



Name : .....

Roll No. : .....

Invigilator's Signature : .....

**CS/B.Tech (CE)/SEM-4/CE-404/2010**

**2010**

**STRUCTURAL ANALYSIS – I**

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) A pin jointed plane frame is unstable if

- a)  $(m + r) < 2j$                       b)  $(m + r) = 2j$   
c)  $(m + r) > 2j$                       d) none of these,

where  $m$  is the number of members,  $r$  is the reaction components and  $j$  is number of joints

ii) A rigid jointed plane frame is stable and statically determinate if

- a)  $(m + r) = 2j$                       b)  $(m + r) = 3j$   
c)  $(3m + r) = 3j$                       d)  $(m + 3r) = 3j$ .



iii) Bending moment at any section in a conjugate beam corresponds to which of the following in the actual beam ?

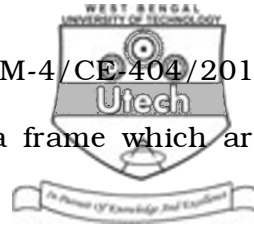
- a) Slope
- b) Curvature
- c) Deflection
- d) Bending moment.

iv) A single rolling load of 8 kN rolls along a girder of 15 m span. The absolute maximum bending moment will be

- a) 8 kN.m
- b) 15 kN.m
- c) 30 kN.m
- d) 60 kN.m

v) When a uniformly distributed load, shorter than the span of the girder, moves from left to right then the condition for maximum bending moment at a section is that

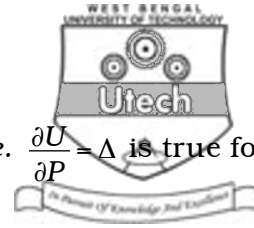
- a) the head of the load reaches the section
- b) the tail of the load reaches the section
- c) the load position should be such that the section divides it equally on both sides
- d) the load position should be such that the section divides the load in the same ratio as it divides the span.



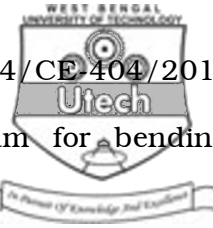
- vi) Ties are load carrying members of a frame which are subjected to
- a) axial tensile force      b) axial compressive force
  - c) shear force              d) bending moment.
- vii) Conjugate beam of a statically determinate beam is
- a) statically determinate
  - b) statically indeterminate
  - c) not related to each other
  - d) none of these.
- viii) Find the force in member  $BC$  of the truss shown in the Fig. 1 below :

**Fig. 1**

- a) 5 kN                              b) 3.53 kN
- c) 10 kN                          d) zero.



- ix) Castigliano's theorem for deflection *i.e.*  $\frac{\partial U}{\partial P} = \Delta$  is true for
- a) linearly elastic material
  - b) rigid material
  - c) non-linearly elastic material
  - d) any material ( elastic or non-elastic ).
- x) If  $\frac{M}{EI}$  diagram is load on a conjugate beam, the shear force at any section gives
- a) the end reaction in the real beam
  - b) the slope at section in the real beam
  - c) the deflection at that section in the real beam
  - d) none of these.
- xi) The force in a diagonal member of a truss under a moving load remains in
- a) tension only
  - b) compression only
  - c) zero force
  - d) both tension and compression.



xii) The ordinate of influence line diagram for bending moment always have the dimension of

- a) force
- b) length
- c) force  $\times$  length
- d) force/length.

xiii) The fixing moment in a fixed beam carrying a central point load is

- a)  $WL/8$
- b)  $WL^2/12$
- c)  $WL/4$
- d)  $WL/12$ .

xiv) The deflection at any point of a perfect frame can be obtained by applying a unit load at the joint in

- a) vertical direction
- b) inclined direction
- c) the direction in which the deflection is required
- d) horizontal direction.

xv) A member having length  $L$ , cross-sectional area  $A$ , modulus of elasticity  $E$ , is subjected to an axial load  $W$ . The strain energy stored in this member is

- a)  $WL^2/AE$
- b)  $WL^2/2AE$
- c)  $W^2L^2/2AE$
- d)  $W^2L/AE$ ,

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**GROUP – B**

**( Short Answer Type Questions )**

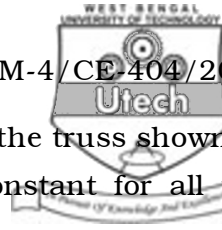
Answer any *three* of the following.

3 × 5 = 15

2. State and explain first and second theorems of moment area method with sketch.
3. Calculate the slope and deflection at the mid-span of simply supported beam shown in Fig. 2 by conjugate beam method :

**Fig. 2**

4. State and explain Castigliano's 1st & 2nd theorems stating assumptions used in defining them.



5. Find out the vertical deflection of joint C of the truss shown in Fig. 3 using unit load method.  $AE$  is constant for all the members.

**Fig. 3**

6. A train of 6 wheel loads shown in Fig. 4 (a) passes over a simply supported beam of span 16 m of 4 (b). Find the influence line diagram ( I.L ) for the load system at point C as shown in Fig. 4 (b) for reaction at A or B

**Fig. 4 (a)**

**Fig. 4 (b)**

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7. Calculate the strain energy due to bending stored in the beam *AB* shown in Fig. 5 :



**Fig. 5**

**GROUP – C**

**( Long Answer Type Questions )**

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

8. Analyze the portal frame shown in Fig. 6. Draw shear force diagram and bending moment diagram.

**Fig. 6**





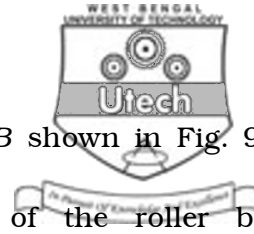
9. Calculate the slope and deflection at the mid-point of the simply supported beam shown in Fig. 7, by conjugate beam method.

**Fig. 7**

10. Find out the fixed end moments for the fixed beam loaded as shown in Fig. 8, by second theorem of Castigliano.

**Fig. 8**

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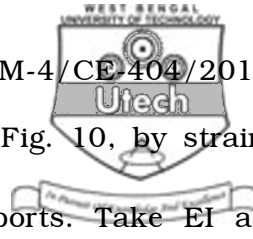


11. A semi-circular arch carries a load  $P$  at  $B$  shown in Fig. 9.

Find out the horizontal displacement of the roller by Castigliano's method. Assume that  $EI$  is constant throughout.

**Fig. 9**

12. Draw the influence line diagram at a section of 10 m from one end of a beam of span 25 m and using this diagram find out the maximum shear force due to the passage of a knife edge load of 5 kN, followed immediately by a UDL of 2.4 kN/m extending over a length of 5 m.



13. Analyse the continuous beam shown in Fig. 10, by strain energy method. Neglect yielding of supports. Take  $EI$  as constant for the beam.

**Fig. 10**

