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MANIPAL INSTITUTE OF TECHNOLOGY

A Constituent Institute of Manipal University, Manipal

VII SEMESTER B.TECH. (MECHANICAL ENGG.) END SEMESTER MAKE-UP EXAMINATIONS, DECEMBEER 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 A shaft of 100 mm diameter and 1m long is fixed at one end and carries a flywheel of weight 500 KN at the other end. The flywheel has a radius of gyration of 50 mm. Find the natural frequency of the system for longitudinal, transverse and torsional vibration. Take young's modulus of $0.2x10^{12}$ N/m^2 and shear modulus of $0.08x10^{12}$ N/m^2 for the shaft material. The mass of the shaft is neglected. 04

1B Define logarithmic decrement. Determine the time at which the weight in the spring mass damper system should settle down to 1/10th of its initial deflection if deflected and released. Take stiffness of the spring k = 32kN/m, Weight of the mass W = 4 kN and damping factor $\zeta = 0.05$. 04

1C Derive an expression for amplitude loss per cycle in a coulomb damped system. 02

2A An air compressor weighs 1000 N and is operated at constant speed of 1750 rpm. The unbalanced reciprocating parts weigh 25 N and rotating parts are well balanced. The crank shaft radius is 40mm. If the damper used for the mounting introduced a damping factor $\zeta = 0.15$. 04

a) Design the spring for the mounting such that only 20% of the unbalanced force is transmitted to the foundation.
b) Determine the amplitude of the excitation force and the free force transmitted.
c) Determine the steady state displacement of the system.

2B A shaft 12 mm diameter rotates in long bearings and a disc weighing 196.2 N (20 kg mass) is attached to the mid-span of the shaft. The span of the shaft between the bearings is 0.75 m. The mass center of the disc is 0.5 mm from the axis of the shaft. Neglecting the mass of the shaft and taking the deflection as for a beam fixed at both ends, determine the critical speed of the shaft. Also determine the range of the speed over which the stress in the shaft due to bending will exceed 100 N/mm^2. Take E = 196 MPa. 04

2C What is quality factor? Find an expression to determine the damping factor of a system subjected to forced vibration using half power point method. 02

3A Derive an expression to obtain amplitude ratio of a base excitation system. 04

3B An accelerometer has a natural frequency of 6 Hz and a damping factor of 0.65. Determine the frequency range within which the error is less than 1%. 04

3C Explain the difference between an accelerometer and vibrometer with the help of equations and frequency response curves. 02

4A Determine the natural frequencies of the system shown in the figure Q4(A) if k_1 = 40000 N/m, k_2 = 50000 N/m, k_3 = 60000 N/m, m_1 = 10 kg, m_2 = 12 kg, r_1 = 0.1 m and r_2 = 0.11 m. 04

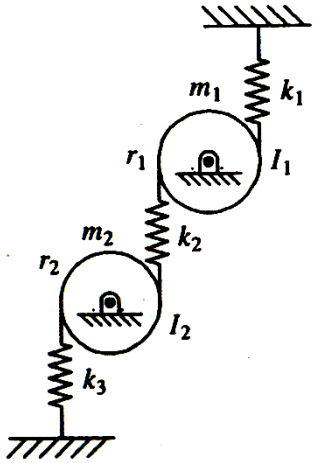

Fig. Q4(A)

4B Explain the dynamic vibration absorber used for standalone engines to eliminate vibrations which are near to resonant frequency. 04

4C What is a semi definite system? Show with an example how the first natural frequency of a 2 degree of freedom system becomes zero. 02

5A Explain Maxwell Reciprocity theorem for finding Influence coefficient of a Multi-degree Freedom System. 04

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

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

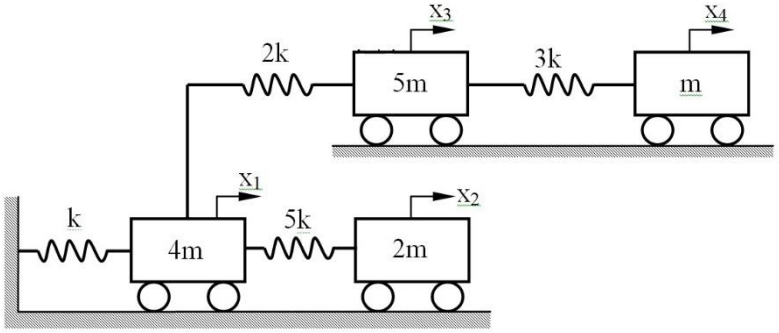

Fig.Q5(C)