Project Guidelines

Project Groups: The project should be done in groups of 3-7 students each.

Software: The project should be done using **Octave or MATLAB only**. **No builtin** are allowed. No libraries or code snippets from the Internet are allowed.

Project Deliverables:

- Complete source code and any other files needed to run the models
- Report detailing the implementation steps, figures for the results, comments on the results, and ***detailed description of the role and contribution of each team member***
- Submission should include all source files, any figures or plots, and any data files used and/or generated.
- Write your code so it can be readable by others. Define your variables clearly (not abbreviated). Use comments as much as you want.
- The figures that you are going to show must be well presented. They must have clear labels, titles, and legends.

Project Assessment

The project assessment will be based on the following points:

i. Complete and working code/model (60%).
ii. Report (20%) (Completeness, Clarity, Correctness of the content, Quality of presentation.
iii. Presentation (20%) (Clarity , Ability to present and defend the work).

Project Deadlines

Sat 10-5-2025: Project submission for **part 1** (MATLAB files and report submission on moodle)

Wed 21-5-2025: Project submission for **part 2** (final MATLAB files and report submission on moodle)

Thur 22-5-2025: Project evaluation (each team will present a quick presentation and specifying the role of each member).

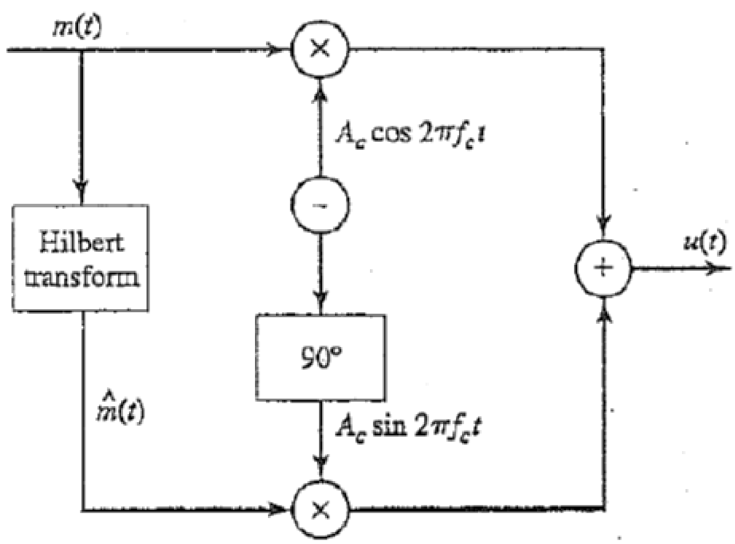
Project Statement

Part 1

The figure below shows the block diagram of an SSB-SC modulator. The Hilbert transform operation is simply a $-\pi/2$ phase shift for positive frequencies and a $\pi/2$ phase shift for negative frequencies.

The SSB signal can be represented mathematically as $u(t) = Acm(t)\cos(2\pi f c\ t) \mp Ac\hat{m}(t)\sin(2\pi f c\ t)$,

where $\hat{m}(t)$ is the Hilbert transform of $m(t)$, and the plus-or-minus sign determines which sideband is obtained (the minus sign is for the upper sideband and the plus sign for the lower sideband).



Assume you have two audio signals that need to be modulated and transmitted. If the bandwidth of each signal is B Hz, then using DSB-SC modulation will require 2B Hz for each signal, and 4B Hz to transmit both signals. To save the bandwidth we will use SSB and QAM modulation.

1. SSB modulation:

a- Implement a SSB modulator.

b- Use your SSB modulator to modulate one of the signals into the upper side band and the other signal into the lower side band of the carrier signal. Use a carrier signal with 100 kHz frequency.

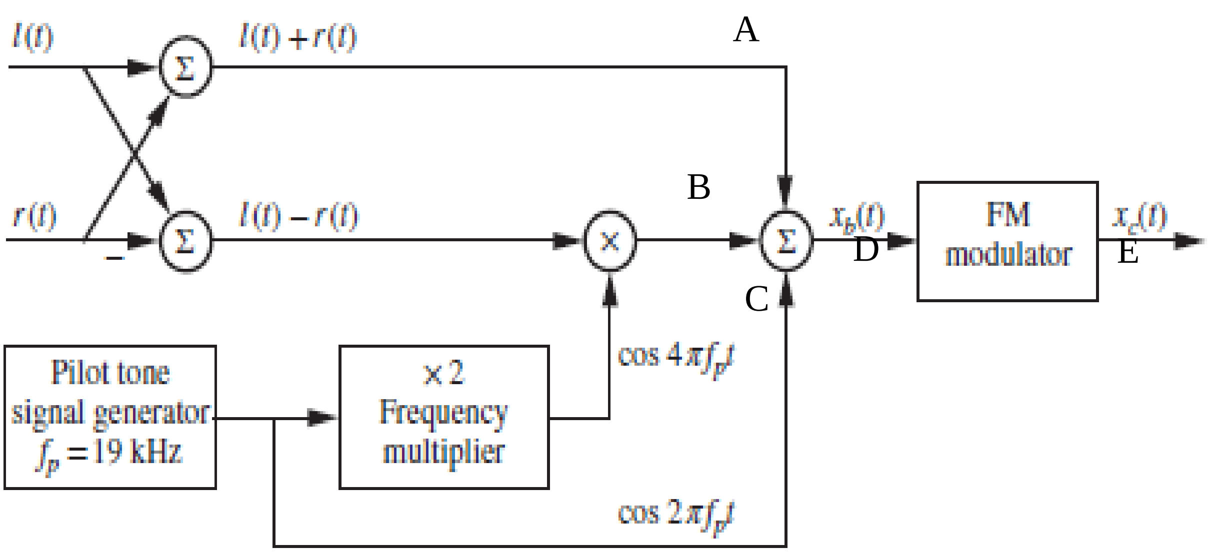
c- Implement the SSB demodulator and recover the two signals.

2. QAM Modulation:

a. Implement a QAM modulator.
b. Use your modulator to modulate one of the signals into the I-channel and the other signal into the Q-channel. Use a carrier signal with 100 kHz frequency.
c. Implement the demodulator and recover the two signals.
3. For each of the two systems above, show how the demodulated signals will be affected by phase and frequency errors between the transmitter and receiver local oscillators.

Part 2

The figure below shows the block diagram of an FM Sterio transmitter.



(a)

The scheme adopted for stereophonic FM broadcasting is shown in the Figure above.
We need to implement the FM stereo transmitter as shown in the above figure.

1. Use your mobile phone or laptop to record this sentence ‘Iam a student in electrical engineering department at Nile university’.
2. Save the audio file in a folder where you run your script and change the extension of the sound file to ‘L.wav’. This is the *l*(t) signal.
3. Repeat steps 1, and 2 above to generate the *r*(t) signal.
4. Generate the sum and the difference of the left- and right-channel signals, $l(t) \pm r(t)$.
5. The difference signal, $l(t) - r(t)$, is then translated to 38 kHz using DSB modulation with a carrier derived from a 19-kHz oscillator.
6. A frequency doubler is used to generate a 38-kHz carrier from a 19-kHz oscillator.
7. The baseband signal is formed by adding the sum and difference signals and the 19-kHz pilot tone.
8. The baseband signal $X_b(t)$ is the input to the FM modulator.

9. For the FM modulator, each group should use the carrier frequency corresponding to its group ID as shown in the following table.

Plot signals at point A, B, C, D, and E in both time domain and frequency domain.

Group #	Frequency
1	90 MHz
2	90.3 MHz
3	90.6 MHz
4	90.9 MHz
5	91.2 MHz
6	92.5 MHz
7	92.8 MHz
8	93.1 MHz
9	93.4 MHz
10	93.7 MHz
11	94 MHz
12	94.3 MHz
13	94.6 MHz
14	94.9 MHz
15	95.2 MHz
16	95.5 MHz
17	95.8 MHz
18	96.1 MHz
19	96.4 MHz
20	96.7 MHz
21	97 MHz
22	97.3 MHz
23	97.6 MHz
24	97.9 MHz

25	98.2 MHz
26	98.5 MHz
27	98.8 MHz
28	99.1 MHz