Radio Teacher
Technician Test
Subelement T5 Notes

These notes cover the information needed to answer the questions on Subelement T5 of the Amateur Radio Technician Test. They can be used by instructors as a reference to make sure that all of the information in this subelement is addressed in class.

Subelement T5 covers your knowledge of repeaters, radio operation, components, controls, and trouble shooting.

Microphones, Speakers and Headphones:
A microphone connects to a transmitter in a basic amateur radio station for phone (voice) operation. The microphone converts your voice into electrical signals. At the receiving station a speaker or headphones convert electrical signals to sound waves

If a speaker from a receiving radio is too close to the microphone transmitting, Audio Feedback will result.

Ways to reduce audio feedback are to use headphones or to separate the microphone from the speaker a greater distance or to lower the speaker volume. Headphones can also be used in noisy areas to improve the operators' ability to copy signals.

Regulated Power Supply:
To protect equipment from voltage fluctuations use a regulated power supply for all communications equipment.

Emissions and RF Overload:
Spurious emissions can be created by your transmitter. These emissions are signals that are not on the frequency you wish to operate on and can cause interference to others trying to use their radios. The best way to reduce spurious emissions is to install a filter at the transmitter.

Another problem that can occur is RF Overload. If you are using a 2-meter transmitter near a TV, the TV will try to receive the 2-meter signal. One way to help the TV to not be bothered by the 2-meter transmitter is to install a notch filter on the TV's antenna jack. This notch filter should be tuned to the 2-meter band and help block the 2-meter transmissions from the TV receiver but will allow the TV signals trough.

Packet Radio and Data Transmissions:
In the 1980's a new mode for amateur radio started called Packet Radio. Packet radio is easy to operate due to protocols and hardware developed by amateur radio operators for amateur radio operators. At the forefront of digital activity is the Tucson Amateur Packet Radio (TAPR) group in Arizona.

Using packet radio one amateur station can send text, chat or send files to another amateur station error free. This activity is slow by today's standards but still has many uses such as finding your stolen car using Automatic Position Reporting System (APRS).

A simple packet radio station consists of a computer terminal (laptop), a Terminal Node Controller (TNC) and a radio. You can send text and receive text on the computer and then it is processed on the Terminal Node Controller (TNC). The TNC is wired to the radio and transmits your text to another connected station.

A microphone is not required since the audio coming to and from the radio is sent to the Terminal Node Controller (TNC).

Software has now been developed to utilize a Computer and a Sound Card to send and receive Packet Radio. This same setup can be used for many other modes that used to take dedicated hardware such as Radio Teletype (RTTY) and Slow Scan TV (SSTV). To operate a Sound Card mode this one needs to connect the computer Sound Card to the Radio. You can build or buy these interfaces as required for your radio.

Signal reports:
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 is picking up noise from the vehicle's electrical system.

If you receive a signal report that your SSB signal is very garbled and breaks up, RF energy may be getting into the microphone circuit and causing feedback.

If you receive a report that your signal through the repeater is distorted or weak, your transmitter may be slightly off frequency, your batteries may be running low or you could be in a bad location.

Operation notes and procedures:
If a transmitter is operated with the microphone gain set too high it may cause the signal to become distorted and unreadable.

The operator of a VHF/UHF transceiver can store information about repeater systems in memory. This is a great help since repeaters require certain settings for use. Storing in memory the transmit frequency, receive frequency, CTCSS tone frequency and transmit power level makes using repeaters much easier.

Storing the frequencies in memory channels enables quick access to favorite frequencies on your transceiver.

Most radios have two ways to select a frequency. It can be either entered directly on a keypad or by turning the VFO knob. Buttons labeled "up" and "down" on many radio microphones make it easy to change memories and frequency.

When no signal is being received you can use the squelch control to quiet the transceiver.

To improve the reception if the station is hard to copy because of ignition noise interference turn on the noise blanker.

The purpose of the "shift" control found on many VHF/UHF transceivers is to adjust the offset between transmit and receive frequency for repeater operation.

Receiver Incremental Tuning (RIT) allows the operator to adjust the receive frequency independently without moving the transmit frequency.

The "step" menu function sets the tuning rate when changing frequencies.

Because of the complexity of many radios each button can have many functions. To access some of these alternate functions you might have to press the “F” or function key.

Digital vs. Analog Signals:
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.

Repeater Operations:
The best way to extend the usable range of mobile and low-power stations on VHF and higher frequencies is to use a repeater. A repeater receives on one frequency and retransmits the audio received on another frequency.

The most important information to know before using a repeater is the repeater input and output frequencies. The next item to know is the repeater's offset. For two meters (144 MHz to 148 MHz) the most common offset is 0.6 MHz and for the 70 centimeter band (430 MHz to 450 MHz) the offset is normally 5.0 MHz.

For example if a hand held radio transmitting FM on 146.34 MHz can be received by the repeater listening on 146.34 then the repeater can send that audio to its transmitter on 146.94 MHz. After transmitting with a hand held you would need to listen to the repeater's transmitter on 146.94 MHz to hear any other stations reply through the repeater.

To keep the repeater transmitter from overpowering the repeater receiver a number of methods can be used. The most popular method is to use a duplexer filter. This type of filter blocks the repeater transmitter's signal from the repeaters receiver.

Repeaters use a controller to enable and disable certain features and functions. One of the features is called a courtesy tone. A courtesy tone is used to indicate when a station's transmission is complete.

You should pause briefly between transmissions when using a repeater to listen for anyone wanting to break in.

Simplex Operation:
Transmitting and receiving on the same frequency is called simplex operation. One reason to use simplex instead of a repeater is to avoid tying up the repeater when direct contact is possible.

You can find out if you can communicate with a station using simplex instead of a repeater by listening to the input frequency of the repeater. If you can hear the station that you are talking to on the input frequency then you can communicate to them simplex.

Linked Repeaters:
A "linked repeater system" is a series of repeaters that can be connected to one another to provide users with a wider coverage.

Repeater Coordination:
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. Also, in a dispute or interference complaint with the FCC the coordinated repeater has a better standing.

Repeater access limits:
Access to any repeater may be limited by the repeater owner. A closed repeater is generally restricted to the members of a club or group that owns or controls the repeater.

Interference causes and remediation:
“Fundamental Overload” in reference to a receiver is interference caused by very strong signals from a nearby source. It is very similar to front end overload discussed in the subelement T4 notes.

The most likely cause of telephone interference from a nearby transmitter is that the transmitter's signals are causing the telephone to act like a radio receiver.

One step when attempting to cure a radio frequency interference problem in a nearby telephone is to install an RF filter at the telephone

Snap-on ferrite chokes, low-pass filters and high-pass filters may be useful in correcting a radio frequency interference problem.

The first action you should take if someone tells you that you are causing interference is to make sure that your station is operating properly and make sure it meets the standards of good amateur practice.

If a neighbors TV reception is having problems when you transmit, see if your transmitter causes interference to your own television.

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.

FYI, “Doppler Shift” in amateur radio normally is a concern of operators working satellites in space. Doppler Shift has nothing to do with RF Interference.

The Technicians Question Pool release 2 and Rules for Amateur Radio, Part 97 are the source documents of these notes. This information is available to the public.
If you have any questions, comments or corrections please post a message at http://groups.google.com/group/RadioTeacher