Menoufia university
Faculty of Engineering
Mechanical Vibrations
Time: 3 hours

Mech .Design & Prod .Eng .Dept.
Date: 21-9-2014
Post Graduate Master Level 500
Total marks: 100

Problem (1): **(25 Marks)**

I)- Use the finite element technique to find
(a) the nodal displacements, strain and stress induced in the axially loaded stepped bar shown in Fig.1-a
(b) Formulate the eigen-value problem of the system.
A3=2A2=4A1=16cm2. ρ1=ρ2=ρ3=7.8x103 kg/ m3
II) Use a three element model to approximate the lowest natural frequency and mode shape for the system shown in Fig.1-b .

Problem (2): **(25 Marks)**

The milling machine shown in Fig.2 is mounted on spring –damper set and the machine tool is connected to an isolator . The driving motor of the machine vibrates due to the out of the balance of its rotor which is equivalent to a force : Fm=1200sin90t N. The machine and the machine tool are characterize by : Machine as : Mm = 400 kg, Km=106 N/m, Cm = 8000 N. s/m
Tool as : m t = 1 Kg, Kt=3600 N/m ,Ct= 21.4 N .s/m .Determine :
1- the dynamic amplitude of the milling machine (Xsm).
2- The amplitude of the chatter (U) and the amplitude of the machine tool (Xt).
3- The proper damped absorber (ma, Ka, Ca) such that the permissible chatter U per= 0.5 mm .

Problem (3): **(25 Marks)**

A machine is modeled as 2-DOF system as shown in Fig.3 and characterized by : m1 = 0.5 m2 = 5 kg, K1= K2= 0.5 K3 = 20000 N/m C1= 4 C2= 0.5 C3= 80 N.S/m
1- construct a model as a single degree of freedom system
2- prove that the damping in the system is proportional damping, and
3- calculate the pole location , residue , modal parameter model and hence

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Problem (4) **(25 Marks)**

a-A cantilever of flexural rigidity EI, length L and mass per unit length ρ performs a transverse vibration . If the free end of the beam is fastened to a motor of mass m as shown in Fig.4 derive the frequency equation of the present continuous system.
b- A rotor of mass 10 kg and unbalance mo. e =0.01 kg .m of speed Ω =5 sec-1 is mounted at the end of a set of a two mass-less connected rods of equal length L= 1 m as shown in Fig . 4-b. .If the torsion rigidity of the first rod GIp =1258 N.m2 and the flexural rigidity of the second rod EI =1625 N.m2 .Design the proper dynamic absorber such that the mass ratio

$\frac{m_2}{} = 0.2$.

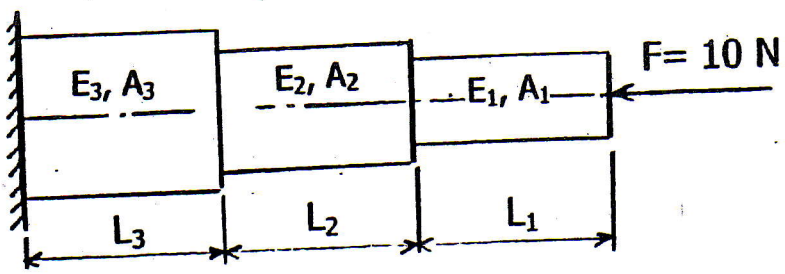

Fig 1-a

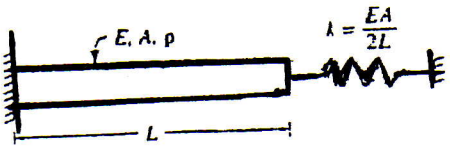

Fig 1-b

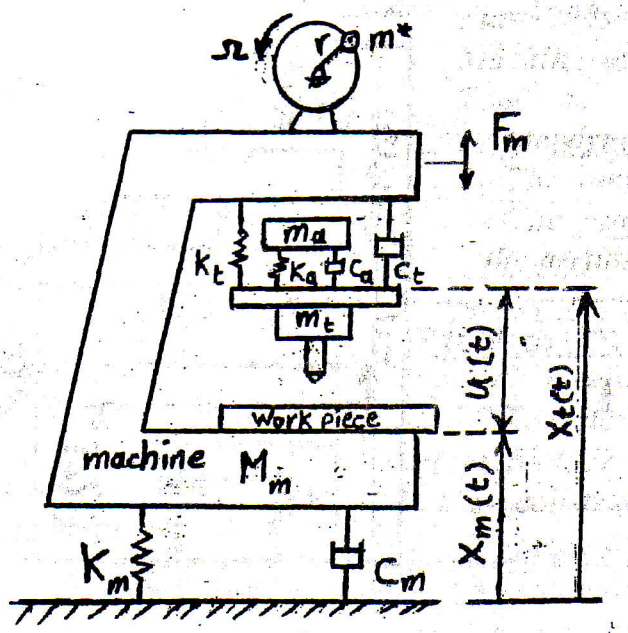

Fig-2

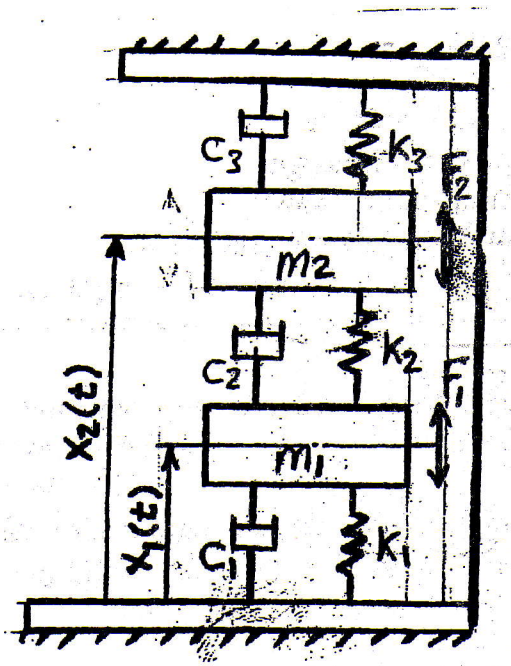

Fig. 3

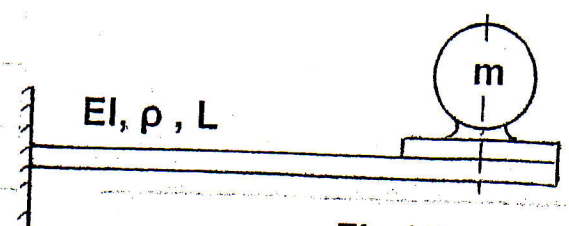

Fig.(4).a