Department of Mechanical Engineering
Indian Institute of Technology Delhi

Vibration and Noise Engineering (MCL733)

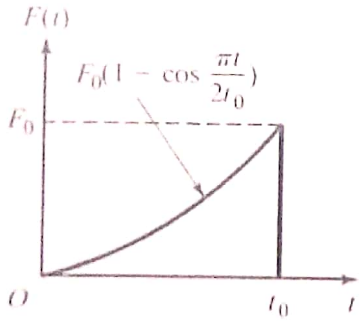
Minor 1 | Dated: Feb 6, 2019 | Time: 1Hr | Max. Marks: 30

NOTE: 1. Part A & B are to be attempted on separate sheets
2. Part A is closed notes, while you may refer class notes + printed moodle ppt for Part B (BOOK is not allowed). You may start Part B any time after returning Part A.

Part A (CLOSED NOTES)

1. Derive the expression for natural frequency of a SDOF system considering the mass of the spring m_s. (4)
2. State the purpose of carrying out the eigenvalue analysis for a vibratory system. (3)
3. Why is the governing equation of motion of a SDOF vibratory system with Coulomb Damping called non-linear? (2)
4. A SDOF system with natural frequency of 10 Hz and damping ratio of 0.002, initially at rest, is excited with a harmonic force with excitation frequency of 15 Hz. Sketch an approximate the time-displacement plot for the system for the duration t = 0 sec to t = 2 sec. (3)
5. A vertical rotor bearing system with a simply supported shaft (with negligible shaft mass) with an unbalanced disc (of mass m and unbalance eccentricity e) is operating at speed more than 10 times its natural frequency. What will be the shaft axis displacement from the bearing axis at the disc location? (2)
6. For a SDOF undamped vibratory system subjected to the force as shown below, write the expression of the response at time $3t_0$. (Do not solve the integral). (4)

The expression of unit impulse response function is given as $h(t) = \frac{1}{m\omega_n}\sin\omega_n t$



Part B (OPEN NOTES)

1. An electric motor of mass 60 kg is mounted on an isolator block of mass 1200 Kg and the natural frequency of the total assembly is 160 cpm. The system is found to have a quality factor of 5. If the motor has an unbalance that results in the excitation force of 100 sin (31.4 *t*) N, determine the amplitude of vibration of the block and the force transmitted to the floor. (6)
2. A simple structure is found to vibrate as a SDOF system. The spring constant is determined using static testing and is found to be 1500 N/m, and the equivalent mass of the structure is assumed to be 2 kg. By using a simple free vibration test, it is found that the vibration amplitude is reduced to 1/5 of the initial amplitude in 4 cycles. Determine the structural damping coefficient and the equivalent viscous damping coefficient. Also find the energy loss per cycle for an amplitude of 0.05 m. (6)