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).

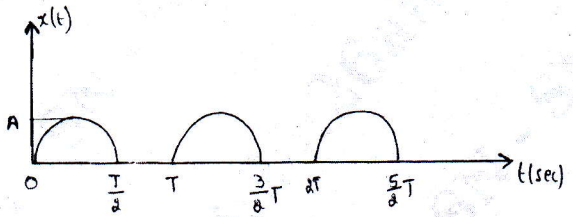


Fig.Q2(b) **(08 Marks)**

### 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).

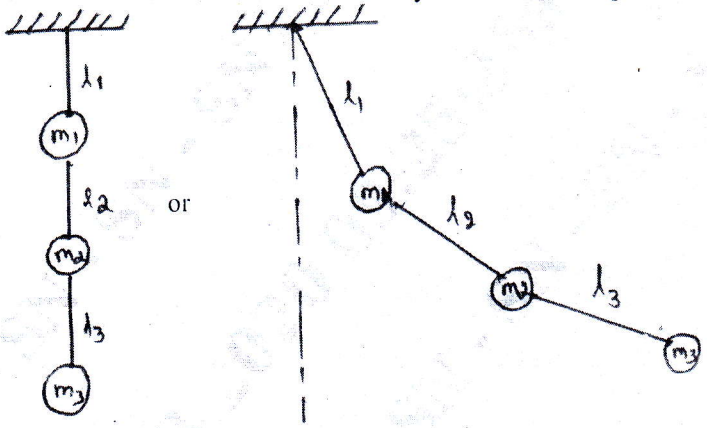


Fig.Q7(a) **(08 Marks)**

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$^4$.

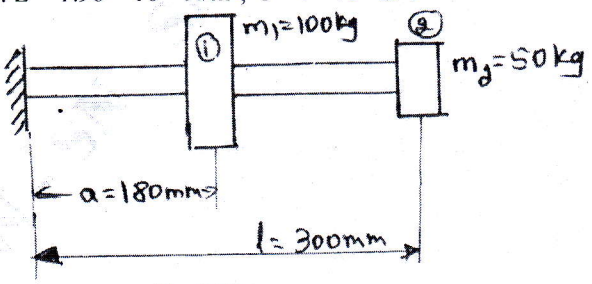


Fig.Q7(b) **(08 Marks)**

**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$^4$.

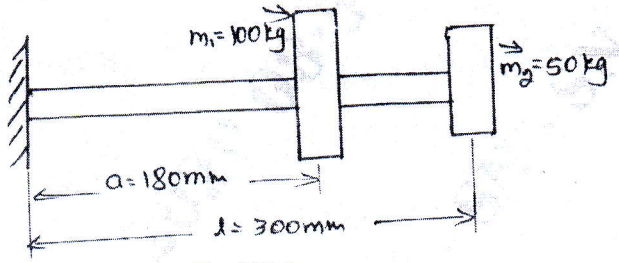


Fig.Q8(a) **(08 Marks)**

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

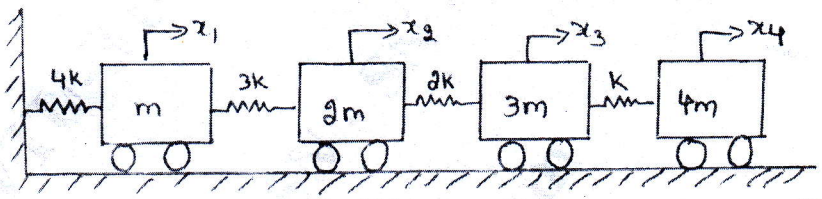


Fig.Q8(b) **(08 Marks)**

## 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)**

* * * * *