Code No: OR410355 **OR**

IV B.Tech I Semester Supplementary Examinations, April/May 2005
MECHANICAL VIBRATIONS
(Common to Mechanical Engineering and Production Engineering)
Time: 3 hours **Max Marks: 70**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Describe with the help of neat sketch about the damped vibrations.
   (b) A small petton wheel rotating at 1500 rpm has a rotor of mass 10 kg mounted at the centre of a steel shaft which has a span of 0.4 m between the bearings. What should be the diameter of the shaft, so that the traverse natural frequency is 50 percent higher than the running speed? Assume E for steel as $2x10^{11}$ Pa.

2. (a) Derive an expression for the natural frequency of free vibrations by equilibrium method.
   (b) The following data refers to vibrating systems with viscous damping: Mass=180 kg, spring stiffness = 70kN/m, damping coefficient = 7kN/m/s. Find the damping factor and the natural frequency of damped vibrations.

3. Determine the total stiffness of the springs used for mounting a bench grinder of mass 50kg and rated speed of 2500 rpm so that the force transmissibility is equal to or less than 0.2. If the unbalance is the rotor is estimated to be 10^{-3} kg-m what will be the dynamic amplitude of the grinder and the force transmitted to the foundation.

4. (a) Explain the following terms:
      i. Transmissibility
      ii. Dynamic Magnifier
   (b) An accelerometer has a natural frequency of 15kHz. Determine the amplitude and phase distorsion of a signal of frequency 7.3kHz. Assume damping ratio 0.7.

5. Figure shown below is a locomotive handling two freight cars. Determine the two non-zero natural frequencies. Assume following data.

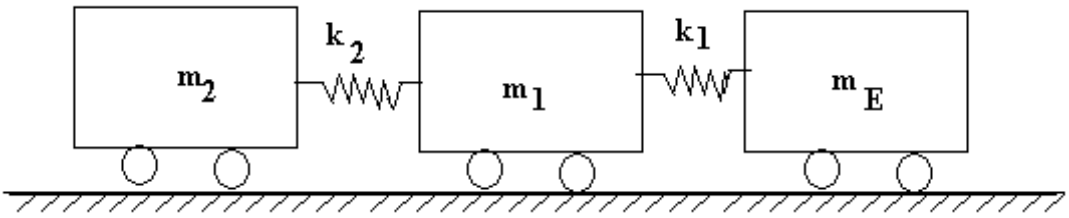
   Engine mass, m_E = 200 tonnes

   Mass of first car, m_1 = 60 tonnes

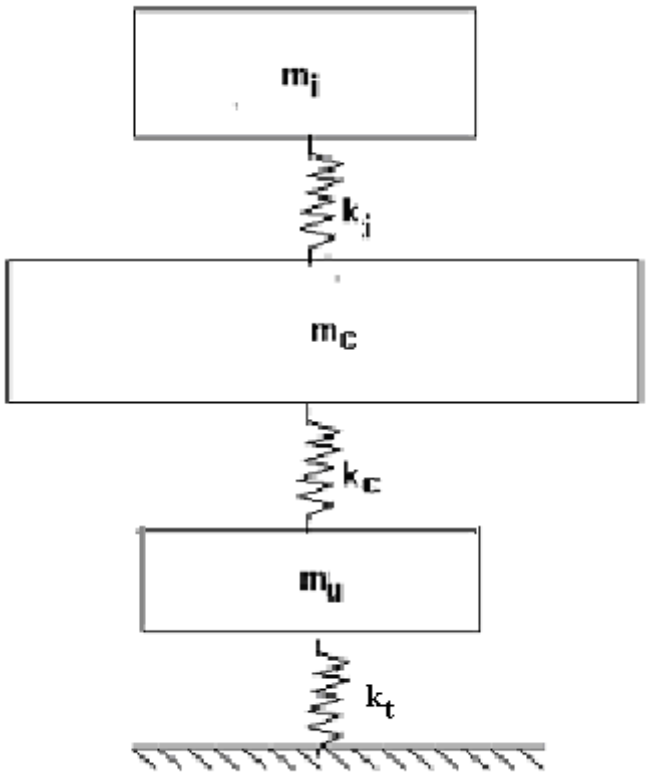
   Mass of second car, m_2 = 80 tonnes

   Stiffness of coupling between the engine and first car K_1 = 10 MN/m

   Stiffness of coupling between the first and the second car, K_2= 15 MN/m

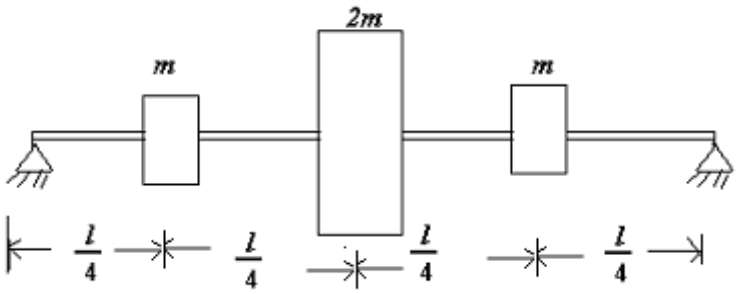


6. Figure shown below is a simplified model of an automobile for consideration of vertical motion only. Mass of the chasis, M_c is 1200 kg and stiffness of shock absorbers, K_c is 80kN/m. Mass of both axles, m_4= 320 kg and stiffness of tyres, k_t= 750kN/m. An instrument of mass, m_i =p which is equal to 200kg is placed on the chasis on a spring of stiffness, k_i = 580kN/m. Determine the lowest natural frequency of the system following Rayleigh's method.



7. Determine the natural frequencies in transverse vibration and the corresponding mode shapes of the mass coupled system shown in figure given below.

8. Write short notes on any THREE of the following:
   (a) Viscous damping
   (b) Vibration measuring instruments
   (c) Matrix Iteration method



(d) Torsional vibration of geared system.

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