



University of Tehran  
Electrical and Computer Engineering Department  
ECE (8101) 342  
Object Oriented Modeling of Electronic Circuits – Spring 1401-02

**Homework 6B: SystemC AMS Modeling - TDF**  
**Due Date: Khordaad 22**

**Amplitude Modulation (AM):**

In this problem you are to model AM modulator and demodulator. As shown in Figure 1, a low frequency sinusoidal message signal (referred to as the *message* signal) is to be transmitted by a high frequency radio wave called the *carrier* signal. In AM modulator, the amplitude of the carrier signal will change based on the amplitude of the *message* signal. For this purpose a *mixer* unit will generate the mathematic formula below:

$$A(t) = C(t) + m(t) * C(t)$$

On the receiver side, the modulated *message* signal can be simply recovered using a parallel RC filter and a half wave rectifier. Note that the Resistor and Capacitor values of the RC filter must be selected in a way that the filter covers the frequencies between  $f_c$  and  $f_m$ .

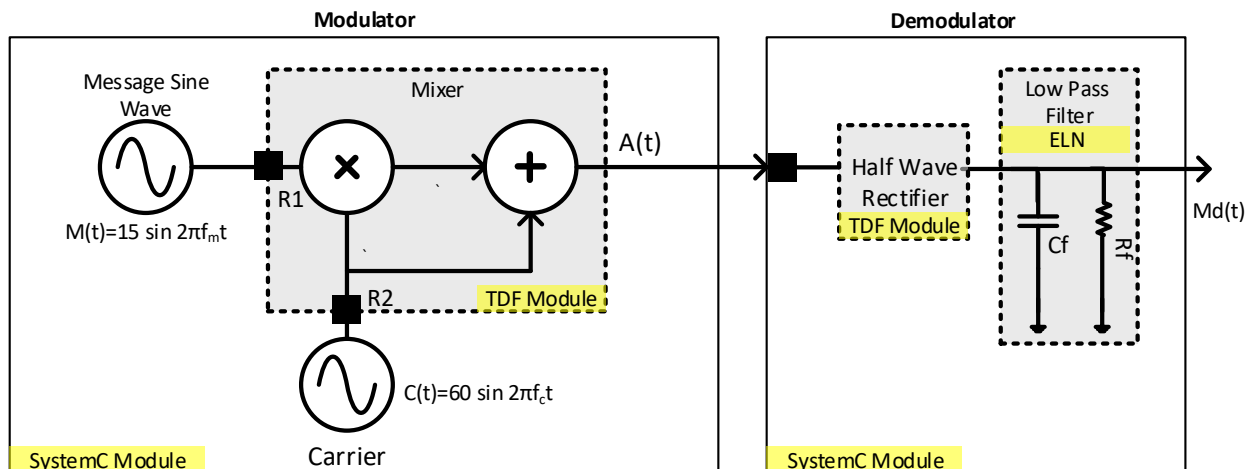


Figure 1 – An overall view of the system

For modeling this system, you are to

- A) Generate two sinusoidal signals for the *carrier* and *message* signals. Consider the frequency of message and the carrier signals as 10KHz and 1MHz, respectively.
  - B) The mixer is a multi-rate TDF module. Based on the frequencies of the *message* and *carrier* signals, determine the R1 and R2 rates for the TDF module.
  - C) Integrate the *carrier*, *message*, and *mixer* units in the *AM\_Modulator* SystemC module.
  - D) Generate a half-wave rectifier in a TDF module.
  - E) Write the *AM\_Demodulator* SystemC module containing a parallel RC filter and the half-wave rectifier. The filter will be implemented using ELN primitive elements. Suggest values for  $R_f$  and  $C_f$  based on the constraint mentioned above.
  - F) Write a testbench and connect the modulator and demodulator units.
  - G) Trace signals  $M(t)$ ,  $C(t)$ ,  $A(t)$ , and  $Md(t)$  in the testbench.
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## **Deliverables:**

1. All SystemC codes with proper naming
  2. A complete report containing
    - Schematic diagrams drawing in Visio or other visualization tools,
    - Enough design illustration and description,
    - Simulation results, input data, and output justification.
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