

ME (CIVIL / STRUCT. Eng), Sem-I, Re-exam

Bharatiya Vidya Bhavan's
SARDAR PATEL COLLEGE OF ENGINEERING
Munshi Nagar, Andheri West, Mumbai 400 058
(An Autonomous Institution Affiliated to University of Mumbai)

Duration : 4 hours

Marks : 100

Subject: Advanced Solid Mechanics

Class/Branch: ME (STRUCT)

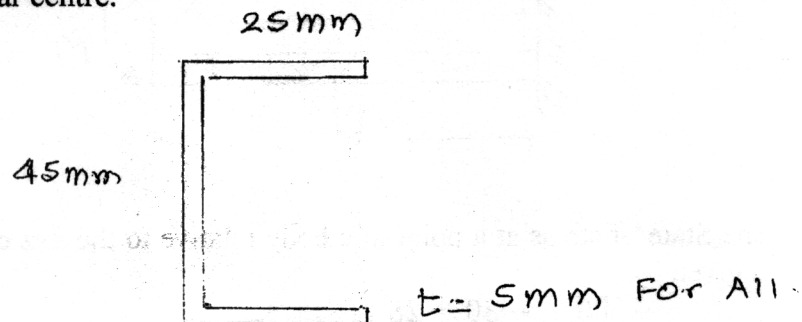
Semester : I

- Attempt any FIVE questions.
- Figures to right indicate full marks.

Master
15/12/14

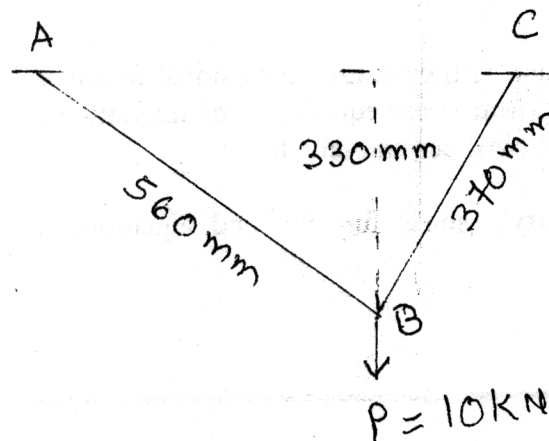
Q.1 Explain concept of shear centre. (04)

For the section shown is undergoing a transverse shear force V_y . Assume t small and determine the shear stress distribution in section. Also determine location of shear centre. (16)



Q.2 (a) Explain the use of complimentary energy theorem. (04)

(b) Calculate forces in cables shown using complimentary energy theorem if effective area of each cable is 105 mm^2 , $P = 10\text{ KN}$, $E = 2 \times 10^5\text{ N/mm}^2$ (16)



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ME (CIVIL / Struct. Eng), Sem-I, Re-exam

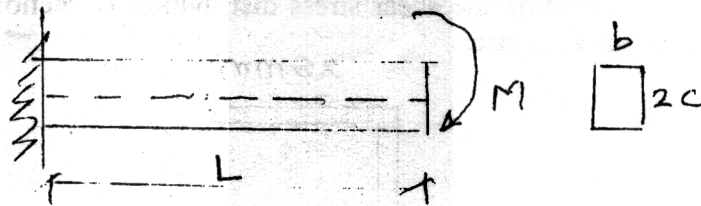
- Q.2 The State of stress at a point in a body relative to the xyz co-ordinate system (20) is given by

$$\begin{bmatrix} 10 & 20 & 0 \\ 20 & 0 & -10\sqrt{2} \\ 0 & -10\sqrt{2} & 0 \end{bmatrix}$$

Determine the principal stresses and the directional co-sines associated with the directions of each Principal stress.. Determine also the maximum shear stress at the point.

- Q.4 (a) Explain the difference between plane stress and plane strain problem and right stress and strain matrix for the same. (08)
- (b) For the elliptical cross section determine maximum shear stress and angle of twist per unit length for following data (12)
- $a = 25 \text{ mm}$, $b = 45 \text{ mm}$ $T = 425 \text{ Nm}$, $E = 200 \text{ GPa}$, and $\nu = 0.3$.

- Q.5 The cantilever beam shown has a moment M applied at the free end. Using $\sigma_x = -Mz * y / I_z$, $\sigma_y = 0$, $\tau_{xy} = 0$, determine the displacement fields $u(x,y)$ and $v(x,y)$ (20)



- Q.6 The State of stress at a point in a body relative to the xyz co-ordinate system (20) is given by

$$\begin{bmatrix} 0 & -30 & 25 \\ -30 & -40 & -15 \\ 25 & -15 & 10 \end{bmatrix}$$

Determine the stress matrix relative to a co-ordinate system defined by first rotating xyz co-ordinate system 45° about X axis, then rotating -45° about new Z axis.

- Q.7 (a) The circular cross section is transmitting a torsional moment T , Determine the stress function, the shear stress equations, the maximum shear stress and its location and angle of twist per unit length. (10)
- (b) Explain the use of Airy's stress function and equations used for Airy's function. (10)

Bharatiya Vidya Bhavan's
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M. T. Chavhan with str. Engrs. sun J

Duration : 4 hours

Marks : 100

Subject: Advanced Solid Mechanics

Class/Branch: ME (STRUCT)

Semester : I

- Question number 1 is compulsory
- Attempt any **FOUR** questions.
- Figures to right indicate full marks

MASTER FILE.

Q. 1 Explain the use of complimentary energy theorem.. (05)

- For plain stress problem , derive relationship between stress and strain (05)

Draw Shear flow due to torsion in circular section, Thin tubular section , (10)
Equilateral triangular section, I section and Thin tubular section with cutout.
Explain which is structurally effective section.

Q. 2 The State of stress at a point in a body relative to the xyz co-ordinate system (20)
is given by

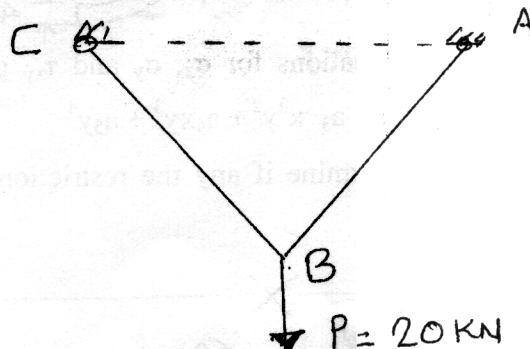
$$\sigma = \begin{bmatrix} -2 & 3 & -5 \\ 3 & 6 & 2 \\ -5 & 2 & -4 \end{bmatrix}$$

Determine the principal stresses and the directional co-sines associated with the directions of major and minor Principal stress.

Determine also the maximum shear stress at the point.

Q.3 (a) Derive Equilibrium equations for state of stress in 3-D with body forces. (06)

- (b) Calculate forces in cables shown using complimentary energy theorem if (14)
effective area of each cable is 105 mm², P = 10 KN, length of AB = 400 mm
and BC = 650 mm E = 2 x 10⁵ N/mm²



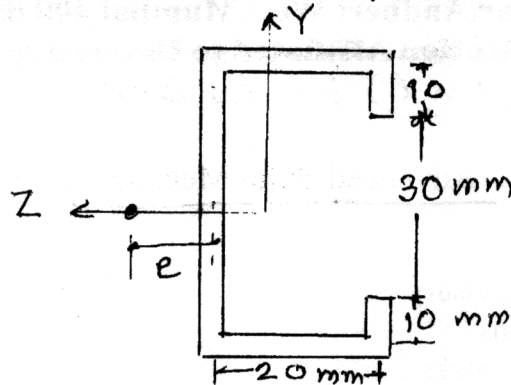
Page (1)

Advanced solid Mechanics.

M.E. (STRUCT)

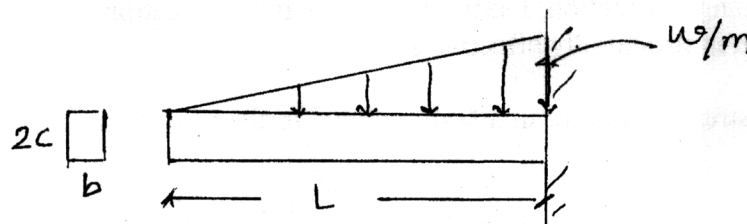
M.E. Ceramics with Str. Engg. Sem I
12/11/14

- Q.4 (a) The beam cross section shown is transmitting a bending moment about the z axis and transverse shear force V_y in the y direction. The thickness of each wall is 4 mm. Locate the shear centre by evaluating e. (12)



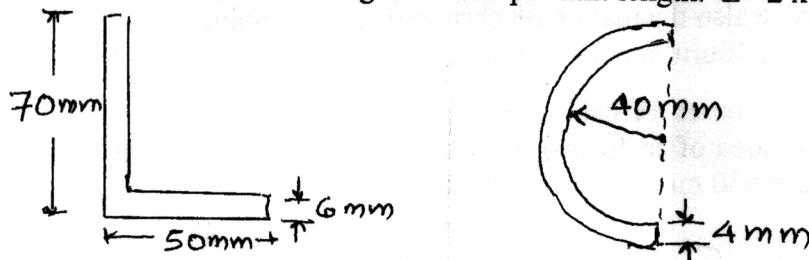
- (b) For the elliptical cross section determine maximum shear stress and angle of twist per unit length for following data (08)
 $a = 20 \text{ mm}$, $b = 35 \text{ mm}$, $T = 400 \text{ Nm}$, $E = 200 \text{ GPa}$, and $\nu = 0.3$.

- Q.5 The cantilever beam shown has a varying load w /length as shown and dimension $b \times 2c$. Using $\sigma_x = -M_z \cdot y / I_z$, prove that $\sigma_x = wx^3y / (6I_zL)$. Determine the displacement fields $u(x,y)$ and $v(x,y)$. (20)



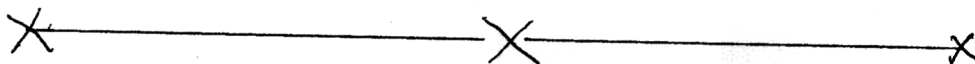
- Q.6 Derive Stress distribution for a plate with small circular hole and subjected to pure tension. Use Airy's stress function approach. (20)

- Q.7 (a) For the sections shown transmitting torque 110 Kn-cm. Estimate maximum shear stress in each section and angle of twist per unit length. $E = 2 \times 10^5$ (08)



- (b) Determine the resulting stress equations for σ_x , σ_y and τ_{xy} given the Airy stress function as $\Phi = a_1x^4 + a_2x^3y + a_3x^2y^2 + a_4xy^3 + a_5y^4$ (12)

Where a_i are constants. Also determine if any the restrictions between the constants.



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ME (Struct. Eng), Sem - I, Re-exam

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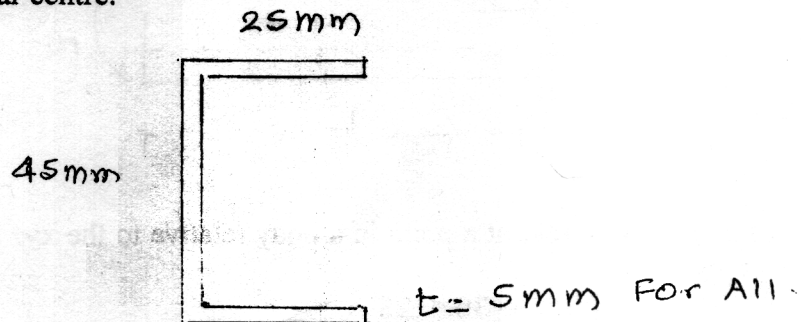
Semester : I

- Attempt any FIVE questions.
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Master

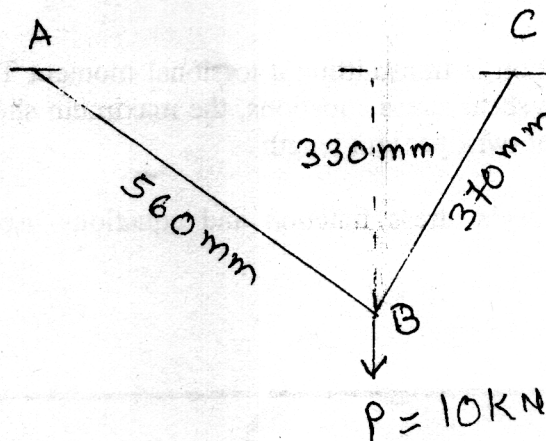
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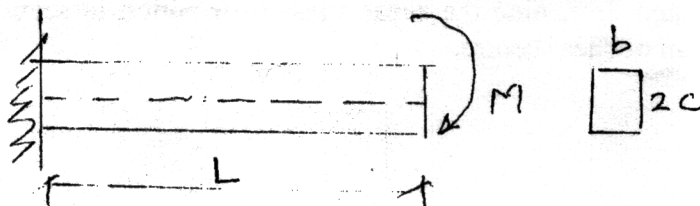
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the stress function, the shear stress equations, the maximum shear stress and
its location and angle of twist per unit length.
(b) Explain the use of Airy's stress function and equations used for Airy's (10)
function.

Bharatiya Vidya Bhavan's
SARDAR PATEL COLLEGE OF ENGINEERING
(An Autonomous Institution Affiliated to University of Mumbai)

ADVANCED STRUCTURAL ANALYSIS (Structural. Eng)

Total Marks : 100

M.E.(Civil)/Sem I:

DECEMBER 2014

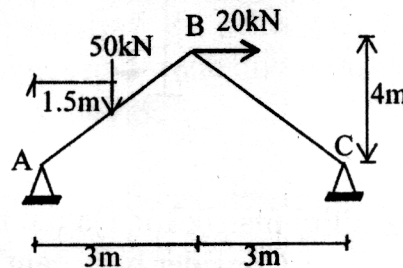
Duration 4hrs.

MASTER FILE

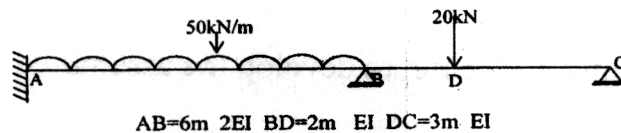
NOTE: 1) Answer any FIVE .

2) Assume any data if required and state it clearly

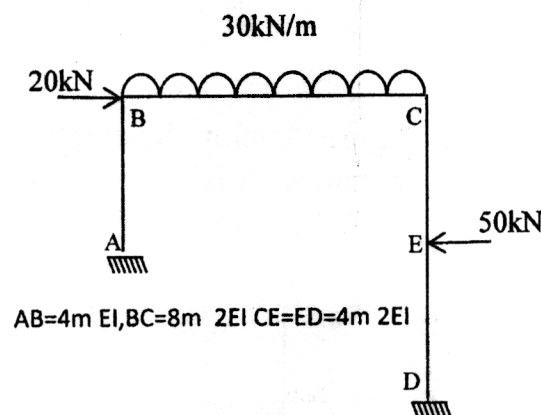
- Q 1 a Analyse the frame shown in the figure using slope deflection equation .EI is constant and support A and C are hinged. 10



- b Analyse the beam shown in the figure using slope deflection equation .Support 'B' settles by 30mm $E=200\text{GPa}$
 $I=2 \times 10^9 \text{mm}^4$. 10



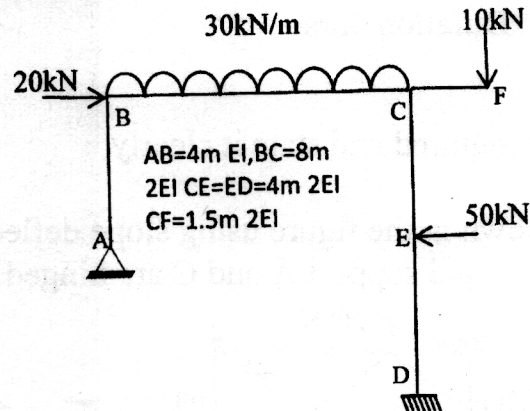
- Q 2 Draw the SFD and BMD for the frame shown in the fig Use flexibility method 20



M.E. (Civil) sem I (Struct. Eng) 18/12/14.

Advanced structural Analysis - C

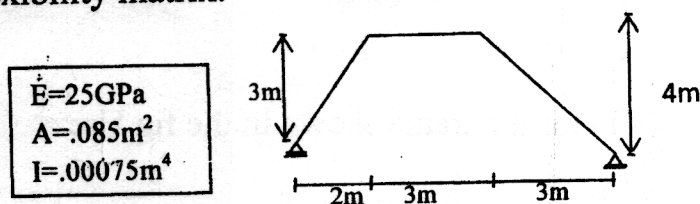
- Q 3 In Q(2) if the support A is hinged analyse the frame using stiffness method to analyse the frame shown in the fig. Draw the SFD and BMD 20



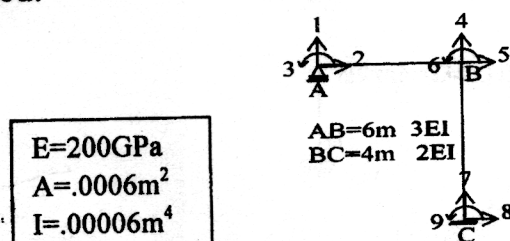
- Q 4 a Develop the member flexibility matrix for 1) axial member 2) beam member 3) grid member. Consider both cantilever and simply supported beam. Draw the figures and show the coordinates 12

- b Develop the element stiffness matrix with figures 08

- Q 5 a For the frame shown in the figure develop the assembled flexibility matrix. 10



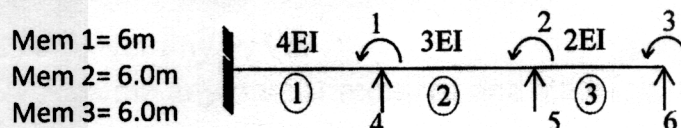
- b For the frame shown in the figure develop the element stiffness matrix and structure matrix. A is roller support and C is fixed. 10



M.E. (Civil) sem I (Structural Eng),
18/12/14.
Advanced Structural Analysis

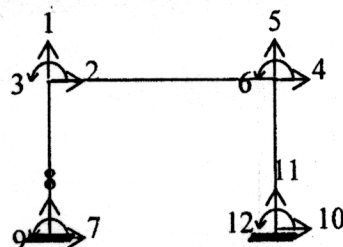
Q 6 a For computer analysis, draw the schematic diagram showing the process of analysis and write down the steps to be followed for flexibility method 10

b For the beam shown in the figure develop the transfer matrix considering for flexibility method. Encircled numbers indicate member no. and global coordinates are shown. Coordinates 1, 2 and 3 are the load for primary structure 10



Q 7 a For computer analysis, draw the schematic diagram showing the process of analysis and write down the steps to be followed for stiffness method 10

b In the frame shown in the figure determine the transformation matrix for stiffness method in the members. The two vertical columns are 6m long and beam is 4m long. The global coordinates are shown in the figure 10



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SARDAR PATEL COLLEGE OF ENGINEERING
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M.E. (Civil), Sem - I, (Struct. Engin)
ADVANCED STRUCTURAL ANALYSIS

Total Marks : 100

M.E.(Civil) Sem I:

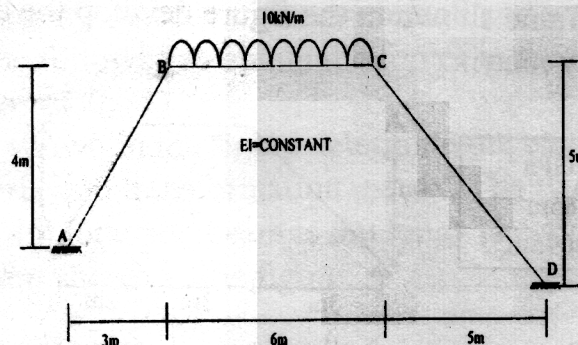
November 2014

M.E. (Civil) with 50% engg. Sem I master
Duration 4hrs.

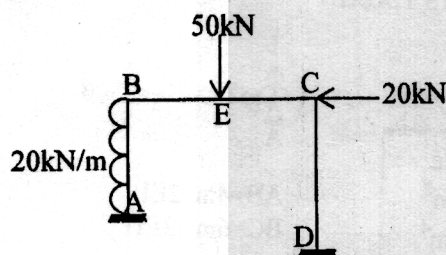
NOTE: 1) Answer any FIVE .

2) Assume any data if required and state it clearly

Q 1 Analyse the frame shown in the figure using slope deflection equation 20

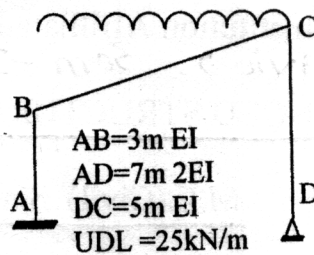


Q 2 Draw the SFD and BMD for the frame shown in the fig Use flexibility method 20



$AB=3m \text{ EI}, BE=EC=2.5m \text{ } 3EI, CD=4m \text{ } 2EI$

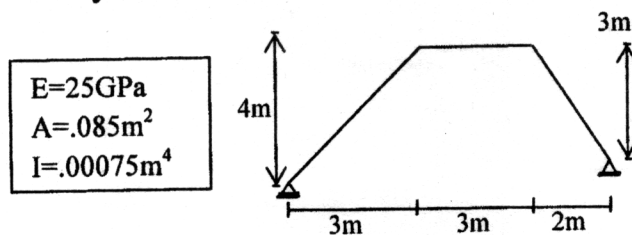
- Q 3 Using stiffness method to analyse the frame shown in the fig. 20
Draw the SFD and BMD



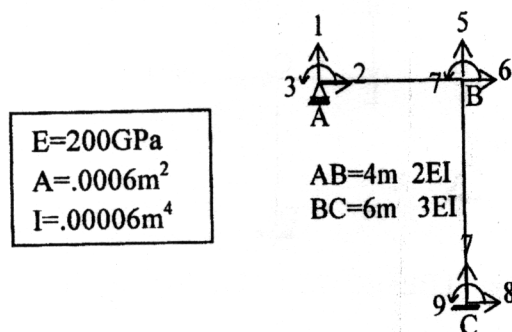
- Q 4 a Develop the member flexibility matrix for 1) axial member 2) 12
beam member 3) grid member. Consider both cantilever and
simply supported beam. Draw the figures and show the
coordinates

- b Develop the element stiffness matrix with figures 08

- Q 5 a For the frame shown in the figure develop the assembled 10
flexibility matrix.

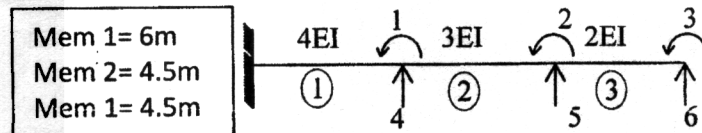


- b For the frame shown in the figure develop the element 10
stiffness matrix and structure stiffness matrix. A is roller
support and C is fixed.

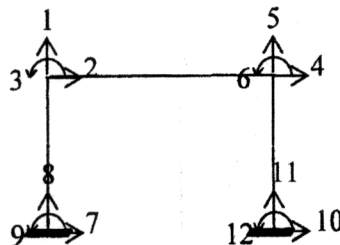


- Q 6 a Draw the schematic diagram showing transforming 10
unassembled flexibility matrix to structure flexibility matrix
and write down the steps to be followed to obtain the forces in
the structure using flexibility method

- b For the beam shown in the figure develop the transfer matrix considering .Encircled numbers indicate member no. and global coordinates are shown. 10



- Q 7 a Draw the schematic diagram showing the transformations inter-relating element forces and displacement vectors in local and global axes system for stiffness method and write down the steps to be followed to obtain the forces in the structure using stiffness method 10
- b In the frame shown in the figure determine the element stiffness matrix and transformation matrix. The two vertical columns are 4m long and beam is 6m long. The global coordinates are shown in the figure 10



Bharatiya Vidya Bhavan's
SARDAR PATEL COLLEGE OF ENGINEERING

(An Autonomous Institution Affiliated to University of Mumbai)

ME (CIVIL. Struct. Engg), Sem - I.

Nov. 2014

Duration: 4 Hours

Total Marks: 100

CLASS/SEM: ME (CIVIL-STRUCTURAL ENGG.) SUBJECT: NON LINEAR ANALYSIS

- Attempt any **FIVE** questions out of **SEVEN** questions.
- Answer to all sub questions should be grouped together.
- Figures to right indicate full marks.
- Assume suitable data if necessary.

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Q.1(a). Explain the following terms in detail (10)

- Load factor
- Shape factor
- Concept of Redistribution of Moments
- Plastic Hinge

Q.1(b). A three span continuous beam ABCD with span AB=6m, BC=6m and CD=4m respectively. Span AB carries udl of 17 KN/m. Span BC carries point of 51KN at a distance of 2m from B and 25.5 KN at distance of 4m from B. Span CD carries point load of 34 KN at center. Point A is hinge support, joints B, C and D are roller supported. Find plastic moment capacity if beam is to have uniform section throughout. (10)

Q.2. For the frame shown in fig.2, find the collapse load factor. Loads shown in figure are working loads (KN) and the bracket values give the plastic moment capacity for each respective section in KN-m. (20)

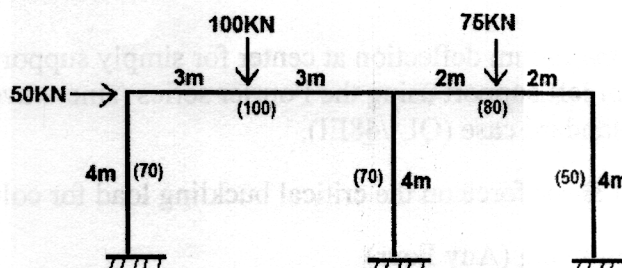


Fig.2

PTO

M.E. (Civil) with Str. Engg Sem I
Non Linear Analysis 21/11/14

Q.3(a) Find the shape factor for the T beam section with following dimensions, what is plastic moment capacity of section for stress = 250 N/mm^2 . What is the working udl supported by the simply supported beam if span is 3.5m. (FOS = 1.5);

Flange = 100mm wide x 10.8mm, Web = 89.2mm (Clear depth) x 5.7mm (10)

Q.3(b) Find the shape factor for the I section beam with following dimensions. What point load can be applied on beam at center span if stress = 250 N/mm^2 , FOS = 1.75 for simply supported beam of span 4m; Top & Bottom Flange = 125 mm wide x 12.5 mm,

Web = 225 mm (Clear depth) x 6.9 mm (10)

Q.4(a) Explain the following in detail (12)

a. Theorems for Plastic Analysis

b. Types of failure mechanisms considered in plastic analysis.

Q.4(b) A steel beam of rectangular cross section bxd, ($b = 2d$) has plastic moment capacity of M_p .

It is now required to increase its moment capacity by 35% by adding a cover plate at the bottom only. If the width of the cover plate is $2.2b$. Find the thickness 't' of the cover plate required. (08)

Q.5(a) A simply supported column of length $4L$ is under the action of a axial compressive load P . Find the critical load by finite difference method if the flexural stiffness of the member varies according to (Use four sub-intervals); (12)

$EI_0 = EI_0 \quad 0 \leq x \leq 0.25L$

$= 3EI_0 \quad 0.25 \leq x \leq 0.75L$

$= EI_0 \quad 0.75 \leq x \leq 1.0L$

Q.5(b) Explain the following; (08)

a. Different approaches for buckling analysis of column.

b. Types of non-linearity considered in structures for analysis.

Q.6(a) Obtain the value of maximum deflection at center for simply supported beam with point Q at distance of c from left support using the Fourier series (sine-wave). Compare the obtained value with standard case ($QL^3/48EI$). (10)

Q.6(b) What is the effect of shear force on the critical buckling load for column. (10)

Q.7 Explain in detail the following (Any Four) (20)

a. Warping torsion.

b. Lateral buckling of beams.

c. Euler's critical buckling load.

d. Beam-Column concept for buckling.

e. Assumption for plastic analysis of beams.

Bharatiya Vidya Bhavan's
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Subject : Elective CE-615 (Numerical Methods)

CLASS: ME (Structural) SEM I

Date: 19/12/2014

Total Marks : 100

Duration : 4 Hour

- Attempt any five questions.
- Figures to the right indicate full marks.
- Make suitable assumptions if required and justify the same.

MASTER FILE.

- Q.1 (a) Define Truncation and Round-off error and give an example for each. (6)
- (b) Suppose that you have a task of measuring the lengths of a bridge and a rivet and come up with 9999 and 9 c.m. respectively. If the true values are 10000 and 10 c.m. respectively ; compute (I) the error (II) the percentage relative error in each case. (6)

- (c) Round off the following numbers to four significant figures: (8)
- (a) 38.46235 (b) 0.70029 (c) 0.0022218 (d) 81.24513
- (e) 2.3754600 (f) 24.005431 (g) 0.456001 (h) 1.00001

- Q.2 (a) Fit a Straight Line to the following data by the method of Least Squares. (10)

x	1	2	3	4	5	6	7	8	9
y	1	1.5	2	3	4	5	8	10	13

Along with the slope and the intercept, compute the Standard Error of the estimate and the Correlation Coefficient.

- (b) Using Newton's Divided Difference formula, find the value of $f(0.3)$ from the following data (10)

x	0	1	3	4	7
f(x)	1	3	49	129	813

- 3 (a) Integrate the following function using composite Trapezoidal Rule and Simpson's $1/3^{\text{rd}}$ rule using 8 equal subdivisions. (10)

$$I = \int_{-1}^1 \frac{1}{1+x^2} dx$$

- (b) Use Secant Method to obtain root of equation $f(x) = \cos x - xe^x = 0$. Use initial guess $x_1 = 0$ and $x_2 = 1$ to obtain an accuracy of 0.001 (10)

page no. 1.

Elective - CE - 615 (Numerical Methods)

- Q.4 (a) Solve the following set of equations using Gauss Elimination method (10)
- $$\begin{aligned} 5x_1 - 2x_2 + x_3 - 3x_4 &= -8 \\ x_1 - 10x_2 - 2x_3 - x_4 &= -29 \\ 3x_1 - 3x_2 + 10x_3 + x_4 &= 31 \\ 2x_1 + x_2 - 3x_3 + 5x_4 &= 15 \end{aligned}$$
- (b) Using Bisection method determine the roots of $f(x) = x^3 - 1.8x^2 - 10x + 17$ that lies in the interval (1,2) at the end of fifth iteration. (10)
- Q.5 (a) Apply the Newton-Raphson method to find the root of $f(x) = x^4 - x - 10 = 0$ which is near to $x=2$ correct to three places of decimals. (10)
- (b) Use forward, backward and centered difference approximations to estimate the first derivative of $f(x) = -0.1x^4 - 0.15x^3 - 0.5x^2 - 0.25x + 1.2$ at $x = 0.5$ with $h = 0.5$ and 0.25 (10)
- Q.6 (a) Solve $\frac{dy}{dx} = 1 + y^2$ where $y=0$ when $x=0$, find $y(0.2)$, $y(0.4)$, $y(0.6)$ using a step size of 0.2 Runge-Kutta method of Fourth Order. (10)
- (b) Solve the following equation by Gauss Jordan Method. (10)
- $$\begin{aligned} 3x_1 - 0.1x_2 - 0.2x_3 &= 7.85 \\ 0.1x_1 + 7x_2 - 0.3x_3 &= -19.3 \\ 0.3x_1 - 0.2x_2 + 10x_3 &= 71.4 \end{aligned}$$
- Q.7 (a) Write a MATLAB program for Trapezoidal Rule. (10)
- (b) Implement a MATLAB program for Linear Regression. (10)

26/11/14

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SARDAR PATEL COLLEGE OF ENGINEERING
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Master

Subject : Elective CE-615 (Numerical Methods)

CLASS: ME (Structural) SEM I

Total Marks : 100

Date: _____

ME (Struct) (Civil) - Sem-I

Duration : 4 Hour

- Attempt any five out of seven questions.
- Figures to the right indicate full marks.
- Make suitable assumptions if required and justify the same.

Q.1 (a) Evaluate the polynomial $y = x^3 - 7x^2 + 8x - 0.35$ at $x = 1.37$. Use 3- digit arithmetic with chopping. Evaluate the percent relative error. (6)

(b) Define Error? Explain Accuracy and Precision. (6)

(c) Find the third degree Taylor polynomial of $f(x) = \sqrt{x}$ with center $x_0=3$ (08)

Q. 2 (a) Fit a Straight line to the following data (10)

X_i	10	20	30	40	50	60	70	80
Y_i	25	70	380	550	610	1220	830	1450

Compute the total Standard Deviation, Standard Error of the estimate and the Correlation Coefficient for given data.

(b) Construct a divided differences table and write out the Newton form of the interpolating polynomial for the following table of values: (10)

x_i	1	3/2	0	3
$f(x_i)$	3	13/4	3	5/3

Q 3 (a) Use Bisection Method and False Position to locate the root of $f(x) = x^{10} - 1$ between $x = 0$ and 1.3. Also calculate approximate percent relative error and true percent relative error. (08)

(b) Compute forward, backward and central difference approximation of $O(h)$ for the first derivative of $\cos x$ at $x = \frac{\pi}{3}$ using values of $h = 0.1, h = 0.01, h = 0.001, h = 0.0001$. (12)

Q.4 Use Runge-Kutta method of fourth order to obtain the numerical solution of $\frac{dy}{dx} = x^2 + y^2$, $y(1) = 1.5$, in the interval $[1, 1.3]$ with $h=0.1$ (20)

Q.5 (a) Solve the following linear simultaneous equations using Cramer's rule.

(06)

$$3.0x - 0.1y - 0.2z = 7.85, 0.1x + 7.0y - 0.3z = -19.30, 0.3x - 0.2y + 10.0z = 71.40$$

(b) Solve the following system using Gauss Elimination method

(08)

$$2x_1 + 3x_2 + 4x_3 = 11, \quad 9x_1 + 2x_2 - 8x_3 = 1.9, \quad 15x_1 - 8x_2 + 6x_3 = 14.7$$

(c) Use Cholesky Factorization to determine $[U]$ so that

(06)

$$[A] = [U]^T [U] = \begin{bmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 2 \end{bmatrix}$$

Q.6 (a) Solve $\int_1^4 (e^x + x^3 - 2x + 1)dx$ by using (a) Trapezoidal Rule, (b) Simpson's $1/3^{\text{rd}}$ Rule, (c) Simpson's $3/8^{\text{th}}$ Rule. Assume 12 divisions.

(10)

(b) Use Secant Method to obtain root of equation $f(x) = \cos x - xe^x = 0$. Use initial guess $x_1 = 0$ and $x_2 = 1$ to obtain an accuracy of 0.001

Q.7 (a) Write a MATLAB program for Naïve Gauss Elimination.

(10)

(b) Implement a MATLAB program for Linear Regression.

(10)

Ub
16/12/14

Bharatiya Vidya Bhavan's
SARDAR PATEL COLLEGE OF ENGINEERING

(An Autonomous Institution Affiliated to University of Mumbai)

ME (CIVIL / STRUCT. Eng), Sem - I, Re-exam

DECEMBER 2014

Total Marks : 100

Duration : 4 Hours

CLASS/SEM : ME Civil with
Structural Engineering Subjects

SUBJECT : STRUCTURAL DYNAMICS

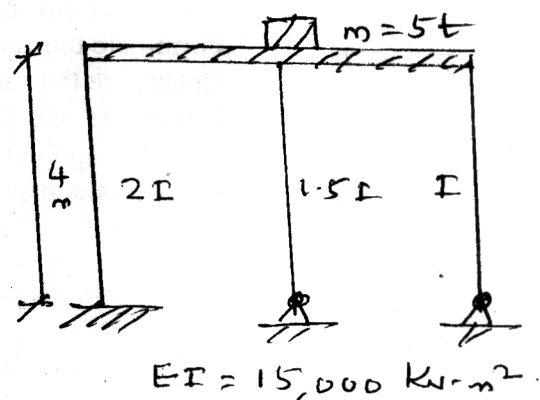
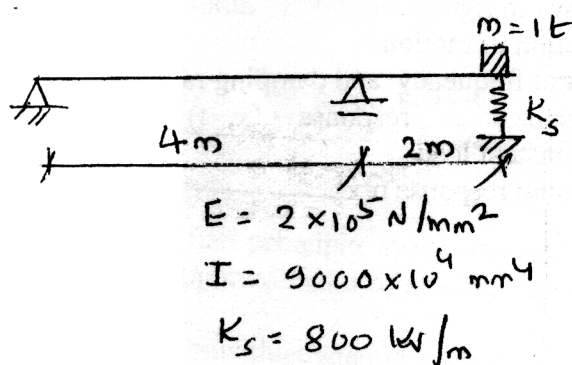
SEM I

- 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.

Master

Q.1 a. Answer the following:

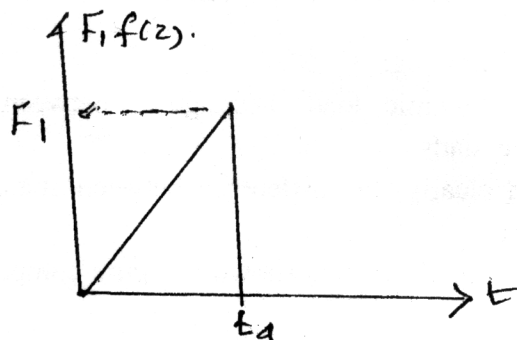
- (i) Define Dynamic load. Distinguish between Prescribed and Random dynamic loads 3
 - (ii) Explain clearly, the difference between static and dynamic analysis of structure 3
- b. For the structural systems shown in figure compute the natural frequency of vibration 8



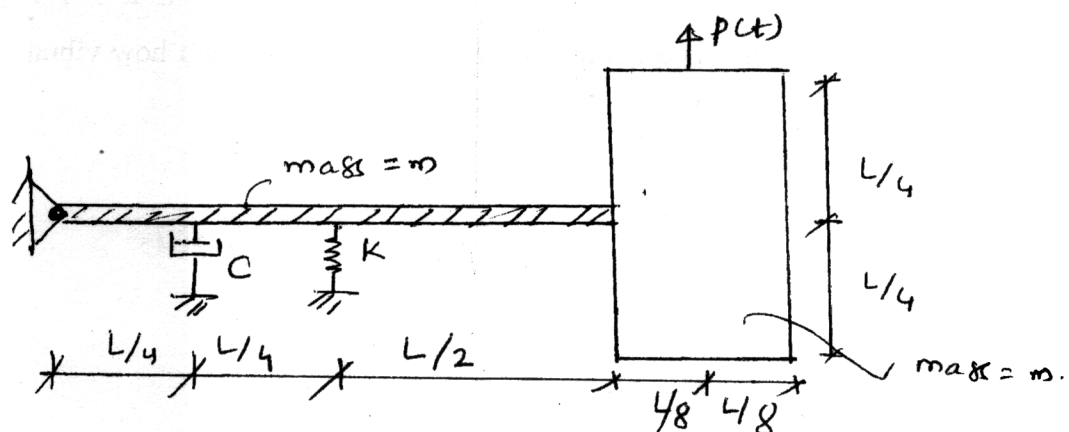
- c. What is transmissibility of a system? Briefly explain how vibration isolation can be achieved 6

16/12/14

- 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 **300 kg**. In this, the mass is displaced by **8 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) Undamped natural frequency (v) Stiffness coefficient
- b. An SDOF system has a mass of 100 kg a damping ratio of 0.1, a natural frequency of 8 rad/sec and is subjected a harmonic excitation of amplitude 2500 N and frequency of 12 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 $u(x)$



$$P_0 = 50 \text{ kN}$$

$$K = 1000 \text{ kN/m}$$

$$L = 2 \text{ m}$$

$$m = 200 \text{ kg} \quad C = 0.3 \text{ N-s/m}$$

Page - (2)

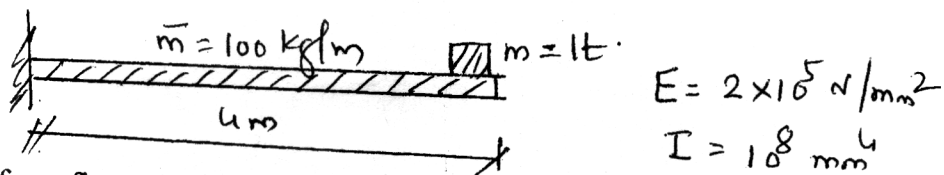
Q.4 A three storey single bay frame has storey height of 4 m. each. All columns are 300 mm wide X 600 mm deep & beams are very stiff. The mass on each and floor is 25 t. $E = 20000 \text{ Mpa}$. Calculate natural frequencies & mode shapes 20

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 200KN 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 $m \text{ kg/m}$. 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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19/11/14

Bharatiya Vidya Bhavan's
SARDAR PATEL COLLEGE OF ENGINEERING

(An Autonomous Institution Affiliated to University of Mumbai)

M. Engineering with 1st Engg. Sem I
First Half 2014

Total Marks : 100

CLASS/SEM : ME Civil with
Structural Engineering Subjects

SEM ~~IV~~ I

SUBJECT : STRUCTURAL DYNAMICS

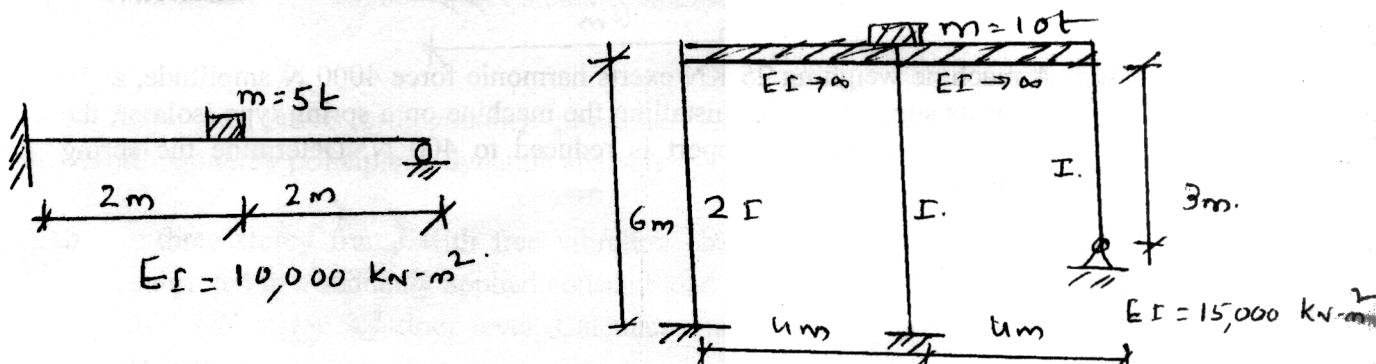
- Attempt any FIVE questions out of SEVEN questions.
- Answers to all sub questions should be grouped together.
- Figures to the right indicate full marks.
- Assume suitable data if necessary and state the same clearly.

Master

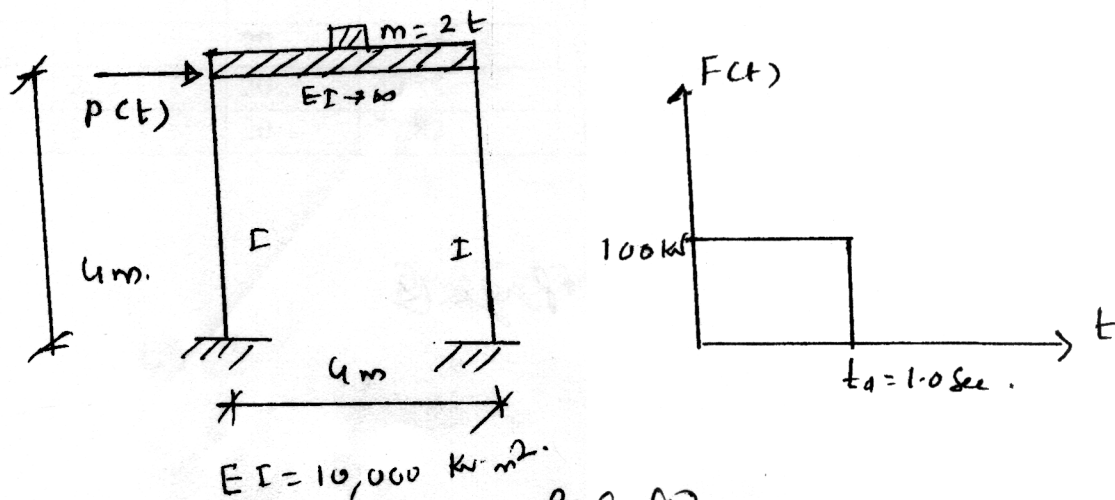
Q.1 a. Answer the following:

- Define Dynamic load. Distinguish between Prescribed and Random dynamic loads. State different types of prescribed loads. 3
- State the different methods for writing equation of motion 2

b. For the structural systems shown in figure compute the natural frequency of vibration 7



c. The frame shown in figure is subjected to a horizontal load as shown in the figure. Calculate the horizontal displacement at girder level at $t=0.5$ sec, $t=1.0$ sec. and $t=2.0$ sec. 8



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M.E (Civil) with str. Engg. Sem I 1974/75

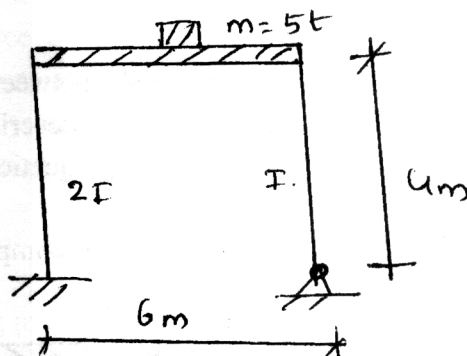
Q.2 A platform weighing 1000 N is supported on four columns. The columns are identical and clamped at both ends. It has been determined experimentally that a force of 200 KN horizontally applied to platform produces a displacement of 2.50 mm. Damping is 5%. Determine the following :

7

- (i) Damped frequency (ii) Damping coefficient (iii) Logarithmic decrement
(iv) Number of cycles and time required for the amplitude of motion to be reduced from initial of 2.50 mm to 0.25 mm.

- b. A rigid steel frame shown in figure is subject to harmonic ground motion with amplitude of ground acceleration $0.2g$ and frequency 1.2 times the frequency of structure. Assuming the ratio as 2%, determine the maximum displacement at girder level.

7



$$EI = 10,000 \text{ K}\cdot\text{m}^2$$

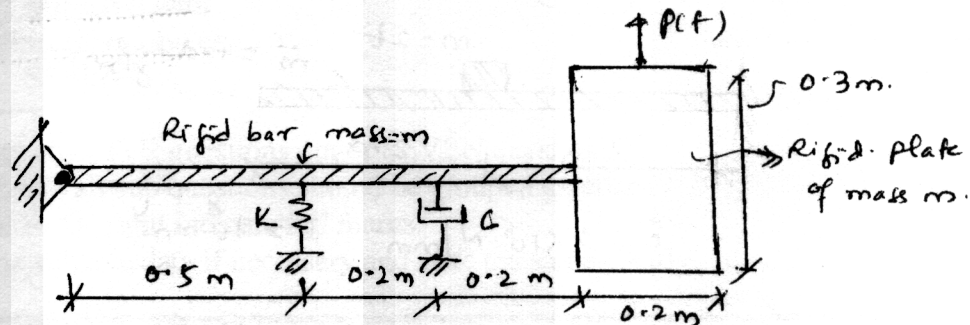
- c. A machine weighing 25 KN exerts harmonic force 4000 N amplitude, at 10 Hz at its supports. After installing the machine on a spring type isolator, the force exerted on the support is reduced to 400 N. Determine the spring stiffness k .

6

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

20

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



$$m = 100 \text{ kg}, \quad K = 1000 \text{ kN/m}, \quad C = 0.5 \text{ N-sec/m}.$$

$$P_0 = 50 \text{ kN}.$$

Q.4 A three storey single bay frame has storey height of 3 m. each. The 20

columns ground and first storey are of size 250 mm wide X 600 mm deep while the columns at second storey are 250 mm wide X 500 mm deep & beams are very stiff. The mass on the first and second floor is 30 t & on third floor is 25 t. $E = 20000 \text{ Mpa}$. Calculate natural frequencies & mode shapes

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

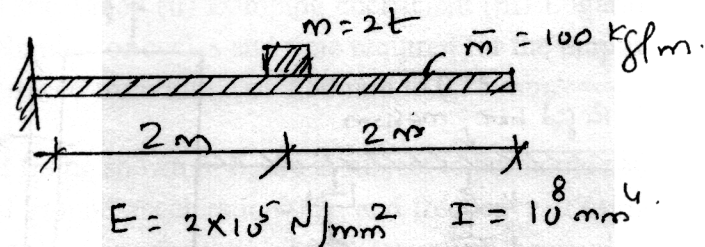
b. A three storey frame with free vibration characteristics as given below is subjected to a suddenly applied constant load of 50 kN at 2nd floor level and 100 kN at the 3rd floor level. Calculate maximum displacements of each storey. 15

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
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3	3	20	77.82	-0.908	1.0	-0.192

M.E.C.E. with str. Engrg. Sem I 19/11/14

- Q.6 a. For the beam shown in figure calculate the fundamental frequency using Rayleigh's Method

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- b. A simply supported beam of 6m span, 300 mm wide 600 mm deep carries a suddenly applied force of 100 kN at 2m from left support. Calculate the maximum displacement and bending moment responses under the load and shear force at left support. $E = 2 \times 10^4 \text{ Mpa}$. and density of material = 2500 kg/m^3 . Take contribution from the four lowest contributing modes

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

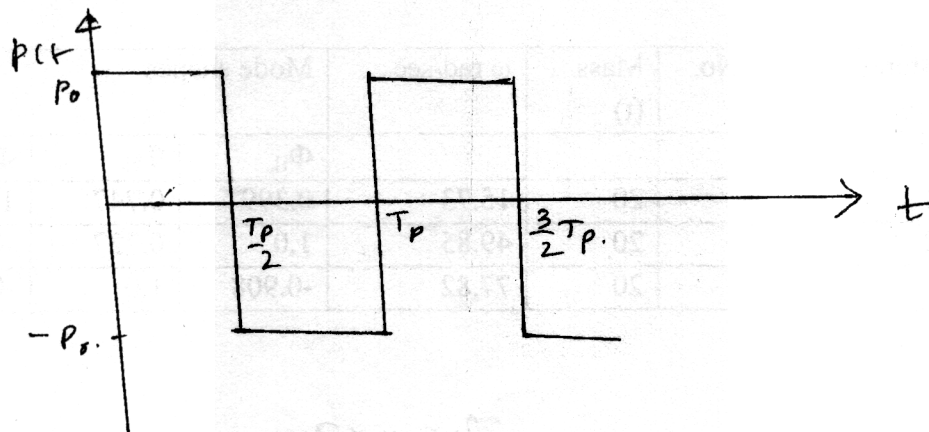
5

(i) Random process (ii) Random variable (discrete and continuous)

(iii) Probability distributions (iv) Power spectral density functions (v) Auto correlation functions

- c. A SDOF system having natural frequency ω is subjected a square wave excitation as shown in figure. Determine the steady state response of the undamped system. Take $\omega = 4\varpi$, where ϖ is excitation frequency

10



Pulse (4)