

Amateur Radio and the Electrical and Computer Engineering Laboratory Curriculum: Federal Communication Commission (FCC) Amateur Radio Licenses are now available completely online for students with no cost.

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The Federal Communication Commission has authorized a range of frequencies to be available to the general public for radio experimentation since 1912. The amateur radio community has been active in many developments in radio science since its inception to current times. Amateur radio activities and the Electrical and Computer Engineering curriculum are well matched for hands-on laboratory experiments. The COVID-19 era in 2020-2021 has now made it easier than ever for students to get their radio license. FCC examinations are now offered completely online with multiple offerings each week starting in 2020. Online examination sessions are offered at no cost to the student in many cases.

This presentation outlines how it is easy to offer a Laboratory assignment activity for students to get their technician class FCC amateur license in the university environment. It also gives several examples of compelling laboratory activities that are associated with amateur radio.

How do students get their technician amateur radio license? The key starting point is the web site www.hamstudy.org. The hamstudy web site provides a learning environment where students can go through the 400 FCC examination questions. Flash cards are available for study that include explanations for each answer. Students typically need about 6 hours of study to become proficient at either memorizing or exercising logic for each test question. Hamstudy then provides sample 36 question practice exams to make sure that students are ready to pass the exam. A score of 26/36 is required to pass the exam. Students can then go to the hamstudy exam appointment feature to set up their online examination via ZOOM. These examination appointments are available many times a week and students should be able to find a time slot quickly that fits into their busy schedule. Getting an amateur radio license can be a key assignment as part of the university laboratory activities.

The presentation will outline several low cost laboratory experiments that use Amateur Radio to give students direct experience with the radio spectrum. RTL-SDR software defined radios and nano-VNAs were purchased by students as part of the laboratory preparation. The RTL-SDR is priced at \$25 and the nano-VNA is priced at \$60 from Amazon. RTL-SDR software defined radios in conjunction with SDR Sharp spectral monitoring software allow for a general purpose receiver that covers the 100 kHz to 1.5 GHz frequency range. The nano-Vector Network Analyzer provides for scattering parameter measurements and a general purpose radio frequency source at frequencies from 10 kHz to 3 GHz. Students were required to take the FCC amateur radio licensing test over the period of the laboratory. A first "hands-on" experiment was to create a broad-band VHF and UHF discone antenna using 12 gauge wire and a BNC panel mount connector. The nano-VNA is used to verify that the antenna the student designed and built was well matched to the 50 ohm input impedance of the RTL-SDR. Students then monitored several radio services including signals from their mobile phone. A next step was to monitor the low frequency spectrum in the 0.5 to 30MHz range where ionospheric propagation is possible. A 14 MHz wire dipole antenna was created and tested with the nanoVNA. The RTL-SDR receiver is configured to receive WSJT4 weak signal transmissions on the amateur radio band at 14.074 MHz. Students were able to identify ionospheric signals transmitted from several continents even though the signal-to-noise ratio was well below 0dB. Students were able to get a wide exposure to the radio spectrum as part of this experiment series with connections to amateur radio.

The intent is to provide a poster presentation at the conference. The poster will cover the new on-line procedure for FCC amateur radio licensing. Amateur radio related ECE laboratory experiments will be demonstrated live.