Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.TECH/CE/SEM-8/CE-801/3/2013

2013

ADVANCED STRUCTURAL ANALYSIS

Time Allotted : 3 Hours *Full Marks* : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following :

$10 \times 1 = 10$

i) Which of the following properties is not valid for stiffness matrix ?

a) Square

b) Non-zero diagonal term

c) Positive definite

d) Skew-symmetric.

ii) Three-moment theorem is

a) energy method b) displacement method

c) iterative method d) force method.

iii) Transformation matrix used for structural analysis is

a) congruent matrix b) orthogonal matrix

c) idempotent matrix d) involuntary matrix.

iv) A power plant is to be built at Asansol. You are appointed as the design engineer. What value will you choose as risk-coefficient during wind load calculation ?

a) 0·9 b) 1·0

c) 1·07 d) 1·08.

v) The unstable oscillatory motion of a structure due to coupling between aerodynamic force and elastic deformation of the structure is known as

a) Galloping b) Ovalling

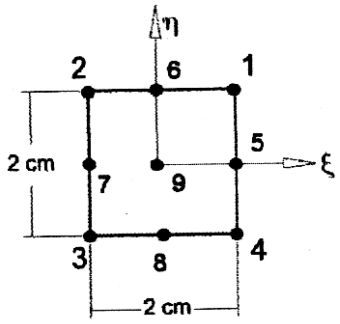
c) Vortex shedding d) Flutter.

vi) Which of the following relations is valid for thin plate ? (where t is thickness, b is width)

a) $\frac{b}{t} \geq 10$ b) $\frac{b}{t} < 10$

c) $\frac{b}{t} < 5$ d) $\frac{b}{t} < 2$.

vii) For a nine noded rectangular element shown in figure below, the shape function of node 5 will be



a) $N_5 = \frac{1}{2}(1-\eta^2)\xi(1+\xi)$ b) $N_5 = \frac{1}{2}(1-\xi^2)\eta(1+\eta)$

c) $N_5 = \frac{1}{2}(1-\eta^2)\xi(\xi-1)$ d) $N_5 = \frac{1}{2}(1-\xi^2)\eta(\eta-1)$.

viii) Plate theory which considers the effect of shear deformation is named after scientists

a) Euler & Bernoulli b) Timoshenko

c) Mindlin d) Kirchhoff.

ix) If the geometry of the element is defined by the shape functions of order higher than that for representing the variation of displacement then the element is called

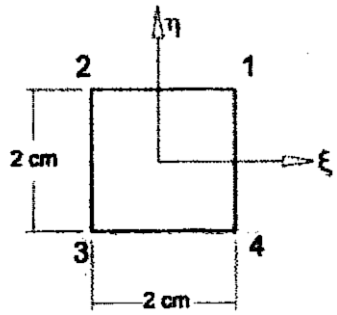
a) isogeometric element

b) isoparametric element

c) super-parametric element

d) sub-parametric element.

x) The node 1 of a four-noded isoparametric quadrilateral element shown in figure below, is collapsed with node 2. The quadrilateral element changes to a



a) Serendipity element

b) Constant strain triangle

c) 6 noded triangular element

d) Discrete Kirchhoff triangle.

xi) As per IS 1893:2000 (Part-1), the value of response reduction factor (R) for an ordinary R.C. building will be

a) 1·5 b) 2·5

c) 3 d) 5.

xii) As per IS 875 :1987, the value of fundamental time period of a 10 storied moment resistant frame without bracing (floor height @ 3·5 m) is

a) 0·35 s b) 1 s

c) 3·5 s d) 2 s.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. Prove that for a linear elastic structure the flexibility matrix is symmetric.

3. A latticed framework steel bridge of 60 m span and 6 m width is to be built at Shimla. *PQR* consultancy has cracked the contract of this project. In *PQR* consultancy, team *A* and team *B* has been assigned to analyse and optimize the structure.

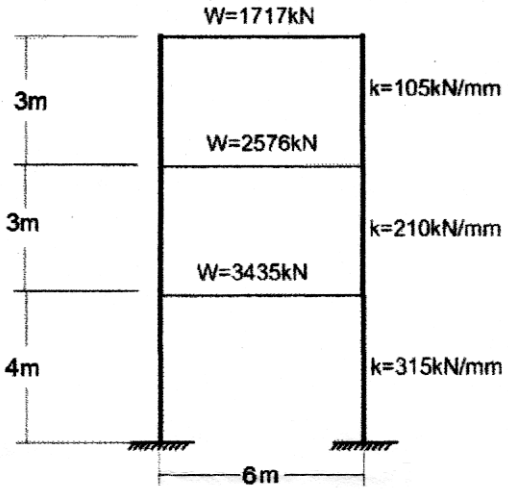
   - Team *A* has chosen rolled I-section whereas team *B* opted for wide-flanged I-section.
   - Both the team calculated the design wind pressure as 1006 N/m^2.

   Which team will be able to minimize the wind force ? Explain with proper calculations.

4. Prove that slope-deflection method is a displacement method.

5. Write a short note on Mesh refinecement in Finite Element Method.

6. Consider the three-storey steel building (for official purpose) shown in the figure below, located at Kolkata. Soil conditions are medium stiff and the entire building is supported on a raft foundation. The steel frames are infilled with unreinforced brick masonry. Determine the seismic load on the structure as per IS 1893. The seismic weights as shown in the figure have been calculated considering 50% of the live load lumped at the floors and no live load at roof.

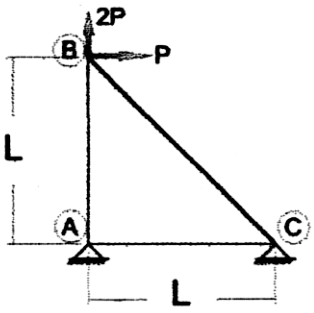


GROUP – C

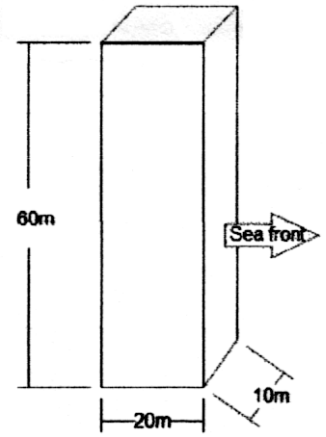
(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. Calculate the displacements of node *B* and the member forces in the following truss for the loading system shown in the given figure. Area of member *AB* and *AC* is *A* ; area of member *BC* is 2*A*. Young's modulus of all the members can be taken as *E*.



8. Calculate design wind forces (only the along wind) using the gust factor approach on a steel multistorey building 60 m tall and of size 20 m × 10 m as shown in figure below, to be constructed in Mumbai, about 500 m from the sea shore. Assume the average storey height to be 3 m. The frame are to be spaced at 5 m c/c in both directions. The building has its smaller dimension facing the sea.



9. a) Write down the assumptions of bending theory of thin plates. 3
   b) Derive the general expression for thin plate bending. Derive the plate bending equation for an isotropic material (thin plate). 7 + 5
10. a) What is membrane theory of shell ? 2
    b) Write down the generalized equations for a shell, where *X, Y* and *Z* are intensities of loading in *x, y* and *z* directions respectively (No derivation). 6
    c) Derive the equations of membrane theory of cylindrical shell. 7
11. Derive the stiffness matrix of a 3 noded two dimension truss element from first principle using Finite Element formulation.

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