CBCS SCHEME

USN | | | | | | | | | | |

18AE56

Fifth Semester B.E. Degree Examination, Jan./Feb. 2021
Theory of Vibrations

Time: 3 hrs. Max. Marks: 100

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

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.

Module-1

1 a. Explain the phenomenon of beats. **(10 Marks)**

b. Add the following harmonic motion and check the solution graphically:
$x_1 = 2\cos(\omega t + 0.5)$; $x_2 = 5\sin(\omega t + 1.0)$ **(10 Marks)**

OR

2 a. Determine the Fourier series for the curve shown in Fig.Q2(a).

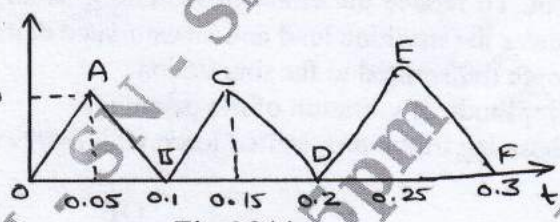

Fig.Q2(a) **(10 Marks)**

b. Derive an expression for work done by a harmonic force on a harmonic motion. **(05 Marks)**

c. Define the terms:
(i) Periodic motion (ii) Natural frequency (iii) Resonance
(iv) Degree of freedom (v) Vibration **(05 Marks)**

Module-2

3 a. Obtain the differential equation of motion for a single degree of freedom system by :
(i) Newton's method (ii) Energy method **(10 Marks)**

b. Determine natural frequency of the system shown in Fig.Q3(b) by:
(i) Newton method (ii) Energy method

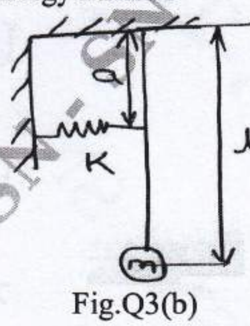

Fig.Q3(b) **(10 Marks)**

OR

4 a. Vibrating system consist of a mass of 50 kg a spring a stiffen 30 kN/m and a damper. Damping is 20% the critical value. Determine:
(i) Damping factor (ii) Critical damping coefficient
(iii) Logarithmic decrement (iv) Ratio of two consecutive amplitude
(v) Natural frequency of free vibration (vi) Natural frequency of damped vibration
(10 Marks)

VTU-03-03-2021 01:04:22pm - SN - SN - SN - SN
03-03-2021 01:04:50pm - SN - SN - SN - SN

b. Obtain the differential equation of motion for the system shown in Fig.Q4(b) and hence find (i) Critical damping coefficient (ii) Natural frequency of damped oscillation

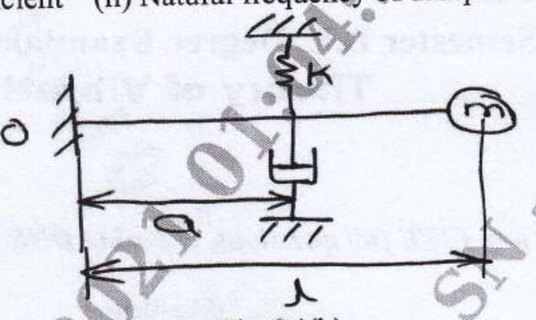

Fig.Q4(b) **(10 Marks)**

Module-3

5 a. Determine expression for steady state amplitude of vibration of mass in a spring mass damper system when the mass is subjected to harmonic excitation. **(10 Marks)**

b. A machine of mass one tonne is acted upon by an external force of 2450 N at a frequency of 1500 rpm. To reduce the effect of vibration, isolator of rubber having a static deflection of 2 mm under the machine load and an estimated damping factor of 0.2 are used. Determine:
(i) Force transmitted to the foundation
(ii) Amplitude of vibration of the machine
(iii) Phase lag of the transmitted force with respect to the external force. **(10 Marks)**

OR

6 a. Explain Fullarton tachometer and Frahm tachometer. **(10 Marks)**

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

Module-4

7 Fig.Q7 shows a spring mass system. Determine
(i) Equation of motion
(ii) Frequency equation and natural frequencies of the system
(iii) Modal vector and mode shapes

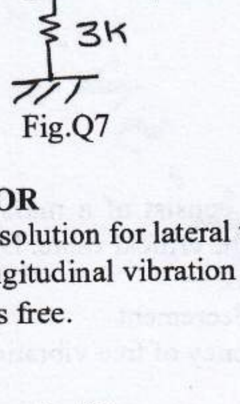

Fig.Q7 **(20 Marks)**

OR

8 a. Determine an expression for the general solution for lateral vibration of string. **(10 Marks)**

b. Determine an expression for the free longitudinal vibration of a uniform bar of length ℓ, one end of which is fixed and the other end is free. **(10 Marks)**

Module-5

9 a. A shaft shown in Fig.Q9(a) of 50 mm diameter and 3m long is supported at the end and carries three weight of 1000 N, 1500 N and 750 N at 1m, 2m and 2.5m from the left support. Taking E = 200 GPa, find the frequency of transverse vibration.

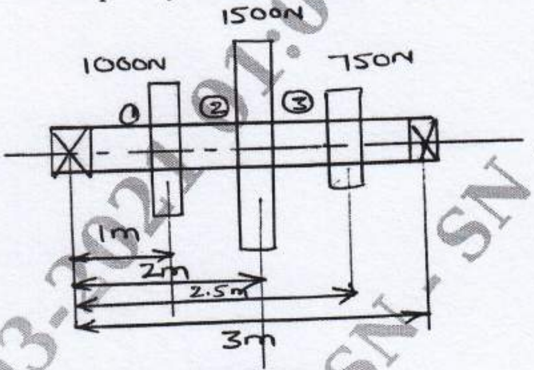

Fig.Q9(a)

(10 Marks)

b. Determine the influence co-efficient of the triple pendulum shown in Fig.Q9(b).

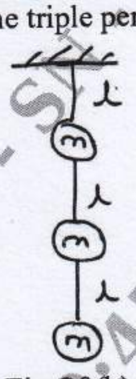

Fig.Q9(b)

(10 Marks)

OR

10 a. Using Stodola's method, determine the fundamental mode of vibration and its natural frequency of the spring mass system shown in Fig.Q10(a).

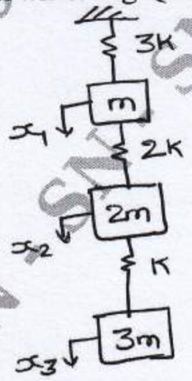

Fig.Q10(a)

(10 Marks)

b. Determine the natural frequency and the mode shape of the system shown in Fig.Q10(b) by Holzer's method.

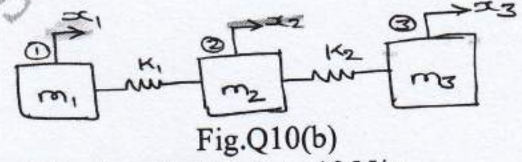

Fig.Q10(b)

$m_1 = 2$ kg, $m_2 = 4$ kg, $m_3 = 2$ kg, $k_1 = 5$ N/m, $k_2 = 10$ N/m

(10 Marks)

* * * * *