Code No: 07A62401 **R07** **Set No. 2**

**III B.Tech II Semester Examinations,December 2010**
**VEHICLE DYNAMICS**
**Automobile Engineering**

**Time: 3 hours** **Max Marks: 80**

**Answer any FIVE Questions**
**All Questions carry equal marks**

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1. Explain the following :
   (a) Free vibrations with reference to vehicle system.
   (b) Suspension system of an automobile. [8+8]
2. (a) What do you mean by vibration Isolation? Explain with neat diagram.
   (b) An industrial machine weighing 485 kg is supported on a spring with a statical deflection of 0.6 cm. If the machine has a rotating unbalance of 28 kg-cm, determine the force transmitted at 1300 rpm and the dynamic amplitude at that speed. [6+10]
3. (a) Explain working principle of the frequency measuring device with neat sketch? Also mention advantages and disadvantages of it?
   (b) The rotor of a turbo charger of mass 20 kg is keyed to the center of 2 cm diameter steel shaft, 30 cm between the bearings. determine:
      i. The critical speed.
      ii. The amplitude of vibration of rotor at a speed of 3300 rpm, if the eccentricity is 0.002 cm and the vibratory force transmitted to the bearings at this speed. Assume the shaft to be simply supported. [6+10]
4. A three rotor system shown in figure 4 has the following physical constants: $J_1 = 60$ kg - cm -$sec^2$, $J_2 = 110$ kg - cm -$sec^2$, $J_3 = 80$ kg - cm -$sec^2$, $k_{t1} = 2.22 \times 10^6$ kg - cm/rad, $k_{t2} = 0.82$ x $10^6$ kg - cm/rad. Find the natural frequency of the system and corresponding mode shapes. [16]

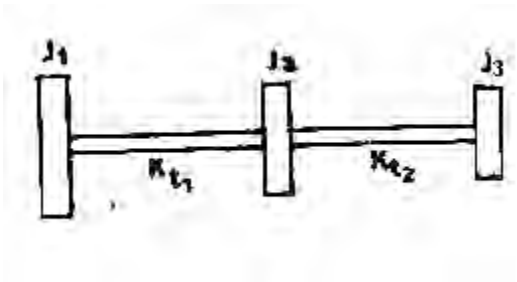


Figure 4:

5. The flywheel of an engine dynamo weighs 150 kg and has a radius of gyration of 25 cm. The shaft at the flywheel end has an effective length of 22 cm and 4.5

cm in diameter. The armature weights 90 kg and has a radius of gyration of 20 cm. The dynamo shaft has a diameter of 4 cm and an effective length of 18 cm. Neglecting the inertia of the shaft and the coupling, calculate the frequency of torsional vibrations and positions of the node. [16]

6. (a) Discuss the effect of damping on the displacement of a vibrating system.
   (b) A spring mass dashpot system consists of a spring of stiffness 313 N/m. The mass is 3.23 kg, the system is displaced 1 cm beyond the equilibrium position and released. Find the equation of motion for the system, if the damping coefficient of the dashpot is
      i. 127.2 N-sec/m,
      ii. 58.6 N-sec/m
      iii. 11.72 N-sec/m. [7+9]

7. (a) Write the procedure for the selection of tyre size and ply rating?
   (b) List out the precautions while removing tyres. [8+8]

8. For an indicator mechanism shown in figure 8, the arm pivoted at point O has a mass moment of inertia I. Find the natural frequency of the system. [16]

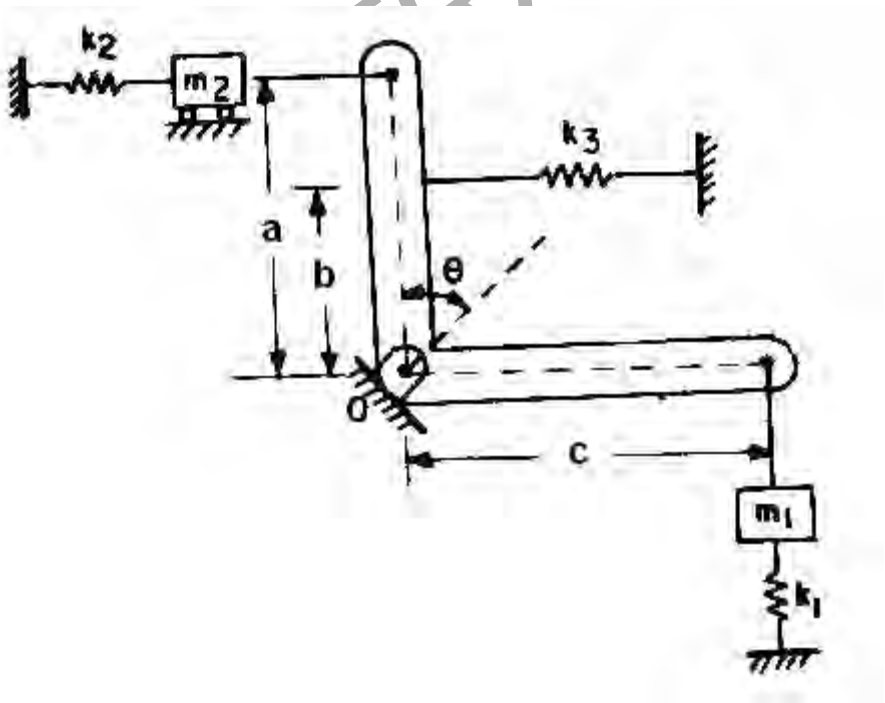


Figure 8:

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Code No: 07A62401 **R07** **Set No. 4**

**III B.Tech II Semester Examinations,December 2010**
**VEHICLE DYNAMICS**
**Automobile Engineering**

**Time: 3 hours** **Max Marks: 80**

**Answer any FIVE Questions**
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1. Explain the following terms with neat sketches.
   (a) Tyre size
   (b) Tyre balancing.
   (c) Bleeding of tyre.
   (d) Tread cracking. [4+4+4+4]
2. Describe the following :
   (a) Necessity of balancing the engine.
   (b) Transmissibility of engine mounting vibrations. [8+8]
3. Write short notes on:
   (a) Reyleigh's method
   (b) Dunkerley's method.
   (c) Holzer's method. [16]
4. (a) Write the advantages and disadvantages of stoboscope accelerometer.
   (b) A 55 kg compressor rotor is mounted on a shaft of stiffness $1.4 \times 10^7$ N/m. Determine the critical speed of the rotor assuming the bearing to be rigid. If the rotor has an eccentricity of 1000 micron and its operating speed is 6000 rpm, determine the unbalance response. The damping in the system can be assumed to be $\xi = 0.05$. If the compressor is started from the rest, what will be the maximum whirl amplitude of the rotor before it reaches its full operational speed? [6+10]
5. (a) An industrial machine weighing 450 kg is suspended on a spring with a statical deflection of 0.6 cm. If the machine has a rotating imbalance of 30 kg-cm, determine the force transmitted at 1200 rpm and the dynamic amplitude at that speed.
   (b) A motor of mass 65 kg is mounted on a simple beam that has a stiffness of 39500 N/m at that point. The rotor of the motor has a mass of 10 kg and has an eccentricity of 0.11 mm. What will be the amplitude vibration of motor when it runs at 1460 rpm? Neglect damping, the weight of the beam and deflection of the motor shaft. [8+8]

6. Calculate the natural frequencies of a shaft of diameter 10 cm and length 300 cm carrying 2 discs of diameter 125 cm & 200 cm respectively at its ends and weighing 480 kg & 900 kg respectively as shown in figure 6. Modulus of rigidity of the shaft may be taken as G= 2 $\times$ $10^6$ kgf/$cm^2$. [16]

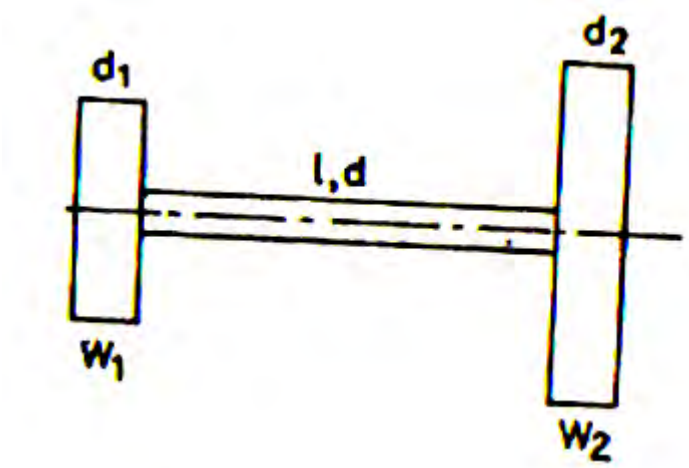


Figure 6:

7. Find the natural frequency of vibration of a half solid cylinder when slightly displaced from equilibrium position and released as shown in Figure 7. [16]

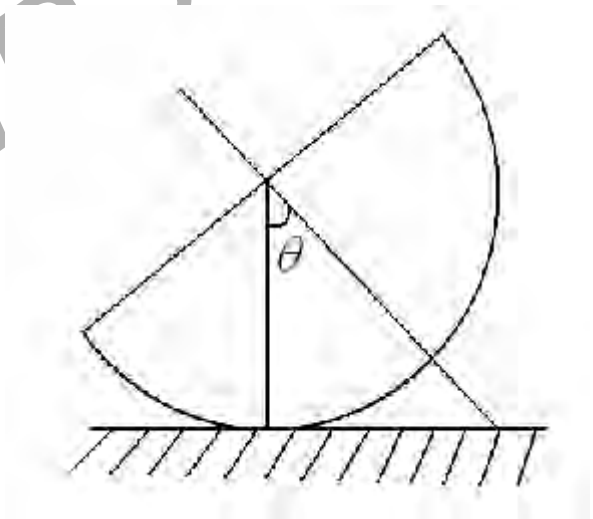


Figure 7:

8. The mass of 12 kg is kept on two slabs of isolators placed one over the other. One of the isolators is rubber having a stiffness of 5 kN /m and damping coefficient of 120 kN-sec /m while the other isolation is felt with stiffness of 15kN/m and damping coefficient of 350 N. sec / m. If the system is set in motion in vertical direction, determine the damped and undamped natural frequency of the system. [16]

Code No: 07A62401 **R07** **Set No. 4**

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Code No: 07A62401 **R07** **Set No. 1**

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**VEHICLE DYNAMICS**
**Automobile Engineering**

**Time: 3 hours** **Max Marks: 80**

**Answer any FIVE Questions**
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1. (a) What are the various types of tyres? Explain in detail.
   (b) State the various functions preformed by an automobile tyre. Discuss the properties expected in the tyres? [8+8]

2. (a) Explain the phenomenon of viscus damping.
   (b) A 4 kg mass is suspended in a box by a spring as shown in figure 2b. The box is put on a platform having vibration y = 0.82 Sin (6t) cm. Determine the absolute amplitude of the mass. Given K=6200 N/m. [4+12]

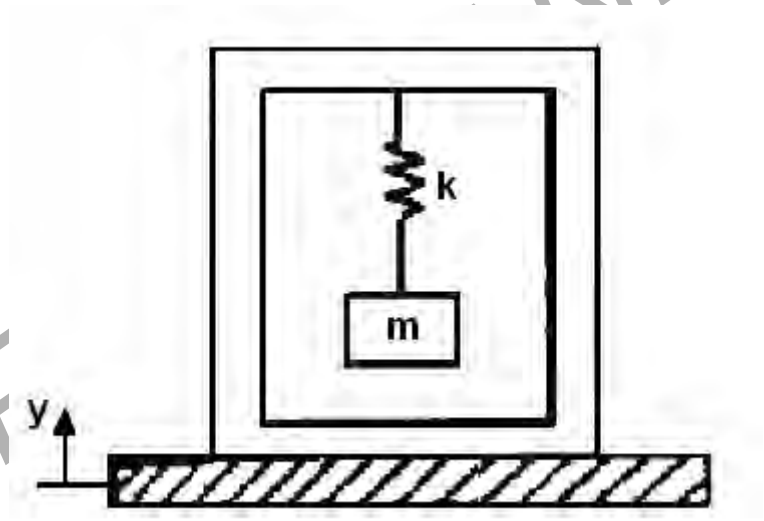


Figure 2b:

3. (a) What are the factors affecting the vibration of vehicle and explain briefly.
   (b) Discuss the frequency ratio $\omega/\omega_n$ for different values of damping factors? [8+8]

4. Determine the natural frequency of oscillation of the system shown in figure 4 when the massless rigid bar is hinged at C. [16]

5. Derive the equation of motion and find the natural frequencies and amplitude ratio of the system shown in figure 5. [16]

6. (a) Explain Dunkerley's equation by considering suitable system.
   (b) Using matrix iteration, find the natural frequencies of the system as shown in figure 6b (equal masses equally spaced on strings). [4+12]

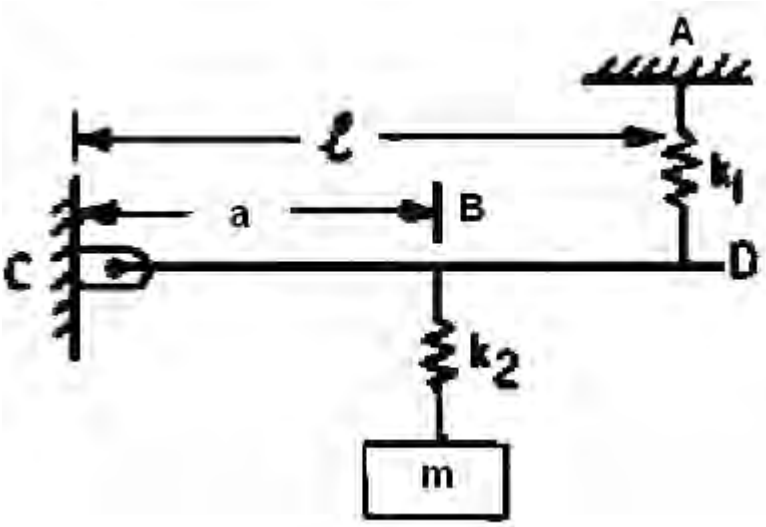


Figure 4:

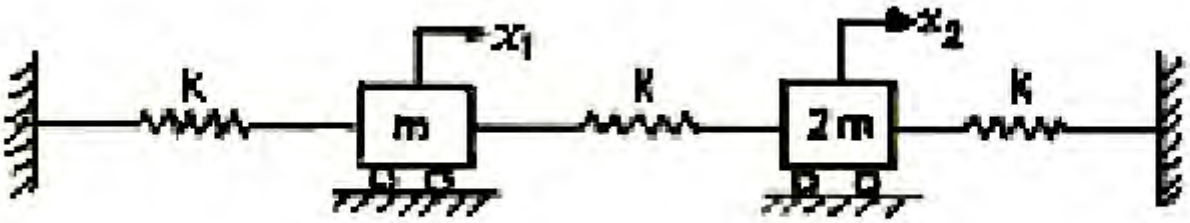


Figure 5:

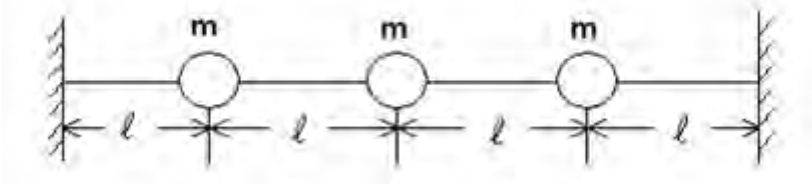


Figure 6b:

7. (a) A vibration measuring device is used to find the displacement, velocity and acceleration of a machine running at 120 rpm. If the natural frequency of the instrument is 5 Hz and it shows 0.004 cm. what are the three readings? neglect damping.

   (b) A machine member is vibrating freely at 3000 times per minute. How will you determine its exact frequency and amplitude of vibration. [8+8]

8. (a) Drive the differential equations of motion for the system shown in figure 8a.

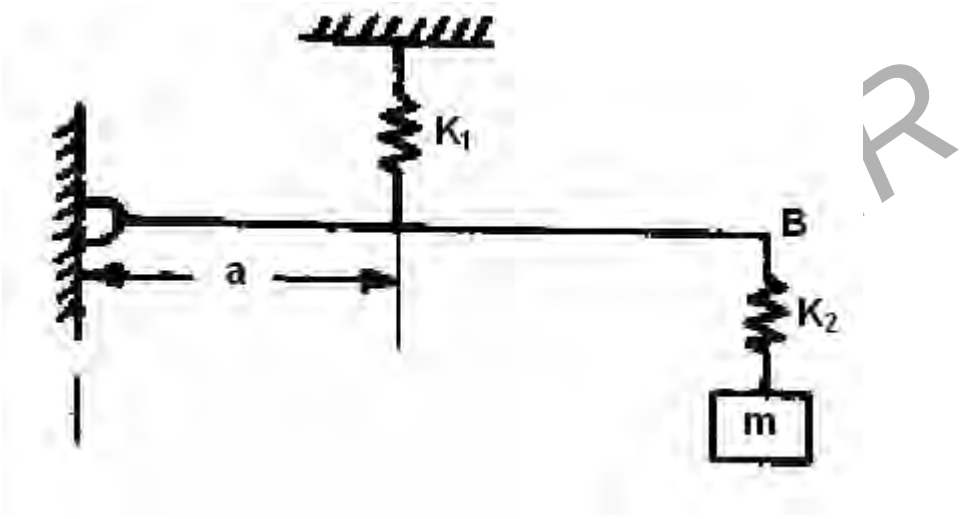


Figure 8a:

   (b) Show that for the damped spring mass system, the peak amplitude occurs at a frequency ratio given by the expression $\left(\frac{\omega}{\omega_n}\right) = \sqrt{1-2e^2}$. [8+8]

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Code No: 07A62401 **R07** **Set No. 3**

**III B.Tech II Semester Examinations,December 2010**
**VEHICLE DYNAMICS**
**Automobile Engineering**

**Time: 3 hours** **Max Marks: 80**

**Answer any FIVE Questions**
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1. (a) Sketch and explain the features of tyre?
   (b) Discuss in detail various factors affecting tyre life. [10+6]

2. (a) Explain Holzer's method of analysis for a system with fixed ends.
   (b) Find the frequencies of the system shown in figure 2b by matrix inversion method? [6+10]

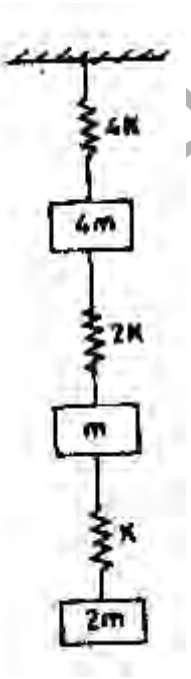


Figure 2b:

3. (a) Explain reciprocating systems with unbalanced mass with a neat sketch.
   (b) An engine is mounted on 4 rubber pads such that the static deflection is 5 mm. If the engine and coupling weigh 400 kg above, what speed must the motor run for 90% isolation? [6+10]

4. An automobile weighs 200 kg and has a wheel base of 3.0 meters. Its centre of gravity is located 1.4 meter behind the front wheel axis and has a radius of gyration about its C.G as 1.1 meter. The front springs have a combined stiffness of 6000 kg/cm & rear springs 6500 kg/cm. Find the principle mode of vibration of the automobile, & locate the nodal points for each mode. [16]

5. (a) Write the advantages and limitations of using frequency measuring device.
   (b) The motion of a vibratory system is to be recorded by a seismic instrument having natural frequency 3 rad/sec. What is the reading of the instrument if the motion is given by the equation.
   Z= 2 sin 2t+ 3 sin 3t Take $\epsilon$ is 0.5. [6+10]

6. (a) With neat sketches explain different single degree of Freedom systems.
   (b) A mass of 3 kg is supported on an isolator having a spring constant of 3000 N/m and viscous damping. If the amplitude of free vibration of the mass falls to one half its original value in 2 sec., determine the damping coefficient of the isolator.
   [6+10]

7. Determine the natural frequency of the system shown in figure 7. [16]

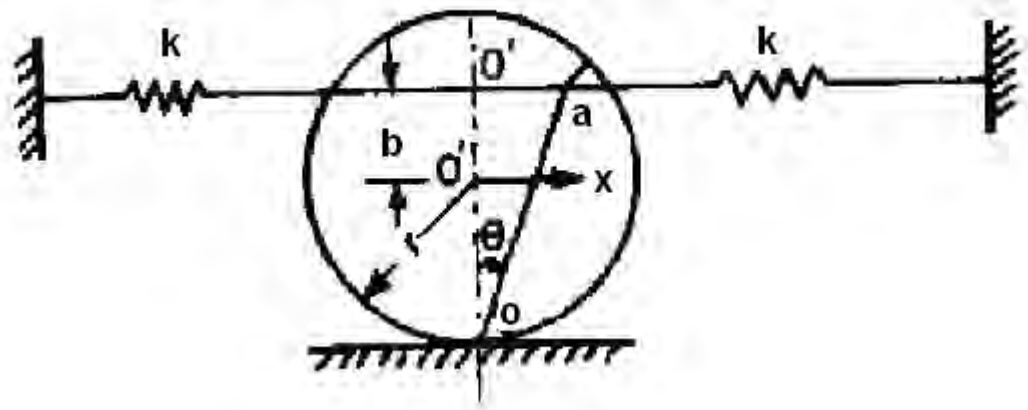


Figure 7:

8. Derive the differential equation of vehicle vibration with single degree of freedom for forced vibration and obtain the solution for magnification factor in the case of vibration due to road roughness? [16]

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