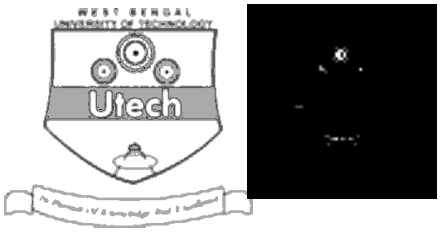
STRUCTURAL ANALYSIS - I (SEMESTER - 4)

CS/B.TECH(CE)/SEM-4/CE-404/09



1. .....
Signature of Invigilator

2. .....
Signature of the Officer-in-Charge

Reg. No.

Roll No. of the Candidate

CS/B.TECH(CE)/SEM-4/CE-404/09

ENGINEERING & MANAGEMENT EXAMINATIONS, JUNE – 2009

STRUCTURAL ANALYSIS - I (SEMESTER - 4)

Time : 3 Hours] [Full Marks : 70

INSTRUCTIONS TO THE CANDIDATES :

1. This Booklet is a Question-cum-Answer Booklet. The Booklet consists of **36 pages**. The questions of this concerned subject commence from Page No. 3.
2. a) In **Group – A**, Questions are of Multiple Choice type. You have to write the correct choice in the box provided **against each question**.
   b) For **Groups – B** & **C** you have to answer the questions in the space provided marked 'Answer Sheet'. Questions of **Group – B** are Short answer type. Questions of **Group – C** are Long answer type. Write on both sides of the paper.
3. **Fill in your Roll No. in the box** provided as in your Admit Card before answering the questions.
4. Read the instructions given inside carefully before answering.
5. You should not forget to write the corresponding question numbers while answering.
6. Do not write your name or put any special mark in the booklet that may disclose your identity, which will render you liable to disqualification. Any candidate found copying will be subject to Disciplinary Action under the relevant rules.
7. **Use of Mobile Phone and Programmable Calculator is totally prohibited in the examination hall.**
8. You should return the booklet to the invigilator at the end of the examination and should not take any page of this booklet with you outside the examination hall, **which will lead to disqualification**.
9. Rough work, if necessary is to be done in this booklet only and cross it through.

No additional sheets are to be used and no loose paper will be provided

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Marks Obtained

	Group – A										Group – B			Group – C				
Question Number																	***Total Marks***	***Examiner's Signature***
Marks Obtained																		

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Head-Examiner/Co-Ordinator/Scrutineer

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Time : 3 Hours] [Full Marks : 70

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following : 10 × 1 = 10

i) Minimum number of equilibrium equations required for a plane frame structure analysis must be

a) 2 b) 3

c) 5 d) 6. ☐

ii) In the Moment Area method the difference in slope between any two sections of a loaded flexural member is equal to the

a) area of the M/EI diagram between these two sections.

b) moment of the M/EI diagram between these two sections.

c) 1/2 × area of the M/EI diagram between these two sections.

d) 1/2 × moment of the M/EI diagram between these two sections. ☐

iii) 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.

iv) A two span beam with an internal hinge is shown below.

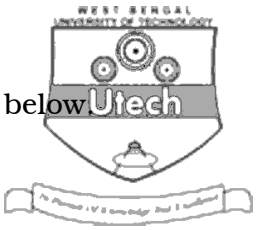

Fig. 1

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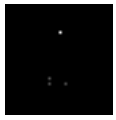


The conjugated beam corresponding to the beam is [ ]

a)

b)

c)

d)

v) Determine the degree of static indeterminancy of the portal frame as shown in *fig. 1 (a).*

Fig. 1 (a)

a) 2 b) 3

c) 4 d) 6. [ ]

vi) When all members of a rigid jointed frame line in a single plane and the loads also act in the same plane, then the twisting moments are

a) 0 b) 2

c) 3 d) none of these. [ ]

vii) 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) $W^2 L^2 / 2AE$ d) $W^2 L / AE$. ☐

viii) Maximum deflection at free end of a cantilever of span l, under a uniformly distributed load of w per unit length, modulus of elasticity E, moment of inertia I, is given by

a) $wl^4 / 8EI$ b) $wl^4 / 2EI$

c) $wl^4 / 3EI$ d) wl^4 / EI. ☐

ix) A uniform beam of span I is rigidly fixed at both supports. It carries a uniformly distributed load w per unit length. The bending moment at mid-span is

a) $wl^2 / 8$ b) $wl^2 / 12$

c) $wl^2 / 16$ d) $wl^2 / 24$. ☐

x) In the truss shown in *fig. 1 (b)*, define the no force members

Fig. 1 (b)

a) AF, CF b) EF, CF

c) AF, EF d) CF. AB. ☐

xi) The principle of virtual work in the analysis of structures results in

a) compatible deformation b) equilibrium of forces

c) stress-strain relation d) none of these. ☐

xii) Maxwell's reciprocal theorem in structural analysis can be applied to

a) all elastic structures b) plastic structures

c) symmetrical structures only d) none of these. ☐

xiii) The fixed support in a real beam becomes in the conjugate beam a

a) roller support b) hinged support

c) fixed support d) free end

e) none of these. ☐

xiv) In the displacement method of structural analysis the basic unknown is/are

a) displacement b) force

c) displacement and force d) none of these. ☐

xv) A pin jointed plane frame is unstable if

a) $(m + r) < 2j$ b) $(m + r) = 2j$

c) $(m + r) > 2j$ d) none of these. ☐

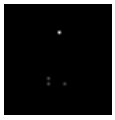
xvi) The ordinate of influence line diagram for bending moment always has the dimensions

a) force b) length

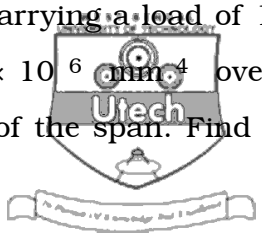
c) force × length d) force / length. ☐

GROUP – B
(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15



2. A simply supported beam (*Fig. 2*) *AB* of span 4 m, carrying a load of 100 kN at its mid-span *C*, has cross-sectional moment of inertia 24×10^6 mm^4 over the left half of the span and 48×10^6 mm^4 over the right half of the span. Find the deflection at point *C* under the load by conjugate beam method.



Take $E = 200 \times 10^6$ kN/m^2 .

Fig. 2

3. State and derive the two theorems of Moment Area Method.

4. What is meant by Strain Energy ? Derive the expression for strain energy due to bending.

5. Calculate the slope and deflection at the mid-span of simply supported beam by conjugate beam method. Refer *fig. 3*.

Fig. 3

6. Draw the infleunce line diagram for bending moment and shear force at one-third span of a simply supported beam.

7. An overhanging beam of uniform EI is loaded as shown in *fig. 4*. Find out the deflection at the free end.

Fig. 4

8. Write the support conditions of conjugate beam corresponding to conditions at the same points in the actual beam.

GROUP – C

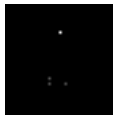
(Long Answer Type Questions)

Answer any *three* questions. 3 × 15 = 45

9. Analyse the portal frame, shown in *fig. 5*. Sketch S.F.D. and B.M.D.

Fig. 5

10. Find the horizontal deflection at joint *B* and slope at *C* in the frame shown in *fig. 6*.



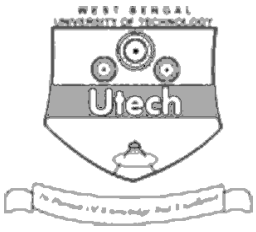


Fig. 6

11. Determine the vertical and horizontal deflections at *E* for the truss as shown in *fig. 7*. Area of cross-section of each member is 1500 mm ^{2} and $E = 200 \times 10^6$ kN/m ^{2} are constant for all members.

Fig. 7

12. A train of wheels consists of three loads, 15 kN followed by 12 kN at 3 m distance and another 10 kN, 2 m behind the second wheel. Determine the maximum bending moment and shear force at 1/3 span from left support of a 24 m long bridge.

13. a) Draw the Shear Force and Bending Moment diagrams for the portal frame as showin in *fig. 8*.

Fig. 8

b) Find the slope and deflection at the free end of a cantilever shown in *fig. 9*. Moment of inertia of *AC* is twice the moment of inertia of *BC*.

Fig. 9

8 + 7

14. Find the vertical and horizontal deflections of joint *G* of the truss shown in *fig. 10.* The sectional areas of the members are as follows :

Horizontal members : 1500 mm ^{2} ; vertical members : 1800 mm ^{2} ; Inclined members : 2500 mm ^{2} .

Take E = 200 kN/mm ^{2} .

Fig. 10

END