Title of the Exercise: Variable-Frequency Oscillator

Date: 4.9.2020

Aim: To Simulate the dynamic modal of a given Variable-Frequency Oscillator equation given below and plot various Characteristics curves and analyzes the results

$$\frac{d^2y_1}{dt^2} = -\omega^2 y_1$$

Tool used: MATLAB

Electrical Circuit: NIL

Parameters used for the study:

Input: $y_1(0) = v_{pk} = 5$, $y_2(0) = 0$, w=377.

Output: $y_1(t) = v_{pk}coswt$,

$y_2(t) = -v_{pk}sinwt$

Theoretical Analysis: It's a harmonic oscillator equation with 2 roots one sine and cosine function with a phase shift of pi. For implementation purposes, we split the double derivative equation to 2 single derivative equations.

Calculations (Predetermination):

y1(t)= 5*cos(100*pi*t)
y1(0)=5*cos(100*pi*0)=5 [t=0]
y1(0.02)=5*cos(100*pi*0.02)=4.95[t=0.02]
y1(0.03)=5*cos(100*pi*0.03)=4.9[t=0.03]
y1(0.04)=5*cos(100*pi*0.04)=4.827[t=0.04]

Procedure for simulation study:

1.Convert second order differential equation into two first order differential equations and express them in integral form.

2.Introduce a new state substituting this equation in Eq.1 we obtain

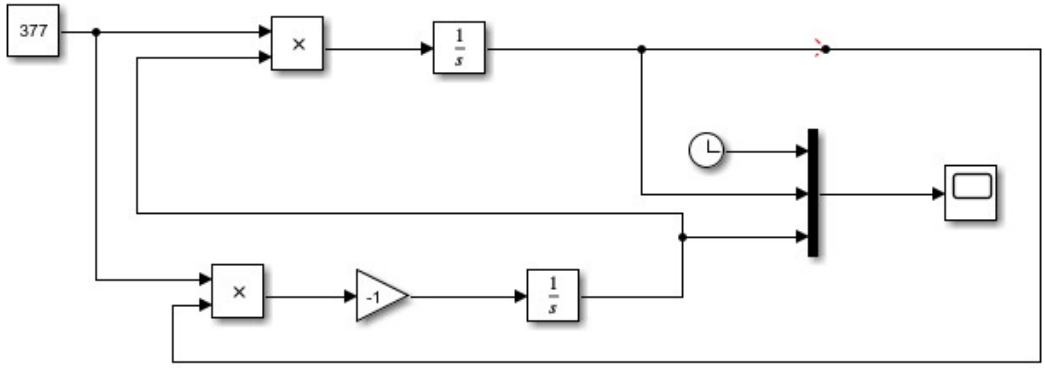
3.Rewrite the above equation in integral form

4.Open new Simulink and make mathematical modelling as per circuit diagram and save it. By using Eq.3 implement the Simulink modal.

5. Run Simulink file and view the result in Scope.

Simulation Diagram and m.file coding :

Simulation rendered wave form:-



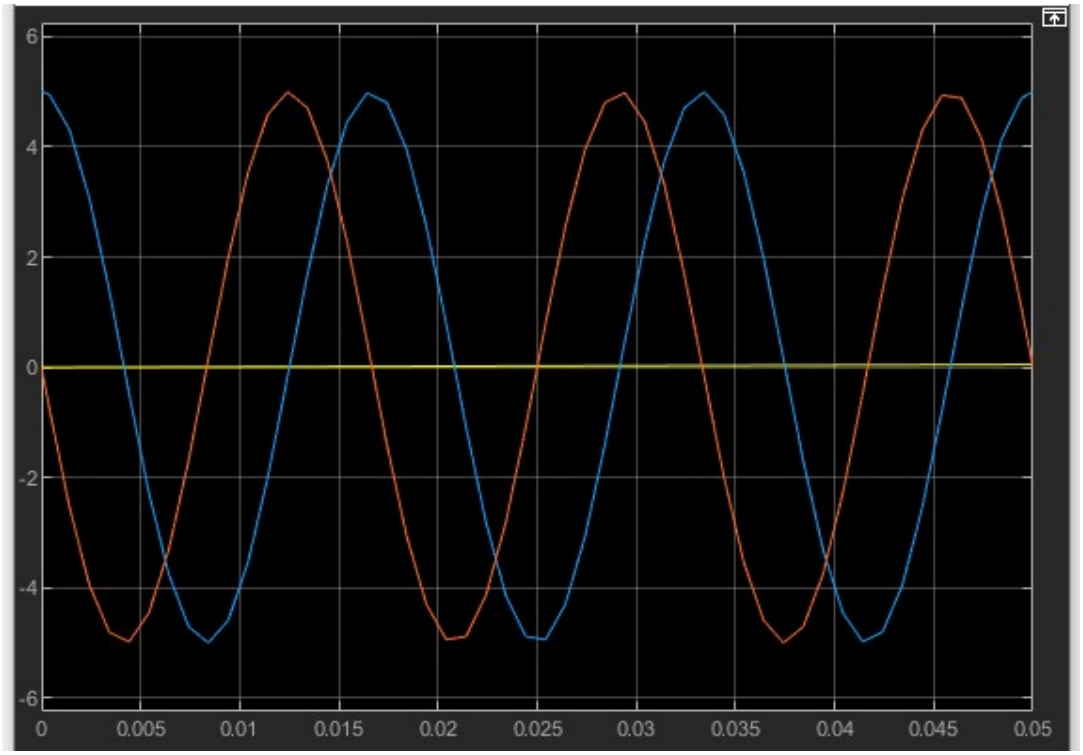
m.file coding:

NIL

Results and Discussions:

This section contains both waveforms with respect to time along with the theoretical value.

Simulation rendered waveforms



Comparison (Observations):

Time	Theoretical Value(y1)	Simulation(y1)
0	5	5
0.02	4.95	4.97
0.03	4.9	4.93
0.04	4.827	4.831

Conclusion: The theoretical value is the same as the simulation results.

Inference: The analysis of the variable frequency oscillator's dynamic model provides the following inferences:

- The frequency of the wave form is same as the parameter w.
- The amplitude of the sinusoidal waveforms depends on the initial conditions of the same.

References: NIL