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

III B.Tech II Semester Examinations,APRIL 2011
VEHICLE DYNAMICS
Automobile Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) What is damping? Explain the importance of the critical damping.
   (b) The successive amplitudes of vibrations of vibratory system as obtained under free vibration are 0.69, 0.32, 0.19, 0.099 units respectively. Determine the damping ratio of the system. [6+10]

2. Determine the two natural frequencies and the corresponding mode shapes for the system shown in figure 1. The string is stretched with a large tension T. [16]

Figure 1:

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) Why does a radial ply tyre comfortable ride at high speeds and a cross ply tyre at low speed?
   (b) Why the steering characteristics of radial ply tyres better than those of cross ply tyre? [8+8]

5. A machine of mass one tonne is acted upon by an external force of 2500 N at a frequency of 1600 rpm. To reduce the effects of vibration, isolator of rubber having a static deflection of 3 mm under the machine load and an estimated damping ξ= 0.2 are used. Determine:

(a) The force transmitted to the foundation.

(b) The amplitude of vibration of machine.

(c) The phase lag. [16]

6. (a) State and explain Maxwell's reciprocal theorem

(b) Determine the natural frequencies and mode shapes for the system shown in figure 2 using influence coefficient method. [4+12]

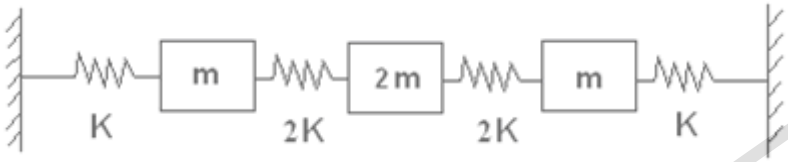

Figure 2:

7. (a) Determine the natural frequency of the system shown in figure 3. Assume k_1 = k_2 =1200N/m, k_3 =1800 N/m.

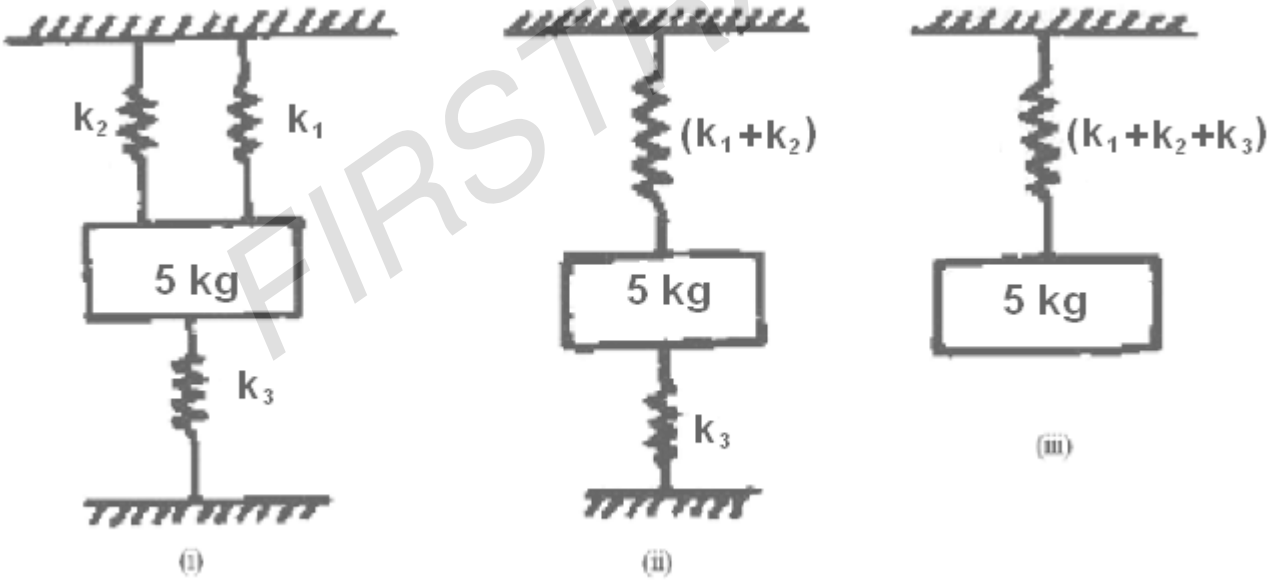

Figure 3:

(b) Find the natural frequency of vibration of a pendulum suspended vertically and oscillates with small amplitude. [8+8]

8. To effectively isolate engine vibration from an automobiles structure, the stiffness and damping coefficient of the engine mounts should be as small as possible. Design an engine mount for an engine having a mass of 200 kg that vibrates with a harmonic force of 10 N amplitude (assume constant for all engine speeds) by answering the following questions:

(a) What is the smallest stiffness that can be used if the vibration amplitude must be less than 5 mm as $\omega \rightarrow 0$?

(b) What is the smallest damping coefficient that can be used if the vibration amplitude must be less than 20 mm at resonance? [16]

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

III B.Tech II Semester Examinations,APRIL 2011
VEHICLE DYNAMICS
Automobile Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

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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. Find the natural frequencies and mode shapes for the system as shown in figure 4. [16]

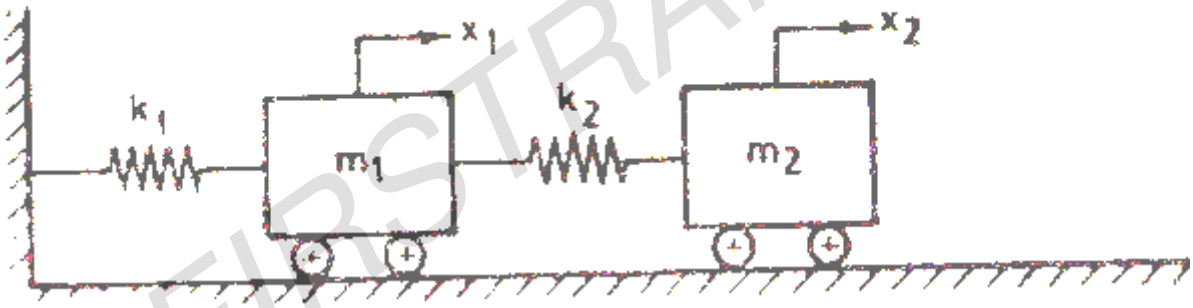

Figure 4:

3. (a) Explain the orthogonality principle.
   (b) Describe Holzer's method applied to systems with fixed ends. [8+8]

4. Using D'Alembert's principle, derive the differential equation of vehicle vibration with two degree freedom for forced vibration and obtain the solution and find the successive amplitudes for any one damped case. [16]

5. (a) Discuss the effect of damping on the frequency of a vibrating system. A damping force having magnitude of 2cos (2πt - $\pi/4$) N and gives 5 cos2πt m displacement. Calculate:
      i. The energy dissipated during first 5 seconds.
      ii. The energy dissipated during the first 3/4 seconds. [6+10]

6. A machine 105 kg mass has a 22 kg rotor with 0.6 mm eccentricity. The mounting springs have K=88x10^3 N/m, ε = 0.021. The operating speed of the machine is 500 rpm and the unit is constrained to move vertically. Find

(a) The dynamic amplitude of the machine.

(b) The force transmitted to the supports. [16]

7. (a) Explain the working of a bonded strain gauge accelerometer.

   (b) For turbines operating above the critical speed, stops are provided to limit the amplitude as its runs through the critical speed. In a certain turbine, a 15 kg rotor is supported at the middle point of 25 mm diameter shaft. If the clearance between the shaft and the stops is 0.5 mm and the eccentricity is 0.2 mm, determine the time required for the shaft to hit the stops, assuming that the critical speed is reached with zero velocity amplitude. Distance on the shaft between the bearings = 0.4m. Material of the shaft is steel. [4+12]

8. Determine the torsional natural frequency of the system shown in the figure 5. Neglect the mass moment of inertia of the shaft. J=0.0095 kg-m^2. [16]

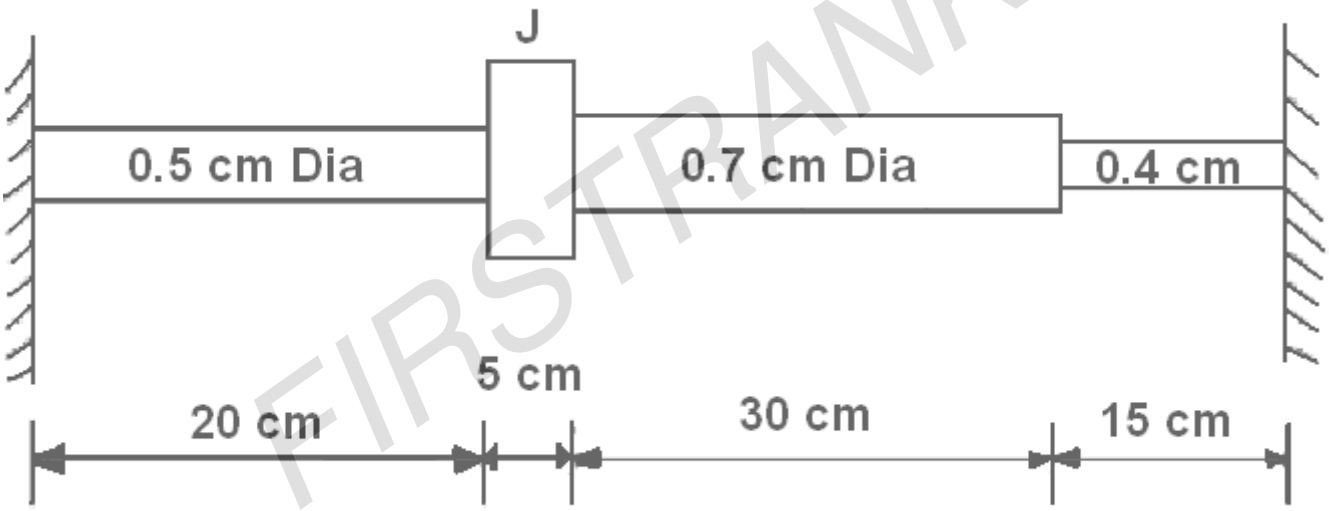

Figure 5:

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

III B.Tech II Semester Examinations,APRIL 2011
VEHICLE DYNAMICS
Automobile Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Explain the phenomenon of viscus damping.
   (b) A 4 kg mass is suspended in a box by a spring as shown in figure 6. 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]

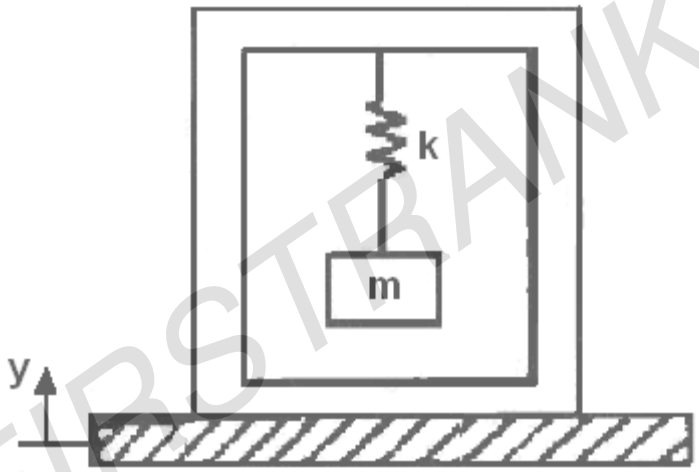


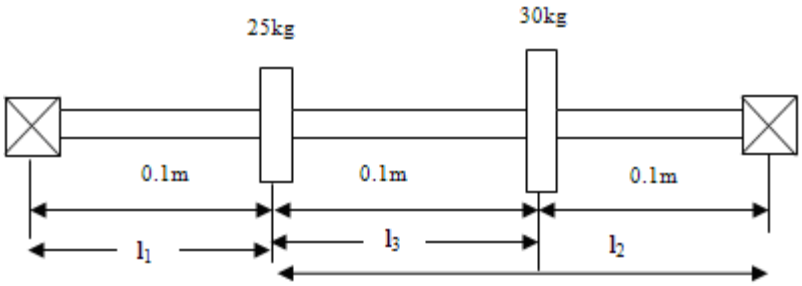
Figure 6:

2. (a) Sketch and explain the features of tyre?
   (b) Discuss in detail various factors affecting tyre life. [10+6]

3. (a) Find the expression for the logarithmic decrement.
   (b) A body of 7 kg is support on a spring of stiffness 250 N/m and has dashpot connected to it which produces a resistance of 0.003 N at a velocity of 1.3 cm/sec. In what ratio will the amplitude of vibrate be reduce after 8 cycles. [6+10]

4. Determine the natural frequency of vibration for the system shown figure 7. [16]

5. (a) Derive an expression for the natural frequency of the torsional equivalent shaft.
   (b) A machine runs at 5000rpm. Its forcing frequency is very near to its natural frequency. If the nearest frequency of the machine is to be at least 20% from the forced frequency, design a suitable vibration absorber for the system. Assume the mass of the machine as 30kg. [6+10]



Q .No.4 Figure 7:

6. The exhaust from a single cylinder four stroke diesel engine is connected to silencer and the pressure therein is to be measured with a simple U tube manometer. Calculate the minimum length of a manometer tube so that the natural frequency of the oscillation of the liquid column will be 4 times slower than the frequency of the pressure fluctuations in the silencer for an engine speed of 800 r.p.m. [16]

7. An Engine weighing 185 kg is to be supported on four helical springs when engine speed is 920 rpm. There is a primary vertical disturbing force of maximum value 31.9 kg due to the unbalanced reciprocating weights. Assuming that the engine vibrates in the vertical direction, find the stiffness of each spring in kg/cm of deflection to limit the maximum total periodic force on the foundations to 2.29 kg. What will be the amplitude of vibration of the engine when speed is 620 rpm. [16]

8. (a) Explain how a vibrometer is calculated to measure the acceleration.
   (b) A vertical shaft 1.3 cm in diameter rotates in long bearings and a disc weighing 142 N is attached to the mid span of the shaft . The span of the shaft between the bearings is 48 cm. The mass center of the disc is 0.05 cm from the axis of the shaft. Neglecting the mass of the shaft and taking the deflection as for a beam fixed at both the ends, find the critical speed of the rotation. Determine the range of speed over which the stress in the shaft due to bending will exceed 120 k-N/cm^2. Take E= 20.1x$10^6 N/cm^2$. [6+10]

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

III B.Tech II Semester Examinations,APRIL 2011
VEHICLE DYNAMICS
Automobile Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) What is vibration? How do you measure it and explain any one instrument working principle in detailed?
   (b) The rotor of a turbo charger weighing 9 kg is keyed to the center of a 25 mm diameter steel shaft, 40 cm between bearings. Determine:
      i. The critical speed of shaft.
      ii. The amplitude of vibration of the rotor at a speed of 3200 rpm, if the eccentricity is 0.015 mm and
      iii. The vibratory force transmitted to the bearings at this speed.
      Assume the shaft to be simply supported and the shaft material has a density of 8 gm/cm^3. Take E= 2.1x$10^6 kg/cm^2$. [6+10]

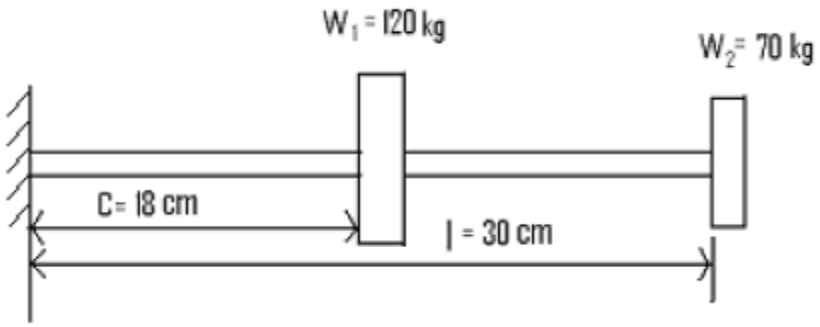
2. (a) A circular cylinder of mass 2 kg and radius 8 cm is connected by a spring of stiffness 2000 N/m as shown in figure 8. It is free to roll on horizontal rough surface without slipping, determine the natural frequency.

Figure 8:

   (b) A spring mass system has a period of 0.2 sec, what will be the new period if the spring constant is increased by 45%. [8+8]

3. (a) What is influence co-efficient? Explain with an example.
   (b) Find the natural frequency of vibration for the system shown in figure 9 by Rayleigh method? [6+10]

4. A gun barrel weighing W kg has a recoil spring whose stiffness is k kg/m. If W = 450 kg, k = 36000 kg/cm and the barrel recoils 1m on firing, determine.
   (a) The initial recoil velocity of the barrel.



Q .No. 3(b) Figure 9:

(b) The critical damping coefficient of a dashpot which is engaged at the end of the recoil stroke.

(c) The time required for the barrel to return to a position 5 cm from its initial position.

[16]

5. (a) What is the need of isolation? Explain.

(b) An electric motor is supported on a spring and a dashpot. The spring has the stiffness 6400 N/m and the dashpot offers resistance of 600 N at 4.5 m/s. The unbalanced mass 0.6 kg rotates at 6 cm radius and the total mass of vibratory system is 22 kg. The motor runs at 450 rpm. Determine:

i. Damping factor
ii. Amplitude of vibration and phase angle
iii. Resonant speed and resonant amplitude
iv. Forces exerted by the spring and dashpot on the motor. [6+10]

6. Explain the following with examples.

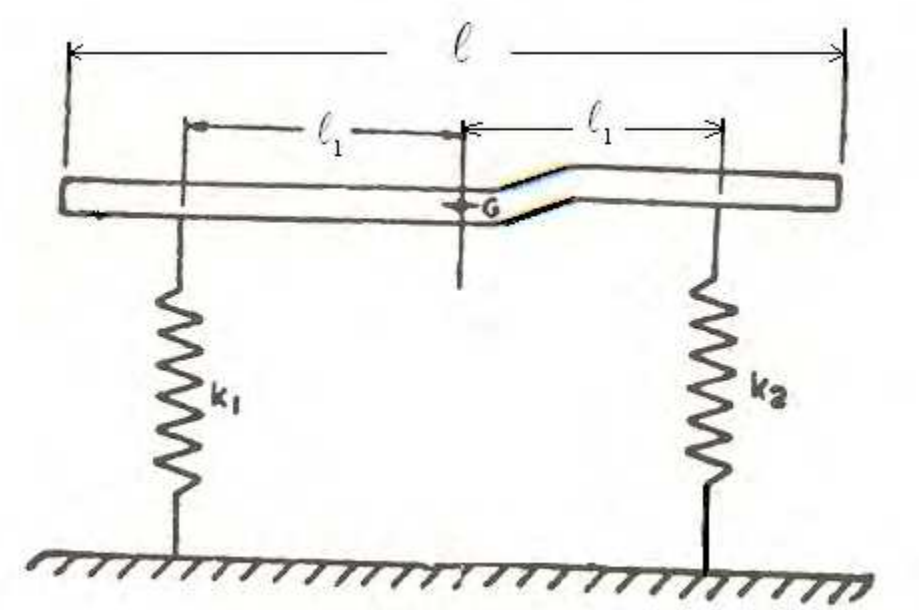
(a) Effect of wetness.

(b) SAE standards for tyre design. [8+8]

7. A thin rod of length l and mass m is supported on two unequal springs of stiffness k_1 and k_2, at point's l_1 and l_2 from the centre as shown in figure 10. Derive the frequency equation and show that the two frequencies are equal if $k_1 = k_2$ and $l_1 = l / (2\sqrt{3})$. [16]

8. A vertical single cylinder engine weighing 540 kg is carried on elastic beams whose static deflection under the weight of the engine is 0.965 cm. Calculate the frequency of free vibration in a vertical plane. The engine is now run at 130 rpm. The reciprocating parts weigh 45.5 kg. Stroke is 17.8 cm and the length of CR 35.6 cm. Calculate from first principles, the vertical moment of the engine due to

(a) Lack of primary balance. (b) Lack of secondary balance [16]



Q .No. 7 Figure 10:

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