Q.P. Code : **4995**

(3 Hours) | **Total Marks : 80**

N.B. : (1) Question No.1 is compulsory.
(2) Answer any three questions from remaining five.
(3) Assume suitable data if required.
(4) Answer to questions showed be poupsed and written together.

1. Answer any four of the following : 20

(a) A spring-mass system has a natural period of 0.25 second. What will be the new period of the Spring constant is :
(i) increased by 60% and (ii) decreased by 30%?

(b) A viscously damped spring-mass-damper systems has mass of 10 kg, damping coefficient of 150 N-s/m, and spring stiffness of 1000 N/m. Determine the values of the damping ratio, damped natural frequency logarithmic Decrement

(c) Two masses of 1kg each are inter connected by a spring of stiffness 10 N/m. Estimate the natural frequencies and draw their corresponding mode shapes.

(d) A mass is suspended from a spring of stiffness 5000 N/m and is subjected to a harmonic force of amplitude 100 N and a frequency of 10Hz. The amplitude of the forced motion of the mass is found to be 20 mm. Find value of the mass.

(e) Explain with a neat sketch, the principle of vibration measuring instruments.

(f) A rotating unbalance system consists of a disc of mass 2 kg, which is eccentric to the axis of shaft by 2mm. Adding two counter masses of 1kg, each at an axial distance of 1cm. and 2 cm. respectively from either side of the disc, the system is completely balanced. Find the radial location of the counter masses if all the masses lie in the same axial plane.

2. (a) The block Shown has a mass M and slides over two rollers having mass m and radius r each. The stiffness of the spring is k. The second roller is pivoted to a light and stiff rod which is connected to the block at the other end. If the block has a harmonic motion x(t), determine the system's undamped natural frequency. 10

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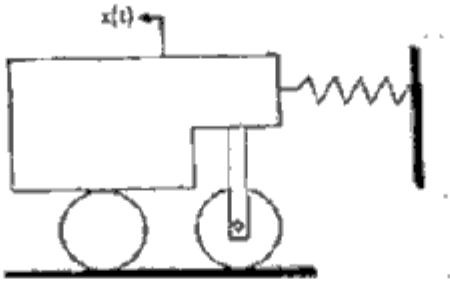
2. (a)



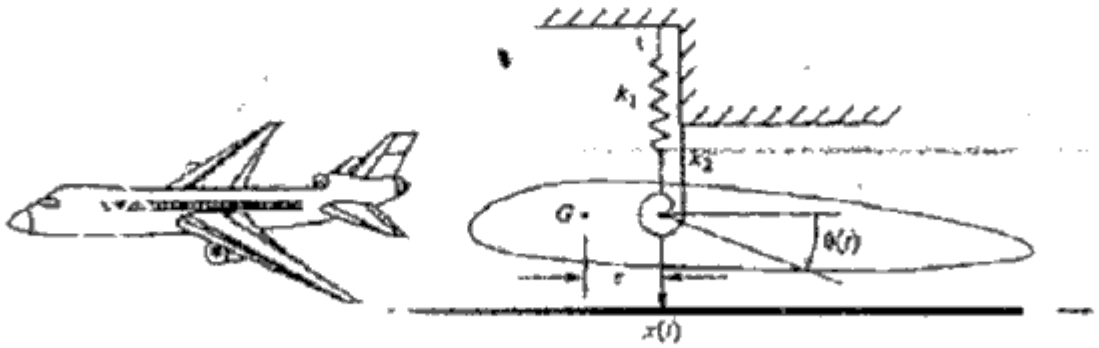
(b) Show that the inertia effect of a shaft of mass moment of inertia J_s can be taken into effect by adding 1/3rd of its value to the mass moment of inertia of the disc J fitted at its end, in order to compute the natural frequency of the system. 5

(c) Define Whirling Speed. Derive the equation for the critical speed of a light shaft with a single disc without damping. 5

3. (a) Explain with a neat sketch, the effect of forcing frequency and damping factor on Displacement Transmissibility. 4

(b) An instrument with mass 13 kg is to be isolated from aircraft engine vibrations ranging from 1,800 to 2,300 cycles per minute. What should be the stiffness of an isolator for at least 65% isolation? Assume that the damping ratio is 0.045. 8

(c) Consider the wing vibration model as shown in the following figure. Using the vertical motion of point attachment of the springs and the rotation of this point, determine the equations of motions using Lagrange's method. G indicates the centre of mass and e denotes the distance between the point of rotation and centre of mass. Ignore the gravitational force. 8



(a) (b)

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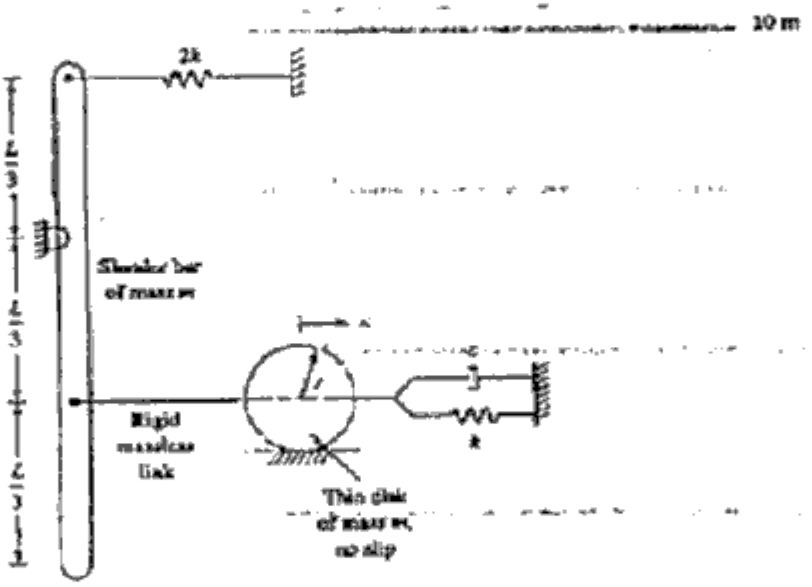
4. (a) Determine the frequency of transverse vibration of the beam shown in figure below using Dunkerley's and Rayleigh's energy methods. Deflection at A: due to 1000 N at A =1.52mm, due to 1000 N at B = 1.37 mm. 10

(b) Derive the equivalent system parameters for the following figure,taking x as the generalized coordinate. 10



5. (a) A 2 kg mass connected to a spring of stiffness 1 kN/m has a dry sliding friction force of 2 N. As the mass oscillates, its amplitude decreases 22cm. How long does this take? 5

(b) Explain why only a part of the unbalance force in reciprocating mass is balanced by revolving mass. Derive the resultant unbalance primary force if c% balancing is achieved. 5

(c) An accelerometer with mass 0.01 kg and a damping ratio 0.707 is to be designed. What should be undamped natural frequency of the system so that the measurement error never exceeds 2%? The vibration signal,which is to be measured,can have a frequency as high as 200Hz. 10

6. (a) The natural frequency and the damping ratio of a vibrometer are 6 Hz and 0.22 Hz, respectively. What is range of frequencies for the measurement error to be below 3%? 10

(b) Four pulleys are equally spaced along a shaft and each has an out of balance mass at the same radius. The out of balance mass in second pulley is 3 kg and the third and fourth out of balance masses are at 75° and 200° to it. Determine the masses in the first, third and fourth pulleys and also the angle of the first mass relative to second if complete balance is to be obtained. 10