Reg. No.									

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

VII SEMESTER B.TECH. (AERONAUTICAL & AUTOMOBILE ENGINEERING)

END SEMESTER EXAMINATIONS, JANUARY 2021 (ONLINE)

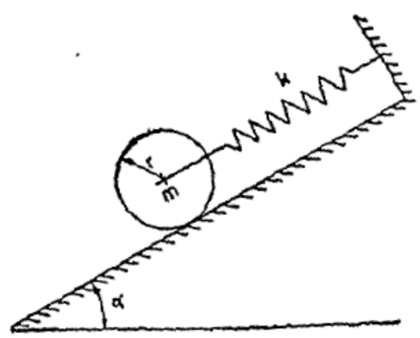
SUBJECT: THEORY OF VIBRATION [AAE 4101]

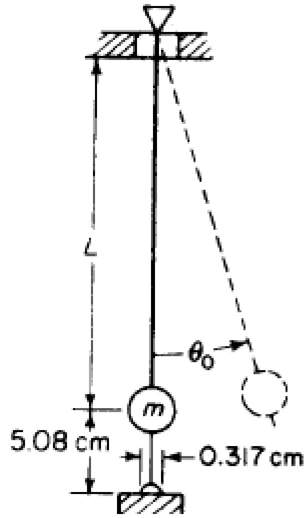
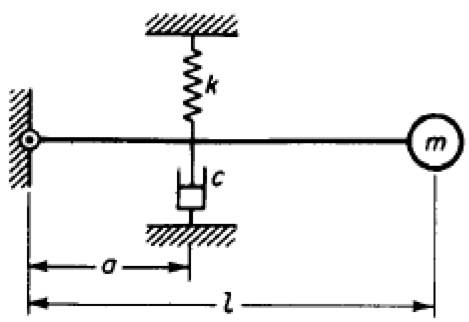
REVISED CREDIT SYSTEM
(25/01/2021)

Duration: 3 Hours | Max. Marks: 50

Instructions to Candidates:

- **Answer all the questions.**
- **Assume missing data if any.**

1A)	Differentiate between a) deterministic and non-deterministic vibrations and b) linear and non-linear vibration.	**(02)**
1B)	Determine the natural frequency of the following system (figure 1)for small amplitudes.  Figure 1	**(03)**
1C)	A chronograph is to be operated by a 2 sec pendulum of length *L* as shown below. A platinum wire attached to the bob completes the electric timing circuit through a drop of mercury as it swings through the lowest point. (a) what should be the length of the pendulum? (b) If the platinum wire is in contact with the mercury for 0.3175 cm of the swing, what must be the amplitude θ to limit the duration of contact to 0.01 sec? (Assume that the velocity during contact is constant and that the oscillation is small).	**(05)**

	 Figure 2	
2A)	A mass of 0.907 kg is attached to the end of a spring with constant of 7 N/cm. Determine the critical damping coefficient.	**(02)**
2B)	Determine the natural frequency of the following system and derive an expression for the critical damping coefficient for the same.  Figure 3	**(03)**
2C)	A weight attached to the spring of stiffness 525 N/m has a viscous damping device. When the weight is displaced and released, the period of vibrations was found to be 1.8 sec. and the ratio of consecutive amplitudes is 4.2 to 1.0. Determine the phase and amplitude when a force $f(t) = 3 \cos (3t)$ acts on the system.	**(05)**
3A)	A sensitive instrument with a mass of 113 kg is to be installed where the acceleration is 15.24 cm/sec2 and a frequency of 20 Hz. It is proposed to mount the instrument on a rubber pad with stiffness of 2802 N/cm and ζ=0.1. What acceleration is transmitted to the instrument?	**(05)**
3B)	Derive the equation governing the longitudinal vibrations of the bar and obtain the general solution of the differential equation derived above.	**(05)**
4A)	A reciprocating engine has a mass of 40 kg and runs at constant speed of 3000pm. After it was installed it vibrated with a large amplitude at operating speed. What dynamic vibration absorber should be coupled to the system if the nearest resonant frequency of the combined system has to be at least 25% away from the operating speed. Under these conditions what amplitude of the absorber will be obtained?	**(06)**

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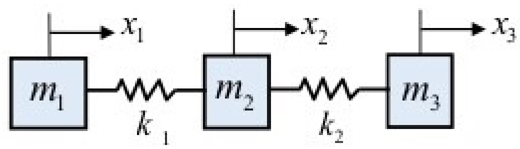
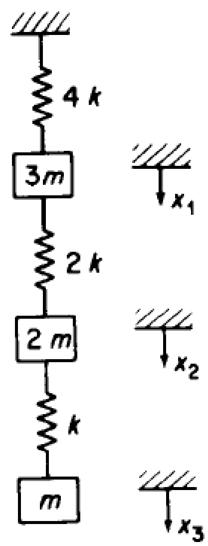
4B)	Prove that the following system in figure 4 is a semidefinite system. m_1=m, m_2=2m and m_3=3m, and k_1=k_2=k.  Figure 4	**(04)**
5A)	Determine the flexibility matrix of the following by influence coefficient method of the following MDOF system.  Figure 5	**(02)**
5B)	Determine ω_{n1} and ω_{n3} of the system shown in figure 5 by method of matrix iteration	**(06)**
5C)	Determine the lowest natural frequency of the system shown in figure 5 by Dunkerly's approximation method and compare the answer with that of the matrix iteration method and compute the percentage error. What is the reason for the error?	**(02)**