Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

I SEMESTER M.TECH (CAAD) END SEMESTER EXAMINATIONS, NOVEMBER 2018

SUBJECT: ADVANCED MECHANICAL VIBRATION [MME 5102]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

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

1A. Explain with examples the following:
1. Resonance
2. Static coupling
3. Dynamic coupling
4. Critical speed
5. Force transmissibility.
6. Normal mode. **03**

1B. A refrigerator unit weighing 295 N is to be supported by three springs of stiffness 'k' N/m each. If the unit operates at 580 rpm, what should be the value of the spring constant 'k' if only 10% of the shaking force of the unit is to be transmitted to the supporting structure? **03**

1C. With the usual notations derive an expression for the longitudinal vibration of bars. Take the bar as a continuous system. Solve the resulting equation of motion. **04**

2A. Define 'magnification factor' and derive the expression for the same. Show that it will be maximum for a frequency ratio of $\sqrt{1-2\xi^2}$, where ξ is the damping factor. **04**

2B. A single rotor of mass 7 Kg is mounted midway between bearings on a steel shaft 1 cm diameter. The bearing span is 0.4 m. It is known that the CG of the rotor is 0.025 mm from its geometric axis. If the system rotates at 1000 rpm, determine the load transmitted to the bearings, when the shaft is vertically supported. Neglect weight of the shaft and the damping in the system. Assume shaft is simply supported. Young's modulus of steel is 2 x 10^{11} N/m^2. **03**

2C. For a simply supported beam of length 'l' shown in figure **2C** and of uniform cross section, find the first natural frequency of transverse vibration by the Rayleigh's method. **03**

3A. Distinguish between linear and nonlinear systems. Explain the jump phenomenon in nonlinear systems with a neat sketch. **02**

3B. Explain the simultaneous iteration scheme for evaluating the eigen values and eigen vectors. **03**

3C. Obtain the equations of motion for the system shown in figure **3C**. x_1 and x_2 are absolute displacements. Find the two natural frequencies when m_1 =200 kg, m_2 = 50 kg, $k_1 = 1x10^5$ N/m and $k_2 = 2 \times 10^4$ N/m **05**

4A. What do you understand by sub harmonic and super harmonic vibrations. Explain with neat sketches. **02**

4B. Describe the Lindstedt's perturbation method for solution of equations describing nonlinear equations. **03**

4C. A 3 rotor system has the following physical constants :

$J_1 = 4.9$ kg-m^2, $J_2 = 9.8$ kg-m^2, $J_3 = 6.86$ kg-m^2,

$K_{t1} = 2.16 \times 10^5$ N-m/rad, $K_{t2} = 0.78 \times 10^5$ N-m/rad

Find the first natural frequency of the system and the corresponding mode shape **05**

5A. Discuss the time domain and frequency domain vibration monitoring techniques **03**

5B. With an example, describe the Holzer method to obtain the natural frequencies of a multi-degree freedom system. **03**

5C. With a neat sketch explain the working of an electrodynamic shaker **04**

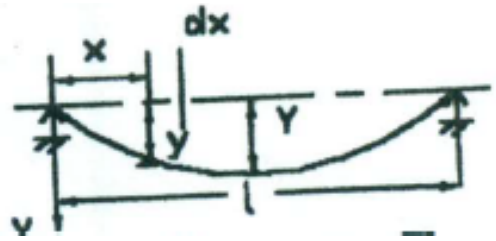

Figure 2C

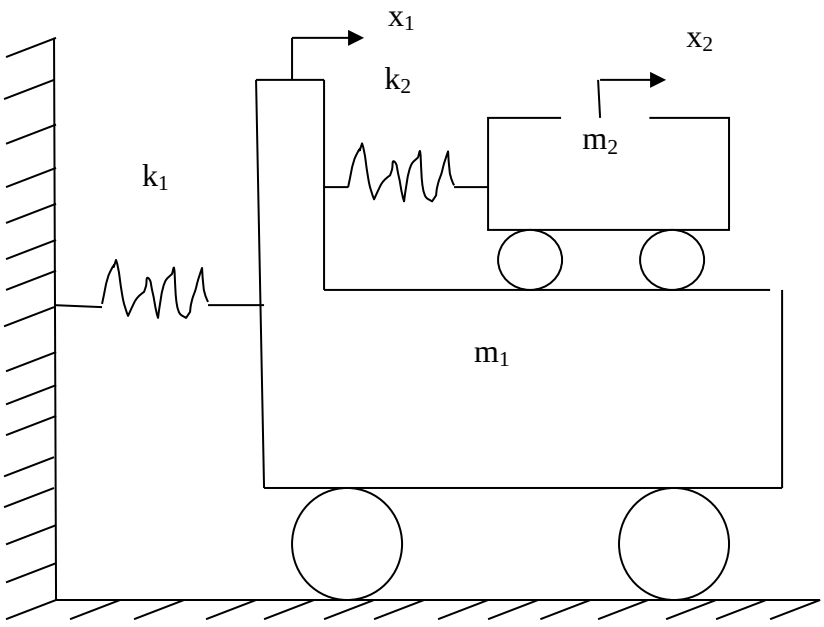

Figure 3C