Roll No. _____

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination - April 2017

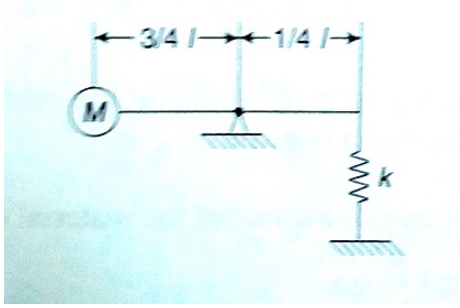
Program/Course: B.Tech/Mechanical | **Semester: VIII**
Subject: Mechanical Vibrations | **Max. Marks: 100**
Code: MHEG 481 | **Duration: 3 hrs**
No. of page/s: 3

Note: The question paper contains section A, B & C.

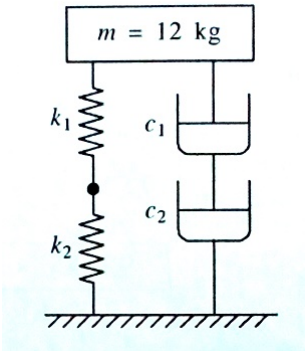
Section A

Note: *Answer all the questions. Each question carries* ***5 marks***.

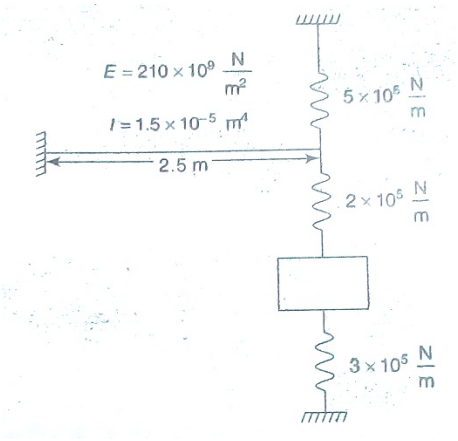
1. A simply supported beam of length L has a concentrated load m on the mid span. If the mass of the beam is negligible, determine the natural frequency of the system.
2. A rigid weightless rod is restrained to oscillate in a vertical plane as shown in the figure below. Determine the natural frequency of the system.



3. Between a solid mass of 12 kg and the floor, there are two springs and two dampers. Spring and Damping coefficients given are as follows, k_1 = 3200 N/m and k_2 = 12,800 N/m, c_1 = 110 and c_2 = 330 N-s/m. Determine the damped and undamped frequencies of the system.



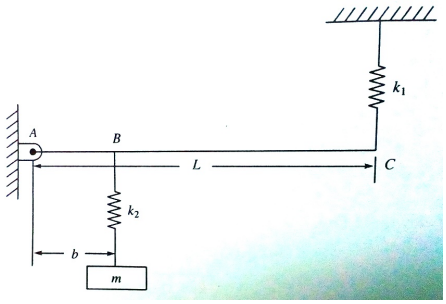
4. What is the equivalent stiffness of the system using the displacement of the block as the generalized coordinate.



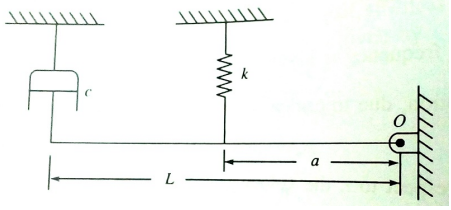
Section B

Note: *The first three questions are compulsory. Attempt any one from the last question(Q.8). Each question carries **10 marks**.*

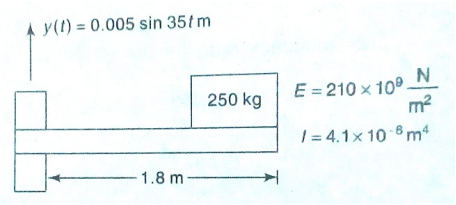
5. Find the natural frequency of vibration of the system shown below. The rod AC may be assumed to be weightless and of length L. The rod is supported by a spring of stiffness k_1 at C and supports a spring-mass system (k_2, m) at an intermediate point B distant b from A.



6. A rigid uniform bar of mass m and length L is pinned at O and supported by a spring and a viscous damper as shown below. Measuring θ from the static equilibrium position, determine -
   a. the equation of motion for small θ
   b. the expression for undamped natural frequency
   c. the expression for critical damping



7. Determine the steady state amplitude for the system given below.



8. The damped natural frequency of a system as obtained from a free vibration test is 10.5 Hz. During the forced vibration test, with constant excitation force, on the same system, the maximum amplitude of vibration is found to be 9.5 Hz. Find the damping factor of the system and its natural frequency.

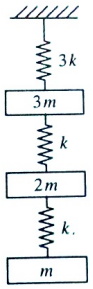
OR

Show that the peak amplitude takes place at a frequency ratio (r) = $\frac{\omega}{\omega_n} = \sqrt{1-2\epsilon^2}$ where ϵ is the damping ratio.

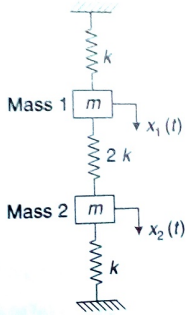
Section C

Note: *Q.9 is compulsory. Attempt any one from Q.10. Each question carries* ***20 marks***.

9. For the multi degree freedom shown below, find out the three natural frequency of the system.



10. Determine the natural frequency of the two degree freedom system shown below



OR

Determine the equation of motion and the natural frequencies of the two degree freedom shown below.