs on all sorts of accessories
  - www.mfjenterprises.com
- **QSLs by W4MPY**
  - sample QSL cards
  - www.w4mpy.com
- **QSLs by Star Printing**
  - sample QSL cards
  - www.qth.com/wx9x
- **Radio Works**
  - antenna catalogs
  - www.radioworks.com
- **Universal Radio**
  - 100-page full ham catalog
  - www.universal-radio.com
- **W5YI Group**
  - VEC info / License prep materials
  - www.w5yi.org
- **Yaesu Electronics**
  - frequency charts, world maps
  - www.vertexstandard.com

We’ll be happy to supply you with band plan charts, grid square maps, manufacturer’s discount coupons, and more for each of your ham class students when you order your student’s study manuals from The W5YI Group.

A special word of thanks to “the big four” – Alinco, Icom, Kenwood, and Yaesu – for their continuous free classroom materials with our books to instructors in support of the Gordon West / W5YI Ham Instructor Program!

When your students graduate, I want to know about it! I have a very nice certificate suitable for framing (below) – plus free ham operating materials from equipment manufacturers. All I need is a large, self-addressed envelope with 12 first-class stamps inside for each student to cover postage and handling, and I’ll send one their way. They can write me at:

Gordon West Radio School
2414 College Drive
Costa Mesa, CA  92626

Certificate of Achievement

Be it known that _____________________________ has fulfilled the Federal Communications Commission requirements to be a Licensed Amateur Radio Operator

Whereas: Having been examined in communications radio regulations, operating practices, station equipment and electronics; and

Whereas: Having been found qualified to construct, install, and maintain amateur radio transmitting equipment, it is

Resolved: that the above named candidate possesses the necessary operational and technical qualifications required by international treaty and domestic telecommunications regulations to be an FCC licensee in the U.S. Amateur Radio Service.

Date: ___________________________  Class of license: ___________________________  Signed: Gordon V. West, WB6NOA
AN INVITATION TO SIT-IN & SEE FOR YOURSELF

Now that we are at the end of this Instructor’s Guide for you, the instructor, on how to teach a ham radio class, allow me to invite you to sit in on any one of my ham classes throughout the country – or any of the seminars that I present at hamfests or club get-togethers. Feel free to adopt any of the demos that I do, and please share with me any demonstrations that you have developed so I might adopt them myself and pass them on to others.

Also, beginning on the next page, is my Pre-Study Q&A for the 2014-18 Technician class. Feel free to make copies of it for your students. You can use it for the weekend seminar format, or you can adapt it as homework for a weeknight course. If you can get your students to pre-study your classes will be much more fun with more time for demos, and you student pass rate will soar!

All of my theory books, audio theory CDs, code CDs, and the W5YI computer programs are available at a discount to you. We offer you these discounts because you are our most valuable resource for the growth of Amateur Radio, the Elmer/instructor. Get all of my materials at a discount, and use any small amount of profit towards continuous improvement of your presentations and classes. If you are teaching for a club, the club may want to purchase the materials and offer them to the students as a group discount. Or it may want to use the profits to help pay the cost of conducting the classes, or to pay the classroom or testing facility fee.

If you have your own ideas on what should be in the three amateur radio question pools, feel free to send me your revised Q & A’s. Become an active contributor to future question pools that are revised every 4 years.

Work closely with your local amateur radio dealers. They can assist by providing space for your class announcements, as well as providing demo gear during your upcoming course. Chances are, when you start turning brand new licensed students over to them, they’ll want to provide a lot more for you in appreciation of what you are doing to help ham radio grow.

Remember – teaching ham class is supposed to be fun for you, too! The more excitement you generate, the more fun for everyone!!

Gordon West’s Instructor’s Guide for 2014-18 Technician Class – Page 34
Finally, don’t hesitate to call me personally and share with me your comments on what we all may do to better our ham radio presentation to students throughout the country. I can be reached Monday through Friday, 10 am to 4 pm Pacific time, by calling me at 714-549-5000. Say hi to my wife, Suzy, N6GLF, too. Or write me a note at:

Gordon West Radio School  or you may e-mail me at:  
2414 College Drive  WB6NOA@ARRL.NET  
Costa Mesa, CA  92626

So what are you waiting for? Start looking over my Technician Class book, play the tapes, create your home study pre-course workbook, and let’s get started with your upcoming ham radio class. I’m right here with you!

73  
Gordon West  
WB6NOA

The natural curiosity of kids makes teaching them ham radio particular fun. Adults. RVers. Boaters. Hunters. There’s something for everyone in our Amateur Radio hobby. And the rewards for you – the instructor – are tremendous as you help our hobby grow!
Welcome to your weekend class pre-study homework. Your upcoming weekend class is absolutely NOT a cram session, followed by the test. Rather your weekend course will take your textbook questions and answers and relate them to the real world of ham radio operating.

This pre-study material comes straight out of the Gordon West Technician Class book for the 2014 through 2018 Element 2 question pool, and his Audio Theory Course. The fill-in-the-blank questions in this pre-study guide follow the exact order of the book. We even give you page numbers to quickly spot the correct answer!

In addition to the Gordon West Technician Class book, this pre-study material is covered in the exclusive audio CD course. The CD audio course is a fun way to hear the radio sounds behind some of these questions.

This pre-study homework is fill-in-the-blank. Your actual Element 2 written examination will be a multiple choice exam – all the easier.

This fill-in-the-blank homework also parallels the computer home study course. Taking sample exams on the computer is fun, educational, and a double-check that you will do well on the upcoming written examination.

Begin reading over your Technician Class book, and start filling in the home study answers. The page numbers will help! Be sure to bring your completed home study to the first class session.

To order the Gordon West Technician Class book, or his Audio Theory Course go to www.w5yi.org or call 1-800-669-9594
GETTING INTO HAM RADIO (book pgs. 1–4; CD #1, Track 1)

1. How many hams worldwide? ____________________________
2. How many hams in the USA? ____________________________
3. How many questions on your upcoming Technician Class test? ______
4. How many bands will your new handheld radio have? _____________
5. What does ATV stand for? ____________________________
6. Ham radio is a hobby and ____________________________.
7. American Radio Relay League website: __________________
8. Will a CB antenna work on 10 meters ham? _________________
9. Ham radio, a hobby, and also a? _________________________
10. A fellow ham to show you the ropes? ____________________
11. Ham Radio’s national association? _______________________

TECHNICIAN CLASS PRIVILEGES (book pgs. 5-20; CD #1, Track 1)

1. Frequency range for HF? ____________________________
2. Frequency range for VHF? ____________________________
3. Frequency range for UHF? ____________________________
4. You have voice privileges on this worldwide HF worldwide band.____
5. Six meters, work the moon? ________________ MHz
6. Two meters, the most popular band ________________ MHz
7. How many meters is the 222 MHz band? ________________
8. The 70 cm band is very popular! ________________ MHz
9. What two bands in a dual band hand held? ______________
10. CW – only privileges on these three bands? ____________
11. Do this when you receive your call letters: Get on the __________ !
12. Technician privileges include _______________ bands for HF operation?

13. Voice band for Technician HF sky waves? _______________________

14. Technician Class power output on 10 meters? _______________________

15. Ten meter HF voice privileges? _______________________

16. Four worldwide bands for Technician Class Morse code? ______________

17. ___________ cm for 902 – 928 MHz?

18. ___________ cm for the 1240 - 1300 MHz?

19. This chapter for learning the Morse code? __________ Page?__________

A LITTLE HAM HISTORY (book pgs. 21-26)

1. Ham radio has been around for ___________ years.

2. First ham license issued around ____________.

3. What requirement has been totally eliminated from the ham radio test? _____________

4. When did the FCC restructure the Amateur service? ___________

5. When did self-testing ham exams begin? ______________

6. How many grades of ham radio licenses? ______________

7. How many examiners to give you the Element 2 exam? ______

8. Can you jump over the entry level Tech test and go direct to the General Class test?____

9. Exam element number for Technician Class? ______________

10. Exam element number for General Class? ______________

11. Exam element number for Extra Class? ______________

GETTING READY FOR THE EXAM (book pgs. 27-32; CD #1, Track 1)

1. How many test questions for Technician? __________

2. How many questions in the total Technician Question pool? __________

3. May the test wording be changed or modified? __________

Gordon West's Instructor's Guide for 2014-18 Technician Class - Page 38
4. Passing score? ______________%  
5. How many questions could you miss and still pass? ___________  
6. You receive this paper when you pass? ________________  
7. The questions on the CDs and in the book have been ________ for faster and smarter learning.  
8. What color are key words to study before the test? ___________  
9. Got a question? Call Gordo at this number: ________________  
10. How many exam questions on Rules? ________________  
11. How many exam questions on math? ________________  
12. How many exam questions on antennas and feedlines? _____________  
13. Can exam questions be reworded? ________________  
14. May numerical values in questions be changed on your test? ____________

ABOUT HAM RADIO & CALL SIGNS (book pgs. 33-50; CD #1, Track 2)  
1. Minimum age for a ham radio license? ___________  
2. Who regulates and enforces the ham service? ___________  
3. Licenses are issued for ________________ years.  
4. Grace period for an expired license? ________________  
5. Give your call sign every ________________ minutes.  
6. Phonetic alphabet for H I? ________________  
7. Which language to identify your call sign? ________________  
8. Which ITU region are we in? ________________  
9. May we send third party traffic to Haiti? ________________  
10. Country call sign prefix for United Kingdom? ________________  
11. Does the US have reciprocal operating agreements with The Netherlands? ____________  

12. May you continue to transmit on an expired license? ________________

13. Call signs in the United States begin with one of these 4 letters? ________

14. Another name for your amateur radio apparatus? _______________________

15. Maximum power allowed to radio control a “quad-copter”? _____________

16. Call sign type with a single letter in prefix and suffix? (K7A) ____________

17. Required club members for a club station license? _____________________

18. Which call sign area for a license in Florida? _________________________

19. A call sign type when identifying as “Race Headquarters?”_______________

20. Who regulates ham radios aboard a US documented vessel on the high seas? ________________

**CONTROL** (book pgs. 51-56; CD #1, Track 3)

1. Every transmitting station needs a _______________ operator.

2. What type of control when using a handheld radio? _____________

3. Mountaintop repeaters normally operate ______________ control.

4. May a Technician control op transmit on General Class frequencies? ________________

5. When may a control operator be “on the clock” while transmitting? ______________

6. May a non-ham be designated as a control operator? ________________

7. What type of control when operating your handheld radio? _____________

8. What type of control for APRS? ________________________________

**MIND THE RULES** (book pgs. 57-62; CD #1, Track 4)

1. What part of the Rules covers ham radio? _________________

2. Prohibited transmissions? ________________________________

3. How much power should you transmit? _______________________

4. May intentional SECRET code be transmitted over ham radio? ______

*Gordon West's Instructor's Guide for 2014-18 Technician Class - Page 40*
5. Normally, music is ____________________?

6. When may the FCC inspect your station? ____________________

7. What might result if the FCC can’t reach you by mail? ____________________

8. Which Rules section covers ham radio? ____________________

9. How much power SHOULD a ham operator use? ____________________

10. This radio service is protected from ham radio interference under all circumstances? ____________________

11. May we broadcast local city general news to the general public? _________

12. May we buy and sell ham radio gear on the air? ____________________

TECH FREQUENCIES (book pgs. 63-72; CD #1, Track 5)

1. What two letters stand for a radio emission? __________

2. Radio waves are considered ______________.

3. Velocity of radio waves through free space? ______________

4. Unit of radio frequency? ______________

5. The abbreviation kHz stands for ______________

6. Frequency bands are usually called out in a ______________.

7. Frequency and wavelength are inversely proportional. What is that magic number? ____

8. 52 megahertz is located in which meter band? __________

9. 28.4 MHz is located in which meter band? ______________

10. 146.52 MHz is located on which meter band? ______________

11. 223.5 MHz is located on which meter band? ______________

12. 432 MHz is located on which meter band? ______________

13. To go from METERS to MEGAHERTZ, or MEGAHERTZ to METERS the magic division number is ______________.

Gordon West's Instructor's Guide for 2014-18 Technician Class - Page 41
14. 28.5 MHz is how many kilohertz? ____________________________
15. Ten meter worldwide voice privileges extend from 28._______ to 28._______MHz.
16. Cycles per second? ________________________________
17. Radio wave distance? ________________________________
18. Frequency limits of the HF spectrum? ________________________________
19. Frequency limits of the VHF spectrum? ________________________________
20. VHF 2 meter national calling frequency? ________________________________
21. UHF 70 cm national calling frequency? ________________________________
22. Are band plans voluntary of FCC enforced? ________________________________

YOUR FIRST RADIO (book pgs. 73-77; CD #2, Track 1)
1. Get your radio pre__________ by your local ham dealer or club.
2. Store favorite frequencies in your radio’s ____________.
3. Don’t use a rubber duck inside your ____________.
4. What type of modulation do we use for 2 meters and the 440 MHz band? __________
5. In noisy environments, hook this in to your handheld.____________
6. What is the advantage of SSB over FM when working satellites? __________
7. What device takes output on one band and produces output on another band? __________
8. The www for ham equipment reviews? ____________
9. Abbreviation for mic transmit button? ________________________________
10. Do rubber duck antennas all have the same connector? ____________
11. Common emission for VHF Packet radio? ________________________________
12. Common emission for VHF repeaters? ________________________________
13. Bandwidth of a VHF repeater FM phone signal? ________________________________
GOING SOLO  (book pgs. 79-90;  CD #2, Track 2)

1. Speak into your radio’s ___________________.
2. Listen to radio audio on this ____________________.
3. Which circuit silences background white noise? _____________
4. Transmitting on the same frequency is called ________________.
5. We use duplex when transmitting when transmitting through a ____________.
6. When you test over the air, always give this. _____________
7. What does CQ mean? ____________________________
8. Interference from another station on frequency is called by which Q code? ____________
9. This Q code means change frequency. __________________________
10. Someone asks “What is your QTH?” __________________________
11. Your friend is going QRT. This means _______________ ___________
12. The locator system based on 1 degree latitude by 2 degrees longitude? ______________
13. UHF signals on 440 MHz sometimes take a ______________ off nearby buildings.
14. Squelch does this to background noise? __________________________
15. Abbreviation for tone controlled squelch system? _______________
16. Always give your _________________ when transmitting a test?
17. Before transmitting, always ___________________ ____________________
18. Term for rapid fluttering signal from a mobile station? _______________
19. Term for contacting as many stations as possible? _______________

REPEATERS  (book pgs. 91-97;  CD #2, Track 3)

1. Repeaters transmit on their output and listen on their ____________.
2. What is the term to describe transmitting on a repeater channel? ________plex.
3. What is the usual repeater offset for the 2 meter band? __________
4. What is the usual repeater offset for the 70 cm band? __________

5. Most repeaters also require CTCSS. What’s this? __________

6. What else do you need to program in your handheld to access a local repeater? ________

7. Who maintains these free repeaters? ______________________

8. The difference between repeater transmit and receive frequencies is called?

_______________________________________________________

9. Common difference between receive and transmit for repeaters on 2 meters?

__________________________________________ 0.?? MHz

10. Common repeater offset for 70 cm band? ________________MHz

11. Say this, instead of CQ, on repeaters to announce that you are monitoring?

________________________________________________________?

12. Repeaters usually give their call sign in? ______________________

EMERGENCY! (book pgs. 99-104; CD #2, Track 4)

1. Which communications have the highest priority? __________

2. What does RACES stand for? ______________________

3. What does ARES stand for? ______________________

4. What does the term “check” mean? ______________________

5. What words do we use to indicate an emergency on the 2 meter band? __________

6. What words to indicate an emergency on the 10 meter worldwide band? __________

7. What Morse Code characters are sent in an emergency? __________

8. Do this before transmitting on an emergency net? _________________

9. When passing emergency traffic, pass the message exactly as?

_____________________________________________________________

10. Use this alphabet when spelling unusual words? _________________
WEAK SIGNAL PROPAGATION  (book pgs. 105-112; CD #3, Track 1)

1. What do we call radio signals that travel through space? __________

2. Use “Knife-edge” propagation to transmit over ________________.

3. A warm air inversion creates this type of propagation. __________________

4. Catch a falling star and try this? ______________________

5. How many layers of the Ionosphere during the day? __________

6. What layer disappears at night? ______________________

7. When can you get 10 meter propagation? Day or night? __________

8. Skip is not reflections, but rather, ______________________

9. Signals that hug the Earth are called __________ ________waves.

10. Does the ionosphere ever effect common 2 meter and 70 cm repeater communications? ______________________

11. The ionosphere will regularly skip frequencies, during the day, on these bands?

12. Does sunspot activity influence the ionosphere? __________

13. “Short skip” signals normally refract off which layer of the ionosphere?

14. Long range skip is refracted by this layer of the ionosphere, at the peak of the solar cycle?

15. Which characteristic of a radio wave describes its polarization?

16. When would the ionosphere affect 2 meter and 70 cm handheld communication?
TALK TO OUTER SPACE!  (book pgs. 113-118;  CD #3, Track 2)

1. How many miles above the Earth to qualify as a space station? ______
2. What does LEO stand for? _______________________
3. Signals that contain information about an on board satellite computer? ________________
4. What causes satellite signals to fade in and out? ________________
5. Compensate for this shift when the satellite is approaching. ______
6. In the V/U mode, what band do you transmit on? ________________
7. How much power should you use when transmitting to a satellite? ________________
8. AMSAT’s website to join them? _______________________
9. May a Technician Class operator talk with hams aboard the International Space Station? ________________
10. ________________ elements are input to a satellite tracking program? (starts with K)
11. A satellite will transmit this information on its? ________________
12. Why are ham satellites slowly rotating in space? ________________
13. What word describes a satellite’s transmission of internal sensors? ________________
14. What word describes how specific hams may control a satellite function? ________________

YOUR COMPUTER GOES HAM DIGITAL!  (book pgs. 119-126;  CD #3, Track 3)

1. Is Morse Code a digital mode? ________________
2. The device connected between your transceiver and computer? ________________
3. What portion of your computer might decode digital signals? ________________
4. What does CW stand for? ________________
5. A __________ ham station connects other ham stations into the internet?

6. What does VoIP stand for? ____________________________

7. What do IRLP and Echolink have in common? ______________

8. Another name for fast scan television? ________________

9. What does ARQ stand for? ______________________________

10. Packet data signals may contain more ______________when traveling over multiple or reflections?

11. What does GPS stand for? ____________________________

12. What does PSK stand for? ____________________________

13. Four letters that represent analog fast scan color ham television? ______

**MULTI-MODE RADIO EXCITEMENT** (book pgs. 127-135; CD #3, Track 4)

1. To operate satellite SSB, which emission mode? ______________

2. What emission has the narrowest bandwidth? ______________

3. We find a product detector in what type of radio receiver? ______

4. How wide is the SSB voice signal? ______________________

5. What does RIT stand for? ______________________________

6. The ability of a receiver to hear signals close together? ______

7. How wide is fast scan television? ______________________

8. A fancy name for your new two-way radio? ________________

9. The emission type for a handheld VHF/UHF radio? ______________

10. For a base or mobile radio to transmit MORE modes than just FM, we call that radio? ____________________________________

11. Which popular voice mode is used for long range 10 meter contacts? ____________________________________________

12. Can you access the 10 meter band with a common 2 meter.70 cm handheld or mobile radio? ____________________________

*Gordon West’s Instructor’s Guide for 2014-18 Technician Class – Page 47*
13. Which has the narrowest bandwidth, FM or SSB? ________________

14. What sideband do we use on 10 meters? ________________

15. What word describes combining speech with an RF carrier signal?
______________________________

16. An SSB signal is about 3,000 Hertz narrow. How many kHz is 3,000 Hz?
____________________ ??? kHz

17. Are all mobile and base station mic connectors wired the same way? ______

18. What word describes the ability of a receiver to detect weak signals?
______________________________

19. What word describes a receiver’s ability to discriminate between multiple signals?
______________________________

20. Should automatic gain control be set to FAST or SLOW for SSB reception?
______________________________

**RUN SOME INTERFERENCE PROTECTION** (book pgs. 137-144; CD #3, Track 5)

1. On 10 meters, if your mic gain is too high, it could create this. ________________

2. On 2 meters, speaking too softly will create under-__________.

3. A whistle on your handheld tied in to your car’s 12 volts is likely from ______________

4. What type of filter would you use to minimize harmonic emissions on your high
frequency transmitter? ________________________________

5. When your neighbor spots that new antenna, tell them it is ______________

6. What snap on device may minimize interference on audio equipment? ______________

7. What might be causing your transmit radio frequency interfering with your neighbor’s
stereo network? ________________________________

*Gordon West's Instructor's Guide for 2014-18 Technician Class - Page 48*
8. Using shielded wire will prevent _______________ of unwanted signals to and from the wire.

9. A small weather station transmitter falls under which part of the FCC Rules?
   _______________________________________________________________

ELECTRONS - GO WITH THE FLOW!  (book pgs. 145-157; CD#4, Track 1)

1. The name for EMF? ___________________________

2. The flow of electrons__________________________

3. The opposition to the flow of electrons_____________

4. What device stores a chemical charge? _________________

5. Most ham radios require ___________volts for mobile operation.

6. Measure current with this _____________________________.

7. ____________ is measured in series, and ____________is measured in parallel.

8. A good conductor___________________________

9. A good insulator___________________________

10. The amount of voltage that comes out of you home socket___________

11. A device that allows current to flow in only one direction_________

12. The unit of resistance___________________________

13. A variable resistance device____________________

14. What device stores energy in a magnetic field? _________________

15. Which device stores energy in an electric field?

16. The unit of capacitance? _____________________________

17. A device that turns on or off a circuit? _________________

18. A device that might amplify a signal? _________________

19. FET stands for _____________________________
20. Which battery chemistry is most dangerous with an overcharge?

21. What are the two electrodes of a diode?

22. How is the cathode lead of a semiconductor diode usually identified?

23. Opposition to AC current flow in a circuit is called?

24. What component can be used as an electronic switch or amplifier?

25. What are the three electrodes of a PNP transistor?

26. What are the three electrodes of a field effect transistor? (FET)

IT'S THE LAW, PER MR. OHM! (book pgs. 158-162; CD #4, Track 1)

1. Draw 2 different types of Ohm’s Law Circles.

2. Power equals ______ X ________.

3. Voltage equals ______X ________.

4. If you are calculating current, it is Voltage divided by ________.

5. If you are calculating resistance, it is Voltage divided by ________.

6. In all of the problems, you are always dividing the larger number by the ______ number.

7. Could they ever substitute different numbers than what is in the book and on the audio course on your upcoming examination?___________

8. What voltage across a 2 Ohm resistor with 0.5 amps flowing through it?

9. What is the current flowing through a 24 Ohm resistor connected across 240 volts?

Gordon West's Instructor's Guide for 2014-18 Technician Class - Page 50
10. What is the resistance with 3 amps current flow through a resistor connected to 90 volts?

PICTURE THIS! (book pgs. 163-174; CD#4, Track 2)

1. Draw the symbol for a resistor

2. Draw the symbol for a variable capacitor

3. Draw the symbol for an antenna

4. Draw a transistor symbol

5. Draw a chassis ground symbol

6. Draw a transformer symbol

7. Draw a diode symbol

8. Draw an LED symbol

9. Doubling your power output results in how much db gain? ______

10. A ten times increase in power will result in how much db gain? _____

11. What does LED stand for? ______________________

12. How many watts are 500 milliwatts? ______________

13. A cold solder joint looks like this__________________

14. What will happen if you measure voltage with your multimeter on the resistance scale?

15. What do the 2 vertical lines represent in a transformer schematic?

16. Another name for a switch controlled by an electromagnet? ___________

17. How many GHz on a dial that reads out 2425 MHz? ________________

18. How many MHz is 28,400 kHz? _______________________

19. How many microfarads are 1,000,000 picofarads? ________________

20. A cold solder joint will look? ____________________________

Gordon West's Instructor's Guide for 2014-18 Technician Class - Page 51
ANTENNAS (book pgs. 175-181; CD #4, Track 3)

1. What type of antenna is half wavelength, parallel to the Earth? ____________________
2. From tip to tip, how long is a half wave dipole for 10 meters? _________________
3. Tip to tip, how long is a half wave dipole for 2 meters? __________
4. The electric field in a vertical antenna is ________________to the Earth.
5. What is the formula for calculating the length of a half wave dipole, if you know the
   frequency in MHz? ___________________________
6. Which antenna concentrates energy in just one direction? _________
7. What’s a popular sport that uses handheld, directional antennas? ____________
8. If your antenna and that of the other station are cross polarized, your signal will get ___?
9. With a dipole, where is the radiation strongest? _____________________
10. Your new dipole has best lowest SWR just below the band. Do this to the dipole ends?
    __________________________________________________________________
11. Best place to mount a VHF or UHF mobile antenna for uniform radiation patterns?
    ___________________________________________________________________
12. Another name for that antenna coil on the base of your 10 meter mobile short whip?
    ___________________________________________________________________

FEED ME WITH SOME GOOD COAX!  (book pgs. 183-192; CD #4, Track 4)

1. Coax cable is round or flat? _____________________
2. Impedance of coax cable for ham use? _____________Ohms
3. Common coaxial cable connector for a mobile high frequency radio? _________
4. Common coaxial cable connector for a handheld radio? _________
5. Don’t nick this____________________________
6. The larger the diameter of the cable, the lower the signal ________.
7. The ratio of forward power to reflected power is _______________.

8. An SWR meter 4:1 means _________________________________.

9. What device prevents signal radiation when testing your transmitter? ______________

10. What is the coax connector called for your multimode radio? ___________

11. Name a couple of antenna connector types for your handheld? ______________

12. What happens when moisture enters coax cable? _________________

13. What happens to power lost in water-logged feedline? ________________

14. What does a dummy load consist of? _____________________________

SAFETY FIRST! (book pgs. 193-206; CD #4, Track 5)

1. Good way to guard against shock? _____________________________

2. The green wire in an AC power cord provides what? ____________

3. An intentional weak link in a wiring circuit___________________

4. Should you replace a blown 10 amp fuse with a 40 amp fuse? _____

5. Precautions around a 12 volt lead acid battery? ________________

6. Wear this when climbing an antenna tower_____________________

7. Make sure your antenna is well away from these_______________

8. If on the ground looking up, always wear these to protect your eyes ______________

9. Never climb a tower that has not been cranked __________________

10. Use this for good RF grounding, not round wires_______________

11. What is the device to help erect an antenna tower top section? ____

12. What frequency has the lowest MPE limit? _______________meters.

13. A good place for a magnetic mobile antenna on your car___________

14. If you touch a transmitting antenna you could get_______________
15. Below what power level are most radio signals considered safe? ____________

16. Make sure your volt meter test lads are rated when measuring this type of voltage?
   ______________________________________________________________________

17. What might happen if you short out a 12 volt storage battery?
   ______________________________________________________________________

18. If time exposure to RF is measured at 6 minutes, what happens to RF exposure if the
    signal is only transmitting for half that time?
   ______________________________________________________________________

19. To minimize over-exposure to RF transmit radio waves, always run
   __________________________ amounts of transmit power.

   **PASSING THE EXAM (book pgs. 207-216; CD #4, Track 6)**

1. What number to call to locate an exam site? ________________

2. Typical exam cash cost? ________________________________

3. Complete this NCVEC form____________________________

4. Always be sure to __________________your paperwork.

5. What letters in your first call sign? ______________________

6. What number in your first call sign? ______________________

7. Trade in your first call sign for one with your initials under the _____ call sign program.

8. Its good to learn the code. What chapter covers learning Morse Code? ______________

9. What page will help you locate a VEC examination coordinator? _____

10. What pages discuss RF safety and safe distances? _____________

11. Pages _______ include the cross reference list showing Question Pool question numbers
    and book pages?

   **Bring this completed pre-study homework to class. Have your instructor help you
   with any UNANSWERED questions. If you have correctly completed more than
   80% of these questions, give yourself an A for effort!**

   *Gordon West's Instructor's Guide for 2014-18 Technician Class - Page 54*
Congratulations on completing your pre-study assignment! If you were able to complete most of this homework, you’ll do just fine on your upcoming Technician Class exam.

Be sure to send me your information, found on page 216, for your graduation certificate and manufacturer coupons and band charts. Please don’t forget the stamps on the inside of a LARGE envelope. Let me know how well you did on the test.

Continue to review the book before class and before taking your exam. I look forward to hearing from you soon!

Gordon West, WB6NOA