Reg. No. | | | | | | | | | |

MANIPAL INSTITUTE OF TECHNOLOGY

A Constituent Institute of Manipal University, Manipal

VII SEMESTER B.TECH (MECHANICAL ENGINEERING)
END SEMESTER EXAMINATION – NOV./DEC. 2016
SUBJECT: MECHANICAL VIBRATIONS (MME 403)
REVISED CREDIT SYSTEM

06/12/2016

Time: 3 Hour **Max. Marks: 50**

Note: (i) Answer any 5 full questions
(ii) Missing data, if any, may be appropriately assumed
(iii) Draw the sketch as applicable
(iv) Assumptions made must be clearly mentioned

1A. Find the natural frequency of vibration for the system shown in Fig. Q1A. 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 located at a distance 'b' from A. 05

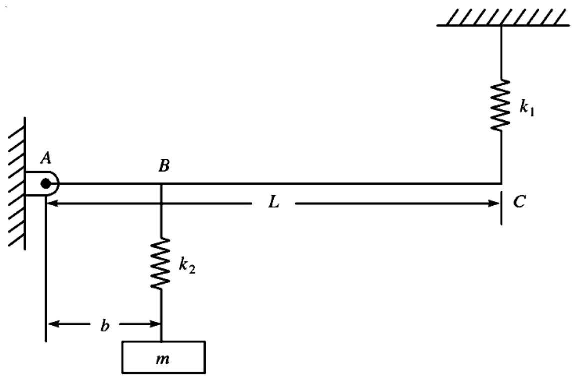

Fig. Q 1A

1B. A thin plate of area 'A' and Weight 'W' is attached to the end of a spring and allowed to oscillate in a viscous medium (fluid). If 'T_1' is the natural period of un-damped oscillation (system oscillating in air) and 'T_2' the damped period with plate immersed in the fluid. 05

(i) Show that

$$\mu = \frac{2\pi W}{gA}\frac{\sqrt{T_2^2 - T_1^2}}{T_1 T_2}$$

where damped force on the plate is $F_d = 2A\mu V$ and '2A' is the total area of the surface of the plate and 'V' is the velocity.

(ii) What is the damping coefficient of the system when it is vibrating in fluid?

2A. Differentiate between viscous and Coulomb damping. With usual notations and displacement diagram, derive an expression for the amplitude loss per cycle of a Coulomb damped vibration system. 05

2B. Derive an expression for displacement transmissibility ratio of a base excited vibration system with the help of proper sketch and vector diagram. 05

3A. A shaft 12.5 mm diameter carrying a disc of mass 20 kg at its mid-span is mounted on long bearings. The span of the shaft between the bearings is 600 mm. The mass center of the disc is 0.5 mm from the axis of the shaft. Modulus of elasticity of shaft material is 205 GPa. Neglecting the mass of the shaft, determine 05

(i) the critical speed of the shaft.

(ii) the range of the speed over which the dynamic bending stress in the shaft will not exceed 115 MPa.

3B. A machine part weighing 39 N vibrates in a viscous medium. Determine the damping coefficient when a harmonic exciting force of amplitude 49 N results in a resonant amplitude of 12.5 mm with a period of 0.2 second. If the system is excited by a harmonic force of frequency 4 Hz, what will be the percentage increase in the amplitude of forced vibration, if the damping is neglected? 05

4A. Explain the design principle of (i) vibrometer and (ii) accelerometer. 05

4B. A commercial type vibration pickup has a natural frequency of 10 Hz and a damping factor of 0.52. What is the range of frequencies at which the amplitude can be measured within (a) one per cent error and (b) two per cent error? 05

5A. Determine the equations of motion and find the natural frequencies for the torsional vibration system shown in figure Q5A. *Take* $J_1 = J$, $J_2 = 2J$, $k_{t1} = k_{t2} = k_t$. 05

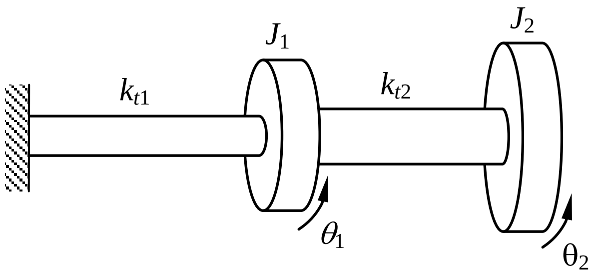

Fig. Q5A

5B. Explain the Rayleigh's method of finding the fundamental natural frequency of a multi-degree of freedom system and hence deduce an expression for the same. 05

6A. Derive and show how the amplitude of vibration of the main mass becomes zero by attaching an auxiliary mass in a dynamic vibration absorber. 05

6B. Using Holzer's method find the fundamental natural frequency of a spring mass system shown in figure Q6B. Take k = 1000 N/m and m = 1 kg. 05

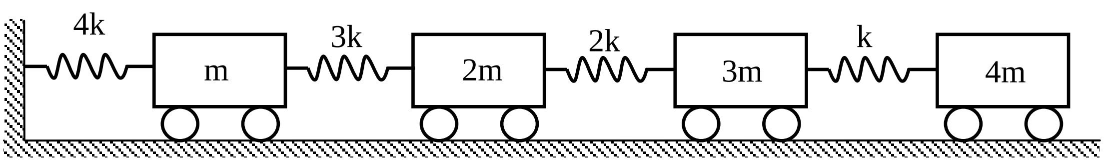

Fig. Q6B

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