Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

VII SEMESTER B. TECH (MECHANICAL ENGINEERING)

END SEMESTER EXAMINATIONS, NOVEMBER 2018

SUBJECT: MECHANICAL VIBRATIONS I [MME 4101]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data if any, may be suitably assumed.

1A. A horizontal spring controlled simple pendulum is supported by two springs as shown in figure Q1A. If the system oscillates with small amplitudes about 'O', find the natural frequency of oscillation of the system about its mean position. **04**

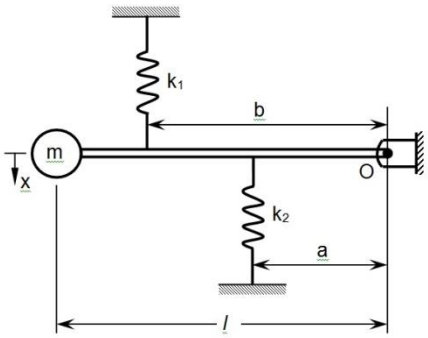

Fig Q1 A

1B. The disc of a torsion pendulum has a moment of inertia of 0.06 kg-m^2 and is immersed in a viscous fluid. The brass shaft attached to it is of 10 cm diameter and 40 cm long. When the pendulum is vibrating, the observed amplitudes on the same side of the rest position for successive cycles are 9°, 6° and 4°. Determine: **04**

i) Logarithmic decrement,
ii) Damping torque at unit velocity and
iii) Periodic time of damped vibration.
Assume that for the brass shaft G = 4.4 x 10^{10} N/m^2.

1C. For a coulomb damped system find the amplitude loss per cycle during free vibrations. **02**

2A. Derive an expression for magnification factor and plot the frequency response curve for a forced vibration system. **05**

2B. A car has a natural frequency of vibration of 110 CPM. It travels on a road, the surface of which is assumed to be sinusoidal profile with a distance of 0.1 m between the peak and the depression. The distance between the two peaks measured horizontally is 0.3 m. Assuming the car to be a single degree of freedom system with damping ratio of 0.2 for shock absorbers, determine the maximum amplitude of vibration of the car when the car travels at a speed of 40 kmph. **05**

3A. What is a seismic instrument? Explain the design principle used in Vibrometers and accelerometers. **03**

3B. A vibrometer whose damping is negligible is amplified to find the magnitude of vibration of a machine structure. It gives a record of relative displacement of 0.02 mm. Natural frequency of the vibrometer is given as 300 cpm and the machine is running at 100 rpm. What will be the magnitude of displacement, velocity and acceleration of the vibrating machine elements? **03**

3C. A shaft 12 mm diameter rotates in long bearings and a disc weighing 196.2 N (20 kg mass) is attached to the mid-span of the shaft. The span of the shaft between the bearings is 0.75 m. The mass center of the disc is 0.5 mm from the axis of the shaft. Neglecting the mass of the shaft and taking the deflection as for a beam fixed at both ends, determine the critical speed of the shaft. Also determine the range of the speed over which the stress in the shaft due to bending will exceed 100 N/mm^2. Take E = 196 GPa. **04**

4A. Derive the frequency equation for the pulley-mass system shown in figure Q4A. The pulley has a mass of *M* and effective radius of R and is pivoted at O. Assume that the cord, which passes over the pulley, does not slip. If k_1 = 60 N/m, k_2 = 40 N/m, *m* = 2 kg and *M* = 10 kg. Determine the two natural frequencies. **05**

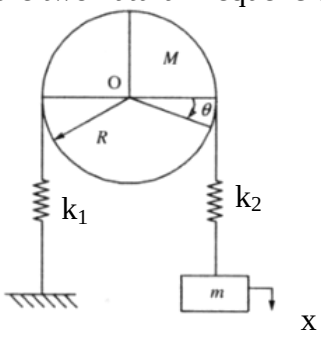

Fig Q4A

4B. Explain the design principle used in dynamic vibration absorber and show how the vibration of the system is eliminated. **05**

5A. Derive an expression for determining the fundamental natural frequency of a multidegree freedom system using Rayleigh's method. **05**

Find the fundamental natural frequency of the string mass system shown in the figure Q5B using Dunkerley's method.

5B. **05**