

Amateur Radio Technician License Training

Welcome to 2023 Amateur
Radio Technician Class License
Training

Amateur Radio Technician License Training

These presentations are sponsored by:

**Mendocino Auxiliary Communications Service (MACS)
Office of Emergency Services**

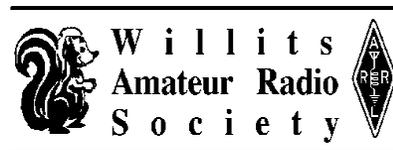
Mendocino County Amateur Radio Communications Service (McARCS)

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Adventist Health

Public Health of Mendocino County

Long Valley Health Center



**LONG VALLEY
HEALTH CENTER**



Topics on Exam

Section	Contents	Questions on Exam	Questions in Pool	Covered in Session
T1	FCC Rules and Regulations	6	67	Session 5
T2	Operating Procedures	3	36	Session 4
T3	Radio Wave Propagation	3	34	Session 2
T4	Amateur Radio Practices	2	24	Session 4
T5	Electrical Principles	4	52	Session 1
T6	Electronic Components	4	47	Session 1
T7	<i>Practical Circuits</i>	4	43	Session 3
T8	<i>Signals and Emissions</i>	4	48	Session 3
T9	<i>Antennas and Feedlines</i>	2	24	Session 3
T0	Safety	3	36	Session 2

Practical Circuits

Topics in the lesson:

- **Basic test equipment**
 - Voltmeter, ammeter, ohmmeter (multi-meter)
- **Station equipment/terms**
 - Transmitter, receiver, transceiver, amplifiers
 - Sensitivity, selectivity, modulation
 - Common circuits - mixers, oscillators, PTT
- **Common problems/solutions**
 - Transmit/receive
 - Interference
- **Antenna and transmission line measurements**
 - SWR measurement
 - feed line characteristics/failures

Measurement Tools

Common amateur measuring tools:

- **Multimeter**
- **SWR meter**
- **Antenna analyzer**
- **Directional wattmeter**

Measurement Tools

Multimeters:



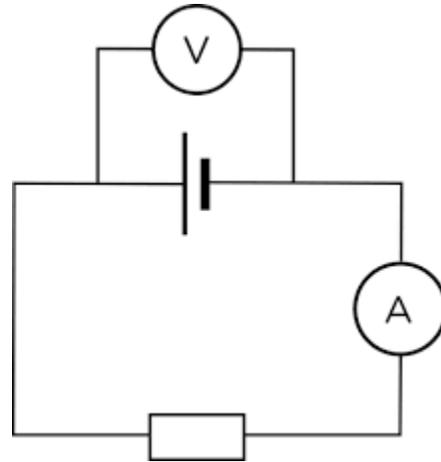
Measurement Tools

Multimeter:

- **All components of Ohm's law can be measured**
- **Multimeter (VOM) can measure volts, ohms, amps**
 - Voltmeter measures electrical potential (voltage) in parallel with circuit
 - Ammeter measures current in series with circuit
 - Ohmmeter used on de-energized circuits only

Measurement Tools

Multimeter:



Measurement Tools

Multimeter warnings:

- **Special care needed when measuring high voltage**
 - Use appropriately rated meter & leads for HV
 - Ensure operator does not contact HV circuit
- **Do not try to measure ohms (resistance) in powered circuit**
 - Likely to damage meter circuitry

Measurement Tools

Ohmmeter connected to unpowered circuit

- **Indicates increasing resistance with time**
 - Circuit likely contains a large discharged capacitor

Electrical connections

Electrical connections

- **Solder used to make electrical/mechanical connections**
 - Low melting point lead-tin or tin-copper alloy
 - Rosin core solder is used for electrical work
 - Inadequate heat = cold solder joint (rough, lumpy surface)

Measurement Tools

Standing Wave Ratio (SWR):

- **SWR measure of how well load is matched to a transmission line**
- **SWR reading of 1:1 indicates a perfect impedance match**
- **High SWR (4:1) indicates impedance mismatch**
 - Energy reflected from antenna back to transmitter
- **Protection circuits reduce transmitter power when SWR increases**
 - Prevents damage to output amplifier transistors

Measurement Tools

Measuring SWR:

- **SWR meter or bridge**
 - Inserted in feedline between tx and antenna
- **Antenna analyzer**
- **Directional wattmeter**
 - Forward vs reflected power

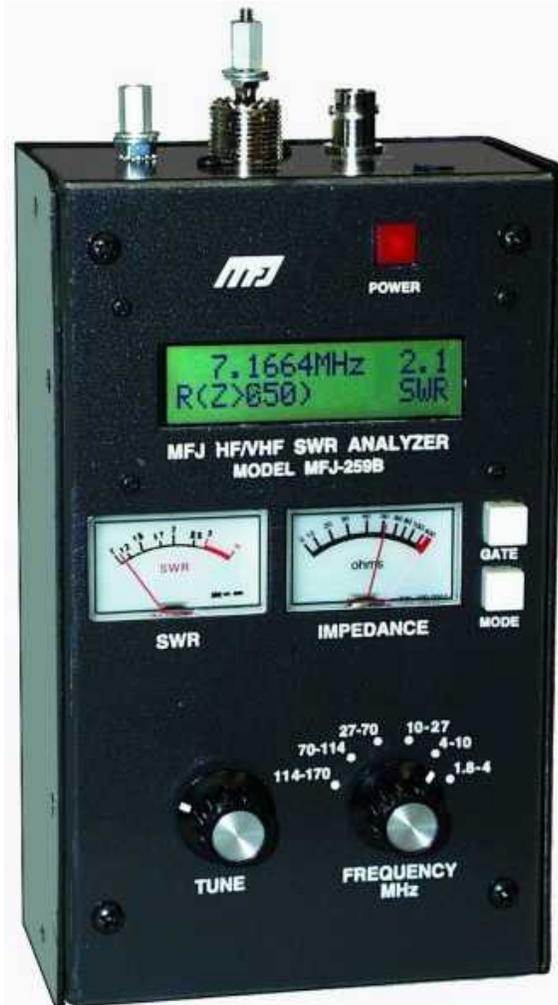
Measurement Tools

SWR meter:



Measurement Tools

Antenna analyzer:



Measurement Tools

Standing Wave Ratio (SWR):

- **High SWR may be due to coaxial feedline failure**
 - Moisture contamination common failure mode
 - Outer jacket of cable is water barrier, must be UV resistant
 - Air core coaxial cable requires special installation to exclude water

Section questions:

How is a voltmeter connected to a component to measure applied voltage?

- A. In series
- B. In parallel
- C. In quadrature
- D. In phase

Section questions:

Which of the following can damage a multimeter?

- A. Not allowing it to warm up properly
- B. Attempting to measure voltage when using the resistance setting
- C. Failing to connect one of the probes to ground
- D. Attempting to measure resistance using the voltage setting

Section questions:

What does an SWR reading of 4:1 indicate?

- A. Loss of -4dB
- B. Good impedance match
- C. Gain of +4dB
- D. Impedance mismatch

Section questions:

Which instrument is used to measure electric current?

- A. An ohmmeter
- B. A wavemeter
- C. A voltmeter
- D. An ammeter

Section questions:

Which instrument can be used to determine SWR?

- A. Voltmeter
- B. Ohmmeter
- C. Iambic pentameter
- D. Directional wattmeter

Station equipment and circuits

Basic amateur station equipment:

- Receiver to detect signals
- Transmitter to generate signal
- Most often both functions built into a single unit
 - Transmitter + receiver = *Transceiver*

Station equipment and circuits

Two essential tasks for a receiver:

- **Hear a signal and only one signal**
 - *Sensitivity* is ability to detect presence of a signal
 - *Selectivity* is ability to discriminate between multiple signals

Station equipment and circuits

Several types of circuits in transceivers

- **Oscillator** – generates signal at a specific frequency
- **Mixer** – used to convert radio signal from one frequency to another
- **Modulator**
 - Process of combining speech with RF carrier signal
- **PTT (push to talk)**
 - Switches transceiver between receive and transmit modes

Station equipment and circuits

Amplifier circuits

- Used to increase the power level of a signal
- **RF pre-amplifier**
 - Installed between the antenna and the receiver to boost incoming signal
 - Increases the sensitivity of the receiver
- **RF power amplifier**
 - May be used to increase low-power output of handheld transceiver
 - SSB/CW-FM switch to set proper operation in selected mode

Station equipment and circuits

Transverters

- **Transceiving Converter = Transverter**
 - Converts RF input/output of transceiver to another band
 - Utilizes mixer circuits to convert frequencies
 - Cost effective way to operate on a different band
 - Can be used to allow 144 MHz transceiver to operate on 10 GHz

Section questions:

What is a transceiver?

- A. A device for matching feed line impedance to 50 ohms
- B. A device that combines a receiver and transmitter
- C. A device for automatically sending and decoding Morse code
- D. A device for converting receiver and transmitter frequencies to another band network

Section questions:

What is the name of a circuit that generates a signal at a specific frequency?

- A. Reactance modulator
- B. Phase modulator
- C. Low-pass filter
- D. Oscillator

Section questions:

Which term describes the ability of a receiver to discriminate between multiple signals?

- A. Discrimination ratio
- B. Sensitivity
- C. Selectivity
- D. Harmonic distortion

Section questions:

What device converts the RF input and output of a transceiver to another band?

- A. High-pass filter
- B. Low-pass filter
- C. Transverter
- D. Phase converter

Section questions:

Where is an RF preamplifier installed?

- A. Between the antenna and receiver
- B. At the output of the transmitter's power amplifier
- C. Between a transmitter and antenna tuner
- D. At the receiver's audio output

Common signal problems

On-air signal reports may point to problems:

- **Over-deviation = distorted or breaking signal**
 - If told of over-deviation, back off from microphone
- **Signal reported as garbled, distorted, unintelligible**
 - Symptom of RF feedback in transmitter/transceiver
- **Audio through repeater distorted, unintelligible**
 - Transmitter slightly off frequency
 - Batteries running low
 - In a poor location

Interference

Common problem for hams:

- **Problem whether generated or received by station**
- **Use dummy load (antenna) for transmitter adjustment**
 - Non-inductive resistor with heat sink
 - Prevents signal from going out over the air when testing transmitter

Interference

RFI and TVI:

- **Radio Frequency Interference and Television Interference**
- **Interference generated by station operation**
- **Problem for you and your neighbor**
- **Three common sources**
 - Harmonic radiation
 - Spurious emission
 - Fundamental overload

Interference

Fundamental overload:

- **Can cause AM/FM broadcast radio to unintentionally receive ham signal**
 - Overloaded receiver unable to reject strong out of band signal
 - Install filter at antenna of affected radio to block ham signal
- **VHF transceiver may be overloaded by nearby FM broadcast station**
 - Install band-reject filter

Interference

Ferrite choke



Interference

Interfering with your neighbor:

- **If neighbor complains, investigate!**
 - Check your station for proper operation
 - Check for interference on your radio or TV when tuned to same channel
- **Cable/satellite TV less susceptible, but...**
 - Most problems caused by loose/corroded cable connections
 - Check that all TV coaxial connectors are properly installed



Interference

Interference from your neighbor:

- Part 15 devices are everywhere
- Unlicensed devices that generate low level RF signals
- If interference is coming from neighbor:
 - Check your station
 - Work to identify source
 - Politely inform of rules prohibiting interference to licensed service



Section questions:

Which of the following can cause radio frequency interference?

- A. Fundamental overload
- B. Harmonics
- C. Spurious emissions
- D. All of these choices are correct

Section questions:

Which of the following actions should you take if a neighbor tells you that your station's transmissions are interfering with their radio or TV reception?

- A. Make sure that your station is functioning properly and that it does not cause interference to your own radio or television when it is tuned to the same channel
- B. Immediately turn off your transmitter and contact the nearest FCC office for assistance
- C. Install a harmonic doubler on the output of your transmitter and tune it until the interference is eliminated
- D. All these choices are correct

Section questions:

What should be the first step to resolve non-fiber optic cable TV interference caused by your amateur radio transmission?

- A. Add a low-pass filter to the TV antenna input
- B. Add a high-pass filter to the TV antenna input
- C. Add a preamplifier to the TV antenna input
- D. Be sure all TV feed line coaxial connectors are installed properly

Section questions:

What might be a problem if you receive a report that your audio signal through an FM repeater is distorted or unintelligible?

- A. Your transmitter is slightly off frequency
- B. Your batteries are running low
- C. You are in a bad location
- D. All of these choices are correct

Section questions:

What would cause a broadcast AM or FM radio to receive an amateur radio transmission unintentionally?

- A. The receiver is unable to reject strong signals outside the AM or FM band
- B. The microphone gain of the transmitter is turned up too high
- C. The audio amplifier of the transmitter is overloaded
- D. The deviation of an FM transmitter is set too low

Section questions:

What should you do if something in a neighbor's home is causing harmful interference to your amateur station?

- A. Work with your neighbor to identify the offending device
- B. Politely inform your neighbor about the rules that prohibit the use of devices which cause interference
- C. Check your station and make sure it meets the standards of good amateur practice
- D. All of these choices are correct

Section questions:

What can you do if you are told your FM handheld or mobile transceiver is over-deviating?

- A. Talk louder into the microphone
- B. Let the transceiver cool off
- C. Change to a higher power level
- D. Talk farther away from the microphone

End of Subelement 7

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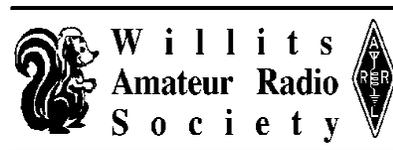
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