2002 SCHEME

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ME65

Sixth Semester B.E. Degree Examination, June 2012
Mechanical Vibrations

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions.***

1 a. Define the following :
i) Degree of freedom ii) Natural frequency. **(03 Marks)**

b. Add the following two harmonic waves (motions) analytically and check the solution graphically : $x_1 = 3 \sin(\omega t + \pi/6)$, $x_2 = 4 \cos(\omega t + 10^0)$. **(07 Marks)**

c. Starting from general solution for transverse vibration of beams, derive an expression for the natural frequency of a simply – supported beam. **(10 Marks)**

2 a. Derive equation of motion and thus the expression for the natural frequency of a single degree of freedom spring mass system taking it into account the mass of the spring also. **(08 Marks)**

b. Using energy method, find the natural frequency of the system shown in fig. Q2(b). **(12 Marks)**

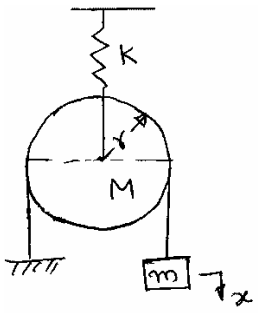


Fig.Q2(b)

3 a. What is damping? List various types of damping and discuss any two types of them. **(08 Marks)**

b. Explain the following : i) damping factor ii) logarithmic decrement. **(04 Marks)**

c. A vibrating system of single degree of freedom is defined by the following :
Mass m = 3kg ; Stiffness k = 100 N/m ; Damping co-efficient c = 3N-S/m. Determine the following : i) damping factor ii) damped natural frequency iii) logarithmic decrement iv) number of cycles after which the original amplitude is reduced to 20 percent. **(08 Marks)**

4 a. Derive an expression for the magnification factor (MF) for a single degree of freedom system subjected to damped forced vibration and thus obtain the condition for peak amplitude. **(08 Marks)**

b. An air compressor of mass 450kg operates at a constant speed of 1750 rev/min. Rotating parts are well balanced. The reciprocating part is 10kg and crank radius is 100mm. The mounting introduces an effective viscous damping of damping factor 0.15. Specify the spring stiffness for the mounting such that only 20 percent of the unbalanced forces is transmitted to the foundation. Also determine the amplitude of transmitted force. **(12 Marks)**

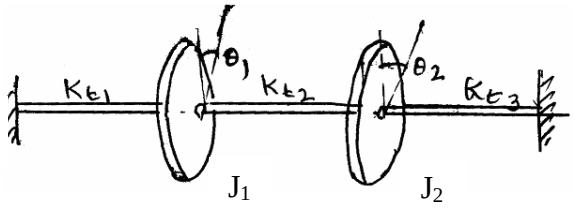
5 a. Distinguish between vibrometer and accelerometer. Sketch and explain the working of Frahm Tachometer. **(08 Marks)**

b. A disc of mass 4 kg is mounted midway between bearings which may be assumed to be simple supports. The bearing span is 48cm. The steel shaft is horizontal and of 9mm diameter. The centre of gravity of the disc is displaced by 3mm from the geometric centre. The equivalent viscous damping at the centre of the disc – shaft may be taken as 49 N-S/m. If the shaft rotates at 760 rev/min, find the maximum load on the shaft. Take 'E' of material as 200 GPa. **(12 Marks)**

6 a. With reference to a two degree of freedom system, explain the following :
i) Coordinate coupling ii) Dynamic vibration absorber. **(08 Marks)**

b. Find the natural frequency and mode shapes for the torsional system shown in fig.Q6(b). Given $J_2 = 2J_1$, $K_{t_1} = K_{t_2} = K_{t_3} = K_t$. **(12 Marks)**

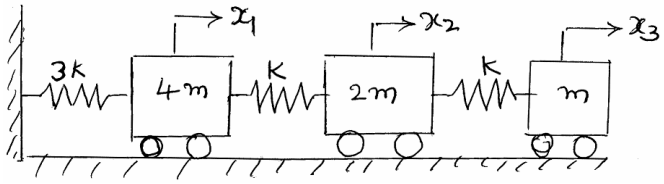
Fig.Q6(b)



7 a. State and prove Maxwell's reciprocal theorem. **(08 Marks)**

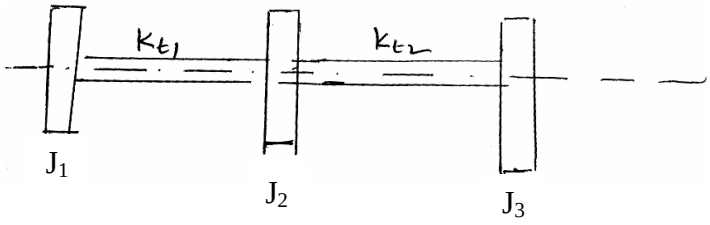
b. Applying above theorem, determine the influence coefficients of the system shown below and write the equations of motion for x_1, x_2 and x_3, in terms of influence co-efficient. **(12 Marks)**

Fig.Q7(b)



8 Determine the natural frequencies of the torsional system shown in fig.Q8 by Holzer method. (Hint : Trial frequency may be assumed as 0.25). Take $J_1 = J_2 = J_3 = 1$, $K_{t_1} = K_{t_2} = 1$. **(20 Marks)**

Fig.Q8



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