

# JK LAKSHMIPAT UNIVERSITY, JAIPUR

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Regular/Backlog), November 2017

B. Tech in Mechanical Engineering, Semester - VI

Roll No.....

ME 605: Mechanical Vibration and control

Time: 3 hours

Max. Marks: 100

### Instructions to students:

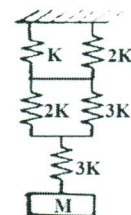
1. Do not write anything other than your roll number on question paper.
2. Assume suitable data wherever required and mention it clearly.
3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.

### Q.1A Objective type multiple choice questions (10 questions @ 1 mark)

10

- i. A shaft carrying three rotors will have
  - (a) No node
  - (b) Three Nodes
  - (c) Two nodes
  - (d) One node
- ii. In matrix iteration method, Eigen value represents the
  - (a) Mode shapes
  - (b) Natural frequency
  - (c) Mode shapes and Natural frequency
  - (d) None of these
- iii. Calculate a damped natural frequency, if damping factor is 0.48 and natural frequency of the system is 45 rad/sec.
  - (a) 25.62 rad/sec
  - (b) 20.78 rad/sec
  - (c) 39.47.4 rad/sec
  - (d) None of these
- iv. In vibration isolation system if  $(\omega/\omega_n) > 1$  then the phase difference between the transmitted force and the disturbing force is
  - (a)  $0^\circ$
  - (b)  $90^\circ$
  - (c)  $180^\circ$
  - (d)  $145^\circ$
- v. An accelerometer is an instrument which is used to measure
  - (a) High natural frequency
  - (b) Low natural frequency
  - (c) High and low natural frequency
  - (d) None of these
- vi. Determine logarithmic decrement, if the amplitude of a vibrating body reduces to  $1/9$ th in two cycles.
  - (a) 0.223
  - (b) 0.8958
  - (c) 0.3890
  - (d) None of the above
- vii. For the shaft speed less than the critical speed, the phase difference between displacement and centrifugal force is
  - (a)  $0^\circ$
  - (b)  $90^\circ$
  - (c)  $180^\circ$
  - (d)  $45^\circ$
- viii. Rotating shaft tend to vibrate violently in transverse directions at certain speed. This speed is called
  - (a) Whirling speed
  - (b) Whipping speed
  - (c) Critical speed
  - (d) all of the above
- xi. Calculate the equivalent stiffness of the system shown below, where  $K=150\text{N/m}$

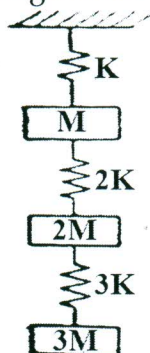
- (a) 125 N/m
- (b) 150 N/m
- (c) 225 N/m
- (a) None of these



- x. Static coupling occurs due to
- (a) Static displacements and dynamic inertia forces
  - (b) Static displacements
  - (c) Dynamic inertia forces
  - (d) All the above statements are true
- Q.2 Short answer type questions (4 questions @ 2.5 marks) 10
- i. What is coulomb damping? Differentiate between coulomb damping and structural damping.
  - ii. Discuss the working principle of vibration isolation with neat sketch.
  - iii. Discuss the coordinate coupling and principle mode of vibrations.
  - iv. Differentiate between under damping, critical damping and over damping with suitable example.
- Q.3A Define the Dunkerley's equation. Drive the suitable expression of natural frequency for n degree of freedom system. 05
- Q.3B Discuss the competitive requirement of CBM and differentiate between prognostic and diagnostic with suitable example. 05
- Q.4A Define the logarithmic decrement and derive the suitable expression of logarithmic decrement ( $\delta$ ). 05
- Q.4B Prove that normal modes of multi-degree of freedom system are following the orthogonal properties. 05
- Q.5A What are the transient vibrations? Discuss the different types of transient vibration with neat sketch. 05
- Q.5B What is the main requirements of vibration isolators? Discuss the different materials used for vibration isolation in details. 05
- Q.6A Derive the expression for maximum energy dissipated by damping. 05
- Q.6B Derive the expression of response amplitude in forced vibration using Particular integral method. 05
- OR
- Q.6B What is transmissibility? And derive the suitable expression for transmissibility ratio using force polygon diagram. 05
- Q.7A Write short notes on CBM. Discuss the different steps involve in CBM with suitable example. 05
- Q.7B Define the longitudinal vibration of rod and derive the suitable expression for equation of motion in terms of  $\omega$  and c where  $\omega$  is the natural frequency and c is the velocity of wave propagation. 05
- OR
- Q.7B Define the torsional vibrations of rod and derive the suitable expression for equation of motion in terms of  $\omega$  and c where  $\omega$  is the natural frequency and c is the velocity of wave propagation. 05
- Q.8A What is the importance of vibration measuring instrument? Explain the working 10

principle of vibrometers with neat sketch along with their range of frequency of operation.

- Q.9A Determine the influence coefficient, normal modes and mode shape of spring-mass system as shown in figure using matrix iteration method. 10



- Q.9B A body of 90 kg mass is suspended by a spring which deflects by 2.5 cm under the self-weight of the body. It is having a damper with damping ratio of 0.25. It is distributed by a periodic force of amplitude 900 N and frequency which is 0.6 times the natural frequency of the system. Determine the following 10

- (i) Amplitude
- (ii) Damping coefficient
- (iii) Natural frequency
- (iv) Damped natural frequency
- (v) Phase angle

OR

- Q.9B A vibrating system is defined by the following parameters:  $m = 5 \text{ kg}$ ,  $k = 120 \text{ N/m}$ ,  $c = 3.5 \text{ N-s/m}$ . Determine 10

- (i) Damping factor
- (ii) Natural frequency of damped vibration
- (iii) Logarithmic decrement
- (iv) Ratio of successive amplitudes,

The number of cycles after which the original amplitude is reduced to 20%.