Amateur Radio Technician Class License Study Guide

For use July 1, 2006 to June 30, 2010

Compliments of:

Earl Paazig
N8KBR

American Red Cross
Yolo County Chapter

Yolo County ARES

Amateur Radio Technician Class License Study Guide

(For use July 1, 2006 to June 30, 2010)

Compliments of:

Earl
N8KBR

Source Material is Publicly Available

Question Pool of 393 questions released 6 Feb 2006
and CFR Title 47, Part 97, Amateur Radio Service.

Revision Date: 12/19/2006

Foreword

This document is simply a compilation of the publicly available question pool which has been converted into statements and formatted. The intent was to retain as much of the original words from the question pool as possible to leverage familiarization in the learning and memory process. The 15 terms most frequently used in the text are:

amateur	**emergency**	**power**
antenna	**exam**	**radio**
call	**FCC**	**repeater**
communications	**frequency**	**signals**
control	**license**	**station**

The author's hope is that this document might be useful as a resource in studying for the Element 2, Technician Class License Amateur Radio Exam.

Table of Contents

SUBELEMENT T1 - FCC Rules and Station Licensee Responsibilities
[4 exam questions – 4 Groups]

T1A [1 exam question]

Basis and purpose of the Amateur Radio Service
- An Amateur Radio Station is a station in an Amateur Radio Service consisting of the apparatus necessary for carrying on radio communications.
- An amateur operator as defined in Part 97 is a person named in an amateur operator/primary license grant in the FCC ULS database.
- One of the basic purposes of the Amateur Radio Service as defined in Part 97 is to provide a voluntary noncommercial communications service to the public, particularly in times of emergency.
- Two of the five fundamental purposes for the Amateur Radio Service are to increase the number of trained radio operators and electronics experts, and improve international goodwill.

Penalties for unlicensed operation, other penalties
- The Federal Communications Commission makes and enforces the rules for the Amateur Radio Service in the United States.
- Harmful interference is a transmission that disturbs other communications.

Examinations
- The classes of US amateur radio licenses that may currently be earned by examination are Technician, General, and Amateur Extra.
- A Volunteer Examiner (VE) is an amateur accredited by one or more Volunteer Examiner Coordinators (VECs) who volunteers to administer amateur license exams.
- A Certificate of Successful Completion of Examination (CSCE) is valid for license upgrade purposes for 365 days.
- Three Volunteer Examiners holding a General Class license or higher are required to administer an Element 2 Technician written exam.

T1B – [1 exam question]

ITU regions
- International Telecommunication Union (ITU)
- The purpose of ITU Regions is to assist in the management of frequency allocations.

International regulations
- You are allowed to operate your amateur station in a foreign country when there is a reciprocal operating agreement between the countries.

US call sign structure
- The FCC uses a system, called the Sequential Call Sign System, where call signs are assigned in sequential order to select new amateur radio call signs.
- An amateur radio club would obtain a club station call sign by applying through a Club Station Call Sign Administrator.
- The letters, A, K, N and W, must be used for the first letter in US amateur call signs.
- A single digit, 0 through 9 number is used in US amateur call signs.
- KB3TMJ is a valid US amateur callsign.

Special event calls

- Any FCC-licensed amateur is eligible to apply for temporary use of a 1-by-1 format Special Event call sign.

Vanity call signs

- You would use the vanity call sign program to obtain a call sign containing your initials.

T1C – [1 exam question]

Authorized frequencies (Technician), operation near band edges

- The frequency, 52.525 MHz, is within the 6-meter band.
- You are using the 2 meter band when you are transmitting on 146.52 MHz.
- The 70-centimeter frequency, 443.350 MHz, is authorized to a Technician class license holder operating in ITU Region 2.
- The 23 centimeter frequency, 1296 MHz, is authorized to a Technician class license holder operating in ITU Region 2.
- If you are operating on 223.50 MHz then you are operating on the 1.25 meter amateur band.

Reciprocal licensing

- You must be named in the FCC amateur license database, or be an alien with reciprocal operating authorization before you can control an amateur station in the US.
- A US amateur license allows you to transmit from wherever the Amateur Radio Service is regulated by the FCC or where reciprocal agreements are in place.
- A US amateur operator may communicate with an amateur in a foreign country at any time unless prohibited by either government.

Spectrum sharing

- When authorized by the FCC, amateur stations are allowed to communicate with stations operating in other radio services.
- Communications on a regular basis that could reasonably be furnished alternatively through other radio services are *not* permitted in the Amateur Radio Service.
- When an amateur frequency band is said to be available on a secondary basis, amateurs may *not* cause harmful interference to primary users according to the FCC rules.

T1D - [1 exam question]

The station license

- The government agency that grants your amateur radio license is the Federal Communications Commission (FCC).
- The FCC issues operator/station licenses in the Amateur Radio Service.
- Anyone except a representative of a foreign government can become an amateur licensee in the US.
- There is no minimum age requirement to hold an amateur license.
- You may transmit after passing the required examination elements for your first amateur radio license and as soon as your license grant appears in the FCC's ULS database.
- Your responsibility as a station licensee is to ensure your station is operated in accordance with the FCC rules.

Correct name and address on file

- The FCC requires the station licensee mailing address to be kept up to date on the Universal Licensing System (ULS) database.
- An Amateur radio operator must have a correct name and mailing address on file with the FCC to receive mail delivery from the FCC by the United States Postal Service.
- The FCC may revoke or suspend a license if the mailing address of the holder is not current with the FCC. If mail is returned to the FCC as undeliverable this could be a cause.

License term, renewals, grace period

- The normal term for an amateur station license grant is 10 years.
- You are not permitted to continue to transmit if you forget to renew your amateur license and it expires. Transmitting is not allowed until the license is renewed and appears on the FCC ULS database.
- The grace period during which the FCC will renew an expired 10-year license without re-examination is 2 years.

SUBELEMENT T2 - Control operator duties – [4 exam questions – 4 groups]

T2A – [1 exam question]

Prohibited communications: music, broadcasting, codes and ciphers, business use

- An amateur station is *never* authorized to transmit information to the general public.
- Amateurs *may not* transmit music, except as incidental to transmissions from manned spacecraft.
- An amateur station may *never* transmit false or deceptive signals?
- Indecent and obscene language is specifically prohibited in the Amateur Radio Service.
- Broadcasting is defined as: Transmissions intended for reception by the general public, either direct or relayed.
- Broadcasts intended for reception by the general public *may not* be transmitted in the Amateur Radio Service.
- Calls to your employer requesting directions to a customer's office are *prohibited* when using a repeater autopatch.

Permissible communications, bulletins, code practice, incidental music

- Transmission of codes or ciphers is allowed to hide the meaning of a message transmitted by an amateur station *only when* transmitting control commands to space stations or radio control craft.
- An amateur station may transmit unidentified communications *only when* sent from a space station or to control a model craft.
- The FCC allows an amateur radio station to be used as a method of communication for hire or material compensation *only when* in accordance with part 97 rules.
- You may use your amateur station on an *occasional basis* to tell people about equipment you have for sale when you are offering amateur radio equipment for sale or trade.

T2B – [1 exam question]

Basic identification requirements, non-voice modes, mobile and portable operation

- You must transmit you callsign to identify your amateur station.
- A transmission that does not contain a station identification is unidentified communications or signals.
- An amateur station must transmit the assigned call sign every 10 minutes during communications and at the end of each communication.
- Each station must transmit its own call sign when two amateur stations end communications.
- The longest period of time an amateur station can operate without transmitting its call sign is 10 minutes.
- You must identify using the English language to identify your station when you are speaking to another amateur operator using a language other than English.
- When operating while using a special event call sign you must identify using your assigned call sign once per hour.
- When using one or more self-assigned indicators with your assigned call sign the indicator must not conflict with an indicator specified by FCC rules or with a prefix assigned to another country.
- The correct way to identify when visiting a station is send his call sign first; followed by your call sign, if you hold a higher class license than

that of the station licensee and you are using a frequency not authorized to his class of license.
- When exercising the operating privileges earned by examination upgrade of a license, the indicator "/AG" means Authorized General.

Repeater ID standards
- All of the following are acceptable methods of transmitting a repeater station identification:
  - By phone using the English language
  - By video image conforming to applicable standards
  - By Morse code at a speed not to exceed 20 words per minute
  - *All of these answers are correct*

T2C – [1 exam question]

Definition of control operator
- A control operator of an amateur station is an operator designated by the licensee to be responsible for the station's transmissions to assure compliance with FCC rules.
- The Control Operator is responsible for the transmissions from an amateur station.
- Every amateur station must have a control operator when transmitting.
- Only one amateur operator / primary station licenses may be held by one person.
- The minimum class of amateur license you must hold to be a control operator of a repeater station is the Technician class.
- An amateur station must have a control operator whenever the station is transmitting.

Location of control operator
- The location at which the control operator function is performed is the control point of an amateur station.
- An automatically controlled amateur station does not require a control operator to be at the control point.

Automatic and remote control, auxiliary stations
- The three types of station control permitted and recognized by FCC rule are:
  - local,
  - remote, and
  - automatic control.
- Automatic control is being used on a repeater when the control operator is not present.
- Local control is being used when transmitting using a handheld radio.
- Remote control is used when the control operator is not at the station location but can still make changes to a transmitter.

T2D – [1 exam question]

Operating another person's station
- Both you and the other person are responsible for proper operation if you transmit from another amateur's station.
- Only the operating privileges allowed by your license are allowed when you are the control operator at the station of another amateur who has a higher class license than yours.

- You may operate your amateur station aboard an aircraft only with the approval of the pilot in command and not using the aircraft's radio equipment.

Guest operators at your station
- All operating privileges allowed by the higher class license are allowed when another amateur holding a higher class license is controlling your station.
- Unlicensed persons in your family are not allowed to transmit on your amateur station if you are not there because they must be licensed before they are allowed to be control operators.

Third party communications
- A message sent between two amateur stations for someone else is third-party communications.

Autopatch, Incidental business use
- Using amateur radio for conducting business is a *prohibited* amateur radio transmission.

Compensation of operators
- It is permissible for the control operator of a club station to accept compensation for sending information bulletins or Morse code practice when the station makes those transmissions for at least 40 hours per week.

Club stations
- At least 4 persons are required to be members of a club for a club station license to be issued by the FCC.

Station inspection
- The FCC is allowed to inspect your station equipment and station records at any time upon request.

Station security and protection against unauthorized transmissions
- You might best keep unauthorized persons from using your amateur station by disconnecting the power and microphone cables when not using your equipment.

SUBELEMENT T3 - Operating practices – [4 exam questions – 4 groups]

T3A – [1 exam question]

Choosing an operating frequency
- You should listen to determine if the frequency is busy when selecting a frequency on which to transmit.

Calling CQ
- You indicate you are looking for any station with which to make contact by calling CQ followed by your callsign.
- The meaning of the procedural signal "CQ" is: Calling any station.
- The brief statement, simply saying you call sign, is often used in place of "CQ" to indicate that you are listening for calls on a repeater.

Calling another station
- If you know the station's call sign, say the station's call sign then identify your own station when calling another station on a repeater.
- You should transmit the other station's callsign followed by your callsign when responding to a call of CQ.
- You should avoid using cute phrases or word combinations to identify your station because they are not easily understood by some operators.
- You should use the International Telecommunication Union (ITU) phonetic alphabet when identifying your station because the words are internationally recognized substitutes for letters.

Test transmissions
- An illegal unidentified transmission describes a brief test transmission that does not include any station identification.
- An amateur must properly identify the station when making a transmission to test equipment or antennas.
- Station identification is required at least every ten minutes and at the end of every transmission.

T3B– [1 exam question]

Use of minimum power
- An amateur must use the minimum transmitter power necessary to carry out the desired communication.

Band plans
- A band plan is a voluntary guideline, beyond the divisions established by the FCC for using different operating modes within an amateur band.
- Band Plans are voluntary guidelines for efficient use of the radio spectrum.
- The amateur community developed the band plans used by amateur radio operators.

Repeater coordination
- The recognized frequency coordination body is in charge of the repeater frequency band plan in your local area.
- The main purpose of repeater coordination is to reduce interference and promote proper use of spectrum.

Mode restricted sub-bands
- The 6-meter, 2-meter, and 1 1/4-meter bands available to Technician class licensees have mode restricted sub-bands.

- The only emission mode that is permitted in the restricted sub-band at 50.0-50.1 MHz is CW.
- The only emission mode that is permitted in the restricted sub-band at 144.0-144.1 MHz is CW.
- The emission modes that are permitted in the restricted portion of the 1 1/4-meter band are CW and Data.

Accountability

- The transmitting station is accountable if a repeater station inadvertently retransmits communications that violate FCC rules.

T3C – [1 exam question]

Courtesy and respect for others
- The proper way to break into a conversation between two stations that are using the frequency is to say your call sign between their transmissions.
- Proper repeater operating practice:
  - Monitor before transmitting and keep transmissions short
  - Identify legally
  - Use the minimum amount of transmitter power necessary
  - *All of these answers are correct*
- Before responding to another stations call, make sure you are operating on a permissible frequency for your license class.
- No frequency will be assigned for the exclusive use of any station and neither has priority. This rule applies when two amateur stations want to use the same frequency.
- If you hear a newly licensed operator that is having trouble with their station you should contact them and offer to help with the problem.
- When circumstances are not specifically covered by FCC rules the general operating standard of good engineering and good amateur practices must be applied to amateur station operation.

Sensitive subject areas
- Amateur radio operators should avoid the use of racial or ethnic slurs when talking to other stations because it is offensive to some people and reflects a poor public image on all amateur radio operators.
- These types of subjects are not prohibited communications while using amateur radio:
  - Political discussions
  - Jokes and stories
  - Religious preferences
  - *All of these answers are correct.*

Obscene and indecent language
- Indecent and obscene language is prohibited in the Amateur Service.
  - Because it is offensive to some individuals
  - Because young children may intercept amateur communications with readily available receiving equipment
  - Because such language is specifically prohibited by FCC Rules
  - *All of these choices are correct*
- There is no official list of prohibited obscene and indecent words that should not be used in amateur radio.

T3D – [1 exam question]

Interference to and from consumer devices

- The owner of the television receiver is responsible for taking care of the interference if signals from your transmitter are causing front end overload in your neighbor's television receiver.
- The major cause of telephone interference is the telephone was not equipped with adequate interference protection when manufactured.
- A break in a cable television transmission line may result in TV interference when the amateur station is transmitting, or interference may occur to the amateur receiver.
- Receiver front-end overload is the result of interference caused by strong signals from a nearby source.

Public relations

- RACES and ARES have in common the fact that both organizations provide communications during emergencies.
- FCC rules apply to your station when using amateur radio at the request of public service officials or at the scene of an emergency.

Intentional and unintentional interference

- You should check your transmitter for off frequency operation or spurious emissions if you receive a report that your transmissions are causing splatter or interference on nearby frequencies.
- The proper course of action if you unintentionally interfere with another station is to properly identify your station and move to a different frequency.
- You may never deliberately interfere with another station's communications.
- No station has exclusive use of any specific frequency when the FCC has not declared a communication emergency.
- The best way to reduce on the air interference when testing your transmitter is to use a dummy load when testing.

SUBELEMENT T4 -Radio and electronic fundamentals – [5 exam questions – 5 groups]

T4A- [1 exam question]

Names of electrical units, DC and AC, what is a radio signal

- Electrical current is measured in the following units: Amperes
- Electrical Power is measured in the following units: Watts
- The name for the flow of electrons in an electric circuit is Current.
- The name for a current that flows only in one direction is a Direct Current (DC).
- The standard unit of frequency is the Hertz.
- The basic unit of resistance is the Ohm.
- The name for a current that reverses direction on a regular basis is an Alternating Current (AC).

Conductors and insulators

- Copper is a good electrical conductor.
- Glass is a good electrical insulator.
- The term used to describe opposition to current flow in ordinary conductors such as wires is Resistance.

Electrical components

- An automobile battery usually supplies about 12 volts [DC].
- An Ammeter is an instrument used to measure the flow of current in an electrical circuit.
- A Voltmeter is an instrument used to measure Electromotive Force (EMF) between two points such as the poles of a battery.

T4B – [1 exam question]

Relationship between frequency and wavelength

- Wavelength is the term used for the distance a radio wave travels during one complete cycle.
- The term Frequency describes the number of times that an alternating current flows back and forth per second.
- Sixty (60) hertz (Hz) means 60 cycles per second.
- The wavelength gets shorter as the frequency increases.
- Wavelength in meters equals 300 divided by frequency in megahertz.
- A radio wave travels through space at the speed of light.

Identification of bands

- The property of a radio wave often used to identify the different bands amateur radio operators use is the physical length of the wave.
- The frequency range of the 2 meter band in the United States is 144 to 148 MHz.
- The frequency range of the 6 meter band in the United States is 50 to 54 MHz.
- The frequency range of the 70 centimeter band in the United States is 420 to 450 MHz.

Names of frequency ranges, types of waves

- Voice frequencies are sound waves in the range between 300 and 3000 Hertz.
- Electromagnetic waves that oscillate more than 20,000 times per second as they travel through space are generally referred to as Radio waves.

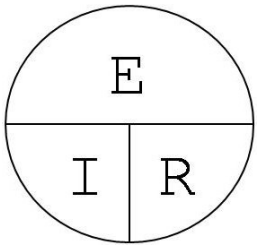
T4C – [1 exam question]

How radio works: receivers, transmitters, transceivers, amplifiers, power supplies, types of batteries, service life

- A Receiver is used to convert radio signals into sounds we can hear.
- A Transmitter is used to convert sounds from our voice into radio signals.
- A Receiver and Transmitter are two devices combined into one unit in a transceiver.
- A Power Supply is the device used to convert the alternating current from a wall outlet into low-voltage direct current.
- An Amplifier is a device used to increase the output of a 10 watt radio to 100 watts.
- A Lithium-ion battery offers the longest life when used with a hand-held radio, when comparing battery types of the same physical size.
- The nominal voltage per cell of a fully charged nickel-cadmium battery is 1.2 volts.
- A Carbon-zinc battery is not designed to be re-charged.
- In order to keep rechargeable batteries in good condition and ready for emergencies:
  - They must be inspected for physical damage and replaced if necessary
  - They should be stored in a cool and dry location
  - They must be given a maintenance recharge at least every 6 months
  - *All of these answers are correct*
- The best way to get the most amount of energy from a battery is to draw current from the battery at the slowest rate needed.

T4D– [1 exam question]

Ohms law relationships



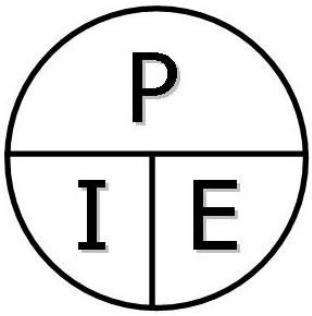
- The formula, Voltage (E) equals current (I) multiplied by resistance (R), is used to calculate voltage in a circuit. **E=I*R**
- The formula, Current (I) equals voltage (E) divided by resistance (R), is used to calculate current in a circuit. **I=E/R**
- The formula, Resistance (R) equals voltage (E) divided by current (I), is used to calculate resistance in a circuit. **R=E/I**

- If I=3 amperes and E=90 volts then R=30 ohms. **R=E/I** == R=90/3= 30
- If E=12 volts and I=1.5 amperes then R=8 ohms. **R=E/I** == R=12/1.5= 8
- If E=120 volts and R=80 ohms then I=1.5 amperes. **I=E/R** == I=120/80= 1.5
- If a current of 0.5 amperes flows through a 2 ohm resistor then voltage across the resistor is equal to 1 volt. **E=I*R** == E=0.5*2= 1 volt
- If a current of 1 ampere flows through a 10 ohm resistor then the voltage across the resistor is equal to 10 volts. **E=I*R** == E=1*10= 10 volts
- If a current of 2 amperes flows through a 10 ohm resistor then the voltage across the resistor is equal to 20 volts. **E=I*R** == E=2*10= 20 volts
- The current flowing through a 100 ohm resistor connected across 200 volts is 2 amperes. **I=E/R** == I=200/100= 2 amperes
- The current flowing through a 24 ohm resistor connected across 240 volts is 10 amperes. **I=E/R** == I=240/24= 10 amperes

T4E – [1 exam question]

Power calculations

- The unit used to describe electrical power is the Watt.



- The formula used to calculate electrical power in a DC circuit is Power (P) equals voltage (E) multiplied by current (I). **P=I*E**
- A power of 138 watts is represented by a voltage of 13.8 volts DC and a current of 10 amperes.
  P=I*E == P=10*13.8=138 watts
- A power of 300 watts is being used in a circuit when the voltage is 120 volts DC and the current is 2.5 amperes.
  P=I*E == P=2.5*120=300 watts
- You can you determine how many watts are being drawn [consumed] by your transceiver when you are transmitting by measuring the DC voltage at the transceiver and multiplying by the current drawn when you transmit.
- A current of 10 amperes is flowing in a circuit when the applied voltage is 120 volts DC and the load is 1200 watts.
  I=P/E == I=1200/120=10 amperes.

Units, kilo, mega, milli, micro

- One thousand volts is equal to one kilovolt.
- **A**nother way to specify the frequency of a radio signal that is oscillating at 1,500,000 Hertz is 1500 kHz [or 1.5 megahertz]
- 1500 milliamperes is the same as 1.5 amperes.
- A hand-held transceiver that has an output power of 500 milliwatts can otherwise be said to output 0.5 watts.
- One one-millionth of a volt is equal to one microvolt.

SUBELEMENT T5 - Station setup and operation –[4 exam questions – 4 groups]

T5A – [1 exam question]

Station hookup – microphone, speaker, headphones, filters, power source, connecting a computer

- A microphone connects to the transmitter in a basic amateur radio station.
- A Speaker is a piece of station equipment that converts electrical signals to sound waves.
- Audio feedback is the term used to describe what happens when a microphone and speaker are too close to each other.
- A set of headphones could be used in place of a regular speaker to help you copy signals in a noisy area.
- A good reason for using a regulated power supply for communications equipment is to protect equipment from voltage fluctuations.
- A filter would be installed at the transmitter to reduce spurious emissions.
- A Notch Filter could be connected to a TV receiver as the first step in trying to prevent RF overload from a nearby 2-meter transmitter.
- A Terminal Node Controller is connected between the transceiver and computer terminal in a packet radio station.
- A Microphone is not required for a packet radio station.
- A Sound Card can be used to connect a radio with a computer for data transmission.

T5B – [1 exam question]

Operating controls

- If a transmitter is operated with the microphone gain set too high it may cause the signal to become distorted and unreadable.
- A VHF/UHF transceiver may be capable of storing in memory the following kinds of information:
  - Transmit and receive operating frequency
  - CTCSS tone frequency
  - Transmit power level
  - *All of these answers are correct*
- One way to select a frequency on which to operate is to use the keypad or VFO knob to enter the correct frequency.
- The squelch control on a transceiver is used to quiet noise when no signal is being received.
- A way to enable quick access to a favorite frequency on your transceiver is to store the frequency in a memory channel.
- To improve the situation if the station you are listening to is hard to copy because of ignition noise interference may be to turn on the noise blanker.
- The purpose of the buttons labeled "up" and "down" on many microphones is to allow easy frequency or memory selection.
- The purpose of the "shift" control found on many VHF/UHF transceivers is to adjust the offset between transmit and receive frequency.
- Receiver Incremental Tuning (RIT)
- The purpose of the "step" menu function found on many transceivers is to set the tuning rate when changing frequencies.
- The purpose of the "function" or "F" key found on many transceivers is to select an alternate action for some control buttons.

T5C – [1 exam question]

Repeaters; repeater and simplex operating techniques, offsets, selective squelch, open and closed repeaters, linked repeaters

- One purpose of a repeater is to extend the usable range of mobile and low-power stations.
- A courtesy tone is a tone used to indicate when a transmission is complete.
- The repeater input and output frequencies is the most important information to know before using a repeater.
- You should pause briefly between transmissions when using a repeater to listen for anyone wanting to break in.
- The most common input/output frequency offset for repeaters in the 2-meter band is 0.6 MHz otherwise stated as 600 kHz.
- The most common input/output frequency offset for repeaters in the 70-centimeter band is 5.0 MHz.
- The terms input and output frequency when referring to repeater operations means the repeater receives on one frequency and transmits on another.
- The term, simplex operation, means transmitting and receiving on the same frequency.
- A reason to use simplex instead of a repeater is to avoid tying up the repeater when direct contact is possible.
- You might find out you could communicate with a station using simplex instead of a repeater if you check the repeater input frequency to see if you can hear the other station.
- Linked repeater system is the term for a series of repeaters that can be connected to one another to provide users with a wider coverage.
- The main reason repeaters should be approved by the local frequency coordinator before being installed is that coordination minimizes interference between repeaters and makes the most efficient use of available frequencies.
- Access to any repeater may be limited by the repeater owner.
- A closed repeater is the term used to describe a repeater when use is restricted to the members of a club or group.

T5D – 1 exam question

Recognition and correction of problems

- The most likely cause of telephone interference from a nearby transmitter is the transmitter's signals are causing the telephone to act like a radio receiver.
- A logical first step when attempting to cure a radio frequency interference problem in a nearby telephone is to install an RF filter at the telephone.
- If someone tells you that your transmissions are interfering with their TV reception you should first make sure that your station is operating properly and that it does not cause interference to your own television.
- The following may be useful in correcting a radio frequency interference problem:
  - Snap-on ferrite chokes
  - Low-pass and high-pass filters
  - Notch and band-pass filters
  - *All of these answers are correct*
- When a neighbor reports that your radio signals are interfering with something in his home the proper course of action to take is to check your station and make sure it meets the standards of good amateur practice.

- If a "Part 15" device in your neighbor's home is causing harmful interference to your amateur station you should:
  - Work with your neighbor to identify the offending device
  - Politely inform your neighbor about the rules that require him to stop using the device if it causes interference
  - Check your station and make sure it meets the standards of good amateur practice
  - *All of these answers are correct*

Symptoms of overload and overdrive

- A fundamental overload, in reference to a receiver, is interference caused by very strong signals from a nearby source.

Distortion

- If you receive a report that your signal through the repeater is distorted or weak, the problem may be any of the following:
  - Your transmitter may be slightly off frequency
  - Your batteries may be running low
  - You could be in a bad location
  - *All of these answers are correct*

Over and under modulation, RF feedback, Off frequency signals

- If another operator reports that your SSB signal is very garbled and breaks up, RF energy may be getting into the microphone circuit and causing feedback.

Fading and noise

- If another operator tells you he is hearing a variable high-pitched whine on the signals from your mobile transmitter, the power wiring for your radio could be picking up noise from the vehicle's electrical system.
- Doppler shift is NOT a cause of radio frequency interference.

Problems with digital communications links

- One of the reasons to use digital signals instead of analog signals to communicate with another station is that many digital systems can automatically correct errors caused by noise and interference.

SUBELEMENT T6 - Communications modes and methods –[3 exam questions - 3 groups]

T6A – [1 exam question]

Modulation modes, descriptions and bandwidth (AM, FM, SSB)

- Phone transmissions are voice transmissions by radio.
- Single sideband (SSB) is a form of amplitude modulation.
- A gateway is a name given to an amateur radio station that is used to connect other amateur stations to the Internet.
- Single sideband (SSB) voice modulation is most often used for long distance and weak signal contacts on the VHF and UHF bands.
- Frequency Modulation (FM) is most commonly used for VHF and UHF voice repeaters.
- The emission type, CW, has the narrowest bandwidth.
- Upper sideband is normally used for VHF and UHF SSB communications.
- The primary advantage of single sideband over FM for voice transmissions is that SSB signals use much less bandwidth than FM signals.
- The approximate bandwidth of a single-sideband voice signal is between 2 and 3 kHz.
- The approximate bandwidth of a frequency-modulated voice signal is between 5 and 15 kHz.
- The normal bandwidth required for a conventional fast-scan TV transmission using combined video and audio on the 70-centimeter band is about 6 MHz.

T6B – [1 exam question]

Voice communications, EchoLink and IRLP

- Information is transmitted between stations via the Internet using Echolink.
- Internet Radio Linking Project (IRLP)
- Any licensed amateur radio operator may operate on the Echolink system.
- Echolink and IRLP have in common Voice over Internet protocol technology.
- Voice over Internet protocol is the method used to transfer data by IRLP.
- IRLP is a method of linking between two or more amateur stations using the Internet.
- EchoLink allows computer-to-radio linking for voice transmission.
- If you hear a brief tone and then a station from Russia calling CQ on a 2-meter repeater you are listening to an Internet linked DX station.
- You might find a list of active nodes using VoIP in a repeater directory or the Internet.
- When using a portable transceiver you select a specific IRLP node by using the keypad to transmit the IRLP node numbers.

T6C – [1 exam question]

Non-voice communications - image communications, data, CW, packet, PSK31, Morse code techniques, Q signals

- Packet Radio is an example of a digital communications method.
- Automatic Position Reporting System (APRS)
- A global positioning system receiver is required along with your normal radio for sending automatic location reports.
- A standard fast scan color television signal transmission is indicated by the term NTSC.
- Point-to-point digital message forwarding emission mode may be used by a Technician class operator in the 219 - 220 MHz frequency range.

- Phase Shift Keying (PSK)
- PSK31 is a low-rate data transmission mode that works well in noisy conditions.
- Any sending speed at which you can reliably receive is recommended when using Morse code.
- A practical reason for being able to copy CW when using repeaters is to recognize a repeater ID sent in Morse code.
- QRM is the "Q" signal used to indicate that you are receiving interference from other stations.
- QSY the "Q" signal used to indicate that you are changing frequency.

SUBELEMENT T7 - Special operations – [2 exam questions – 2 groups]

T7A – [1 exam question]

Operating in the field
- A good thing to have when operating a hand-held transceiver away from home are one or more fully charged spare battery packs.
- A 1500 watt output linear amplifier would probably not be very useful to include in an emergency response kit.
- You can make the signal from a hand-held radio stronger when operating in the field by using an external antenna instead of the rubber-duck antenna.
- A combination headset and microphone would be a good thing to have when operating from a location that includes lots of crowd noise.

Radio direction finding
- Radio direction finding is a method used to locate sources of noise interference or jamming.
- A directional antenna would be the most useful for a hidden transmitter hunt.

Radio control
- The maximum power allowed when transmitting telecommand signals to radio controlled models is 1 watt.
- The station identification requirement when sending commands to a radio control model using amateur frequencies is a label indicating the licensee's call sign and address affixed to the transmitter.

Contests
- Contesting is a popular operating activity that involves contacting as many stations as possible during a specified period of time.
- A grid locator is a letter-number designator assigned to a geographic location.

Special event stations
- A special event station is a temporary station that operates in conjunction with an activity of special significance.

T7B – 1 exam question

Satellite operation, split frequency operation, operating protocols

- The class of license required to use amateur satellites is any amateur whose license allows them to transmit on the satellite uplink frequency.
- The minimum amount of power needed to complete the contact is the power that you should use to transmit when using an amateur satellite.
- Something you can do when using an amateur radio satellite is talk to amateur radio operators in other countries.
- A satellite beacon is a signal that contains information about a satellite.

Doppler shift
- Doppler shift is a change in signal frequency caused by motion through space.

Satellite sub bands
- A satellite sub-band is a portion of a band where satellite operations are permitted.
- The satellite sub-band on 70-CM is 435 to 438 MHz.

LEO

- The initials, LEO, tell you that the amateur satellite is in a Low Earth Orbit (LEO).

Orbit calculation

- You should use a satellite tracking program to determine when you can access an amateur satellite.

AMSAT

- AMSAT is the name of the group that coordinates the building and/or launch of the largest number of amateur radio satellites.

ISS communications

- Any amateur with a Technician or higher class license may make contact with an astronaut on the International Space Station using amateur radio frequencies.

SUBELEMENT T8 - Emergency and Public Service Communications
[3 exam questions – 3 groups]

T8A – [1 exam question]

FCC declarations of an emergency

- The information included in an FCC declaration of a temporary state of communication emergency is any special conditions and rules to be observed during the emergency.
- If you are in contact with another station and an emergency call is heard you should stop your contact immediately and take the emergency call.
- The restrictions on amateur radio communications after the FCC has declared a communications emergency are that you must avoid those frequencies dedicated to supporting the emergency unless you are participating in the relief effort.
- An FCC declaration of a communications emergency is legally required to restrict a frequency to emergency-only communication.
- No station has exclusive use of a frequency if the FCC has not declared a communication emergency.
- If you hear someone reporting an emergency you should assume the emergency is real and act accordingly.
- The appropriate way to initiate an emergency call on amateur radio is by saying "Mayday, Mayday, Mayday" followed by "any station come in please" and identify your station.
- Penalties for making a false emergency call:
  - You could have your license revoked
  - You could be fined a large sum of money
  - You could be sent to prison
  - *All of these answers are correct*
- Emergency communications has priority at all times in the Amateur Radio Service.

Use of non-amateur equipment and frequencies, use of equipment by unlicensed persons

- Priority must be given at all times and on all frequencies to stations providing emergency communications.
- When specially authorized by the FCC, or in an actual emergency, amateur stations are allowed to communicate with stations operating in other radio services.

Tactical call signs

- One reason for using tactical call signs such as "command post" or "weather center" during an emergency is that they are more efficient and help coordinate public-service communications.

T8B – [1 exam question]

Preparation for emergency operations

- To be prepared for an emergency situation where your assistance might be needed, you can:
  - Check at least twice a year to make sure you have all of your emergency response equipment and know where it is
  - Make sure you have a way to run your equipment if there is a power failure in your area
  - Participate in drills that test your ability to set up and operate in the field
  - *All of these answers are correct*

- The following could be used as an alternate source of power to operate radio equipment during emergencies:
  - The battery in a car or truck
  - A bicycle generator
  - A portable solar panel
  - *All of these answers are correct*
- In a genuine emergency you may use any means at your disposal to call for help on any frequency.
  - This may include using non-amateur frequencies or equipment to call for help in a situation involving immediate danger to life or property.
  - This may include using a modified amateur radio transceiver to transmit on the local fire department frequency.

RACES/ARES
- The primary function of RACES in relation to emergency activities is RACES organizations are restricted to serving local, state, and federal government emergency management agencies.
- The primary function of ARES in relation to emergency activities is ARES supports agencies like the Red Cross, Salvation Army, and National Weather Service.
- You must register with the responsible civil defense organization before you can participate in RACES activities.
- You must have an amateur radio license before you can join an ARES group.

Safety of life and property
- You may use your amateur station to transmit a "SOS" or "MAYDAY" signal when there is immediate threat to human life or property.

Using ham radio at civic events
- Casual conversation between stations during a public service event should be avoided because idle chatter may interfere with important traffic.

Compensation prohibited
- If a reporter asks to use your amateur radio transceiver to make a news report you should advise them that the FCC prohibits such use.

T8C [1 exam question]

Net operations, interfacing with public safety officials
- To minimize disruptions to an emergency traffic net once you have checked in do not transmit on the net frequency until asked to do so by the net control station.
- Emergency traffic has the highest priority.
- Personal information concerning victims should not be transmitted over amateur radio frequencies during emergencies.

Responsibilities of the net control station
- A strong and clear signal is of primary importance for a net control station.
- If someone breaks in with emergency traffic the net control station should stop all net activity until the emergency has been handled.
- If a large scale emergency has just occurred and no net control station is available you should open the emergency net immediately and ask for check-ins.

Message handling

- The name of the person originating the message must be included when passing emergency messages.
- One way to reduce the chances of casual listeners overhearing sensitive emergency traffic is to pass messages using a non-voice mode such as packet radio or Morse code.
- The preamble of a message is the information needed to track the message as it passes through the amateur radio traffic handling system.
- The term "check" in reference to a message refers to the count of the number of words in the message.
- The recommended guideline for the maximum number of words to be included in the text of an emergency message is 25 words.

SUBELEMENT T9 - Radio waves, propagation, and antennas
[3 exam questions – 3 groups]

T9A – [1 exam question]

Antenna types – vertical, horizontal
- A vertical antenna is an antenna that consists of a single element mounted perpendicular to the Earth's surface.
- A horizontal antenna is a simple dipole mounted so the elements are parallel to the Earth's surface.

Concept of gain
- A beam antenna is an antenna that concentrates signals in one direction.
- The quad, Yagi, and dish are all types of directional or beam antennas.
- The advantage of 5/8 wavelength over 1/4 wavelength vertical antennas is their radiation pattern concentrates energy at lower angles.

Common portable and mobile antennas, losses with short antennas
- A disadvantage of the "rubber duck" antenna supplied with most hand held radio transceivers is it does not transmit or receive as effectively as a full sized antenna.
- A good reason not to use a "rubber duck" antenna inside your car is that signals can be 10 to 20 times weaker than when you are outside of the vehicle.
- A magnet mount vertical antenna is one type of antenna that offers good efficiency when operating mobile and can be easily installed or removed.

Relationships between antenna length and frequency
- The physical size of half-wave dipole antenna becomes shorter as the operating frequency increases.
- The approximate length, in inches, of a quarter-wavelength vertical antenna for 146 MHz is 19 inches. *[Remember the relationship between wavelength and frequency.]*
- The approximate length, in inches, of a 6-meter 1/2 wavelength wire dipole antenna is 112 inches. *[Remember the relationship between wavelength and frequency.]*

Dummy loads
- The primary purpose of a dummy load is it does not radiate interfering signals when making tests. *[Actually, it may radiate but the signal level radiated is usually well attenuated.]*

T9B – [1 exam question]

Propagation
- VHF/UHF signals not normally heard over long distances due to VHF and UHF signals usually not being reflected by the ionosphere.
- When we hear a VHF signal from long distances a possible cause is sporadic E reflection from a layer in the ionosphere.

Fading, Multipath distortion
- Picket fencing is a term commonly used to describe the rapid fluttering sound sometimes heard from mobile stations that are moving while transmitting.
- If a station reports that your signals were strong just a moment ago, but now they are weak or distorted, try moving a few feet, random reflections may be causing multi-path distortion.

- The most likely cause of sudden bursts of tones or fragments of different conversations that interfere with VHF or UHF signals is when strong signals are overloading the receiver and causing undesired signals to be heard.

Reflections
- A way to reach a distant repeater if buildings or obstructions are blocking the direct line of sight path is to try using a directional antenna to find a path that reflects signals to the repeater.

Radio horizon, Terrain blocking
- The radio horizon is the point where radio signals between two points are blocked by the curvature of the Earth.
- VHF and UHF Radio signals usually travel about a third farther than the visual line of sight distance between 2 stations because the Earth seems less curved to radio waves than to light.

Wavelength vs. penetration
- UHF signals often work better inside of buildings than VHF signals since the shorter wavelength of UHF signals allows them to more easily penetrate urban areas and buildings.

Antenna orientation
- A good thing to remember when using your hand-held VHF or UHF radio to reach a distant repeater is to keep the antenna as close to vertical as you can.
- If the antennas at opposite ends of a VHF or UHF line of sight radio link are not using the same polarization signals could be as much as 100 times weaker.

T9C – 1 exam question

Feedline types

Loses vs. frequency, matching and power transfer
- Coaxial cable is used more often than any other feed line for amateur radio antenna systems because it is easy to use and requires few special installation considerations.
- It is important to have a low SWR in an antenna system that uses coaxial cable feedline to allow the efficient transfer of power and reduce losses.
- The characteristic impedance of the most commonly used coaxial cable in typical amateur radio installations is 50 Ohms.

SWR concepts
- In general terms, standing wave ratio (SWR) is a measure of how well a load is matched to a transmitter.
- A reading on a SWR meter of 1 to 1 (1:1) indicates a perfect impedance match between the antenna and the feed line.
- A loose connection in your antenna or feedline might be indicated by erratic changes in SWR readings.
- The SWR value, 2 to 1 (2:1) is where the protection circuits in most solid-state transmitters begin to reduce transmitter power.
- The power lost in a feed line is converted into heat by losses in the line.

Measuring SWR

- A Directional wattmeter could be used to determine if your feedline and antenna are properly matched.

Weather protection

- Losses can increase dramatically in older coaxial cables that are exposed to weather and sunlight for several years.
- The outer sheath of most coaxial cables is black in color because black provides protection against ultraviolet damage.

Feedline failure modes

- Moisture contamination is the most common reason for failure of coaxial cables.

SUBELEMENT T0 - Electrical and RF Safety – [3 exam questions – 3 groups]

T0A – [1 exam question]

AC power circuits, Electrical code compliance

- A few good ways to guard against electrical shock at your station are:
  - Use 3-wire cords and plugs for all AC powered equipment
  - Connect all AC powered station equipment to a common ground
  - Use a ground-fault interrupter at each electrical outlet
  - *All of these answers are correct*
- The most important thing to consider when installing an emergency disconnect switch at your station is for everyone to know where it is and how to use it.

Hazardous voltages

- The commonly accepted value for the lowest voltage that can cause a dangerous electric shock is 30 volts. *(Note: Lower voltages can be just as dangerous where conditions result in lower levels of resistance and thus current levels approaching 100 miliamperes.)*
- The lowest amount of electrical current flowing through the human body that is likely to cause death is 100 milliamperes.
- A hazard might still exist in a power supply when it is turned off and disconnected. If you aren't careful you might receive an electric shock from stored charge in large capacitors.

Fuses and circuit breakers

- The purpose of a fuse in an electrical circuit is to interrupt power in case of overload.
- If you install a 20-ampere fuse in your transceiver in the place of a 5-ampere fuse excessive current could cause a fire. *(Note: If it didn't cause a fire, it still could result in damage to the equipment.)*

Grounding

- Ground is connected to the green wire in a three-wire electrical plug.

Lightning protection

- The precautions that should be taken when a lightning storm is expected are:
  - Disconnect the antenna cables from your station and move them away from your radio equipment
  - Unplug all power cords from AC outlets
  - Stop using your radio equipment and move to another room until the storm passes
  - *All of these answers are correct*
- Fire prevention is the most important reason to have a lightning protection system for your amateur radio station.

Battery safety

- One way to recharge a 12-volt battery if the commercial power is out is to connect the battery to a car's battery and run the engine.
- If a storage battery is charged or discharged too quickly it could overheat and give off dangerous gas or explode.

- The hazards that are presented by a conventional 12-volt storage battery are:
  - It contains dangerous acid that can spill and cause injury
  - Short circuits can damage wiring and possibly cause a fire
  - Explosive gas can collect if not properly vented
  - *All of these answers are correct*

T0B – [1 exam question]

Antenna installation
- An important consideration when putting up an antenna is make sure people cannot accidentally come into contact with it.
- The maximum allowed height with regard to nearby airports must be considered when erecting an antenna near an airport.

Tower safety
- You should wear a hard hat and safety glasses if you are on the ground helping someone work on an antenna tower in order to protect your head and eyes in case something accidentally falls from the tower.
- A good precaution to observe before climbing an antenna tower is to put on your safety belt and safety glasses.
- You should do all of the following before you climb a tower:
  - Arrange for a helper or observer
  - Inspect the tower for damage or loose hardware
  - Make sure there are no electrical storms nearby
  - *All of these answers are correct*
- Guy wires for an antenna tower should be installed in accordance with the tower manufacturer's instructions.
- The most important safety rule to remember when using a crank-up tower is a crank-up tower should never be climbed unless it is in the fully lowered position.
- Stainless steel hardware is used on many antennas instead of other metals because stainless steel parts are much less likely to corrode.
- A separate 8 foot long ground rods for each tower leg, bonded to the tower and each other is considered to be an adequate ground for a tower.

Overhead power lines
- The most important safety precaution to observe when putting up an antenna tower is look for and stay clear of any overhead electrical wires.
- A safe distance from a power line to allow when installing an antenna is so that if the antenna falls unexpectedly, no part of it can come closer than 10 feet to the power wires.

T0C – [1 exam question]

RF hazards, RF heating hazards, Proximity to antennas, Hand held safety

- VHF and UHF radio signals are non-ionizing radiation.
- Radio waves can cause injury to the human body only if the combination of signal strength and frequency cause excessive power to be absorbed.
- If a person accidentally touched your antenna while you were transmitting they might receive a painful RF burn injury.

Radiation exposure, exposure to others

- The factors that affect the RF exposure of people near an amateur transmitter are:
  - Frequency and power level of the RF field
  - Distance from the antenna to a person
  - Radiation pattern of the antenna
  - *All of these answers are correct*
- The frequency of an RF source must be considered when evaluating RF radiation exposure because the human body absorbs more RF energy at some frequencies than others.
- Some actions amateur operators might take to prevent exposure to RF radiation in excess of FCC supplied limits include:
  - Alter antenna patterns
  - Relocate antennas
  - Change station parameters such as frequency or power
  - *All of these answers are correct*

Recognized safe power levels

- The maximum power level that an amateur radio station may use at frequencies above 30 MHz before an RF exposure evaluation is required is 50 watts PEP at the antenna.
- You can determine that your station complies with FCC RF exposure regulations:
  - By calculation based on FCC OET Bulletin 65
  - By calculation based on computer modeling
  - By measurement of field strength using calibrated equipment
  - *All of these choices are correct*
- Milliwatts per square centimeter is the unit of measurement used to measure RF radiation exposure.
- The duty cycle is one of the factors used to determine safe RF radiation exposure levels because it takes into account the amount of time the transmitter is operating.
- You make sure your station stays in compliance with RF safety regulations by re-evaluating the station whenever an item of equipment is changed.