Project work

Numerical solutions for the dynamic responses of simple system

1. Objectives

The objective of this project work is to calculate the dynamic responses of simple systems subjected to nonperiodic excitations by numerical solutions. A one-degree-of-freedom system with a viscous damping is considered. A code of the numerical methods is developed in MATLAB environment/excel environment.

2. Description of the problem

As seen in Fig.1, The mass is connected to two dampers and three springs. It is observed that the amplitude of vibration of the damped system decreased to 25% of its initial value after 5 consecutive cycles. Determine the response of the system under a force F(t), starting from rest. Considering the data listed in Table 1.

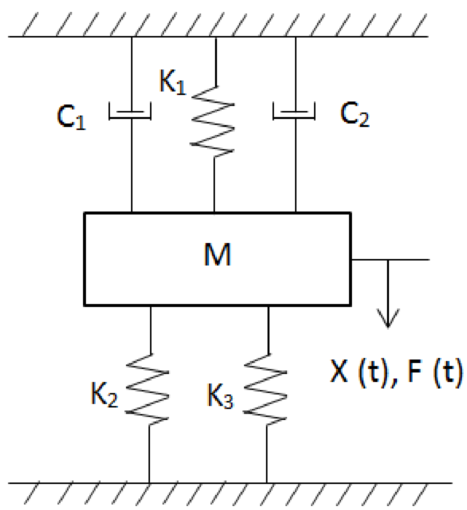


Fig.1

3. Description of the calculations

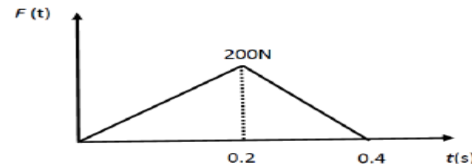
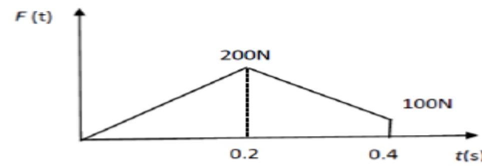
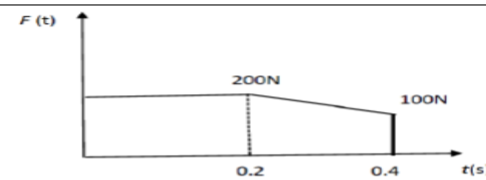
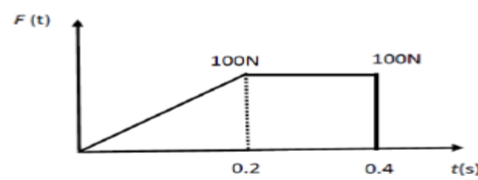
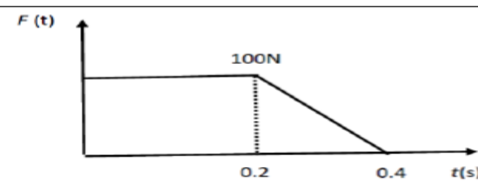
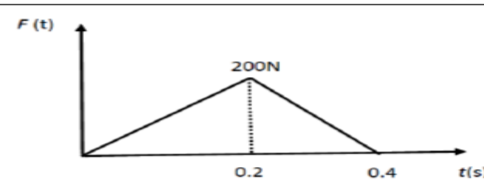
1) Determine the differential equation of the motion of this system.
   - Calculate the equivalent mass, spring constant and damping constant of the system.
   - Free body diagram.

- By using Newton's second law, derive the differential equation of the motion,

2) Calculate the dynamic responses of the system by using direct numerical integration methods. Three methods are considered:
   - Method of Wilson
   - Method of Newmark
     (β=1/1.5 and α =1/6), (β=1/2 and α =1/6), (β=1/3 and α =1/6),
   - Method of Central difference
3) Calculate the dynamic responses of the system by using the methods of response integration. Two methods are considered:
   - Method of integration by Constant Approximation
   - Method of integration by Linear Approximation
4) Compare the results obtained above with the analytical calculation by using the method of Laplace transform method.
5) Work report

   The results should be presented in a report that adequately explains the calculation procedures, the results and report findings. The matlab code should be attached at the end of the report.

Table 1. Data to be used in the calculations for each group.

Group No.	Spring & mass (data)	F(t)
1	K1=400 N/m K2=200 N/m K3=200 N/m m=0.5 kg	
2	K1=400 N/m K2=300 N/m K3=200 N/m m=1.0 kg	
3	K1=400 N/m K2=200 N/m K3=100 N/m m=1.5 kg	
4	K1=500 N/m K2=300 N/m K3=200 N/m m=2.0 kg	
5	K1=600 N/m K2=200 N/m K3=100 N/m m=2.0 kg	
6	K1=300 N/m K2=300 N/m K3=200 N/m m=2.5 kg	

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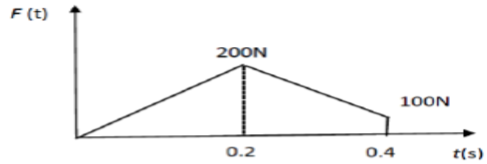
m=0.5 kg</td><td>
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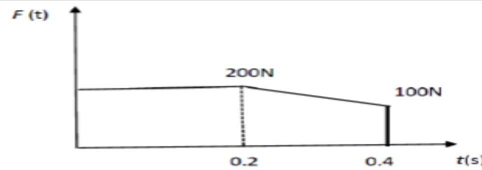
m=1.0 kg</td><td>
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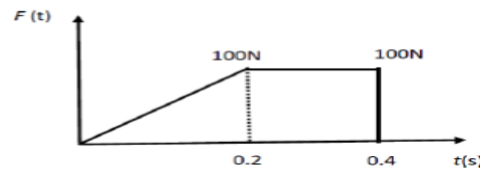
m=1.5 kg</td><td>
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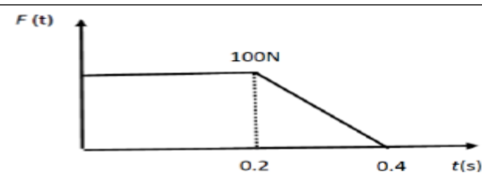
m=2.5 kg</td><td>
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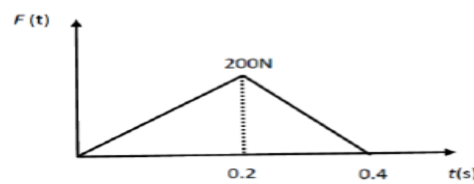
m=1.5 kg</td><td>
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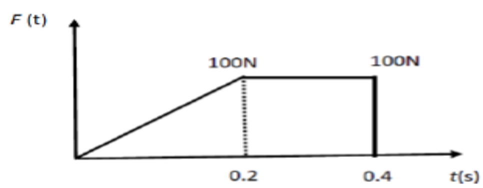
K3=100 N/m
m=2.0 kg</td><td>
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