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M.Tech I Semester Supplementary Examinations August/September 2018

MECHANICAL VIBRATIONS

(Production Engineering & Engineering Design)

(For students admitted in 2013, 2014, 2015 & 2016 only)

Time: 3 hours Max. Marks: 60

Answer any FIVE questions

All questions carry equal marks

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1 (a) Define transmissibility. Derive an expression for motion transmissibility.

(b) The damped natural frequency of the system as obtained from a free vibration test is 9.8 Hz. During the test the constant exciting force on the system, the maximum amplitude of vibration is found to be at 9.6 Hz. Find the damping factor for the system and its natural frequency.

2 (a) Obtain the response of a spring mass damper system subjected to step input force and shown the vibrations of response to different amount of damping with a neat sketch.

(b) Draw the phase plot and displacement time plot for a spring-mass system subjected to a rectangular pulse of duration τ and explain the behavior of the system.

3 (a) With a neat sketch, explain any three vibration measuring instruments and discuss about their advantages.

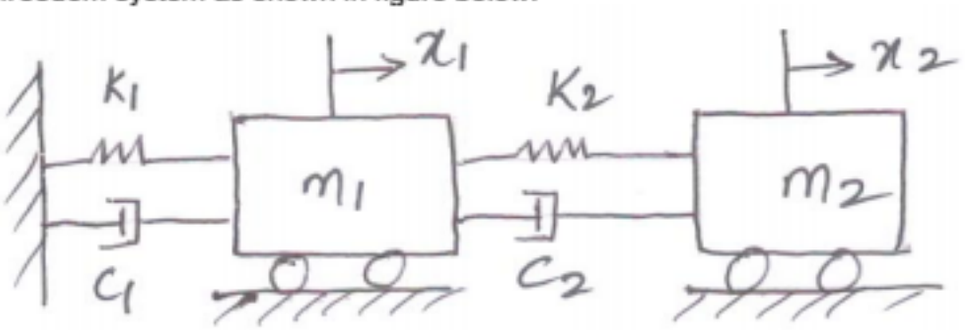
(b) With a neat sketch, show the range of accelerometers in frequency response curve and explain the plot.

4 (a) With a neat sketch, explain any two vibration absorbers.

(b) A section of pipe pertaining to certain machine vibrates with large amplitude at a compressor speed of 220 rpm. For analyzing this system a spring mass system was suspended from the pipe to act as absorber. A 1 kg absorber mass turned to 220 cpm resulted in two resonant frequencies of 188 cpm and 258 cpm. What must be the mass and spring stiffness of the absorber if the resonant frequencies are to lie outside the range of 150 cpm to 310 cpm?

5 (a) Derive an expression for the natural frequency of torsional vibration of a geared system.

(b) Determine the vibratory response of the mass for initial conditions for a damped two degree freedom system as shown in figure below.



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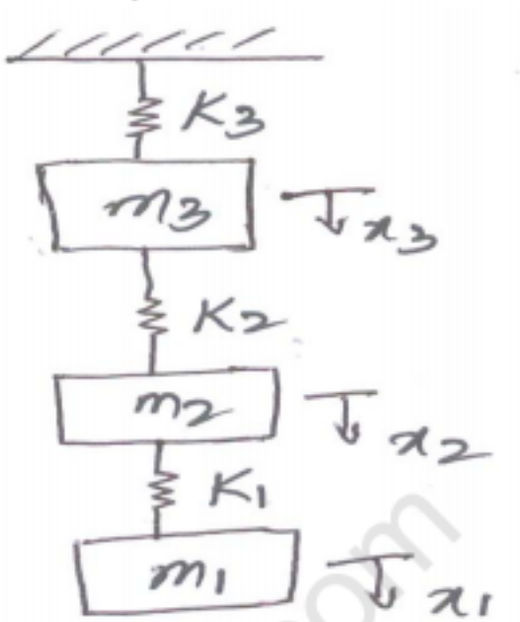
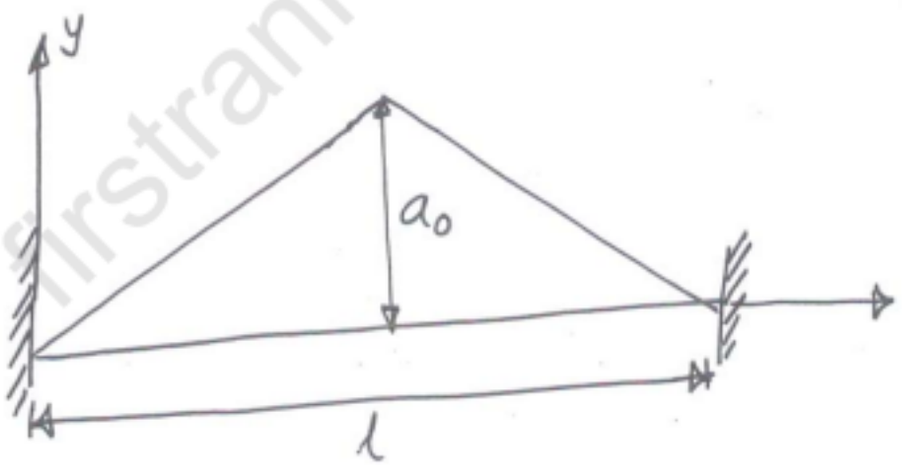
6 Determine the natural frequencies of the system shown in below. Assume $m_1 = m_2 = m_3 = 1$ kg and $k_1 = k_2 = k_3 = 1$ N/m. Solve by Holzer method.



7 (a) Derive the differential equation of motion for the longitudinal vibration of a bar.

(b) A uniform string of length l and a large initial tension s, stretched between two supports is displaced laterally though a distance a_0 at the center as shown in below and released at t = 0. Find the equation of motion for the string.



8 (a) Define critical speed of shafts. Obtain the expression for the critical speed of shaft having a single disc at the center considering damping effect.

(b) A right cantilever steel shaft of 0.3 m effective length has a heavy rotor fixed at its end. The mass of the rotor is 10 kg and has a radius of gyration of 12 cm about its axis. The thickness of the rotor is 6 cm. The moment of inertia of the section of the shaft about its neutral axis is 10 cm^4. This shaft is run at 10000 rpm. Check if this operating speed is safe.

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