DEPARTMENT OF MECHANICAL ENGINEERING

UNIVERSITY INSTITUTE OF ENGINEERINGAND TECHNOLOGY, CSJM UNIVERSITY, KANPUR

DYNAMICS OF MACHINE AND VIBRATIONS (MEE-S301)

Semester: 2021-22 (Even Semester) **Year: 3rd Year (2K19)**

Mid Semester Examination

Time: 1.5 h **Maximum marks: 30**

All questions are compulsory

Section A

9 marks (9 questions of 1 mark each)

1. A structure is idealized as a damped spring mass system with stiffness 10 kN/m, mass 2kg, and dashpot coefficient 2 kNs/m. It is subjected to a harmonic force of amplitude 500N at frequency 0.5Hz. Calculate the steady state amplitude of vibration.

2. An instrument has a natural frequency of 10 Hz. Maximum acceleration of the system is observed to be 24 m/s^2. The maximum displacement of the system is _ _ _ mm.

3. A machine part of 1.95 kg mass vibrates in a viscous medium. Determine the damping coefficient when a harmonic exciting force of 24.46 N results in resonant amplitude of 1.27 cm with a period of 0.20 sec.

4. In a vibrating system a mass of 3 kg is suspended by a spring of stiffness 1200 N/m and it is subjected to a harmonic excitation of 20 N. If the viscous damper is provided with the damping coefficient of 75 N-s/m, the amplitude at resonance is _ _ _ m.

5. In a forced vibratory system a body having 2 kg mass vibrates in a viscous fluid. The harmonic excitation force of 20 N acting on the mass results in a resonance amplitude of 15 mm with a period of 0.15 sec. The damping coefficient of viscous fluid is _ _ _ N-s/m.

6. If the system is excited by the same harmonic force but at a frequency of 5 cycles/s. The amplitude of forced vibration with damper is _ _ _ m

7. A 0.453 kg mass attached to a light spring elongates it 7.87 mm. Determine the natural frequency of the system.

8. A mass is suspended from a spring of stiffness 5000 N/m and is subjected to a harmonic force of amplitude 100 N and a frequency of 10 Hz. The amplitude of the forced motion of the mass is found to be 20 mm. Find value of the mass.

9. A spring mass system is excited by a force $F_0 \sin\omega t$. At resonance the amplitude is measured to be 0.58 cm. At 0.80 resonant frequency, the amplitude is measured to be 0.46 cm. Determine the damping factor of the system.

Section B

9 marks (3 questions of 3 marks each)

1. An underdamped shock absorber is to be designed for a motor cycle of mass 200 kg such that during a road bump, the damped period of vibration is limited to 2 sec and the amplitude of vibration should reduce to one sixteenth in one cycle.

(a) The stiffness of the spring used is _ _ _ kN/m

(b) The damping coefficient of the shock absorber is _ _ _ N-s/m

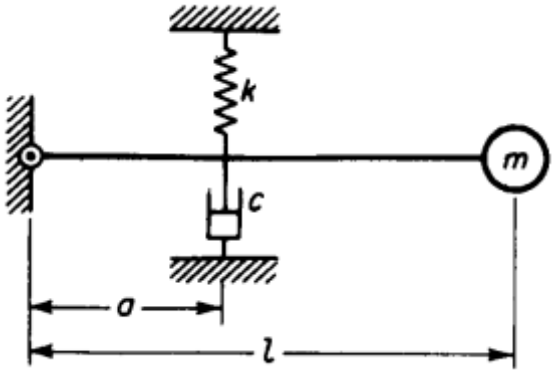
2. A variable speed reciprocating compressor of mass 450 kg has a natural frequency of 16 Hz. Design an optimum auxiliary mass damper so that the maximum dynamic magnification for the compressor is limited to 4. Determine the optimum damping required.

3. A viscously damped spring mass damper system has mass of 10 kg, damping coefficient of 150 N-s/m, and spring stiffness of 1000 N/m. Determine the value of the damping ratio, damped natural frequency logarithmic Decrement.

Section C

12 marks (2 questions of 6 marks each, Each question can have parts)

1. (a) Derive the differential equation of motion for the system shown in below figure.
   (b) Determine the expression for critical damping coefficient.



2. A cylinder of mass m and mass moment of inertia J_0 is free to roll without slipping but is restrained by the spring k as shown in figure below.
   (a) Derive the differential equation of motion.
   (b) Find the natural frequency.