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06ME62

# Sixth Semester B.E. Degree Examination, Dec.2016/Jan.2017
## Mechanical Vibrations

Time: 3 hrs. Max. Marks:100

**Note:** ***Answer FIVE full questions, selecting at least TWO questions from each part.***



### PART – A

1 a. A body suspended from a spring vibrates vertically up and down between two positions 3 cm and 5 cm above the ground. During each second it reaches the top position fifteen times. Find out the time period, frequency, circular frequency and amplitude of motion. **(04 Marks)**

b. A harmonic motion given by $x = 5 \sin (3t + \phi)$ is to be split into two components such that one leads it by 30°and the other lags it by 80°. Find the components graphically. **(06 Marks)**

c. Find the Fourier series for the curve shown in Fig Q1(c). **(10 Marks)**

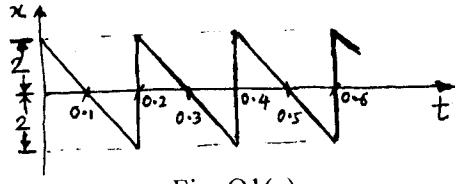



Fig. Q1(c)

2 a. Find the natural frequency of the system shown in Fig. Q2 (a) assuming the bar AB to be weightless and rigid. **(10 Marks)**

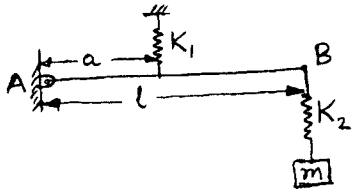


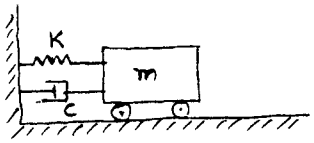

Fig. Q2(a)

b. If the mass of the rod (connecting the point mass and the point of point of suspension) of simple pendulum is not negligible, find the expression for the natural frequency. **(10 Marks)**

3 a. Write a brief note on 'various types of damping' in mechanical systems. **(06 Marks)**

b. A torsional pendulum when immersed in oil indicates its natural frequency as 200 Hz. But when it was put to vibration in Vacuum having no damping, its natural frequency was observed as 250 cycles/sec. Find the value of damping factor. **(06 Marks)**

c. The system shown in Fig Q3 (c) is displaced from its static equilibrium position to the right a distance of 0.01m and released with a velocity of $V_0$ m/s towards left.




K = 15700 N/m
C = 1570 N-s/m
M = 9.8 kg

Fig Q3 (c)

Derive the expression for the displacement from the equilibrium position in terms of time 't' and initial velocity. $V_0$. **(08 Marks)**

4 a. A harmonic force $F = F_0 \sin wt$ acts on the mass of a spring-mass-dashpot system. Obtain
   i) Differential equation of motion
   ii) Expression for Amplitude and phase difference of steady state motion. **(12 Marks)**

b. If the expression for Transmissibility is,

$$Tr = \frac{\sqrt{1+(2\xi r)^2}}{\sqrt{(1-r^2)^2+(2\xi r)^2}}$$ ( $\xi$ is damping factor and $r = \frac{w}{w_n}$, frequency ratio)

Explain, with the help of suitable diagram, the effect of frequency ratio upon transmissibility. **(08 Marks)**

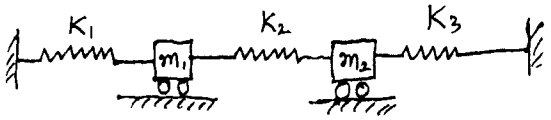
## PART – B

5 a. Explain the principle of accelerometer with equation and a plot. **(05 Marks)**

b. A disc of mass 4 kg is mounted midway between bearings which may be assumed to be simple supports. The bearings span is 48cm. the horizontal steel shaft is of 9 mm diameter. The centre of gravity of the disc is displaced 3 mm from the geometric centre. The equivalent viscous damping at the centre of disc-shaft may be taken as 49 N-s/m. If the shaft rotates at 760 rpm, find the maximum stress in the shaft and compare the same with dead load stress in the shaft. Also find the power required to drive the shaft at this speed. $E = 1.96 \times 10^{11} \frac{N}{m^2}$. **(15 Marks)**

6 a. The two degree of freedom spring mass system shown in Fig. Q6 (a) is constrained to have horizontal oscillations. Determine the differential equations of motions of the masses $m_1$ and $m_2$. **(06 Marks)**

Fig. Q6 (a)




b. A reciprocating m/c weighing 25N running at 6000 rpm after installation has natural frequency very close to the forcing frequency of vibrating system. Design a dynamic absorber of the nearest frequency of the system which is to be at least 20% from the excitation frequency. **(14 Marks)**

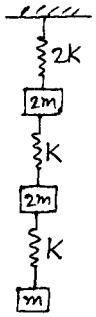
7 a. Derive the differential equation of motion for the longitudinal vibration of uniform bars and obtain its general solution. **(14 Marks)**

b. State the boundary conditions for transverse vibrations of
   i) a simply supported beam ii) a cantilever **(06 Marks)**

8 a. A shaft of negligible mass, 6 cm diameter and 5 m long is simply supported at the ends and carries four masses 50 kg each at distances 1 m, 2 m, 3 m and 4 m from left end support. Find the frequency of vibration by Dunkerley's method. E = 200 GPa. **(08 Marks)**

b. Determine the fundamental natural frequency of the system shown in Fig. 8 (b) by matrix iteration method and draw the corresponding mode shape. **(12 Marks)**

Fig. Q8 (b)

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