Code No: 117ET **R13**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech IV Year I Semester Examinations, March - 2017
MECHANICAL VIBRATION AND STRUCTURAL DYNAMICS
(Aeronautical Engineering)

Time: 3 Hours **Max. Marks: 75**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

Part- A (25 Marks)

1.a) What do you mean by resonance? [2]
b) List out different types of vibration? Explain. [3]
c) What do you mean by logarithmic decrement? [2]
d) In how many ways can a system be damped? Explain at least two in brief. [3]
e) What is orthogonality principle? [2]
f) Explain the importance of influence coefficient in the vibrating system. [3]
g) Why vibration data acquisition system is needed? [2]
h) What is whirling speed? [3]
i) State the Hamilton's principle. [2]
j) Explain the procedure involved in the Rayleigh's method for calculating first natural frequency. [3]

Part-B (50 Marks)

2. A semicircular disc of radius 'R' and mass 'm' is pivoted freely about the centre as shown in figure1. Determine its natural frequency of oscillation for small displacement. Use energy method. [10]

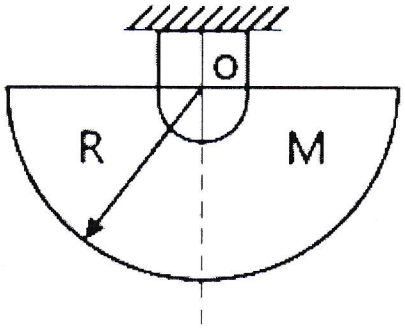

Figure: 1

OR

3.a) Add the following motions analytically and check the solution graphically .
$X_1 = 4 \text{ Cos } (\omega t + 10^\circ)$
$X_2 = 6 \text{ Sin } (\omega t + 60^\circ)$

b) How are vibrations classified? If two springs are attached to a body apart from attaching to each other, derive the equivalent spring stiffness. [5+5]

4. Find the natural frequencies and mode shapes for the torsional system shown in figure 2. Given $J_1=J_0$, $J_2=2J_0$ and $k_{t1} = k_{t2} = k_{t3} = k_t$. [10]

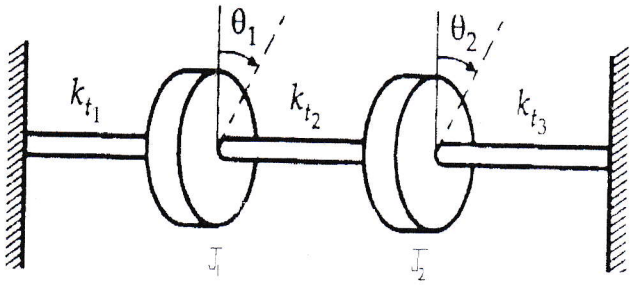

Figure: 2

OR

5. An aerofoil using in its first bending and torsional modes can be represented schematically as shown in figure 3 connected through a translational spring of stiffness k and a torsional spring of stiffness k_T. Write the equations of motion for the system and obtain the two natural frequencies. Assume the following data. m = 5kg, I= 0.12 kg m^2, k = 5×10^3 N/m, K_T= 0.4×10^3 Nm/rad, a = 0.1 m. [10]

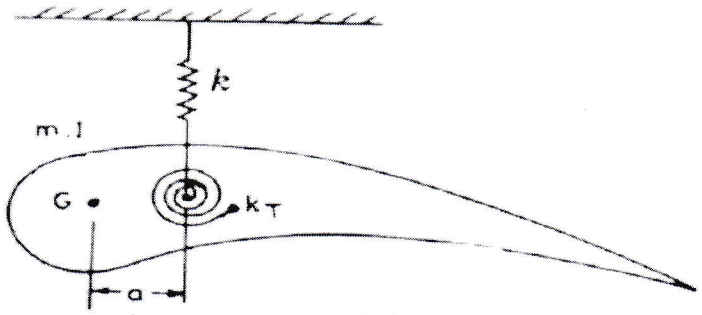

Figure: 3

6. Find the lowest natural frequency of the vibration of system as shown in figure 4, by Rayleigh's method. Given: E = 1.96×10^{11} N/m^2, I = 4×10^{-7}. [10]

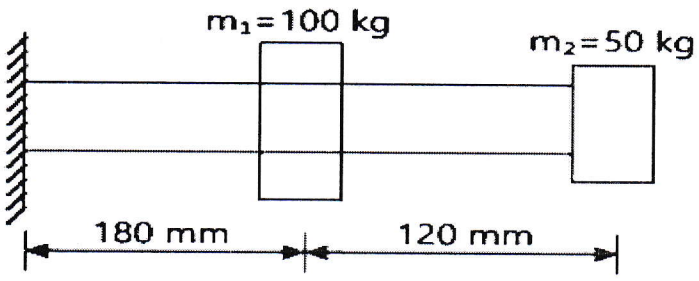

Figure: 4

OR

7. Using the Stodola's determine the fundamental mode of vibration and its natural frequency of the spring mass system as shown in figure 5. [10]

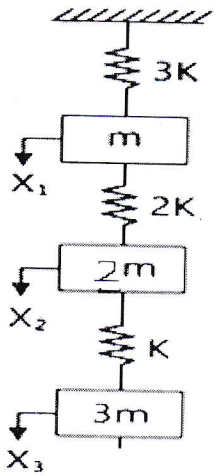

Figure: 5

8. Explain in brief and derive an expression of the Rayleigh Ritz method of vibrational analysis. [10]

OR

9. Determine the dynamic matrix coefficient of the system shown in Figure 6 using matrix method. [10]

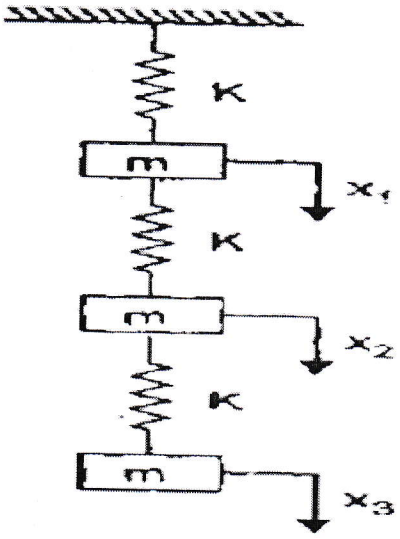

Figure: 6

10. The governing equation of a lateral vibration of a beam is $\frac{\partial^2 y}{\partial t^2} + a\frac{\partial^4 y}{\partial x^4} 0$. Where a = $\sqrt{\frac{EI}{\rho A}}$, Obtain a general solution for the governing differential equation. [10]

OR

11. What are the different methods to compute the frequency domain analysis? Explain in brief. [10]

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