CBCS Scheme

USN | | | | | | | | | | 15AE553

# Fifth Semester B.E. Degree Examination, Dec.2017/Jan.2018

## 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. Write notes on:
i) Degree of reaction
ii) Simple Harmonic motion
iii) Resonance **(06 Marks)**

b. Represent the periodic motion given in the following Fig.Q1(b) by Harmonic series.

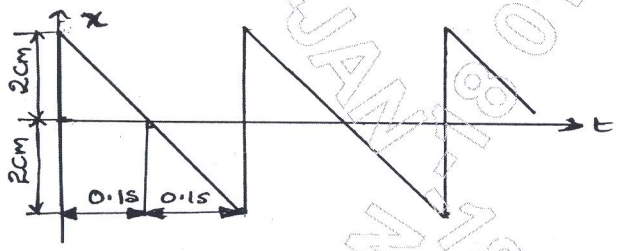


Fig.Q1(b) **(10 Marks)**

**OR**

2 a. Split the Harmonic motion $x = 5\sin(\omega t + \pi/4)$ into two harmonic motions one having phase of zero and other 60°. **(06 Marks)**

b. With a neat sketch, explain the beats phenomenon and obtain its resultant motion. **(10 Marks)**

### Module-2

3 a. Determine the natural frequency of the system shown in Fig.Q3(a) by energy method.

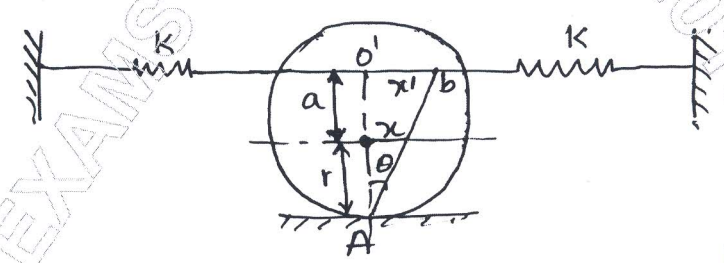


Fig.Q3(a) **(08 Marks)**

b. Determine the natural frequency of spring mass system taking the mass of the spring into account. **(08 Marks)**

**OR**

4 a. A spring mass-dash-pot system is given an initial velocity of $X\omega_n$ where $\omega_n$ is the underdamped natural frequency of the system. Find the equation of motion for the system when (i) $\xi = 2.5$, (ii) $\xi = 1$, (iii) $\xi = 0.5$. **(10 Marks)**

b. Discuss the response of critically damped system using respective response equations. **(06 Marks)**

## Module-3

5 a. Define the term transmissibility and derive the expression for transmissibility ratio due to harmonic excitation. **(08 Marks)**

b. A machine tool of mass 200 kg is supported in spring of total stiffness 16000 N/cm has an unbalanced rotation element which results in a disturbing force 800 N at a speed of 3000 rpm. Assume $\xi = 0.2$. Determine:

i) Amplitude of motion due to unbalance
ii) Transmissibility
iii) Transmitted force. **(08 Marks)**

**OR**

6 a. Explain the following with a neat sketches: (i) Accelerometer, (ii) Vibrometer. **(10 Marks)**

b. A vibrometer gives a reading of relative displacement 0.5 mm. The natural frequency of vibration is 600 rpm and the machine owns at 200 rpm. Determine the magnitude of displacement, velocity and acceleration of the vibrating machine part. **(06 Marks)**

## Module-4

7 a. Derive and explain the principle mode vibration of undamped two-degree of freedom system. **(08 Marks)**

b. Determine the natural frequency of the system shown in Fig.Q7(b).

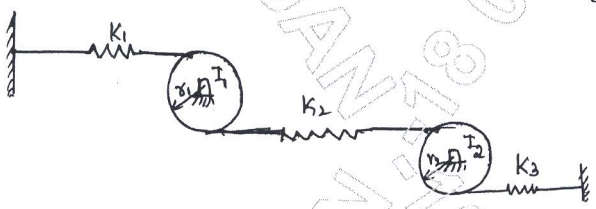


Fig.Q7(b) **(08 Marks)**

**OR**

8 a. Derive the general solution for the longitudinal vibrations of a uniform bar. **(10 Marks)**

b. Derive an expression for the free longitudinal vibration of a uniform bar of length 'L', one end of which is fixed and the other end free. **(06 Marks)**

## Module-5

9 Using Stodola method, determine the lowest natural frequency of the four degree of freedom of spring mass system shown in Fig.Q9.

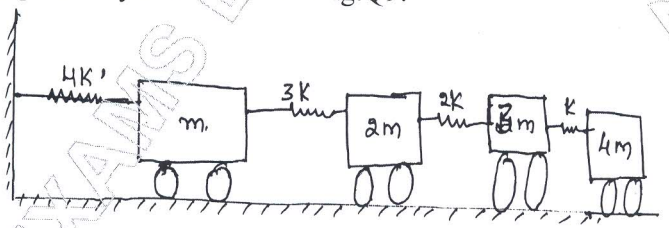


Fig.Q9 **(16 Marks)**

**OR**

10 a. Explain Dunkerly's method of determining the fundamental natural frequency of a multidegree freedom system. **(08 Marks)**

b. Find the lowest natural frequency of vibration for the system shown in Fig.Q10(b) by Rayleigh's method. $E = 1.96 \times 10^{11}$ N/m$^2$, $I = 4 \times 10^{-7}$ m$^4$.

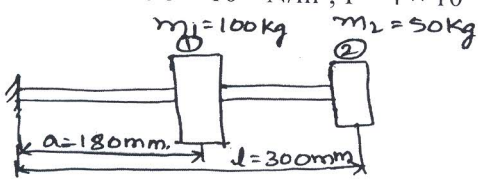


Fig.Q10(b) **(08 Marks)**

* * * * *