U.S.N

P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

First Semester, M.Tech. - Civil Engineering (MCAD)

Semester End Examination; April / July - 2021

Structural Dynamics Theory and Computations

Time: 3 hrs *Max. Marks: 100*

Course Outcomes

The Students will be able to:

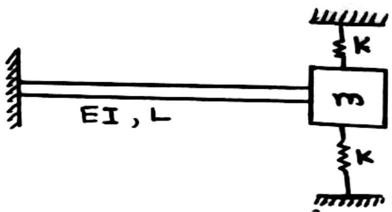
CO1: Understand the basic principles of dynamics.

CO2: Analyze lumped mass systems for their dynamic behaviour.

CO3: Evaluate the structural characteristics of continuous vibratory system.

CO4: Carry out dynamic analysis of beams using FEM.

Note: ***I)*** *Answer any* ***FIVE*** *full questions, selecting* ***ONE*** *full question from each unit.*
II) *Any* ***THREE*** *units will have internal choice and remaining* ***TWO*** *unit questions are compulsory.*
III) *Each unit carries 20 marks.* ***IV)*** *Missing data, if any, may suitably be assumed.*

Q. No.	UNIT - I	Marks	BLs	COs	POs
1a.	Derive the differential equation of motion of a single degree of freedom system using D'Alembert's principle for undamped system for free vibration.	12	L3	CO2	PO1,3,4,5
b.	Calculate the natural frequency and natural period for the structural system shown in Fig. Q 1(b) when $L = 3.6$ m, $E = 22000$ MPa, $I = 1.2 \times 10^{-4}$ m^4, $K = 40$ kN/m, $m = 10$ kN.  Fig. Q 1(b)	8	L3	CO1	PO1,3,4,5
	OR				
1d.	For the free vibration of a spring mass dashpot system, set up the equation of motion. Obtain the solution of the differential equation if the system is critically damped.	12	L3	CO2	PO1,3,4,5
e.	Explain the following: i) D'Alembert's principle ii) Equivalent stiffness of springs connected in series and parallel	8	L2	CO1	PO1,3,4,5
	UNIT - II				
2 a.	Derive the expression for the maximum force transmitted to the foundation due to vibrating mass.	8	L3	CO2	PO1,3,4,5

b. For a spring mass dashpot system subjected to a harmonic excitation $F_0 sinwt$. Obtain an expression for steady state response. — 12 | L3 | CO2 | PO1,3,4,5

OR

2 d. Derive the expression for the response of single degree of freedom system acted upon by a rectangular pulse force for undamped condition. Use Duhamel's integral approach. — 10 | L3 | CO2 | PO1,3,4,5

e. A structure having mass 500 kg and translational stiffness 50 kN/m as shown in Fig. Q. 2(e) subjected to a harmonic force having an amplitude of 1 kN and an operating frequency of 20 rad/sec. The damping ratio is 0.2 to sustain steady state vibration. Determine steady state amplitude and its phase with respect to the exciting force, also determine DMF. — 10 | L3 | CO2 | PO1,3,4,5

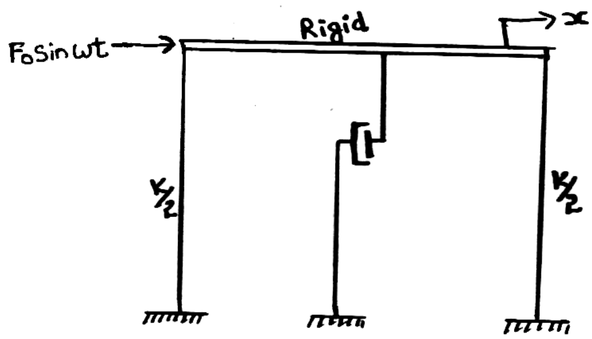


Fig. Q2(e)

UNIT - III

3 a. Determine the natural frequencies and mode shapes for the system shown in Fig. Q3(a). Draw the mode shape. — 20 | L5 | CO2 | PO1,3,4,5

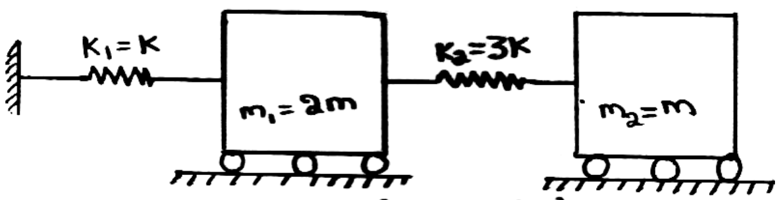


Fig. Q3(a)

OR

3 d. Determine the natural frequencies and mode shapes for the system shown in Fig. Q3(b). Draw the mode shape. — 20 | L5 | CO2 | PO1,3,4,5

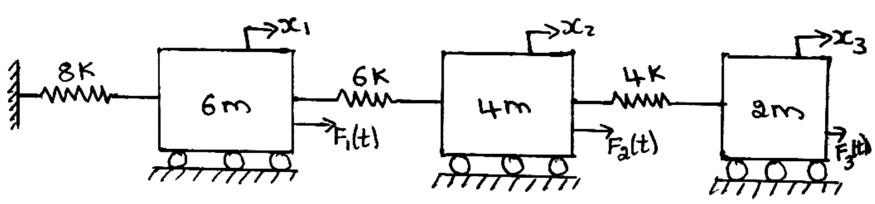


Fig. Q3(b)

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UNIT - IV

4 a.	Derive the differential equation of motion for a free flexural vibration of beam considering beam as continuous system. Also derive the frequency equation for a beam with both ends free having transverse vibration.	20	L3	CO3	PO1,3,4,5

UNIT - V

5 a.	Using cubic Hermitian polynomial, derive the shape function for a two nodded Euler-Bernoulli beam element. Also determine the mass coefficient M_{ij} for $i = 1$ and $j = 1, 2, 3$.	20	L3	CO4	PO1,3,4,5

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