USN | | | | | | | | | |

10AU73

Seventh Semester B.E. Degree Examination, Dec.2019/Jan.2020
Mechanical Vibration and Vehicle Dynamics

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

PART – A

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

   b. Add the following motion analytically and check the solution graphically
   $x_1 = 2 \cos (wt + 0.5)$, $x_2 = 5 \sin (wt + 1.0)$. **(14 Marks)**

2 a. Using Newton's method and Energy method, derive equation of motion and natural frequency of vibration of a spring mass system in vertical position. **(10 Marks)**

   b. Determine the natural frequency of simple pendulum :
   i) Neglecting the mass of rod
   ii) Considering the mass of rod [Newton's method]. **(10 Marks)**

3 a. The mass of a single degree damped vibrating system is 7.5kg makes 24 free oscillation in 14 secs, when distributed from its equilibrium position. The amplitude of vibration reduces 0.25 of its initial value after 5 oscillations. Determine
   i) Stiffness of spring.
   ii) Log. Decrement.
   iii) Damping factor. **(10 Marks)**

   b. A spring mass dashpot system is given an initial velocity of XW_n where W_n is the undamped natural frequency of the system. Find equation of motion for the system when
   i) $\xi = 2.5$ ii) $\xi = 1$. **(10 Marks)**

4 a. Define Transmissibility. Derive an expression for motion transmissibility. **(10 Marks)**

   b. A mass of 10kg suspended from one end of helical spring , the other end is fired. The stiffness of spring is 10N/mm. The viscous damping causes the amplitude to decrease $1/10^{th}$ of initial value in four complete oscillations. If a periodic force of 150cos50t N is applied at mass with vertical direction. Find the amplitude of forced vibration, what is its value at resonance? **(10 Marks)**

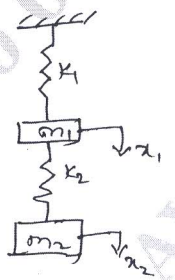
PART – B

5 a. Explain and discuss vibrometer and accelerometer devices with the help of relative amplitude ratio versus frequency ratio plot. **(10 Marks)**

   b. Obtain an expression for whirling of shaft with air damping. **(10 Marks)**

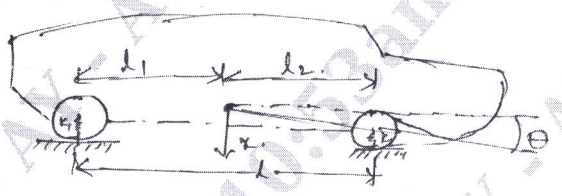
6 A two degrees of freedom vibrating system is shown in fig. Q6. Determine
i) Two Natural frequencies of vibrations.
ii) Ratio of amplitudes of motion m_1 and m_2 for the two modes of vibration.
iii) Modal vector and modal shapes.
iv) Locate the nodes for each mode of vibration.
Given $m_1 = 2kg$, $m_2 = 1kg$, $k_1 = 40N/m$, $k_2 = 20N/m$. **(20 Marks)**

Fig. Q6



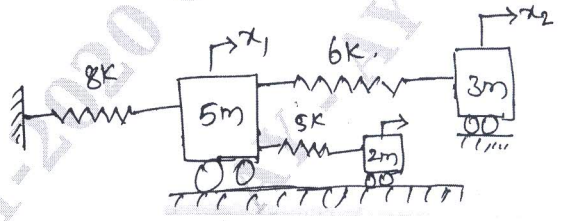
7 Fig. Q7, shows the diagram of an automobile. Determine the normal modes of vibration , if the automobile is simulated by the simplified two degrees of freedom system with the following numerical values.
$m = 1,500$ kg , $\ell_1 = 1.35m$, $\ell_2 = 1.65m$, $\ell = 3m$, $k = 1.2m$,
$k_1 = 35 \times 10^3$ N/m , $k_2 = 40 \times 10^3$ N/m. **(20 Marks)**

Fig. Q7



8 Using Stodola's method, determine the lowest natural frequency of the branched system shown in fig.Q8. **(20 Marks)**

Fig. Q8



*****