CBCS SCHEME

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15AE553

Fifth Semester B.E. Degree Examination, June/July 2019
Theory of Vibrations

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. A force $P_0 \sin wt$ acts on a displacement $x_0 \sin (wt - \pi/6)$. If $P_0 = 25N$, $x_0 = 0.05m$ $w = 2\pi$ rad/sec. Find the work done during i) First second ii) First 1/4 of second. **(06 Marks)**

b. Discuss about Beats phenomena and derive an expression for resultant amplitude. **(10 Marks)**

OR

2 a. Show that the motion of the piston of a reciprocating engine is periodic with terms containing the fundamental and even harmonics **(08 Marks)**

b. Determine the Fourier series representation for the excitation as shown in Fig.Q.2(b) **(06 Marks)**

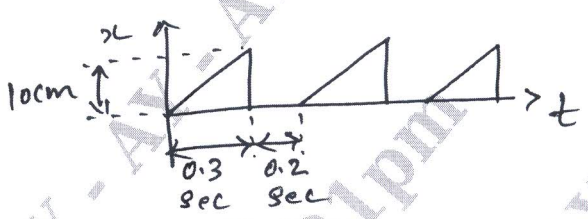


Fig.Q.2(b)

c. What are the important types of vibration? **(02 Marks)**

Module-2

3 a. Determine the natural frequency for the system shown in Fig.Q.3(a) where I-moment of inertia of rocker arm
k_s – spring stiffness
k_p – push rod stiffness
m_s – mass of spring
m_y – mass of valve
m_p – mass of pushrod. **(10 Marks)**

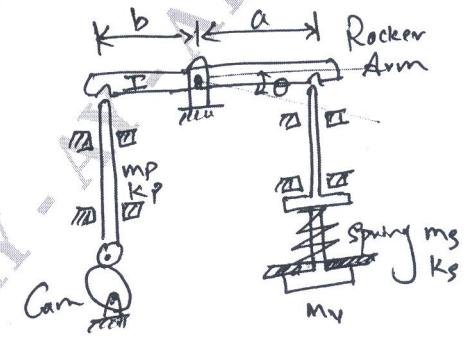


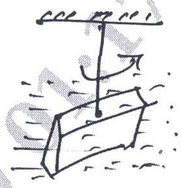
Fig.Q.3(a)

b. Derive an expression for energy dissipated in viscous damping. **(06 Marks)**

OR

4 a. A thin plate of area A and weight W is attached to the end of a spring and allowed to oscillate in a viscous fluid as shown in Fig.Q.4(a). If f_1 is the frequency of the system in air and f_2 in the liquid. Show that $\alpha = \frac{2\pi w}{gA}\sqrt{f_1^2 - f_2^2}$, where the damping force $F_d = \alpha 2AV$, V being velocity. **(08 Marks)**

Fig.Q.4(a)



b. Derive an expression for logarithmic decrement. **(08 Marks)**

Module-3

5 a. With sketch explain working of vibrometer, also deduce amplitude ratio with plots. **(08 Marks)**

b. A disc of mass 4kg is mounted midway between bearings which may be assumed simple support. The bearing span is 50cm, shaft diameter 10mm and is horizontal. The CG of disc is displaced by 2mm from GC (Geometric Centre). The equivalent viscous damping of the centre may be assumed as 50M-s/m. If shaft rotates at 250rpm. Determine maximum stresses and power required to drive the shaft at this speed. **(08 Marks)**

OR

6 a. Derive an expression for amplitude ratio and phase angle of an absolute support motion and draw the characteristic curves and explain. **(08 Marks)**

b. A vehicle of mass 490kg and total spring constant of suspension is 60kN/m. The profile of the road may be approximated to a line curve of amplitude 4cm and wavelength 4m. Determine the critical speed of the vehicle, the amplitude of the steady motion when the vehicle is driven at critical speed with $\xi = 0.5$ and also amplitude of the steady motion when the vehicle is driven at 57 km/hr with $\xi = 0.5$. **(08 Marks)**

Module-4

7 a. Prove the angular displacements of the two rotors are inversely proportional to their inertias. **(08 Marks)**

b. Determine the natural frequencies of the system shown in Fig.Q.7(b)

$K_1 = 40$ kN/m

$K_2 = 50$ kN/m

$K_3 = 60$ kN/m

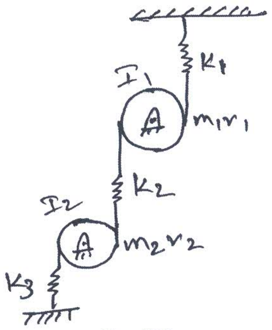
$m_1 = 10$ kg

$m_2 = 12$ kg

$\gamma_1 = 0.1$m

$\gamma_2 = 0.11$m. **(08 Marks)**

Fig.Q.7(b)



OR

8 a. Find frequency equation of a uniform beam fixed at one end and free at the other end for transverse vibration. **(04 Marks)**

b. A bar of length l fixed at one end is pulled at the other end with a force P. The force is suddenly released. Investigate the vibration of the bar. **(06 Marks)**

c. Derive 1D wave equation for torsional vibrations of a uniform shaft. **(06 Marks)**

Module-5

9 a. Find the natural frequency of the system shown in Fig.Q.9(a) by Lagrange's equation **(06 Marks)**

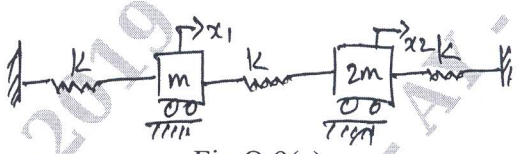


Fig.Q.9(a)

b. Determine the natural frequency of the spring mass system shown in Fig.Q.9(b) by Stodola's method. Take $m_1 = m_2$, $m_3 = m$, $k_1 = k_2 = k_3 = k$. **(10 Marks)**

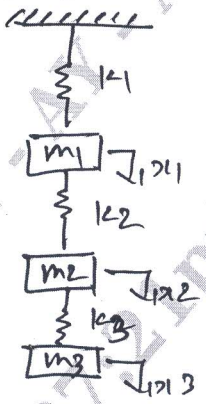


Fig.Q.9(b)

OR

10 a. Find the flexibility influence coefficients for the system shown in Fig.Q.10(a). **(10 Marks)**

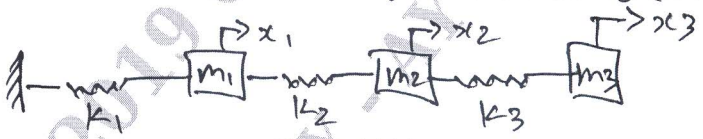


Fig.Q.10(a)

b. Write a short note on Maxwell's reciprocal theorem and influence coefficient. **(06 Marks)**

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