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# MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

*A Constituent Institution of Manipal University*

## I SEMESTER M.TECH. (COMPUTER AIDED ANALYSIS AND DESIGN)

## END SEMESTER EXAMINATIONS, NOV/DEC 2016

SUBJECT: ADVANCED MECHANICAL VIBRATIONS [MME 5102]

**REVISED CREDIT SYSTEM**
**(26/11/2016)**

Time: 3 Hours MAX. MARKS: 50

**Instructions to Candidates:**

- Answer **ALL** the questions.
- Missing data may be suitable assumed.

**1A.** Distinguish between
i) Vibration Isolation and Vibration Absorption
ii) Principle mode and Normal mode of Vibration
iii) Frequency Response and Time Response
iv) Linear and Nonlinear systems. **02**

**1B.** A horizontal shaft is supported between bearings (simply supported). At the centre of the shaft, a disc of mass “m” is mounted. The lateral stiffness of the shaft is “k”. Due to manufacturing inequalities, the centre of gravity is shifted by a distance “e” from the geometric centre. The lubrication at the bearings provides a damping of “c”. Derive the expression for the lateral deflection of the shaft in terms of eccentricity “e” and angular velocity ‘ω’. **04**

**1C.** Determine the natural frequency of a spring mass system, considering the mass of the spring. **04**

**2A.** An automobile chassis has a mass of 600 kg and the total spring constant of its suspension system is 58 kN/m. If the profile of a stretch of a road which it travels at a speed of 60 kmph may be approximated as a sinusoidal profile (rumblers) with peak to peak distance of 100 mm and a wave length of 1.0 m determine the steady state amplitude as well as amplitude corresponding to resonance condition. Assume a damping factor of 0.05. **03**

**2B.** What is the need for a dynamic vibration absorber? Explain its working principle with a neat sketch. **04**

**2C.** Give a brief outline of the Lanczos procedure for Eigen Value Problems. **03**

**3A.** Explain the design principles of Accelerometer and Vibrometer. **03**

**3B.** Describe the Lindstedt's perturbation method for solution of equations describing Nonlinear vibrations. **04**

**3C.** With a neat sketch explain what is meant by a 'limit cycle' **03**

**4A.** Explain Sub harmonic oscillations of Nonlinear systems with a neat sketch. **03**

**4B.** Explain time and frequency domain analysis with respect to machine condition monitoring **03**

**4C.** Derive the free vibration equation for longitudinal vibrations of bars and obtain its solution. **04**

**5A.** Using Holzer's method, determine the length 'L' of the shaft shown in figure Q5A, given that its fundamental frequency is 150 rad/sec. Use $K_t = 2x10^6$ Nm/rad; $J_1 = J_2 = 10$ kgm$^2$ ; $J_3 = J_4 = 30$ kg-m$^2$ G= 80 GPa ; shaft diameter = 10 cm. **04**

**5B.** With a neat sketch explain the working of a Linear Variable Differential Transformer (LVDT). **04**

**5C.** Define the following with respect to random processes

1. Standard Deviation
2. Autocorrelation
3. Spectral Density
4. Covariance **02**

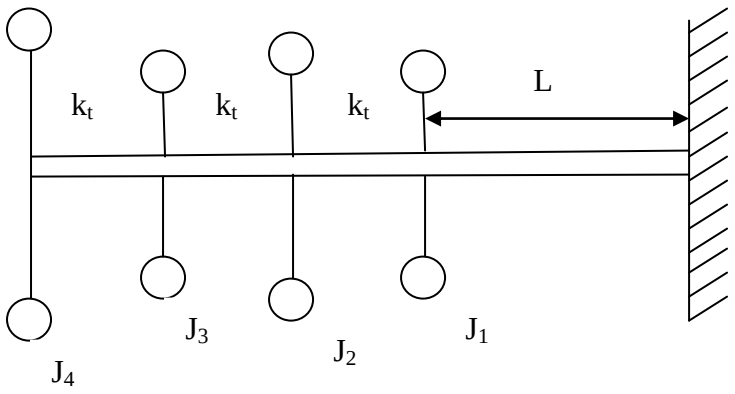


Figure Q 5A