Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(An Autonomous Institution Affiliated to University of Mumbai)

M.E (Civil) with Sem I — JUNE 2013

Total Marks : 100 — Duration : 4 Hours

CLASS/SEM : ME Civil with Structural Engineering Subjects SEM I

SUBJECT : STRUCTURAL DYNAMICS

MASTER

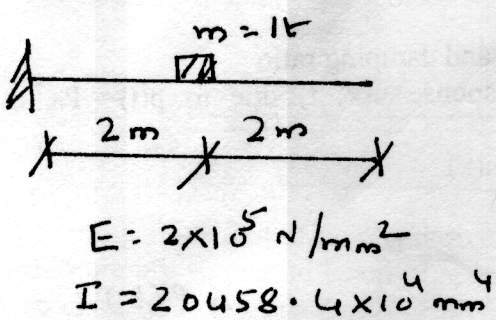
- Attempt any FIVE questions out of SEVEN questions.
- Answers to all sub questions should be grouped together.
- Figures to the right indicate full marks.
- Assume suitable data if necessary and state the same clearly.

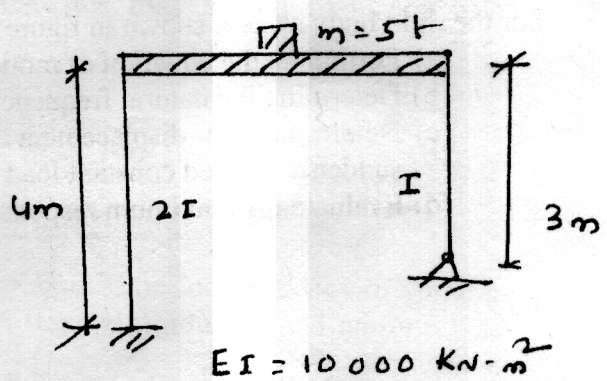
Q.1 **a.** Answer the following:

(i) Define Dynamic load. Distinguish between Prescribed and Random dynamic loads — 3

(ii) Explain clearly, the difference between static and dynamic analysis of structure — 3

b. For the structural systems shown in figure compute the natural frequency of vibration — 8





d. What is transmissibility of a system? Briefly explain how vibration isolation can be achieved — 6

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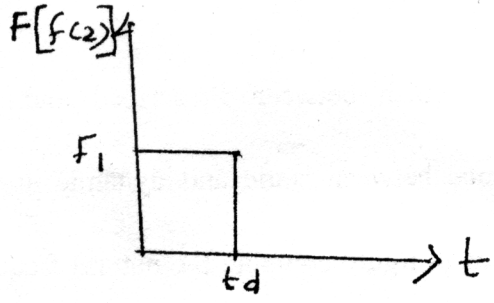
Q.2 **a.** The stiffness and damping properties of a mass spring system are to be determined by free vibration test. The mass is given as **200 kg.** In this, the mass is displaced by **10 mm** by a hydraulic jack and then suddenly released. At the end of **5 cycle**, the time is **1 seconds** and the amplitude is **4 mm.** Determine: 5

(i) Damped frequency (ii) Damping ratio (iii) Damping coefficient (iv)Un damped natural frequency (v) Stiffness coefficient

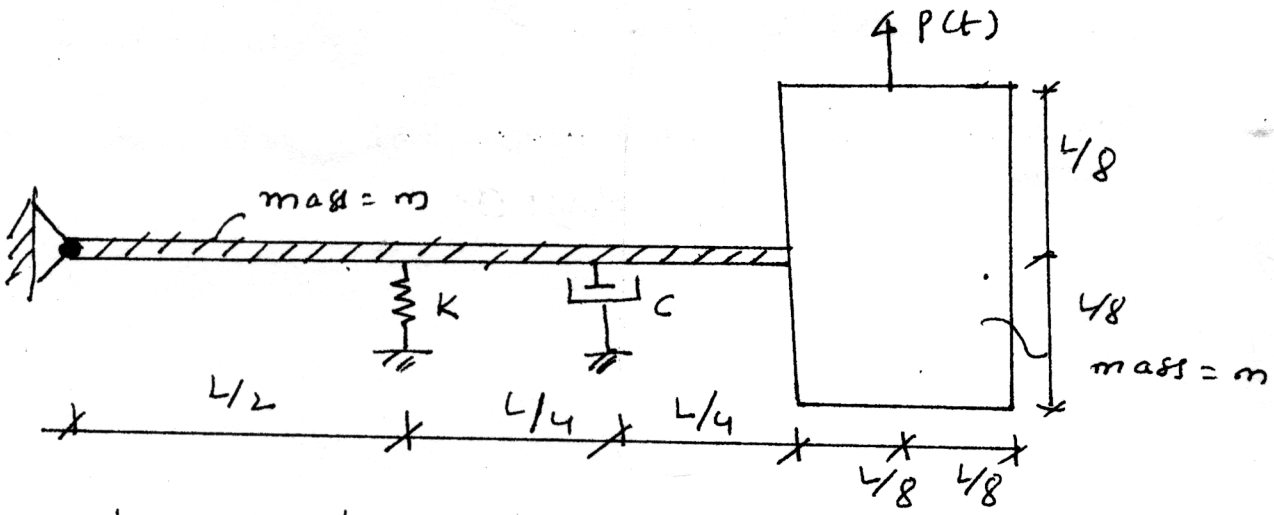
b. An SDOF system has a mass of 50 kg a damping ratio of 0.1, a natural frequency of 10 rad/sec and is subjected a harmonic excitation of amplitude 2500 N and frequency of 15 rad/sec. Determine the steady state amplitude. 8

c. For the pulse type force shown in figure, derive the expression for DLF 7



Q.3 For the rigid body system shown in figure: 20

(a) Formulate the equation of motion
(b) Determine the natural frequency and damping ratio
(c) Determine the displacement response u(x, t) due to $p(t) = P_0$, a suddenly applied constant load
(d) Evaluate the maximum response u(x)



$K = 1000\ KN/m$ $m = 100\ kg$

$C = 0.5\ N\text{-}S/m$ $L = 4\ m$

$P_0 = 50\ KN$

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M.E (C) with Str. Sem I Str. Dynamics. 4/6/13.

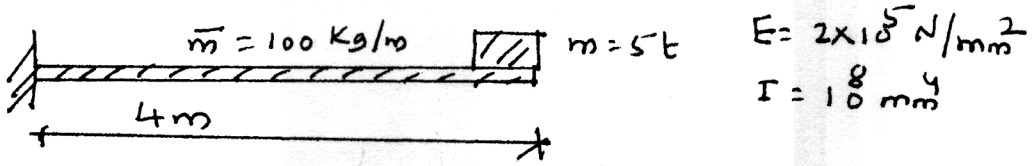
Q.4 A three storey single bay frame has storey height of **4 m.** each. All columns are **250 mm** wide **X 600 mm** deep& beams are very stiff. The mass on each and floor is **30 t.** **E = 20000 Mpa**. Calculate natural frequencies & mode shapes 20

Q.5 **a.** State and prove orthogonality principle. Also state the significance of orthogonality principle in dynamic analysis 5

b. A three storey frame with free vibration characteristics as given below is subjected to a suddenly applied constant load of 100KN at 3rd floor level. Calculate maximum displacements of each storey. 15

Storey No.	Mass No.	Mass (t)	ω rad/sec	Mode shapes		
				Φ_{i1}	Φ_{i2}	Φ_{i3}
1	1	20	15.73	0.399	0.747	1.0
2	2	20	49.85	1.0	0.727	-0.471
3	3	20	77.82	-0.908	1.0	-0.192

Q.6 **a.** For the beam shown in figure calculate the fundamental frequency using Rayliegh's Method. 12



b. Starting from first principle, derive the expression for frequency of vibration of a simply supported beam of span L, flexural rigidity EI and uniform mass m kg/m. 8

Q.7 **a.** Explain clearly how the dynamic analysis for Random dynamic load is done 5

b. Explain the following in connection with random process 5
(i) Random process (ii) Random variable(discrete and continuous)
(iii) Probability distributions (iv) Power spectral density functions (v) Auto correlation functions

c. Derive the expression for steady state response of damped SDOF system subjected Sinusoidal force. 10

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