

**Laboratory 3B**

Applications of the FT: AM-Radio

**Sample Solution**

a) Please check with provided solution, and ask questions when need help.

b) This signal combines a DC-value (peak at f=0Hz), plus a cosine (single harmonic at f0).

c) Use the modulation menu, and set s(t) as the modulating signal.

The signal generator TTI-FuGe TG5011 controls the relative amplitude A1/S0 with the parameter: modulation depth.

* Important: The AM modulation in the FuGe adds the DC-offset to the modulating signal, according to the standard AM (double sideband with carrier). So no need to add an extra offset. Already done by FuGe, when selecting AM.

d) Yes, s(t) is observable in shape of envelope (shapes amplitude of carrier signal).

Yes, an envelope detector (with diode, R + C) can already retrieve modulating signal.

Interesting to try out in LTSpice (need to check how to generate or import csv)

Curiosity: the offset (+1) in the modulating signal, allows to have directly the shape of s(t) in the envelope of the modulated signal, and to retrieve s(t) with simple detector. This was needed at the times that AM started (in 1920’s).

e) Spectrum: 3 peaks, at 10kHz plus +/- 1KHz.

The peak at 10kHz corresponds to the DC-offset multiplied with the carrier. The property freq-shift explains the position of the peaks.

Interesting to see that the “negative” side of the spectrum of s(t) (peak at -1kHz) is now visible after the modulation at 10kHz-1kHz = 9kHz.

Varying the frequency of s(t), varies the delta of side-peaks to the carrier frequency after modulation.

f) It works. Observe how long is the wire wrapped up for the antenna. In order to improve reception antennas match often λ/2 or λ/4 length for the carrier frequency. Let us check here:

fc= 1MHz ; velocity (electromagnetic wave) ~ velocity (light) ~ 3.10^8 m/s

λ = 3.10^8 / 10^6 = 3.10^2 m = 300m

more details can check at: <https://en.wikipedia.org/wiki/Radio_wave>

Roughly signal gets attenuated above 4kHz. Expect BW somehow larger than 8KHz

g) Also works directly with monitor output from the external sound-card