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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, HYDERABAD

B. Tech IV Year I Semester Examinations, November/December-2012

MECHANICAL VIBRATIONS

(MECHANICAL ENGINEERING)

Time: 3 hours

Answer any five questions

All questions carry equal marks

1.a) What effect does a decrease in mass have on the frequency of a system?

b) A cylinder of mass M radius r rolls without slipping on a cylindrical surface of radius R. Find the natural frequency for small oscillation about the lowest point. [15]

2.a) Define the terms generalized impedance and admittance of a system.

b) Find the steady state response of undamped single degree freedom system subjected to the force $F(t) = F_0 e^{i\omega t}$ by using the method of Laplace transformation. [15]

3.a) What methods are available for solving the governing equations of a vibration problem? Discuss.

b) A small reciprocating machine of 40 kg mass runs at constant speed of 6000 rpm. After installation the forcing frequency was found to be too close to the natural frequency of the system. Design a dynamic absorber if the closest frequency of the system is to be at least 10% from the disturbing frequency. [15]

4.a) Indicate some methods for finding the response of a system under non-periodic forces.

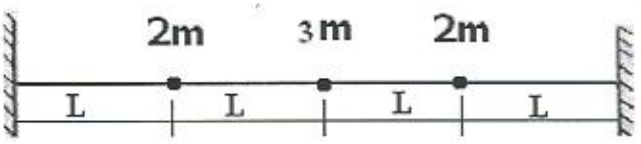
b) Two rotors A and B are attached to the ends of a shaft 800 mm long. The mass of the rotor A is 600 Kg and its radius of gyration is 500mm. The corresponding values of rotor B are 700 Kg and 600 mm respectively. The shaft is 90 mm diameter for the first 300mm, 150mm for next 180 mm length and 120 mm for the remaining length. Modulus of rigidity of the shaft material is 0.8×10^5 MN/m^2. Find:

i) The position of the node.

ii) The frequency of torsional vibrations. [15]

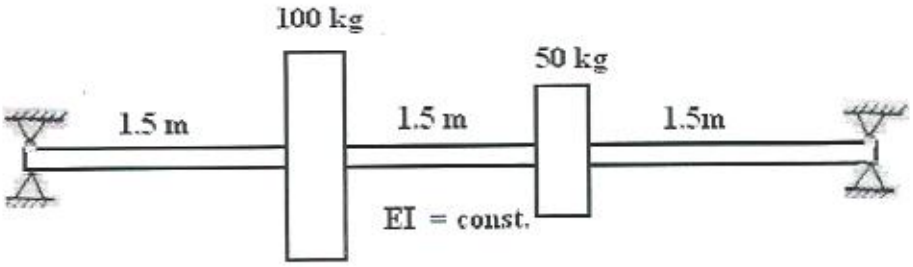
5.a) How is the frequency equation derived for a multi-degree of freedom system.

b) For a taut string having tension T and three concentrated masses as shown below, use the method of influence numbers to find the three natural frequencies. Find also the mode shapes. Check on the orthogonal properties of the normal modes. [15]



6.a) Using the matrix iteration method, how do you find the intermediate natural frequencies?

b) Find the lowest natural frequency of transverse vibrations for the system shown below by Stodola's method, $E = 1.96 \times 10^{11}$ N/m^2. $I = 10^{-6}$ m^4. [15]



7.a) A uniform bar of length l is fixed at one end and the free end is stretched uniformly to l_0 and released at $t=0$. Find the resulting longitudinal vibration.

b) A uniform circular shaft of length l is fixed at the two ends. At its middle point a torque T_0 is applied which twists it by θ_0 radians at the middle point. If the torque is released suddenly find the subsequent motion. [15]

8.a) What causes instability in a rotor system? Explain in detail.

b) A variable speed machine has a diametral clearance of 3 mm between the stator and the rotor. The rotor has a mass of 60 kg and has an unbalance of 0.5 kg-cm. The rotor is mounted on a steel shaft midway between the two bearings. The operating speed of the machine varies from 500 to 5800 rpm. Specify the stiffness of the shaft so that the rotor is always clear of the stator at any operating speed within the range. [15]

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