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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIRST SEMESTER M.TECH DEGREE EXAMINATION, DECEMBER 2017

Mechanical Engineering

(Machine Design)

01ME6101 Advanced Theory of Vibration

Max. Marks : 60 Duration: 3 Hours

Answer any two full questions from each part
Limit answers to the required points.

PART-A

1.a) Derive general solution for damped free vibration of a single D.O.F system of mass 'rn', Spring 'k' and damper 'c', and obtain complete solution for the displacement 'x' (t) for under-damping condition. (5 Marks)

b) Fig 1 shows a massless rigid bar AB pivoted at point A. For small vertical motion of the mass 'm' determine the equation of motion and hence find the period of oscillation (4 Marks)

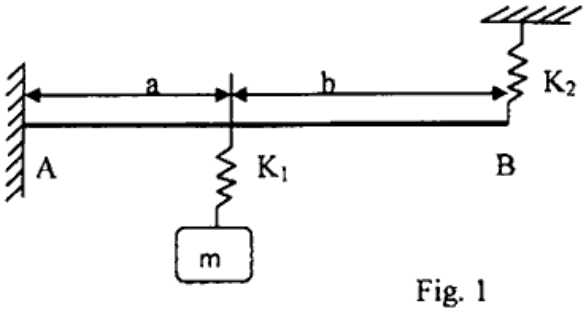

Fig. 1

2. a) A machine of mass 500 kg contains an unbalanced rotating component . The steady state vibration amplitude is measured to be 0.5 mm when the machine is operating at resonance . Determine the unbalance assuming the system is critically damped. (5 Marks)

b) Using Laplace transform obtain the expression for the response x(t) of a SDOF system subjected to step input force of magnitude F_0 (4marks)

3.a) Consider the two D.O.F system shown in Fig-2 . Obtain an expression for the displacement of mass M_1 and show how this amplitude can be brought to zero (5 Marks)

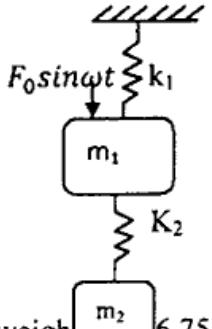

Fig. 2

b) An aircraft radio weighing 6.75 N is to be isolated from engine vibrations ranging fin frequencies from 1600 to 2200 cpm. What statical deflection must the isolators have for

85% isolation ?

(4 marks)

Part B

4. Show that for a vibrating system normal modes are orthogonal to each other. Obtain the normal modes of a three rotor torsional system that is unrestrained to rotate freely in bearings (shown in Fig 3)

(9 Marks)

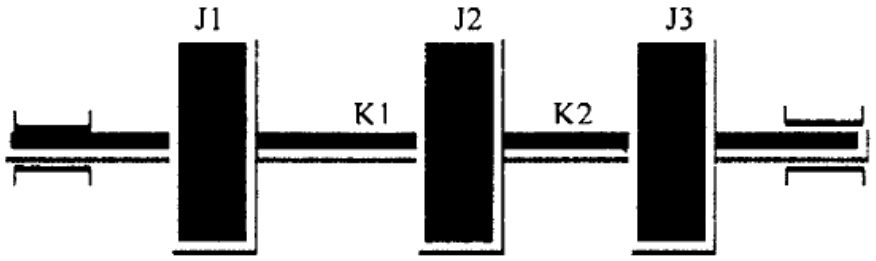

Fig - 3

5. Derive Lagrange's equation for obtaining equation of motion of multi D.O.F conservative system and use the procedure to find the equation of motion of the system shown in Fig 4

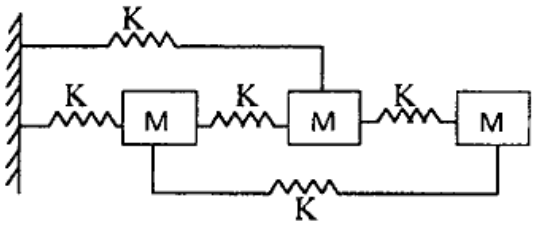

Fig. 4

(9 Marks)

6. Obtain the dynamic matrix of the system shown in Fig-4 and find the fundamental frequency by matrix iteration method. (9 marks)

PART C

7 a) A uniform bar of length L is fixed at one end and fee at the other end. Obtain the frequency of normal longitudinal vibration

(6 marks)

b) An airplane tab showed a resonant frequency of 32 cps when vibrated by an eccentric mass shaker weighing 0.5 kg. By attaching an additional weight of 0.5 Kg to the shaker, the resonant frequency reduced to 25 cps. Determine the true natural frequency

(6 marks)

8 . Determine the natural frequency and mode shapes of the spring mass system shown in Fig by the Holzer's method

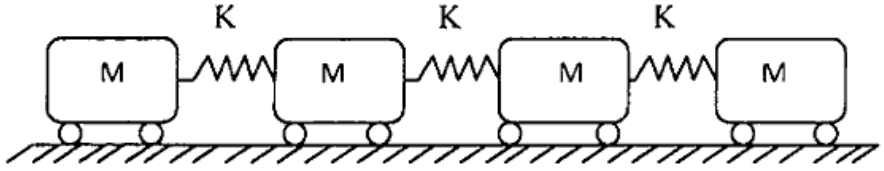

Fig-5 (12 Marks)

9.a) Derive the Dunkerley's equation for determining the fundamental natural frequency of a multi DOF system. (6 marks)

b)Find the velocity of longitudinal waves along a thin steel bar . Assume modulus of rigidity of steel as $200 \times 10^6 N/m^2$, density 7810 N/m^3

(6 marks)