611003

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611003

B. Tech. VI - Sem. (Main) Exam., (Academic Session 2021- 2022)

Mechanical Engineering

6ME4 – 03 Mechanical Vibrations

Time: 2½ Hours **Maximum Marks: 120**

Min. Passing Marks:

Instructions to Candidates:

Part – A: *Short answer questions (up to 25 words) 6 × 3 marks = 18 marks. Candidates have to answer **six** questions out of **ten.***

Part – B: *Analytical/Problem solving questions 3 × 10 marks = 30 marks. Candidates have to answer **three** questions out of **seven.***

Part – C: *Descriptive/Analytical/Problem Solving questions 3 ×24 marks = 72 marks. Candidates have to answer **three** questions out of **five.***

Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.

Use of following supporting material is permitted during examination. (Mentioned in form No. 205)

1. NIL 2. NIL

PART – A

Q.1 What are the three elementary parts of a vibrating system?

Q.2 Define spring stiffness.

Q.3 Define damping constant.

Q.4 Define Logarithmic Decrement.

Q.5 Define damping ratio (ζ).

Q.6 Define the term magnification factor.

Q.7 What is critical speed of shaft?

Q.8 Define transverse vibration.

Q.9 What are the auditory effects of noise?

Q.10 What is principle of conservation of energy?

PART – B

Q.1 (a) Define the following terms -

(i) Sound pressure level

(ii) Sound power level

(iii) Sound intensity level

(iv) Sound spectra

(b) Consider the sum of harmonic motions -

$x(t) = x_1(t) + x_2(t) = A\cos(\omega t + \alpha)$ with

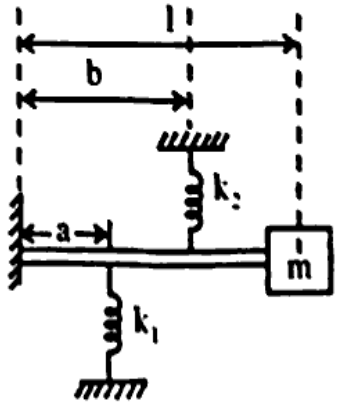
$x_1(t) = 15\cos\omega t$ and $x_2(t) = 20\cos(\omega t + 1)$

then find the value of A (amplitude).

Q.2 (a) What do you mean by natural frequency of a vibrating system? Why it is important to find the natural frequency?

(b) Explain the term centre of percussion and write the practical applications of concept of centre of percussion.

Q.3 Find the natural frequency of the system as shown in figure -



Q.4 Define the following terms -

(i) Specific damping capacity

(ii) Hysteresis damping constant

(iii) Under damped system

(iv) Transmissibility

Q.5 Consider a spring mass damper system, with k = 4000 N/m, m = 10 kg and c = 40 N-s/m.

Find the steady state and total responses of the system under the harmonic force -

$F(t) = 200 \cos 10t$ N and initial conditions are

$x_0 = 0.1$ m and $\dot{x}_0 = 0$

Where - k is stiffness of spring

m is mass

c is co-efficient of viscous damping

Q.6 (a) What is the function of a vibration isolator?

(b) What do you understand by critical speed of a shaft and how is critical speed of a shaft determined?

Q.7 Write the equations of motion of a multi degree of freedom system in matrix form using -

(a) The flexibility matrix

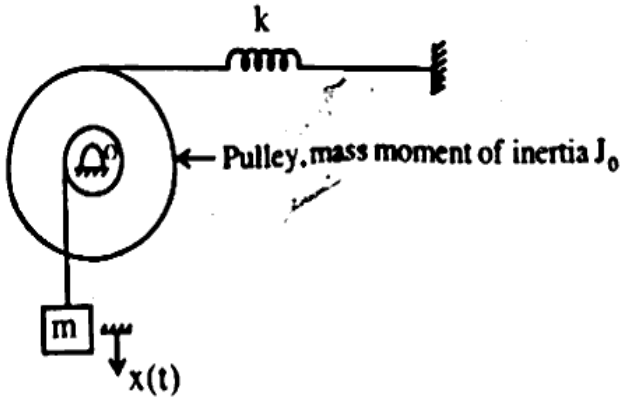
(b) The stiffness matrix

PART – C

Q.1 Draw the free body diagram and derive the equation of motion using Newton's second law of motion for the system shown in figure below, also find the value of natural frequency of the system.

r → radius of smaller pulley

4r → radius of bigger pulley



Q.2 A gun barrel of mass 600 kg has a recoil spring of stiffness 294,000 N/meter. If the barrel recoils 1.3m on firing determine -

(a) The initial recoil velocity of the barrel

(b) The critical damping co-efficient of the dash pot which is engaged at the end of the recoil stroke

(c) The time required for the barrel to return to a position 5cm from the initial position

Q.3 What are different types of damping? Discuss the effect of viscous damping on natural frequency and vibration amplitude in a single degree freedom system.

Q.4 Determine the natural frequency of Torsional vibrations of a shaft with two circular disc of uniform thickness at the ends. The masses of the disc are $M_1 = 450$ Kg and M_2 900 Kg and their other diameters are $D_1 = 120$ cm and $D_2 = 185$ cm. The length of the shaft is $l = 320$ cm and its diameter $d = 10$ cm. Modules of rigidity for the material of shaft is $G = 0.85 \times 10^{11}$ N/m^2. Also find in what proportion will the natural frequency of this shaft is change, if along half of the length of the shaft, the diameters is increased from 10 cm to 20 cm?

Q.5 Determine the natural frequency of the spring-mass system as shown in figure -

Take $m_1 = m_2 = m_3 = m$

$k_1 = k_2 = k_3 = k$

By using Stodola's method -