Name : ....

Roll No. : ....

Invigilator's Signature : ....

2012

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)   The buildings/structures are classified into which of the following categories according to IS 875 (Part-3), 1987 ?

   a)   *A, B*   b)   *A, B, C*

   c)   *A, B, C, D*   d)   none of these.

   ii)   Terrains are categorised as per IS-875 (Part-3), 1987 into

   a)   category 1, 2, 3   b)   category 1, 2

   c)   category 1, 2, 3, 4   d)   none of these.

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iii) If L.L. ≤ 3·0 kN/m², the L.L. considered for seismic mass calculation is

    a) 25% of L.L.   b) 50% of L.L.

    c) 20% of L.L.   d) 5% of L.L.

iv) The design horizontal seismic coefficient $A_h \not< \dfrac{Z}{2}$ if T is

    a) ≤ 0·2 sec   b) ≥ 0·3 sec

    c) ≤ 0·1 sec   d) none of these.

v) For general buildings, the importance factor I is equal to

    a) 1·5   b) 1·0

    c) 1·2   d) none of these.

vi) The fourth order differential equation of isotropic plate subjected to external load intensity q is

    a) $\dfrac{\partial^4 \omega}{\partial x^4} + 2\dfrac{\partial^4 \omega}{\partial x^2 \partial y^2} + \dfrac{\partial^4 \omega}{\partial y^4} = \dfrac{q}{D}$

    b) $\dfrac{\partial^4 \omega}{\partial x^4} + 2\dfrac{\partial^4 \omega}{\partial x^2 \partial y^2} = q$

    c) $\dfrac{\partial^4 \omega}{\partial x^4} + \dfrac{\partial^4 \omega}{\partial y^4} = q$

    d) none of these.

vii) A cylindrical shell may be thought of as a surface generated by a straight line moving over a plane curve. The plane curve is known as

a) directrix
b) traverse

c) chord width
d) none of these.

viii) Isoparametric element is that where the order of the shape function of deformation and geometry is

a) equal
b) unequal

c) symmetric
d) asymmetric.

ix) As per IS 1983, 2002 there are .... nos. of seismic zones in India.

a) 5
b) 3

c) 4
d) 2.

x) A material is said to be more seismic efficient if it is

a) ductile
b) brittle

c) malleable
d) isotropic.

3

[Turn over

xi) The problem where boundary conditions are known is termed as

    a) boundary value problem

    b) initial value problem

    c) equilibrium problem

    d) eigenvalue problem.

xii) In force method we want to achieve .... condition in boundaries.

    a) equilibrium   b) compatibility

    c) consistency   d) deformation.

GROUP – B

(Short Answer Type Questions)

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

2. Write down the basic equilibrium equations of a thin cylindrical shell when it is subjected to an external load.

3. A rectangular plate is subjected to pure bending where $M_x = M_y = M$. Find out the nature of the deflected surface of the plate and the radius of curvature also.

4. Discuss how design base shear for calculation of seismic load is determined following the provisions of IS 1893, 2002.
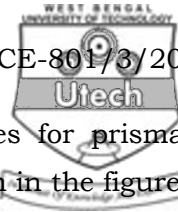
5. Develop the flexibility and stiffness matrices for prismatic beam with reference to the coordinates shown in the figure.
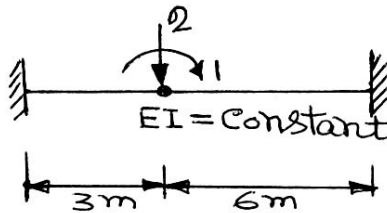
Verify that the flexibility and stiffness matrices are the inverse of each other.

6. Show that if a dummy force applied at any point of truss and force generated at any i^{th} member due to external load is P_i and due to application of unit load is K_i, the deflection in the direction and location of the dummy force is $\sum P_i K_i L_i / AE$.

GROUP – C

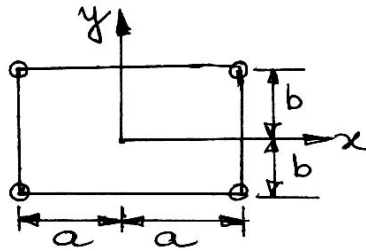### (Long Answer Type Questions)

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

7. a) The figure given below shows a triangular 2D element. Find the shape function using natural coordinate system (Lagrangian shape function)
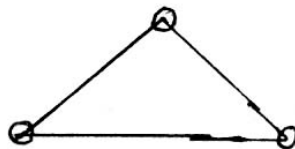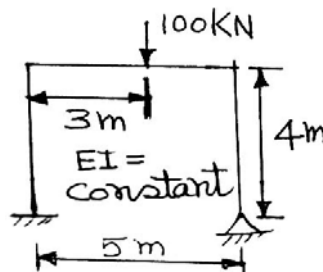
b) The figure given below shows a four noded rectangular 2D element. Find the shape function using Lagrangian polynomial.


8. Analyse the portal frame shown in the figure by flexibility matrix method.

9. What are the basic steps to be followed in a finite element formulation ? Formulate the stiffness matrix and hence the equation considering the virtual work using finite element technique for a truss element. 5 + 10

10. Derive the fourth order differential equation of isotropic plate simply supported at four sides subjected to pure bending.
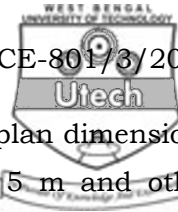
11. A multistoried building having 20 m × 30 m plan dimensions & an overall height of 30 m (ground floor 5 m and other floors are 4 m in height & parapet is 1 m) is to be constructed at New Town, Kolkata. Each floor consists of 4 × 6 panels and each panel is of 5 m × 5 m dimension.

   a) Determine the design wind pressure active on the building and draw the pressure diagram.

   b) Also determine the wind load acting on an internal frame at node points taken through the middle of the building along its width.

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