Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

VII SEM. B.TECH. (MECH. ENGG.) END SEM. EXAMINATIONS NOV/DEC 2015
SUBJECT: MECHANICAL VIBRATIONS [MME-403]
(REVISED CREDIT SYSTEM)

Time: 3 Hours. MAX. MARKS: 50

Instructions to Candidates:

- Answer **ANY FIVE FULL** questions.
- Additional data, if any, may be appropriately assumed.
- Assumptions made must be clearly mentioned.
- Sketches are to be drawn wherever necessary.

1A) Derive an expression for natural frequency of the system shown in Fig. (Q1A), for oscillations about point P.

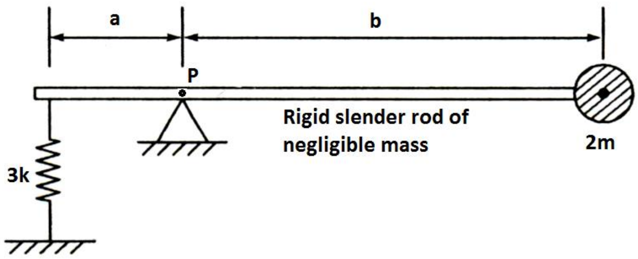

Fig. (Q1A) 04

1B) Derive an expression for the absolute displacement of a spring-mass-damper system subjected to base excitation. 04

1C) A reciprocating machine has a mass of 25 kg and operates at a constant speed of 2400 rpm. After installation, the forcing frequency was found to be too close to fundamental natural frequency of the system. Design a dynamic vibration absorber such that the natural frequency of the system is at least 25% away from the excitation frequency? 02

2A) A car has a natural frequency of vibration of 120 cpm. It travels on a road, the surface of which is assumed to be sinusoidal profile with a distance of 0.15 m between the peak and the depression. The distance between the two peaks measured horizontally is 0.30 m. Assuming the car to be a single degree of freedom system with damping ratio of 0.20 for shock absorbers, determine the maximum amplitude of vibration of the car when the car travels at a speed of 30 kmph. 04

2B) Derive the governing differential equation of a spring mass system undergoing Coulomb damping. Also calculate the amplitude loss per half cycle. 04

2C) Explain the Rayleigh's method for determining the natural frequencies of a Multi-DOF system. 02

3A) Explain with derivation how the bifilar suspension is used to determine the mass moment of inertia of a body about an axis passing through its center of gravity. 04

3B) The following data is the damped vibration record of a spring mass system. The amplitude at the end of 2nd cycle = 12 mm, 3rd cycle = 6mm, 4th cycle = 3 mm

k = 2 kN/m, W = 24 N

Determine:

i) the logarithmic decrement
ii) the damping force at unit velocity
iii) the damped period of vibration. 04

3C) It is required to experimentally verify the damping ratios of three cantilever beams using a forced vibration setup. The actual values of damping ratios of the three cantilever beams are given to be 0.1, 0.3 and 0.5 respectively. State and justify in which case, the experimentally determined value of damping ratio will closely agree with the actual value. 02

4A) What is semi-definite system? Prove that the system shown in Fig. (Q4A) is a semi-definite system.

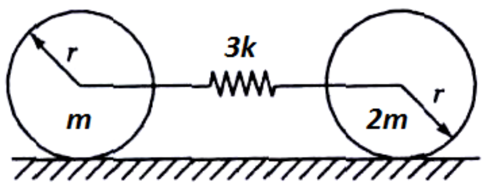

Fig. Q(4A) 04

4B) Determine all the flexibility/displacement influence coefficients of the system shown in Fig. (Q4B).

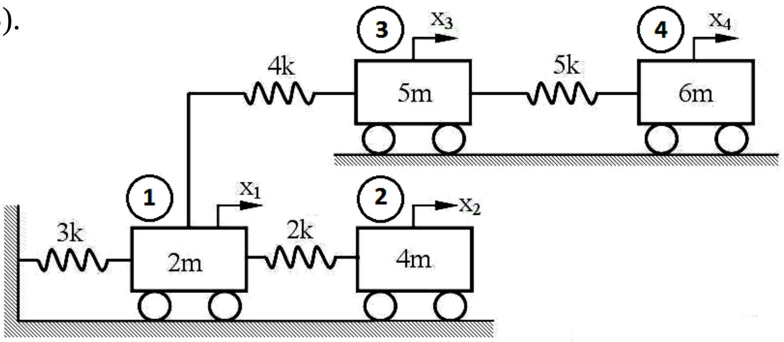

Fig. (Q4B) 04

4C) A seismic instrument is used to measure the vibration characteristics of a machine operating at 100 rpm. If the natural frequency of the instrument is 8 Hz and if it shows 0.05 mm, determine the displacement, velocity and acceleration of the machine. 02

5A) Using Lagrange's equation determine the natural frequencies of oscillations of the system shown in the Fig. (Q5A). Assume the instant when both the pulleys oscillate in the same direction.

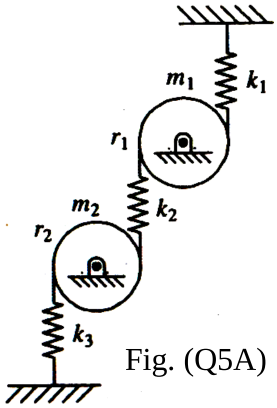

Fig. (Q5A) 04

5B) Explain Dunkerley's method. Find the fundamental natural frequency of the spring mass system shown in Fig. (Q5B) using Dunkerley's method.

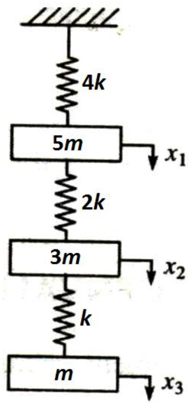

Fig. (Q5B) 04

5C) Explain the terms '*Center of Percussion*' and '*Logarithmic Decrement*'. 02

6A) An instrument with a damping ratio of 0.25 is to be isolated from a vibratory disturbance having disturbing frequencies ranging from 800 to 1300 cpm. What should be the natural frequency of the instrument in order to achieve isolation greater than or equal to 75%? 04

6B) What is critical speed of a shaft? Derive an expression to determine the lateral deflection of a rotating shaft-disc system subjected to damping. 04

6C) Find the equivalent stiffness of the spring mass system shown in Fig. (Q6C).

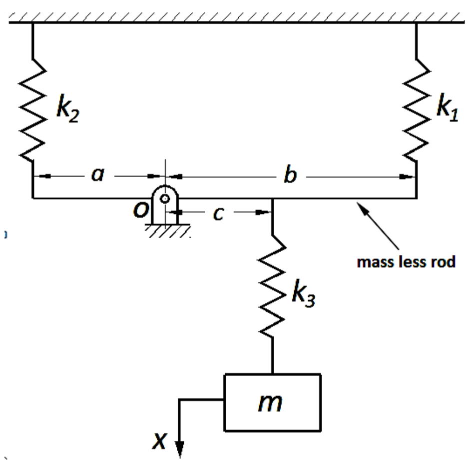

Fig. (Q6C) 02

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