Valid July 1, 2016 to June 30, 2020
Teaching the Top License!

Amateur Extra Class, FCC Element 4, is the highest ham radio operator’s license, and YOU ARE GOING TO TEACH IT!

You don’t need to be an electronics engineer to teach Extra Class. Some Extra Class instructors may only have the General license, and there are some Extra Class instructors who are college professors with NO ham ticket!

As an amateur radio Extra Class instructor, you have several talents all rolled up in one – interpreter, promoter, topic expert, motivator, and, most important, a classroom leader.

One of your jobs as an Extra Class instructor is to keep your students ON TRACK. This guide closely parallels my 2016 to 2020 Extra Class Element 4 study manual. All of the Extra Class questions have been reorganized into like-topic groupings, and this will cut your teaching time in half. The reorganization also fits nicely into 12 evening sessions, or a two-weekend course offered on successive Saturdays and Sundays.

Teaching your students to pass the Extra Class examination will turn you into an INTERPRETER, rather than an instant expert on everything technical! In fact, you might very well have some specific topic technical experts as part of your ham radio club, and even as class members in your upcoming sessions!

You’ll do fine with Rules and Regulations, skywaves, and working satellites. What? You’re not a satellite expert? Your radio club likely has an AMSAT person who would love to spend a few minutes in your classroom!

Not into digital protocols for APRS? No problem – as an interpreter, get with some APRS gurus in your club, learn some new technology, and then “translate” this information to your students, along with a live-action demo.

The more live-action demos you can provide in class the easier it will be to teach some of these more complex subjects. If a student asks for an explanation of the phase angle and scientific calculator keystrokes, and you might not have that on the tip of your tongue, simply thank that student for a great question and assure him you will bring in an expert to fully explain. The students will appreciate your honesty, and EVERYONE realizes there is no such thing as an Extra Class operator who truly understands EVERYTHING detailed in the book.
In my Extra Class book, I show all the problem solving techniques. This will satisfy the majority of your students and I always keep a copy of the American Radio Relay League’s *Handbook* with me as a ready reference for after-class questions.

I also recommend *Basic Electronics*, by McWhorter and Evans. This fully-illustrated, 224-page, big-print textbook is available through The W5YI Group. *Basic Electronics* offers detailed illustrations and practical, worked-out examples that demonstrate circuit applications, adding more background to my *Extra Class* Element 4 Amateur Radio license preparation manual. *Basic Electronics* also includes quizzes and questions for additional student homework to enhance your students’ understanding of some of the more difficult material included in the Element 4 Question Pool.

As you probably know, there’s nothing like “hands-on-ham” to get students 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 another 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 *Extra 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.

Good news – I have prepared pre-study homework pages in the back of this *Instructor’s Guide* that you may reproduce and give out before your class sessions. Having your students work the pre-study material before class begins makes teaching Extra Class even easier!

This *Instructor’s Guide* also tells you where you can purchase our books at an instructor’s discount, or where you can send your students to obtain their books directly, along with some free additional training materials.

Best success to you in teaching Extra. If you get in a jam, or your students have a specific question, I come with the book – call me during the day at 714-549-5000 and I’ll be happy to be part of your upcoming Extra Class course.

*Gordo, WB6NOA*
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 2016-20 Element 4 Extra 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
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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 occurs when they begin operating over the airwaves. Encourage your General Class students to try more things than just FM repeaters – IRLP, Echolink, tropo ducting – encourage your students to get active with their current General Class privileges!

To encourage them on their preparation for Extra Class high frequency operation, the inside front cover of my Extra Class book contains a link to a one-hour “On The Air” audio course. This FREE download audio course includes all of the excitement found on the Extra Class high frequency bands. Your students will hear all of the sounds of worldwide ham radio that awaits them with their new privileges! www.w5yi.org/page.php?id=367

UPGRADE TO EXTRA CLASS

Your upcoming Extra Class course is specifically for General Class operators with a valid General Class license. General Class is a prerequisite. This makes your ham radio orientation easy – hopefully, all of your students have been on the air, and already understand what ham radio is all about!

Remember, getting the Amateur Extra license to operate on ALL THE BANDS is really like getting a license to expand your ham radio knowledge and skills! 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 Extra Class course? A 12-week class gives you plenty of time, and 9-week classes fit well into community college curriculums. A two-weekend Extra 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 30 hours to completely cover all 712 test questions in the new Element 4 question pool. When you review my book, you’ll see that I have taken the 712 total questions and reorganized them into 16 topic groups. By doing this, the question pool is now much more manageable, and all 712 Q & A’s can be covered during 8 to 12 classroom sessions, each about 4-hours long, meeting once-a-week in the evening. Good class hours are 6 to 10 pm, but students may vote for 5 to 9 pm as an alternative.

If you offer a weekly Extra Class upgrade 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 4 exam. Twelve classes held once a week for 4 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 weekly basis. So be prepared to lose half of your students if you decide to hold a 12-week course.

**WEEKEND SEMINARS - FRIDAY, SATURDAY & SUNDAY**

The most popular courses I teach throughout the country continue to be my 3-day weekend seminars. They begin Friday afternoon and evening, Saturday around 8 am and go ‘til 6 pm, and resume on Sunday from 8 am to test-taking around 5 pm, with graduation at 7 pm.

The big selling point for the two-weekend Extra upgrade ham radio seminar is that your students think that in just two weekends 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 *Extra Class* book, looking over all of the 712 questions in a reorganized 16-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.

*Gordon West's Instructor's Guide for 2016-20 Extra Class* - Page 5
The attrition rate you can expect in a two-weekend 3-day seminar-style course should be less than 10 percent. You also will draw much larger numbers of students to the two-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 Extra Class average more than 50 students. For the Extra Class, now that there’s no longer any 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 712 Q&As in the scrambled Element 4 question pool. If you were to try to teach the 712 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 16 logical topic groups in my book, you can easily teach the entire 712 question pool in two weekends 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 2016-2020 *Extra Class* book. The questions in the pre-study homework precisely follow the reorganized Q&As as presented in my *Extra Class* book.

Pre-Study Q&As that guide students using my *Extra Class* book and/or my exclusive audio theory course on 6 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 *Extra Class* book, plus the *Basic Electronics* book.

In addition to the fill-in-the-blanks home-study workbook, I also expect the students listen to the 6 audio CDs that I have recorded that cover Extra 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!

And be sure your students listen to the audio course listed in the front of their *Extra Class* book. It will really give them a preview of the fun that awaits them on the worldwide HF bands.

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 two 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 two-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 two of the 3-day 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 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, instantly zapping your teaching time line, 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 two questions out of 712 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 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, make sure to login to your account on the W5YI HamInstructor.com website and post 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 via your class posting on the website.

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 Extra. 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 upgrades hit the airwaves. So regularly work the clubs, support what they are doing, and you’ll probably find they will support you in a big way!
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 HF dipole and HF vertical 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 worldwide radio to let your students listen in on all of the excitement that is out there. This radio goes 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 and call sign 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 “Party Store” 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.
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 Extra 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 Extra class.

**Your assignment:**

Begin by listening to the one hour audio program that accompanies your students’ Extra Class book. There are some exciting sounds that you may wish to play in class as part of your demonstrations. Download the audio course at www.w5yi.org/page.php?ID=367.

**READ & REVIEW PAGES iv AND SKIM CHAPTER 1**

These first 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 Chapter 1 on pages 1 through 8. Chapter 1 briefly describes to your students the excitement awaiting them as Extra Class 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 1 fully explains all of the frequencies they will earn with their Extra Class license that they will achieve in your upcoming class. Chapter 1 has some excellent band plans that illustrate all of the excitement on the popular HF bands. Since YOU have already been on the air, you can skim the privileges, but please note that on page 2, 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 gain as a new Extra Class operator!

**Your assignment:**

**CHAPTER 2 IS IMPORTANT FOR YOU! A LITTLE HAM HISTORY**

I suggest that you carefully review 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 Extra exam and get on all the HF airwaves. 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!

*Gordon West’s Instructor’s Guide for 2016-20 Extra Class – Page 11*
CHAPTER 3 GETS YOU READY TO TEACH THE COURSE

Chapter 3 – *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 Extra Class question pool, valid 2016 through 2020. Let them know that many questions are asked two and three times over with slightly different wording. This means they are only studying around 300 question topics.

Page 18, *Table 3-1*, shows the new Element 4 syllabus, total questions in each sub-element, and the number of questions taken from each subelement to make up their 50-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 E7 in this Table, they’ll discover that only 8 test questions on their upcoming exam will be taken from this subelement. They’ll breathe a sigh of relief!

**Your assignment:** Turn to page 20

*WHY I REORGANIZED THE QUESTION POOL*

Pay careful attention to pages 20-21. This explains why I decided to reorganize all of the Q&As in the new 2016-20 Element 4 pool into the 16 logical topic groups. Here’s some background.

Each of the three amateur radio question pools is developed by the National Conference of Volunteer Exam Coordinators’ Question Pool Committee. The abbreviations are “NCVEC” and “QPC.” When the QPC developed the new 2016-20 Element 4 question pool, it was after the Federal Communications Commission “re-farmed” the high frequency bands, allowing for expanded voice privileges and the re-defining of CW/data frequencies. This was also after the FCC released its Rule Making that eliminated the Element 1 CW test requirement. These FCC actions have ALL been accounted for in our new *Extra Class* 2016-20 training manual, and this *Instructor’s Guide* for teaching Extra Class.

The Question Pool Committee also eliminated older Extra Class questions that were no longer valid with new technology. The QPC also ADDED new Extra Class questions to better reflect the new technology in high frequency ham radio communications. This makes this new question pool FRESH, and that makes it easier for you to teach!

The new question pool, consecutively numbered by the QPC, continues to present an illogical grouping of similar questions, separated throughout the pool. As one example of our reorganization efforts, several questions on DATA were originally grouped in both Subelement E2, Operating Procedures, and over at Subelement E8, Signals and Emissions. In my new *Extra Class* book, I have grouped DATA questions together in digital operating, placing all questions, one after another, for easy teaching.

Each question and answer choices in the book is followed my upbeat description of the correct answer. And NEW in this book is another terrific study aid – the correct A, B, C, or D answer is listed at the END of the description, not tipping the student off BEFORE reading the
description! This way, your students will read the entire description of the correct answer, and then verify that the correct answer they chose is, indeed, the correct answer on the exam.

Are all of the 712 questions in the book? Absolutely! Look at page 284 and 285, and see the cross-reference of the QPC question order and the specific page where it appears in the book. And a quick glance at our page numbers in this cross-reference will clearly show you our unique reorganization of the entire question pool was needed!

I have been using this rearranged teaching technique for the last 40 years – going all the way back to Novice class – AND IT WORKS! This rearranged question technique also allows you to bring in additional books to further illustrate a specific topic. Best of all, you won’t need to jump around in your training materials because I have grouped all of the 16 logical areas together. And I purposely don’t blow our students away by starting out with digital AND gate and NAND gate problems. I get them baited and on the hook by first reviewing all those questions dealing with the excitement of high frequency operating on their new Extra Class frequencies.

**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 19 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 Program, and for a discount, too.

Now check out our cartoon friend Elmer, who provides numerous Elmer Points in shaded boxes surrounded by a CW border. This breaks up the copy and adds a smile to your instruction. Elmer and his Points 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!
Extra 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 Extra Class book for 2016-2020. I rearranged all of the Q&A in the new question pool into 16 topic groups based on how you should teach Extra class, 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 16 topic areas, grouped into class sessions, based on a 12 week course. You may combine groups for a shorter class schedule. You should be able to cover all of the topics included in each group during the course of a 3 hour session.

<table>
<thead>
<tr>
<th>Session No.</th>
<th>Topic Areas</th>
<th>Pages to Cover</th>
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<tbody>
<tr>
<td>1</td>
<td>Amateur Extra Class – The Highest Grade License</td>
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</tr>
<tr>
<td>2</td>
<td>FCC Rules and Regulations</td>
<td>23 – 41</td>
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<tr>
<td>3</td>
<td>Skywave Propagation</td>
<td>42 – 64</td>
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<td></td>
<td>Space Communications</td>
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<td></td>
<td>Video Modes</td>
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<tr>
<td>4</td>
<td>Digital and Computer Operations</td>
<td>85 – 99</td>
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<td></td>
<td>Modulation</td>
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<td>Receivers and Filters</td>
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<td>Oscillators and Synthesizers</td>
<td>149 – 159</td>
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<td>Mid-Course Review</td>
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<td>Circuits and Resonance</td>
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<td>8</td>
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<td>191 – 204</td>
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<td>9</td>
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DO SOME MORSE CODE

On February 23, 2007, the FCC eliminated the requirement of passing a Morse code test. And now that classroom testing for the CW test is no longer required by the Federal Communications Commission, guess what? YOUR STUDENTS WILL WANT TO LEARN MORSE CODE! They no longer fear the dreaded Morse code tests at the end of the class sessions, so now their minds are wide open to learn Morse code. Give them code practice! This will make them better hams when they get on the HF airwaves.

In each class session, begin teaching Morse code on a straight key or electronic keyer. This introduces your students to the new sounds of dits and dahs and they will actually enjoy code practice in class. Follow the exact progression of learning Morse code characters on my exclusive CW audio CDs from W5YI.

You might even generate a simple fun Morse code “Graduation Test” at the end of the Extra Class course:

VVV VVV THIS IS AN AMATEUR RADIO MORSE CODE TEST. IF YOU CAN COPY WHAT I AM SENDING, STAND UP AND TAKE A BOW.

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 CDs or a computer code program. Do it live yourself for maximum effect.

I also recommend you do some code over 40 meters, 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.
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 16 topic areas. Here’s a host of “show and tell” ideas – keyed to the topic areas in my book – to help 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.

Also review Basic Electronics, and keep your ARRL Handbook available as a student classroom reference.

Rules & Regulations (pages 23 - 41)
♦ Show a sample copy of a CSCE
♦ NCVEC form 605
♦ Old Callbook
♦ Copy of Ham license
♦ FCC Rulebook, CFR 74, Part 97 (available in quantity discounts from the W5YI Group)
♦ Show an active Log book and a computer Log of the World
♦ Show an OO postcard
♦ Quick demo of Fox-hunting
♦ Talk about satellite and space shuttle programs
♦ Discuss third party rules
♦ Review regulations for operating in a foreign country
♦ Show VE credentials
♦ Show a properly filled-out CSCE
♦ Explain penalties for deliberate VE misconduct

Propagation (pages 42 - 64)
♦ 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.
♦ Listen to signals on different bands.
♦ Show HF, VHF, UHF on the board.
♦ Make contacts on 40 or 20 meters.
♦ Have students identify wavelength when looking at a radio’s frequency.
♦ Bring in a radio-controlled small drone or car. 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.
♦ 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 15 meters.

Space Communications (pages 65 - 76)
♦ Hand out AMSAT brochures.
♦ Show satellite passes on your I-Pad.
♦ Show and Arrow handheld satellite antenna.
♦ LISTEN to a satellite pass.
♦ Play EME audio from the On The Air CD.

Video Modes (pages 77 - 84)
♦ Explain the difference between analog and digital modes
♦ LISTEN to an analog FM signal, then tune in a digital one.
♦ Show ATV reception
♦ Show CRT.
♦ Show CRT vs. LCD display.

Digital Modes (pages 85 - 99)
♦ Bring in your lap-top computer with an HF radio on an outside antenna. Tie it in with a TNC (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 20 meters, 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 QSL cards.

♦ Play some of the sound tracks from the audio download course included with the book.

**Modulation (pages 100 - 116)**

♦ Bring in and turn on, older tube radio

♦ Show off new transistorized HF radio

♦ Open up radio and show various transmitter stages

♦ Transmit into dummy load and show modulation on an oscilloscope

♦ Demonstrate oscilloscope patterns

♦ Show a small tube RF amplifier

♦ Show individual crystal elements

♦ Show tube set loading into an antenna

♦ Demonstrate dummy load and watt meters

♦ Talk about dangers around high voltage amplifiers

♦ Demonstrate a spectrum analyzer.

♦ Demonstrate oscilloscope modulation waveform.

♦ Demonstrate Peak reading wattmeter.

♦ Show high pass and low pass filter elements.

♦ Show a small duplexer.

**Amplifiers and Power Supplies (pages 117 - 128)**

♦ Bring in a small tube amplifier.

♦ Bring in a solid-state amplifier.

♦ Demonstrate a filter capacitor and WARN of danger.

**Receivers and Filters (pages 129 - 148)**

♦ Open up HF tube radio and show receiver section

♦ Show receiver in a solid state HF radio

♦ Demonstrate digital signal processing

♦ Demonstrate different filters

♦ Demonstrate notch filter

♦ Show how to read an “S” meter

♦ Demonstrate the use of a signal tracer
**Oscillators and Synthesizers (pages 149 - 159)**
- Demonstrate oscillators with a pendulum
- Show off vacuum tubes
- Demonstrate transistorized transceivers
- Do voltage checks on transistors
- Demonstrate light emitting diodes
- Show an LCD display, and let it bake in the sunlight
- Show off a binary counter chip
- Bring in a programmable scanner to demonstrate memory

**Circuits and Resonance (pages 161 - 190)**
- Show off antenna traps.
- White board impedance demonstrations.
- White board Polar Coordinates demos.
- Small vs. Large antenna coils and Q.
- Show filter networks within a rig.
- Grain of wheat bulb to demonstrate time constants from a charge capacitor.

**Various Electrical Principles**

*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.
- 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 light bulb.

*Courtesy of Forrest M. Mims, III*
♦ 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!!

**Components (pages 191 – 204)**

♦ Teach students how to read the schematic on page 129

♦ Pass around resistors, capacitors, switches, and transformer

♦ Teach resistor color code

♦ Teach to solve resistors in series and parallel

♦ Teach to solve capacitors in series and parallel

♦ Teach to solve inductors in series and parallel

♦ Demonstrate reactance with a permanent magnet down an aluminum tube

♦ Show off torroidal inductor

♦ Demonstrate SAFELY a live step up and step down transformer with a volt meter

♦ Show inside of radio and placement of coils
Logic (pages 205 - 214)
- White board time for digital logic.
- Hand around small logic components and ICs.
- Demonstrate a marker generator.
- Show a frequency counter in action.

OpAmps (pages 215 - 222)
- White board time for OpAmp gain.
- Show OpAmp filter network.
- Demonstrate a photo cell.
- Demo an OPTO-Coupler and Optical Shaft Wheel.

Test Equipment (pages 223 - 229)
- Demonstrate a spectrum analyzer.
- Show a logic probe.
- Demonstrate a frequency counter.
- Demo a bench oscilloscope.
- Demonstrate needle and digital volt meters.

Antennas (pages 231 - 251)
- Start by making a simple dipole for 10 meters.
- Have students build their own different dipole on different bands.
- Have students build a quarterwave ground plane for 10 meters 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.

Courtesy of Forrest M. Mims, III
♦ Show antenna modeling on your computer.
♦ Bring in a small cubical quad antenna.
♦ Illustrate polarization with wire and an automatic HF antenna tuner.
♦ Talk about the little rubber duck antenna.
♦ 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 HF 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.

**Feedlines and Safety (pages 253 - 273)**
♦ 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 HF 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 dB 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.
♦ Bring in various coaxial cable segments and parallel conductor feedlines.
♦ Demonstrate an antenna analyzer.
♦ Demo an electric Smith Chart.
♦ Hand out blank Smith Charts for calculations.  

![Diagram](image)

*Courtesy of Forrest M. Mims, III*

♦ Demonstrate a 10 or 24 GHz dish system (on receive only!!).

*Remember – EVERYONE loves the excitement of live ham radio demos! They are the key ingredient for a successful, memorable ham radio course!!*
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 CDs, & 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. Gordo’s educational, fun 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 CDs contain live sounds of radio, plenty of sound effects, and Gordo’s humor to keep students playing the CDs over and over again.

**Code CDs.** Teaching the code? If you're planning to teach Morse code, Gordo has an in-depth set of 8 audio CDs that students love because of the humor that is on them – they make learning the code fun. I also have a 2 CD code refresher. 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, spaced to 5 wpm word rate.
EXOTIC DEMO TOOLS & PROPS

If you are not into building your own plasma tube, or your own Tesla coil, two commercial educator/experimenter companies have you covered big time: Information Unlimited Amazing Devices (www.amazing1.com, 800-221-1705) and Edmund Scientifics (www.scientificsonline.com, 800-728-6999). Visit their websites and give them a call to order items. 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, DISCOUNT COUPONS & 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 Extra Class book, go to 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

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.

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<th>Company</th>
<th>Description</th>
<th>Website</th>
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<tr>
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<td>LDG Electronics</td>
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<td>MFJ Enterprises</td>
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<td>W5YI Group</td>
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<td>W &amp; W Associates</td>
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<tr>
<td>Yaesu Electronics</td>
<td>frequency charts, world maps</td>
<td><a href="http://www.yaesu.com">www.yaesu.com</a></td>
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</table>
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 Yaesu, Kenwood, and Icom 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 – 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 it has been determined that the above named candidate possesses the necessary operational and technical qualifications required by international treaty and domestic telecommunications regulations to be an FCC Licensed in the U.S.Amateur Radio Service.

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 Licensed in the U.S.Amateur Radio Service.

Date: __________________________

Class of licence: __________________________

Signature: 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 an upgrade 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 2016-20 Extra 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!!
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  
2414 College Drive  
Costa Mesa, CA  92626

or you may e-mail me at:  
WB6NOA@ARRL.NET

So what are you waiting for? Start looking over my *Extra Class* book, play the CDs from my audio course, be sure to listen to the “On The Air” audio course included for download in my book, 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 EXTRA CLASS Element 4 pre-study homework. The upcoming class is absolutely NOT a “cram session” followed by the test. Rather, your upcoming class will take your textbook questions and answers and relate them to the real world of ham radio operating, as an upgrade from General or Advanced Class to EXTRA CLASS!

This pre-study Q&A assignment is straight out of our Gordon West Extra Class book, valid July 2016 through June 2020. The fill in the blank questions in this pre-study guide follow the exact order of the Gordon West book. Questions have been rearranged for easier concept learning, and we even give you page numbers and audio CD references to quickly spot the correct answer.

We also reference technical questions that are detailed in the Basic Electronics book, which may be part of your course or ordered directly from the distributor 1 800 669 9594 (developed and published by Master Publishing, Inc., McWhorter and Evans)

You can also take practice exams using The W5YI Group HamStudy computer software specifically developed to go along with my book.

This pre-study homework is fill-in-the-blank. Your actual Element 4 written examination will be multiple choice – all the easier.

Begin reading over your Extra Class book and start filling in the home study answers. Also consult Basic Electronics (which we will abbreviate BE), and we give you page numbers to find the answers. Be sure to bring your completed home study notes to the first class session.

Good luck with your study! I hope to hear you on the Extra Class airwaves very soon!!

Gordon West
WB6NOA

To order the Gordon West Extra Class book, go to
www.w5yi.org
or call 1-800-669-9594
EXTRA CLASS PRIVILEGES (pages 1 – 8)

1. X refers to the Gordon West Extra Class book. BE refers to the optional Basic Electronics book. Got both? ________________________________________
2. On which bands do you gain 25 kHz window of exclusive CW privileges at the bottom of each band? ________________________________________
3. When you get to Extra, you gain ________ kHz of additional voice and data privileges?

4. On 75 meters, your Extra Class voice privileges, not shared with other operators, are from ________ MHz to ________ MHz?
5. On the popular 20 meter band, Extras have non-shared voice privileges from ________ MHz to ________ MHz.
6. As an Extra Class operator, you may test for all levels as a V ________ E _________.

HAM RADIO HISTORY (pages 9 -16)

1. How many hams in the USA? ________________________________________
2. How old is the amateur radio service? ________________________________________
3. In 1979, what test was eliminated for operation above 30 MHz? ________
4. In 2007, what test requirement was eliminated for high frequency licensing?

5. When did Volunteer testing begin? ________________________________________
6. Which test element is Element 2? ________________________________________
7. Which element is Element 3? ________________________________________
8. Which element is Element 4? ________________________________________
9. May an applicant go from Technician to Extra without taking the General Element?

GETTING READY FOR THE EXAM (pages 17 – 21)

1. How many test questions are on upcoming Extra Class Element 4 exam? ________
2. Answer ________ or more correctly, and you pass!
3. Confirm: Is your General Class license current? ________________________________________
4. Important: When you pass your Extra Class exam, the license term still remains the same – you DON’T automatically get 10 more years before renewal. Check your General license renewal date. This is when your new Extra Class renewal is due. Luckily, no re-test is required!
5. What does Extra subelement E9 cover? ________________________________________
6. After my rearrangement of topics, how many topic areas are there? ________
7. OK, I scrambled the question numbers – where will you find the cross reference? p ________ to p ________? Hint: back of the book!
8. If you haven’t already, it’s time to download and play the audio course in the front of the book. Did you play it? ________________________________________
RULES AND REGULATIONS (p 23 - p 41)

1. When operating USB, how close to the top of the band may you operate? ______
2. How much power output on 60 meters? ______________________________
3. How much power output on 30 meters code and data band? _________________
4. With an Extra ticket, you gain authority in most ___________________ countries.
5. Where is line A restriction for portions of 70 cm? _______________________
6. What type of control for a common repeater up on a mountainside? __________
7. Where may repeater operation take place on 10 meters? __________________
8. Minimum age limit to become a Volunteer Examiner? ___________________
9. What is issued to an examinee after passing a test element? _________________
10. Fraudulent exam results might cost a VE team their own_______________?

PROPAGATION (p 43 – 64) BE (p 108 -119) Take the quiz for extra credit!

1. What are the two fields in an electromagnetic wave? _______________________
2. What is the polarization of an antenna whose ELECTRIC field is perpendicular to the surface of the earth?

__________________________________________________________
3. Which ham band provides great DX for nearly 24 hours? __________________
4. Twilight conditions between two distant stations may lead to fantastic DX, called ____________

_________________ propagation?
5. Best band for a meteor scatter contact? ________________________________
6. What’s that “horn” you see in the sun photo on p 47? ___________________
7. A VHF/UHF contact, sometimes lasting for days between stations separated 2000 miles over the ocean is called

_________________ _________________?
8. You tune in on a DX station on 14.120, who indicates they are listening “up 35”. Where should YOU transmit?

________________________________________

SATELLITE AND SPACE COMMUNICATIONS (p 65 – 76)

1. Which class of amateur license allows satellite communication? ___________
2. What band do you receive on for satellite mode V/U? _____________________
3. Why does a satellite signal tune in higher as it is coming up toward you from the horizon?

__________________________________________________________
4. What type of satellite appears in one steady position in the sky? ____________
5. Where might you find CW and data moon bounce communications on 2 meters?

__________________________________________________________
6. The best time to complete a moon bounce contact is when the moon is at

__________________________________________________________
VISUAL AND VIDEO (p 77 – 84)
1. Amateurs still use analog ham radio TV transmissions. What is the name of the video signal that carries color information? _______________________________
2. Ham analog video fast scan TV is wide! - ______________MHz . Where on high frequency is a reserved spot for slow scan television? _________________MHz
3. On older oscilloscopes, if we exceed ____________________ we could cause the cathode ray tube to generate X-rays.
4. What is the big benefit of a liquid crystal display? ______________________________

DIGITAL (p 85 – 99) BE (p121 – 133) Take the quiz for extra credit!
1. What digital mode is common below 30 MHz? ______________________________
2. Which digital mode to transfer binary files? ______________________________
3. What is the formula to determine digital band width? _______________________
4. Watch this level when adjusting PSK31? ________________________________
5. How might we send our position over the air? ______________________________
6. What is the common 2 meter frequency for sending digital position bursts? ______________________________
7. Spread spectrum transmissions are allowed above ______________MHZ?
8. What is the maximum transmitter power for spread spectrum? _____________watts
9. What is the formula for calculating CW band width? _______________________

MODULATION (p 100 -116) BE (p115 – 117) try the quiz on p 119
1. What is the formula for modulation index? ______________________________
2. What is the formula for deviation ratio? ________________________________
3. What type of wave consists of a sine wave plus all ODD harmonics? __________ wave
4. What influences power output measured on your SSB peak reading watt meter? __________ characteristics
5. What is RMS voltage on your wall socket? ______________________________
6. What would be the Peak voltage on your wall socket? _____________________
7. What stage can generate an FM phone emission? _________________________
8. How might we generate an SSB phone signal? ____________________________
9. What does DSP stand for? ________________________________
10. Which components in the upper arm of a filter will create low-pass? ______________________________
11. Which components in the upper arm of a filter will create high-pass? ______________________________
12. What is it called when too close proximity repeaters have signal mixes and create unwanted interference? __________________________________________
13. What are those large cans seen at repeater sites? __________________________
AMPLIFIERS & POWER SUPPLIES (p117 – 128) BE (p87 – 88, p17 -26)

1. Which amplifier class offers best linearity with least distortion? ______________
2. Which amplifier type eliminates even-order harmonics? ________________
3. Which amplifier type offers best efficiency, but poor linearity? _______________
4. What is the process for preventing unwanted oscillations in a power amplifier? _____________________________________________________________________________
5. What devices do we find at UHF for power amplifier applications? _____________________________________________________________________________
6. What device is used as a stable reference voltage in a linear voltage regulator? _____________________________________________________________________________
7. What circuit is shown in figure E7-3? _____________________________________________________________________________
8. What is the purpose of a bleeder resistor? _____________________________________________________________________________
9. Watch out for this component – it can store a LETHAL voltage, even after the circuit is turned off? _____________________________________________________________________________

RECEIVERS & FILTERS (p129 – 148)

1. Which component in your radio develops the piezoelectric effect? _____________________________________________________________________________
2. Which filter has no ripple and good attenuation beyond the passband? _____________________________________________________________________________
3. The rearranged formula for determining intermodulation interference, frequency 2? _____________________________________________________________________________
4. Is -174 dBm great or fair for receiver sensitivity? _____________________________________________________________________________
5. You SSB voice filter network has this selectivity or greater? __________ kHz _____________________________________________________________________________
6. Where is most of the noise coming from over your high frequency station antenna system? _____________________________________________________________________________
7. What device provides rectification and filtering of RF signals? _____________________________________________________________________________
8. What occurs within the mixer circuit if you introduce excessive pre-amplification? _____________________________________________________________________________
9. Noise blankers are good for eliminating this type of interference? _____________________________________________________________________________
10. What does DSP stand for? _____________________________________________________________________________

OSCILLATORS & SYNTHESIZERS (p149-159) BE (p98-100, 153-174 TOPICAL REFERENCE)

1. The oscillator that uses a quartz crystal? _____________________________________________________________________________
2. Common oscillator for VFOs? ________________________________
3. What does PLL stand for? ________________________________
4. What does DDS stand for? ________________________________
5. What are the unwanted components of DDS? ____________

**RESONANCE - Don't Panic! (p161-190) BE (p54)**

E = voltage  L = inductance in a coil  I = current  C = capacitive reactance in a capacitor

1. In an ELI circuit, is it voltage or current LEADING? ________________
2. In an ICE circuit, does current LEAD or LAG? ________________
3. When working phase angle questions on the test, most correct answers start off with __________ degrees?
4. A (+j) reactance is inductive or capacitive? ________________
5. A circuit (-j) is capacitive or reactive? ________________
6. What coordinate system may display the phase angle of circuits containing resistance, inductance and/or
capacitive reactance? ______________________
7. In polar coordinates, when inductive reactance cancels capacitive reactance, leading only to resistance in series,
what is the phase angle? _____ degrees?
8. Formula to determine half-power bandwidth? ________________________________
9. In a time constant circuit, how many time constants for a capacitor to be charged 63.2 per cent of the supply voltage? ______________ time constants
10. What page in the Gordo book allows you to visualize time constants? ______
11. As frequencies increase, RF current flows in a thinner layer of the conductor, close to the surface. What is this
called? ______________________
12. What is the term for out-of-phase non-productive power within a coil or capacitor? ______________________
13. Formula for computing true power? ________________________________
14. Advantage of a toroidal core inductor? ________________________________

**COMPONENTS (p 191-204) BE (p 59 -84 topically) For extra credit,
complete the quiz for Chapter 4 BE**

1. Draw a PNP transistor. ______________________________________
2. Draw an N-channel dual gate mosfet ______________________________
3. What diode amplifies and oscillates? ______________________________
4. Draw a varactor diode ______________________________
5. Input voltage to a logic “low” in an old TTL device? ________________
6. What is a MMIC? ______________________________
7. MMIC devices require ______________ volts?
1. Draw the symbol for an AND gate ________________________________
2. You can spot an OR gate symbol by a ______________________ on its nose.
3. A list of inputs and corresponding outputs for a digital device is called a _____________________.
4. This provides receiver calibration ____________________________?
5. What does OP-AMP stand for? _________________________________
6. Formula for the gain of an inverting IC OP-AMP? ____________________________
7. Typical output impedance of an integrated circuit OP-AMP? _________________
8. The tuning shaft and LED shine through this device? _______________________
9. What absorbs energy when light shines on a photovoltaic cell? _______________

**TEST EQUIPMENT (p223 -229)**

1. This instrument shows frequencies on the horizontal axis ______________________
2. This instrument indicates pulses in a digital logic circuit. _________________
3. This instrument measures frequencies. ________________________________
4. An increase in current on an RF ammeter in series with the antenna feedline indicates less or more current to the antenna? _____________________________
5. What type of meter shows a traditional needle movement? ________________

**ANTENNAS (p231 - 251)**

1. Do you want maximum or minimum radiation resistance of an antenna? ________________
2. What’s missing on an HF quarter wave antenna? ____________________________
3. What provides the best RF ground to Earth? ______________________________
4. What provides the best RF ground aboard a sailboat? ______________________
5. What is the approximate feedpoint impedance of a half wave dipole? _________
6. What is the approximate feedpoint impedance of a folded dipole? ____________
7. What antenna has no gain in any direction? _______________________________
8. To improve radiation efficiency of a mobile antenna, add a _____________________ to increase top loading?
9. What antenna might produce patterns seen on page 239? ________________
10. Increasing the boom length does what for a Yagi antenna? ________________

**SAFETY (p 253 – 273)**

1. What is one type of matching network to a Yagi antenna? ________________
2. What instrument allows you to test antenna resonance? ________________
3. What is the typical velocity factor of coax cable with a solid polyethylene dielectric? ________________
4. P. 232, that little bird is sitting on which element of my stacked two meter Yagi? ______________________

5. Which chart allows you to calculate impedance along transmission lines? ____________________________

6. Why don’t we see more rhombics in downtown neighborhoods? ________________________________

7. The bigger the dish, beamwidth ____________________________?

8. What does SAR measure? ________________________________

9. What type of direction finding requires multiple bearings at multiple locations? ____________________

CONGRATULATIONS ON COMPLETING YOUR PRESTUDY ASSIGNMENT!

Congratulations! You have completed your Extra Class home study workbook assignment. Don’t worry if there are a couple of blanks in your paperwork. We hope you were able to find MOST of the answers.

If you have a technical background, the Basic Electronics book goes into great detail in specific areas of Extra Class study. These specific details may go well beyond the requirements of your Extra Class exam, but this book should become a handy reference for you.

Bring your completed workbook to your Extra Class session. Your instructor will be very impressed! If you were able to complete some of the quizzes in the Basic Electronics book, bring these too – extra credit!

We look forward to hearing of your Extra Class examination success!

When you pass the examination, be sure to send for your FREE graduation certificate and band charts. Page 282 gives you all the details.

I look forward to seeing or hearing you on the airwaves soon!

Gordon West
WB6NOA