Menoufiya University Faculty of Engineering Shebin El- Kom Second Semester Examination Academic Year: 2014-2015 Date: 30/5/2015	Minufiya University	Dept.: Production Engineering Year : Fourth Subject: Machine Dynamics Code : PRE 421 Time Allowed: 3 hours Total Marks : 90 Marks

Allowed Tables and Charts: None.
Examiners: Prof.Dr./ Taha Ali Salama El-Taweel + Dr/ Mohamed Hesham Belal

Answer All The Following Questions:

Question No.(1): [25 Mark]

(a)- [5]- Explain briefly the various methods for vibration control in machine tool structure.

(b)- [10]- From the experimental measurements of vibratory motion of a prototype of a drilling machine mounted on isolator system by a scale of 1:80, the frequency response function H(Ω) is shown in Fig.(1). Given that: the excitation action is: $F = 10^4 \sin \Omega t$.
$H_1 = 8x10^{-6}$, $\Omega_1 = 87.35$ rad/s, $\Omega_2 = 109.4$ rad/s, $\omega_d = 99.4$ rad/s.
1- Derive the equation of motion of the machine-isolator assembly,
2- Plot *FRF* curve of the prototype and the drilling machine.

(c)- [10]- The milling machine shown in Fig.(2) , is mounted on spring-damper set and the machine tool is connected to an isolator. A driving motor of the machine vibrates due to the out of balance of its rotor which is equivalent to a force: $F_m = 1200 \sin 90t$ N. Given that the dynamic amplitude of the machine is measured as 0.5 mm, and the machine tool is characterized by: $m_t = 1$ kg, $K_t = 3600$ N/m $C_t = 21.4$ N.s/m.
1- Derive the mathematical modeling of chatter and find its amplitude (U),
2- Design the proper damped dynamic absorber (m_a , k_a , c_a) such that the permissible chatter $U_{Per} = 0.7$ mm.

Question No.(2): [20 Mark]

(a)- [5]- Define the modal analysis and compare with the aid of neat sketches between the two types of excitation of a prototype of a machine to obtain the *FRF*.

(b)- [15]- A part of machine is modeled as 2-DOF system as shown in Fig.(3) and given that: $m_1 = 2m_2 = 40$ kg, $k_1 = 0.5k_2 = 2k_3 = 10{,}000$ N/m
$c_1 = 0.5c_2 = 2c_3 = 200$ N.s/m
1- Compute the spectral matrix and modal matrix of the system,
2- In the absence of damping, calculate the changes of spectral and modal matrices due to the following modifications:
$\Delta m_1 = 2$ kg, $\Delta m_2 = 4$ kg, $\Delta k_1 = 500$ N/m, $\Delta k_2 = 200$ N/m.

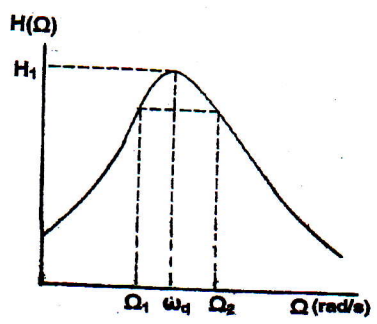

Fig.(1)

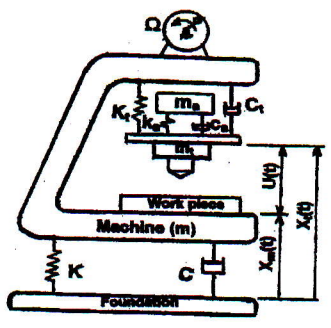

Fig.(2)

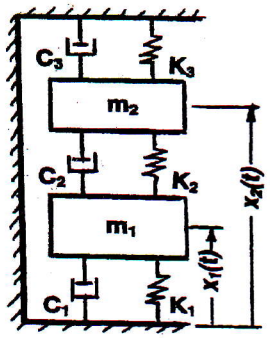

Fig.(3)

Question No.(3): [20 Mark]

(a)- [7]- Choose the correct answer(s):

1- To avoid the chatter, the calculated value of amplitude of m/c tool structure must be (equal- less- greater) than actual characteristic cross-recptance.
2- Dynamic variation of cutting force occurs when m/c tool becomes (cut- vibrates- unstable).
3- Chatter resistance increased when the m/c tools cuts (ductile- soft- hard) materials.
4- The chatter frequency (equal- less- greater) than the resonant frequency of m/c tool structure.
5- Belts always tend to (encourage- reduce- eliminate) vibration.
6- The initial vibration instigated by the hard spot will be influenced greatly by the dynamic characteristics of the (structure- tool- workpiece).
7- When the tool contacts some irregularity in the work surface it will vibrate relative to the workpiece and beginning (instability- self excited vibration- failure).

(b)- [7]- Describe briefly the procedure for determination of dynamic characteristic cross-receptance for lathe m/c.

(c)- [6]- What are the important data, which can be obtain from the general stability charts of any machine tools?

Question No.(4): [25 Mark]

(a)- [5]- write a short notes about the following:
Phase angles (θ and Φ) – Receptance – Mean cutting force coefficients – Strain gauge – Pick-up.

(b)- [10]- Draw the force polygon for representation of the dynamic cutting force components at the limit of stability due to an excitation force by using polar coordinates. From the above drawing prove that:

$$\tan\phi = \frac{C\theta + \mu \sin\theta}{1 - \mu\cos\theta}$$

(c)- [10]- Indicate right or wrong and correct the wrong:

1- If the dynamic cutting force is just sufficient to maintain the vibration between the tool and workpiece, it is known as the instability condition.
2- It is evident that a machine is usually unstable at low than at high cutting speeds.
3- The value of overlap factor zero is worse than 0.5.
4- Forced vibration gives the same type of work surface finish as chatter.
5- To reduce the amplitude of vibration mode of chatter we must fit an absorber tuned to the natural frequency of m/c tool structure.
6- Screw-cutting considered as regenerative cutting process.
7- An open machine tool frame is stiffer than a closed frame.
8- Slide-ways running upon a film of oil have low damping properties.
9- Chatter frequency can be estimated using strain gauge dynamometer.

With our best wishes

This exam measure the following ILOs												
Question No.	Q1-a	Q2-a	Q3-a	Q4-c	Q1-b	Q2-b	Q3-b	Q4-b	Q1-c	Q2-b	Q3-c	Q4-a
Skills	a-19	a-1	a-15	a-19	b-10	b-13	b-3	b-10	c-5	c-17	c-5	c-17
	Knowledge & Understand				Intellectual				Professional			