B.E. Eighth Semester (Aeronautical Engineering) (C.B.S.)

Vibration & Aero Elasticity

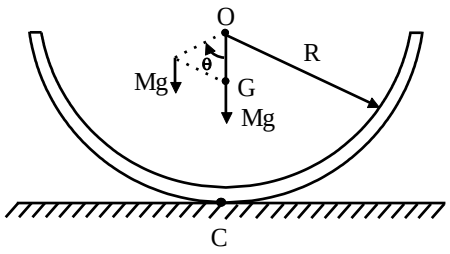
P. Pages : 4 **KNT/KW/16/7644**

Time : Three Hours * 0 3 4 1 * Max. Marks : 80

Notes :
1. All questions carry marks as indicated.
2. Solve Question 1 OR Questions No. 2.
3. Solve Question 3 OR Questions No. 4.
4. Solve Question 5 OR Questions No. 6.
5. Solve Question 7 OR Questions No. 8.
6. Solve Question 9 OR Questions No. 10.
7. Solve Question 11 OR Questions No. 12.
8. Due credit will be given to neatness and adequate dimensions.
9. Assume suitable data whenever necessary.
10. Diagrams and chemical equations should be given whenever necessary.
11. Illustrate your answers whenever necessary with the help of neat sketches.
12. Use of non programmable calculator is permitted.

1. a) Explain the following methods used for solving vibration problems : **7**
i) D'Alemberts Principle. ii) Energy Method.

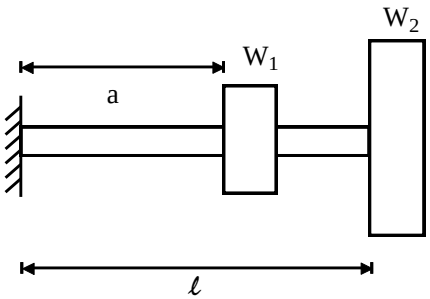
b) In the figure below a thin semi circular cylinder of mass 'M' and radius 'R' slides on the horizontal surface without slipping. Determine the natural frequency. **7**



OR

2. a) Define the followings : **6**
i) Time Period ii) Frequency iii) Amplitude
iv) Natural frequency v) Degree of freedom.

b) Calculate the natural frequency of vibration of a two rotor system a shown below. Neglect the weight of the shaft. **8**



Given : $W_1 = 60\,Kg;\ W_2 = 92\,Kg;$

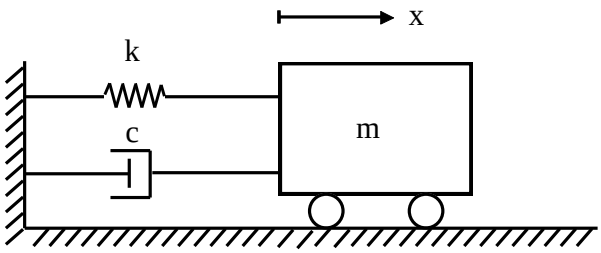
$\ell = 25.6\,cm;\ a = 15\,cm;\ I = 625\,cm^4$

$E = 2\times10^6\ kg/cm^2$

3. a) Determine the power required to vibrate a spring mass system with an amplitude of 15cm and at a frequency of 100Hz. The system has a damping factor 0.05 and a damped natural frequency of 22Hz as found out from the vibration record. The mass of the system is 0.5kg. **4**

b) The system shown below is displaced from its static equilibrium position to the right a distance of 0.01m. An impulsive force act towards the left on the mass at the instant of its release to give it an initial velocity V_o in that direction. If the system has the following parameters : **9**

$k = 15700\,N/m;\ c = 1570\,N-sec/m;\ m = 9.8\,kg$



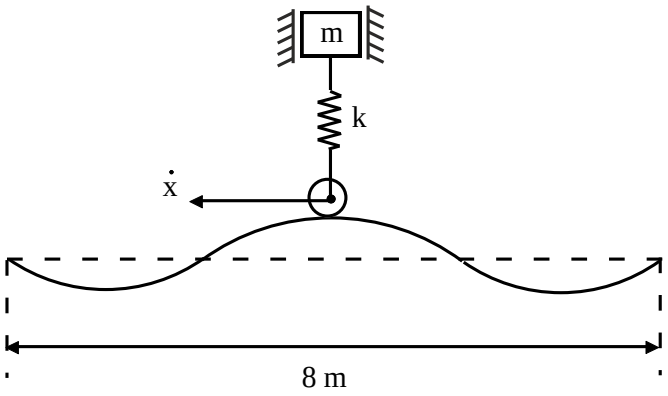
a) Derive the expression for the displacement from the equilibrium position in terms of time 't' and initial velocity V_o.

b) What value V_o would be required to make the mass pass the position of the static equilibrium 1/100 sec. after it is applied?

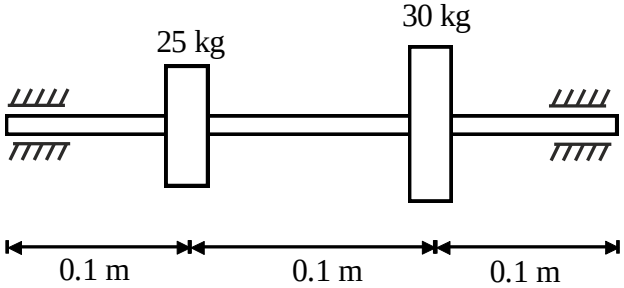
OR

4. a) Describe the concept of Acclerometer with suitable diagrams & graphs. **6**

b) Figure below shows an automobile trailer which moves over the road surface making approximately sinusoidal profile pulled on the road surface with a velocity of 60km/hr. Calculate the critical speed of trailer if the vibration amplitude is 1.5cm for the trailer mass of 50kg. **7**

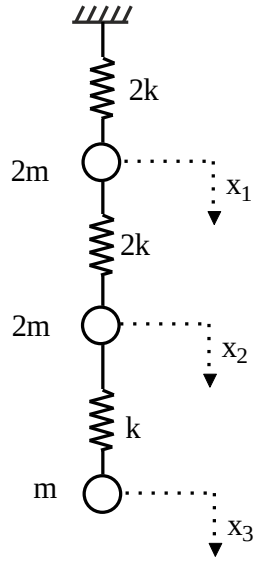


5. a) Determine the influence coefficients of the following system. **4**



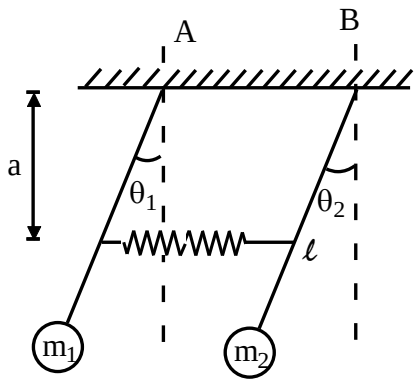
$E = 2\times10^{11}\,N/m^2;\ I = 4\times10^{-7}\,m^4$

b) Determine the natural frequencies of the system shown by the matrix method. **9**

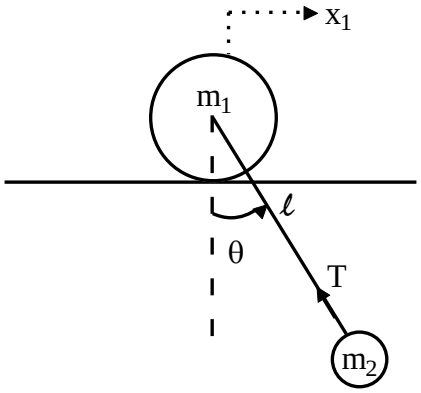


OR

6. a) Determine the natural frequency of each bob of the coupled pendulum shown if **7**
$k = 100 N/m;\ m_1 = 2kg;\ m_2 = 5kg;\ \ell = 0.2m; a = 0.1m$

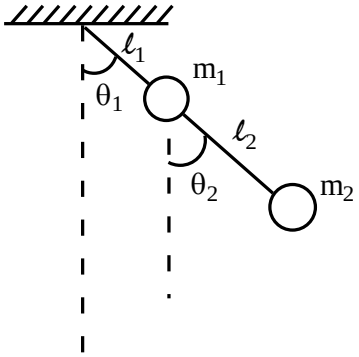


b) Find the natural frequency of the system shown. **6**



7. a) Explain Lagrange's equation of motion. **4**

b) Determine the natural frequency of oscillation of the double pendulum shown below where $m_1 = m_2 = 5\,kg$; $\ell_1 = \ell_2 = 25\,cm$ using Lagrange's equation of motion. **10**

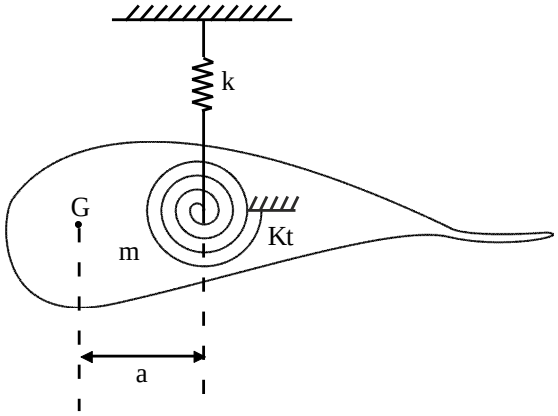


OR

8. Write the equation of motion for the system and calculate the natural frequencies for the following data. **14**

$m = 5kg;\ k = 5\times10^3\,N/m$

$J = 0.12kg\,m^2;\ k_t = 0.4\times10^3\,Nm/rad$



9. Determine the normal function in transversal vibrations of a simply supported beam of uniform cross section and length 'ℓ'. **13**

OR

10. a) Obtain the frequency equation for the lateral vibrations of a cantilever of length 'ℓ' and uniform cross section. **7**

b) Obtain the frequency equation of torsional vibrations of a free-free ends shaft of length 'ℓ'. **6**

11. Write detailed notes on control of surface flutter. **13**

OR

12. a) What is flutter in aero-elasticity?
Explain the concept of coupling in flutter. **7**

b) Explain various types of aeroelasticity problems in detail. **6**

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