USN

10AU73

Seventh Semester B.E. Degree Examination, Dec.2017/Jan.2018
Mechanical Vibration and Vehicle Dynamics

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Explain :
   i) Degree of freedom, with neat sketch show single degree of freedom, two degree of freedom and infinite degree of freedom.
   ii) Longitudinal, Transverse and torsional vibration with a neat sketch. **(06 Marks)**

b. Explain simple Harmonic motion and obtain velocity and displacement equation. **(04 Marks)**

c. Split harmonic motion $x = 5 \sin\left(wt + \frac{\pi}{4}\right)$ into two harmonic motions one having phase of zero and the other of 60° show it graphically. **(10 Marks)**

2 a. Determine the natural frequency of a simple pendulum
   i) Neglecting the mass of rod
   ii) Considering it by Newton's method and energy method. **(12 Marks)**

b. Find natural frequency of system shown in Fig Q2(b) Let $K = 2 \times 10^5$M/m, m= 20kg.

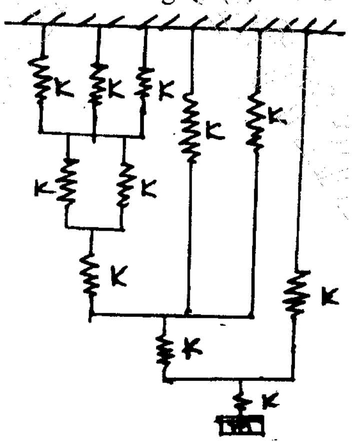

Fig. Q2(b) **(08 Marks)**

3 a. Why Damping is required? Name and explain different types of damping. **(08 Marks)**

b. Define Critical damping? **(02 Marks)**

c. A spring mass damper system has m = 3kg, K = 100N/m, C = 3N.sec/m. Determine :
   i) Damping factor
   ii) Natural frequency of damped vibration
   iii) Logarithmic decrement
   iv) The ratio of two successive amplitude
   v) Number of cycles after which original amplitude is below 20% **(10 Marks)**

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.

4 a. Write difference between vibration isolator and vibration absorber. (02 Marks)

b. A flywheel of mass moment of inertia $0.1 kg\text{-}m^2$ is suspended from a thin wire of stiffness 1.2 N-m/rad. A periodic torque having a maximum value of 0.6 N-m at a frequency of 4 rad/sec is impressed upon the flywheel. A viscous dash pot applies damping couple of 0.8 N-m at an angular velocity of 2 rad/sec. Determine :
   i) Maximum Angular Displacement
   ii) Maximum couple applied to dash pot
   iii) Critical damping co-efficient
   iv) Angle by which the angular displacement lags the torque. (08 Marks)

c. A machine has a total mass of 100kg and unbalanced reciprocating parts of mass 2kg which move through a vertical stroke of 80mm with simple Harmonic Motion. The machine is mounted on four springs symmetrically arranged With respect to centre of mass in which machine has single degree of freedom and can undergo vertical displacement only. Neglecting damping calculate the combined stiffness of spring in order that force transmitted to foundation is 1/25 of applied force when the speed of rotation of machine crank shaft is 1000 rpm. When the machine is actually supported on springs it is found that the amplitude of successive free vibration decreases by 25%. Determine :
   i) Force transmitted to foundation at 1000 rpm
   ii) Force transmitted to foundation at resonance
   iii) Amplitude of forced vibration of machine at resonance. (10 Marks)

PART – B

5 a. Write difference between vibrometer and Accelerometer with appropriate plots required? (06 Marks)

b. What is need of Fullerton Technometer and explain with neat sketch. (04 Marks)

c. A disc of mass 4kg is mounted midway between bearings, which may be assumed to be simple supports. The bearing span is 480mm. The steel shaft which is horizontal is 9mm in diameter. The centre of gravity of disc is displaced 3mm from geometric centre. The equivalent viscous damping at the centre of disc shaft may be taken as 49 N.S/m. If shaft rotates at 760mm. Find Dynamic load on the bearing. (10 Marks)

6 a. Define :
   i) Co-ordinate coupling
   ii) Dynamic Vibration absorber
   iii) Principle and normal modes of vibration (06 Marks)

b. A two degree of freedom vibration system shown in Fig. Q6(b). Determine : (14 Marks)
   i) Equation of motion   ii) Frequency equation and Natural frequencies
   iii) Modal vectors   iv) Mode shapes.

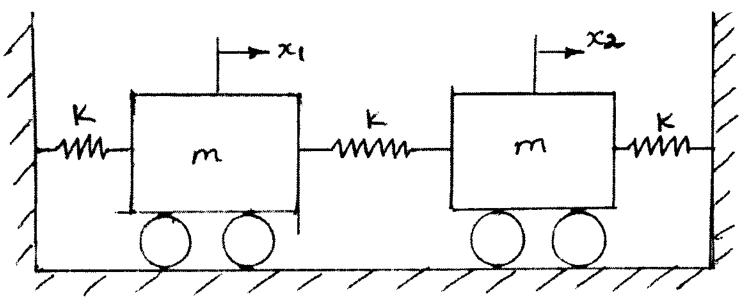

Fig. Q6(b)

7 a. Explain need of Human comfort in vehicle and how vehicle vibration place a critical role to achieve Human comfort. **(06 Marks)**

b. Draw mathematical model of Motor car? **(04 Marks)**

c. Determine pitch and bounce frequencies and location of oscillation centre of an automobile?

Mass of vehicle	=	1500kg
Radias of gyration	=	1.2m
Distance between front axle and C.G	=	1.4m
Distance between rear axle and C.G	=	1.6m
From spring stiffness	=	30kN/m
Rear spring stiffness	=	35kN/m

(10 Marks)

8 a. Define Influence co-efficient. **(02 Marks)**

b. A shaft 100mm diameter is supported in short bearing 3m apart and carries 3 discs weighing 900N, 1400N, 700N situated 1m, 2m, and 2.5m from one of the bearings respectively. Assume E = 200GPa, Density of shaft material = 7000kg/m^3. Calculate frequency transverse vibration, by Dunkerley's method. **(06 Marks)**

c. Find the lowest natural frequency of the system shown in Fig. Q8 (c) Stodola's method. Also plot the mode shape? **(12 Marks)**

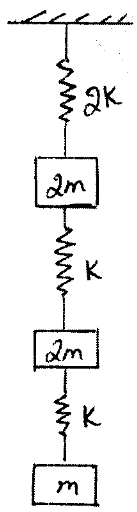

Fig. Q8(c)

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