Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

A Constituent Institute of Manipal University, Manipal

VII SEMESTER B.TECH. (MECHANICAL/IP ENGG.) END SEMESTER EXAMINATIONS, NOVEMBER 2017

SUBJECT: MECHANICAL VIBRATIONS [MME 4101]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

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

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1A Find the natural frequency of small amplitude oscillations of the system shown in Fig Q1(A) by ENERGY METHOD, when the cylindrical disk of mass 'M' rolls without slipping on the horizontal surface. 04

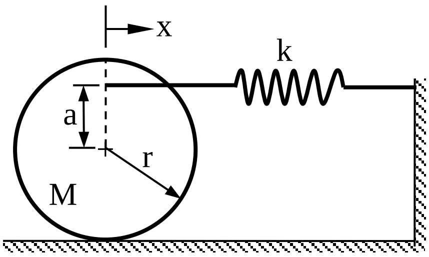

Fig. Q1(A)

1B Define logarithmic decrement. Determine the time at which the weight in the spring mass damper system should settle down to $1/20^{th}$ of its initial deflection if deflected and released. Take stiffness of the spring k = 30kN/m, Weight of the mass W = 5 kN and damping factor $\zeta = 0.1$. 04

1C Differentiate between viscous damping and coulomb damping with figures. 02

2A A vertical reciprocating air compressor driven by a variable speed drive in the range 350 to 1000 RPM, has a mass of 300 kg and is mounted on isolators having stiffness 250 kN/m and a damping constant of 825 Ns/m. The rotating mass is balanced and the total reciprocating mass is 12.5 kg. The crank radius is 7.5 cm. Considering only the primary inertia force, determine: 04
(i) Amplitude of vertical oscillation of the compressor and the phase angle between the motion and the excitation force at 350 RPM.
(ii) Range of speed for which the amplitude is less than 4mm

2B What is critical speed of a shaft? Using usual notations derive the amplitude of vibration of the shaft with respect to the eccentricity of centre of gravity of a mass mounted mid-way between the bearing of the shaft, taking into account the damping effect. 04

2C An aircraft radio weighing118 N is to be isolated from engine vibrations ranging in frequencies from 1600 to 2200 cpm. What static deflection must the isolator have for 85% isolation? 02

3A Derive an expression for the relative displacement ratio of a seismic instrument. 04

3B A vibrometer having a mass of 10 kg is used to measure the vibration, amplitude of the machine structure with a vibrating frequency of 100 cpm. If the error in the reading of dial indicator is to be not more than 2% of actual amplitude of the vibrating machine, determine the stiffness of vibrometer spring. 04

3C 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? 02

4A Find the two natural frequencies of the system shown in figure Q4(A). Also plot the mode shapes for the system. Take a = 0.5 m, l = 2 m, m = 2 kg, M = 5 kg and k = 10 N/mm. 04

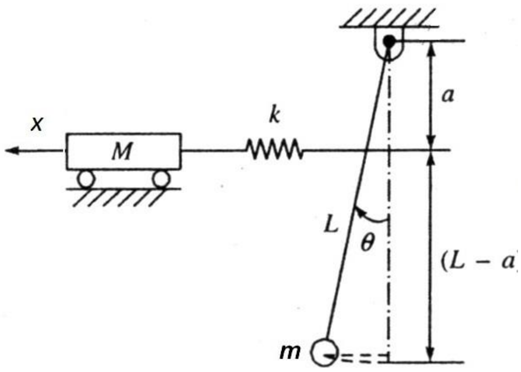

Fig. Q4(A)

4B In a refrigeration plant, a section of pipe carrying the refrigerant vibrates violently at a compressor speed of 230 rpm. To eliminate this difficulty, it was proposed to clamp a cantilever spring mass system to the pipe to act as an absorber. For a trial test, a 1 kg absorber tuned to 230 rpm, resulted in two natural frequencies of 198 and 272 cpm. If the absorber system is to be designed so that the natural frequencies lay outside the region 160 and 320 cpm, what must be the weight and spring stiffness? 04

4C Explain the design principle used in a centrifugal pendulum absorber. 02

5A Determine the shaft length ‘l’ of a system shown in the figure Q5(A), using Holzer’s method. Take $k_t = 10^6$ Nm/rad, J_1 =20, J_2 = 8 kgm^2, $J_3 = J_4 = J_5$ = 3 kgm^2. G = 80 GPa for the shaft material. Diameter of the shaft = 100 mm. Fundamental torsional natural frequency = 53 Hz. 04

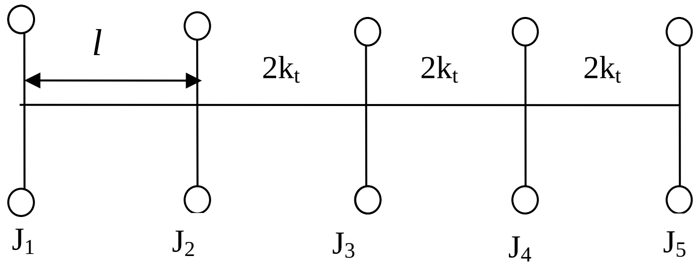

Fig. Q(5A)

5B Derive and explain the Raleigh's method of finding the natural frequency of a multi-degree freedom system. 04

5C Find all the flexibility influence coefficients of the spring-mass system shown in figure Q5(C) and express in matrix form. 02

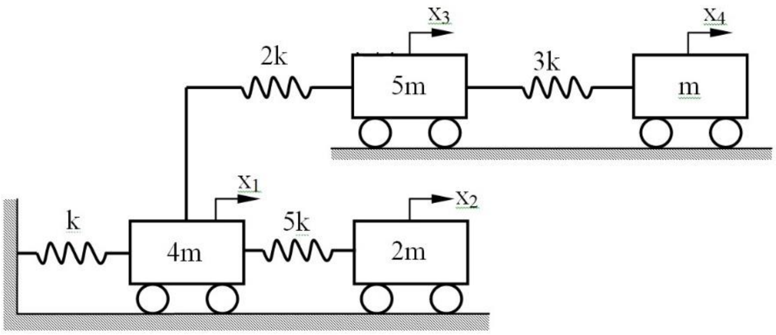

Fig. Q5(C)