VTU B.E/B.TECH QUESTION PAPER SET

CBCS
SEMESTER VII

MECHANICAL VIBRATION AND NOISE CONTROL

Use bookmarks to easily navigate between question papers

CBCS SCHEME

USN | | | | | | | | | | |

15MR72

Seventh Semester B.E. Degree Examination, Dec.2018/Jan.2019
Mechanical Vibration and Noise Control

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Explain:
i) Types of vibrations
ii) Beats phenomenon **(08 Marks)**

b. Add the following harmonic motions and check the solution graphically:
$x_1 = 2\cos(wt + 0.5)$
$x_2 = 5\sin(wt + 1.0)$ **(08 Marks)**

OR

2 a. Define the following:
i) Forced vibration
ii) Degrees of freedom
iii) Simple harmonic motion **(06 Marks)**

b. Find the Fourier series for the saw-tooth curve as shown in Fig.Q2(b).

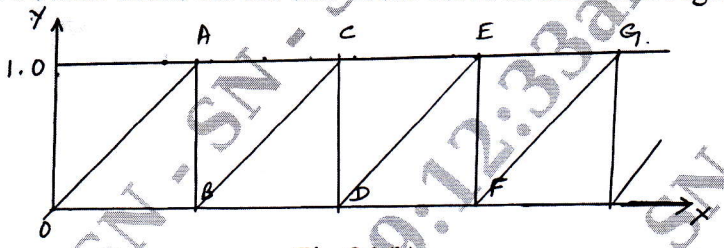

Fig.Q2(b) **(10 Marks)**

Module-2

3 a. Determine the natural frequency of a spring mass system where the mass of the spring is also to be taken into account. **(08 Marks)**

b. Determine the natural frequency of the system shown in Fig.Q3(b).

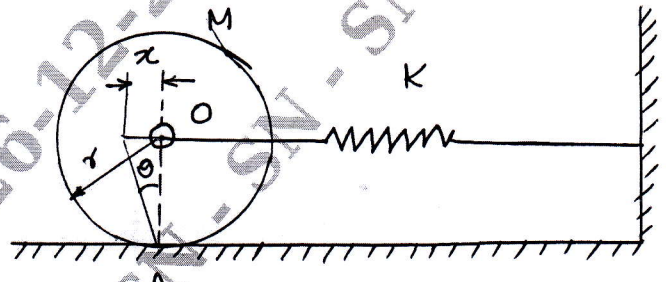

Fig.Q3(b) **(08 Marks)**

OR

4 a. Set up the differential equation for a viscous damping system and obtain the complete solution for the critically damped system. **(08 Marks)**

b. The mass of a single degree damped vibrating system is 7.5 kg makes 24 free oscillations in 14 secs, when disturbed from its equilibrium position. The amplitude of vibration reduces 0.25 of its initial value after 5 oscillations. Determine:
   i) Stiffness of spring
   ii) Critical damping coefficient
   iii) Logarithmic decrement
   iv) Damping factor. **(08 Marks)**

Module-3

5 a. Define force transmissibility. Deduce an expression for the same. Sketch or plot its vibration with frequency ratio for different amounts of damping. **(08 Marks)**

b. A machine of mass one tonne is acted upon by an external force of 2450 N at a frequency of 1500 rpm. To reduce the effects of vibration, isolator of rubber having a static deflection of 2 mm under the machine load and an estimated damping factor of 0.2 are used. Determine:
   i) Force transmitted to the foundation
   ii) Amplitude of vibration of the machine
   iii) Phase lag of the transmitted force with respect to the external force. **(08 Marks)**

OR

6 a. Explain the principle of "Seismic" instrument and indicate how it can be used to measure displacement and acceleration of a vibrating body. **(08 Marks)**

b. A rotor of mass 12 kg is mounted midway on a 25 mm diameter horizontal shaft supported at the ends by two bearings. The span between the bearings is 900 mm. Because of some manufacturing defect the Cg of the rotor is 0.02 mm away from geometric centre of rotor. If the system rotates at 300 rpm, determine the amplitude of steady state vibrations and the dynamic force on the bearings. Take E = 200 GPa. **(08 Marks)**

Module-4

7 a. Find the lowest natural frequency of the system shown in Fig.Q7(a) by Stodola method. Also plot the mode shape.

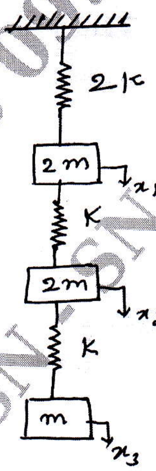

Fig.Q7(a) **(08 Marks)**

b. A shaft of 50 mm diameter and 3m long is supported at the ends and carries three weights of 1000 N, 1500 N and 750 N at 1m, 2m and 2.5 m from the left support. Taking E = 200 GPa, find the frequency of transverse vibrations by Dunkerley's method. **(08 Marks)**

OR

8 a. A torsional vibrating system is shown in Fig.Q8(a). Determine the first two natural frequencies by Holzer's method.

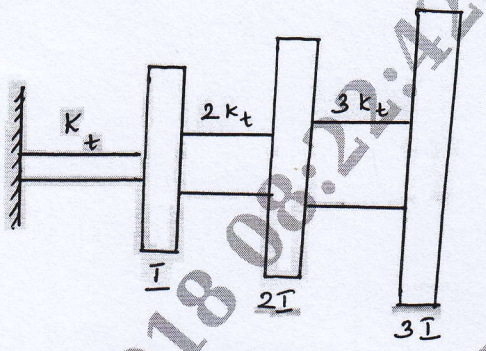

Fig.Q8(a) **(08 Marks)**

b. Obtain influence coefficients for the system shown in Fig.Q8(b).

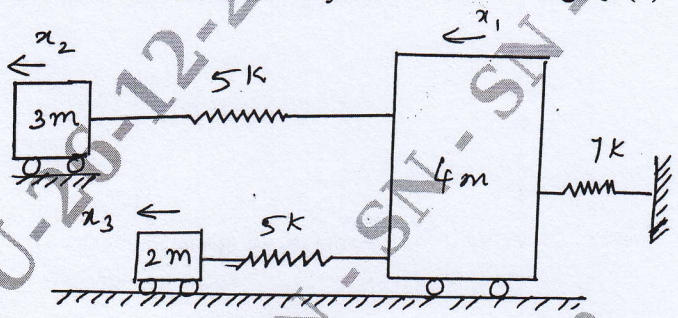

Fig.Q8(b) **(08 Marks)**

Module-5

9 a. Sketch and explain the arrangement for experimental modal analysis. **(08 Marks)**

b. Write short notes on:

i) Machine condition monitoring techniques

ii) Spectrum analysers **(08 Marks)**

OR

10 Explain the following:

a. Sound level meters

b. Human response to noise (OSHA standards)

c. Environmental noise and noise legislation

d. Analog to digital conversion **(16 Marks)**

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CBCS SCHEME

USN | | | | | | | | | | 15MR72

Seventh Semester B.E. Degree Examination, Dec.2019/Jan.2020
Mechanical Vibrations

Time: 3 hrs. Max. Marks: 80

Note: ***Answer FIVE full questions, choosing ONE full question from each module.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. What is vibration? Explain the various causes and types of vibration. **(08 Marks)**

b. A harmonic motion is given by the equation, $x = 5\sin(4t + \phi)$. Find its two components : one that leads it by 30° and the other that lags it by 80°. **(08 Marks)**

OR

2 a. Define the following terms:
(i) Degrees of freedom (ii) Simple harmonic motion (iii) Phase difference (ϕ). **(06 Marks)**

b. Find the Fourier series for the curve as shown in Fig. Q2 (b). **(10 Marks)**

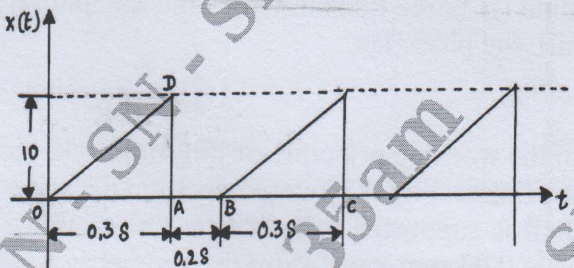

Fig. Q2 (b)

Module-2

3 a. Determine the natural frequency of a simple pendulum as shown in Fig. Q3 (a), if the mass of the rod is not negligible by using Newton's method. **(08 Marks)**

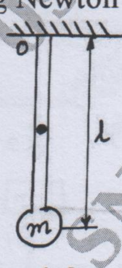

Fig. Q3 (a)

b. Using energy method find the natural frequency of the system shown in Fig. Q3 (b). The cord is inextensible in the spring mass pulley system and no slip.

Given $J = \frac{1}{2} mr^2$ for pulley. **(08 Marks)**

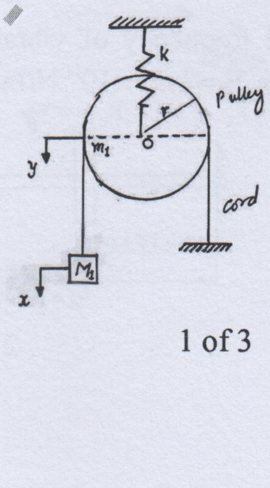

Fig. Q3 (b)

OR

4 a. Define logarithmic decrement and show that logarithmic decrement δ is given by $\delta = \frac{1}{n}\log_e\left(\frac{x_o}{x_n}\right)$,
where
x_o = Amplitude of the zeroth oscillation,
x_n = Amplitude of the n^{th} oscillation,
n = Number of oscillations. **(08 Marks)**

b. A gun barrel weighing 600 kg has a recoil spring of 30000 kg/m stiffness. If the barrel recoils 1.2 m on firing, determine (i) The initial velocity of the barrel. (ii) The critical damping co-efficient of a dash pot engaged at the end of the recoil stroke. (iii) The time required for the barrel to return to a position 5 cm from its position. **(08 Marks)**

Module-3

5 a. Define magnification factor. Sketch and explain the plots of magnification factor versus frequency ratio and phase lag ϕ versus frequency ratio 'r' for different values of damping factor. **(08 Marks)**

b. A machine of 1000 kg mass is acted upon by an external force of 2450 N at a frequency of 1500 rev/min. To reduce the effect, vibration isolators of rubber having static deflection of 2 mm under the machine load and on estimated damping factor 0.2 are used.
Determine (i) Force transmitted to the foundation (ii) Amplitude of vibration of machine and (iii) the phase lag. **(08 Marks)**

OR

6 a. Explain the working principle of fullorton tachometer and Frahm's Tacho meter. **(08 Marks)**

b. A rotor of mass 4 kg is mounted on 1 cm dia shaft at a point 10 cm from one end. The 25 cm long shaft is supported by bearings. Calculate the critical speed. If the centre of gravity of the disc is 0.03 mm away from the geometric centre of rotor, find the deflection of the shaft when its speed of rotation is 5000 rpm. Take $E = 1.96\times10^{11}$ N/m^2. Find the critical speed when the rotor is mounted midway on the shaft. **(08 Marks)**

Module-4

7 a. Determine the first natural frequency and principal mode shape of the system shown in Fig. Q7 (a) by matrix iteration method. **(08 Marks)**

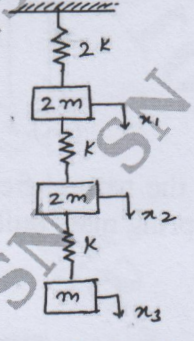

Fig. Q7 (a)

b. Find the lowest natural frequency of vibration for the system shown in Fig. Q7 (b) by Rayleigh's method. Take $E = 1.96\times10^{11}$ N/m^2, $I = 4\times10^{-7}$ m^4. **(08 Marks)**

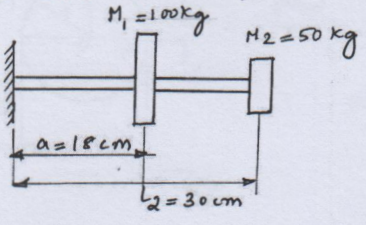

Fig. Q7 (b)

OR

8 Find the natural frequencies for the system shown in Fig. Q8 by using Holzer's method. **(16 Marks)**

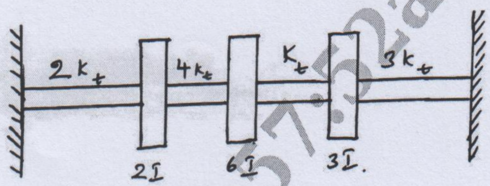

Fig. Q8

Module-5

9 a. Write a short note on Dynamic testing of machines and structures. **(08 Marks)**

b. Explain the following :

(i) Sound level meters.

(ii) Microphones **(08 Marks)**

OR

10 a. Sketch and explain the arrangement for experimental modal analysis. **(08 Marks)**

b. Explain the various techniques for machine condition monitoring. **(08 Marks)**

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CBCS SCHEME

USN | | | | | | | | | | 15MR72

Seventh Semester B.E. Degree Examination, Aug./Sept.2020
Mechanical Vibrations

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define the following:
(i) Degrees of freedom (ii) Simple harmonic motion
(iii) Phase difference (iv) Resonance **(08 Marks)**

b. Add the following harmonic motions analytically and check the solution graphically:
$x_1 = 4\cos(\omega t + 10^\circ)$; $x_2 = 6\sin s(\omega t + 60^\circ)$ **(08 Marks)**

OR

2 a. Explain: (i) Fourier series (ii) Beat's phenomenon **(08 Marks)**

b. Find the Fourier series expansion for the impact force generated by the forging hammer shown in Fig.Q2(b).

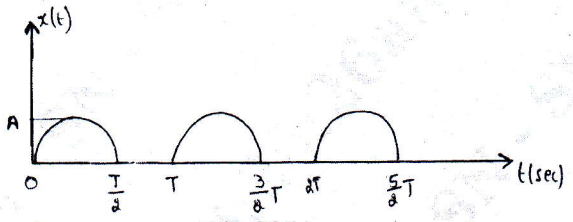

Fig.Q2(b) **(08 Marks)**

Module-2

3 a. Determine the natural frequency of a spring mass system where the mass of the spring is also to be taken into account. **(06 Marks)**

b. Derive equation of motion and natural frequency of vibration of a spring mass system (in vertical position) by energy method. **(04 Marks)**

c. An unknown weight W added to an unknown spring 'k' has a natural frequency of 95 cycles/min. When 5 N is added to W, the natural frequency if lowered to 75 cycles/min. Determine the unknown weight and the spring constant. **(06 Marks)**

OR

4 a. Show that Logarithmic decrement $\delta = \frac{i}{n} \ell n \left(\frac{x_0}{x_n} \right)$. **(08 Marks)**

b. A vibrating system consisting of a mass of 50 kg, a spring of stiffness 30 kN/m and a damper. Damping is 20% of the critical value. Determine:
(i) Damping factor
(ii) Critical damping coefficient
(iii) Logarithmic decrement
(iv) Ratio of two consecutive amplitudes
(v) Natural frequency of free vibration
(vi) Natural frequency of damped vibration. **(08 Marks)**

Module-3

5 a. Derive an equation for forced vibration of damped single degree freedom system by differential equation method. **(08 Marks)**

b. A machine of total mass 200 kg is supported on springs of total stiffness 16000 N/cm has an unbalanced rotating element which results in a disturbing force 800 N at a speed of 3000 rpm. Assuming $\xi = 0.2$. Determine:

(i) Amplitude of motion due to unbalance
(ii) Transmissibility
(iii) Transmitted force **(08 Marks)**

OR

6 a. With neat sketch, explain : (i) Vibrometer (ii) Frahm Tachometer **(08 Marks)**

b. A rotor of mass 12 kg is mounted midway on a 25 mm horizontal shaft supported at the ends by two bearings. The span between the bearings is 900 mm. Because of some manufacturing defect the c.g. of the rotor is 0.02 mm away from geometric centre of rotor. If the system rotates at 3000 rpm, determine the amplitude of steady state vibrations and the dynamic force on the bearings. Take E = 200 GPa. **(08 Marks)**

Module-4

7 a. Determine the influence coefficient for the system shown in Fig.Q7(a).

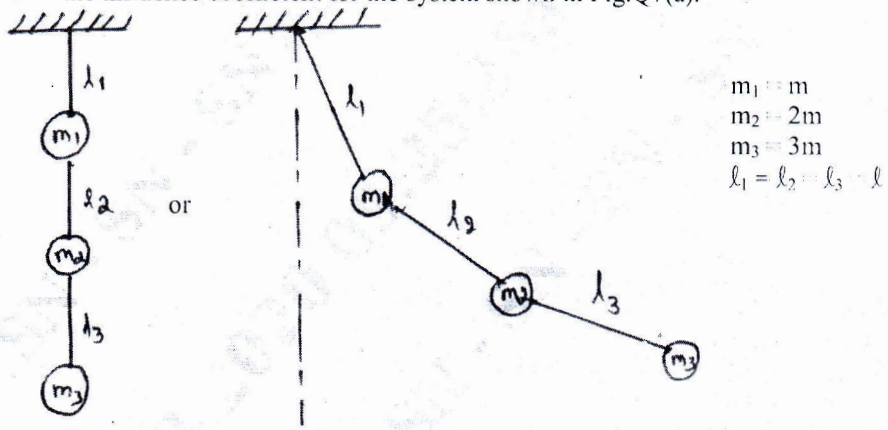

Fig.Q7(a) **(08 Marks)**

b. Find the lowest natural frequency of vibration for the system shown in Fig.Q7(b) by Rayleigh's method. $E = 1.96 \times 10^{11}$ N/m^2, $I = 4 \times 10^{-7}$ m^4.

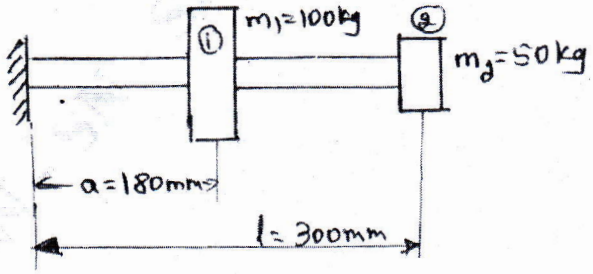

Fig.Q7(b) **(08 Marks)**

OR

8 a. Find the natural frequency of the system shown in Fig.Q8(a) by Dukerley's method. $E = 1.96 \times 10^{11}$ N/m^2, $I = 4 \times 10^{-7}$ m^4.

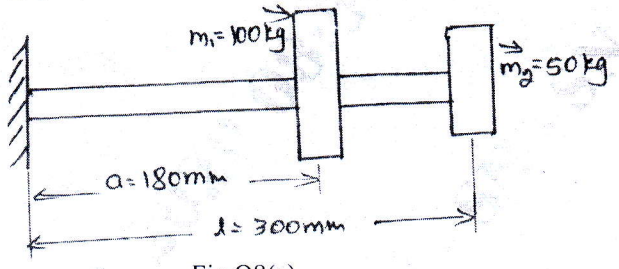

Fig.Q8(a) **(08 Marks)**

b. Using Stodola's method, determine the lowest natural frequency of the system shown in Fig.Q8(b).

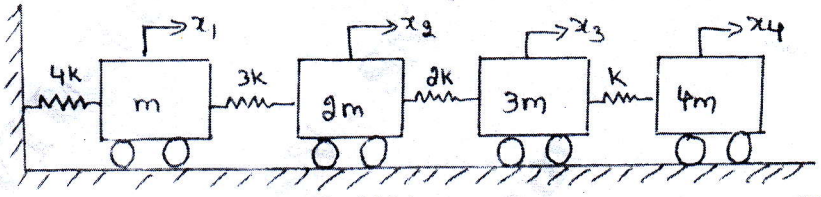

Fig.Q8(b) **(08 Marks)**

Module-5

9 a. Explain briefly machine maintenance techniques with schematic diagram. **(08 Marks)**

b. Write notes on:

(i) Machine condition monitoring techniques

(ii) Human response to noise (OSHA standards) **(08 Marks)**

OR

10 a. Explain with an example, experimental modal analysis. **(08 Marks)**

b. Write notes on:

(i) Environmental noise and noise legislation

(ii) Spectrum analysis **(08 Marks)**

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