CBCS SCHEME

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15AE553

Fifth Semester B.E. Degree Examination, June/July 2023
Theory of Vibrations

Time: 3 hrs. Max. Marks: 80

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Any missing data may be suitably assumed.

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.

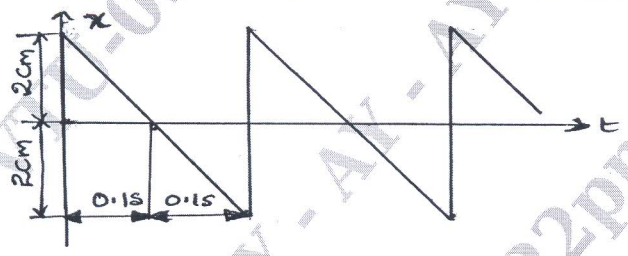

Fig.Q1(b) **(10 Marks)**

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. Define undamped free vibration. Derive an expression for equation of motion and natural frequency of vibration of a spring mass system in vertical position using Newton's method. **(08 Marks)**

b. A flywheel is mounted on a vertical shaft as shown in Fig.Q3(b). Both ends of shaft are fixed and diameter is 50mm. The flywheel has a mass of 500 kg and radius of gyration 0.5m find natural frequency of (i) longitudinal vibration (ii) Transverse vibration (iii) Torsional vibrations.
Take E = 200 GN/m^2, G = 84 GN/m^2, d = 50 mm, m = 500 kg, k = 0.5m **(08 Marks)**

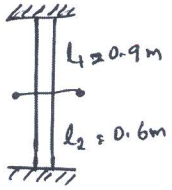

Fig.Q3(b)

OR

4 a. Define Logarithmic Decrement. Derive an expression for the same with usual notation. **(08 Marks)**

b. A mass of 2 kg is supported as an isolator having a spring scale of 2940 N/m and viscous damping. If the amplitude of tree vibration of the mass falls to one half of its original value in 1.5 seconds, determine the damping coefficient of the isolator. **(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. With help of suitable sketches illustrate the working of the following :
(i) Dynamic Vibration Absorber (ii) Dynamics of reciprocating engines. **(10 Marks)**

b. Describe the principle modes and normal modes of vibration. **(06 Marks)**

OR

8 a. 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. **(08 Marks)**

b. Find the frequency and normal modes of transverse vibration of a simply supported beam of length L. **(08 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.

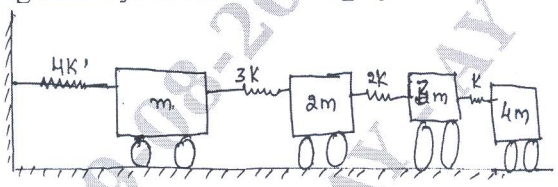

Fig.Q9 **(16 Marks)**

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.

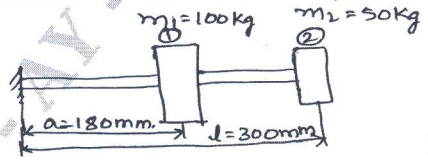

Fig.Q10(b) **(08 Marks)**

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