



✓ This exam measures ILOs no.:

✓ No. of pages: 10+cover – No. of questions: 5

Marks: 100

	اسم الطالب
	الرقم الأكاديمي
مقرر اختياري ٣: تحليل المنشآت باستخدام الحاسب الآلي	اسم المقرر
الثالث	المستوي
موضوعات في تحليل المنشآت باستخدام الحاسب الآلي	عنوان البحث المرجعي

التوقيع	الدرجة	رقم السؤال
	----- / 15	السؤال الأول
	----- / 15	السؤال الثاني
	----- / 20	السؤال الثالث
	----- / 20	السؤال الرابع
	----- / 30	السؤال الخامس
	----- / 100	المجموع

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**Question no. 1**

**3\*3+6 = 15 Marks**

**Answer the following questions**

1	What are the sources of errors in the modelling for structural analysis? Give examples
2	Define the 1D, 2D and 3D elements, what are the condition for each? Give examples



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3	What is the meaning of Restraints, Constraints, modifiers in SAP2000?
4	State <b>Ten</b> commercial software for structural analysis, for each, define its merits and its recommended and precise field of use in the structural analysis and design.



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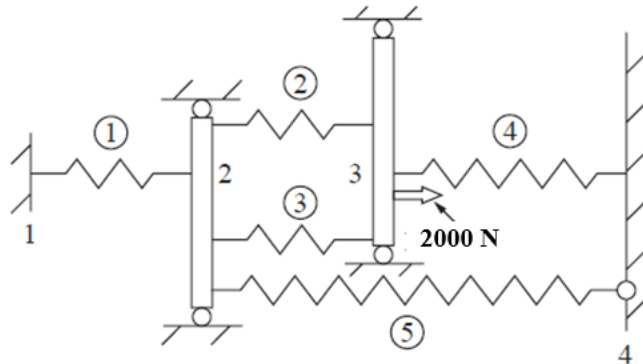
**Question no. 2**

**15 Marks.**

For the five-spring assemblage shown in Figure. Assume the rigid vertical bars at nodes 2 and 3 connecting the springs always remain horizontal but are free to slide or displace left or right.

There is an applied force at node 3 of 2000 N to the right. Let  $k_1 = 1200 \text{ N/mm}$ ,  $k_2 = k_3 = 500 \text{ N/mm}$ ,  $k_4 = k_5 = 600 \text{ N/mm}$ .

1. Determine the displacements at nodes 2 and 3.
2. Determine the reactions at nodes 1 and 4.
3. Determine the internal force in each spring: spring 1 to 5.





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**Question no. 3**

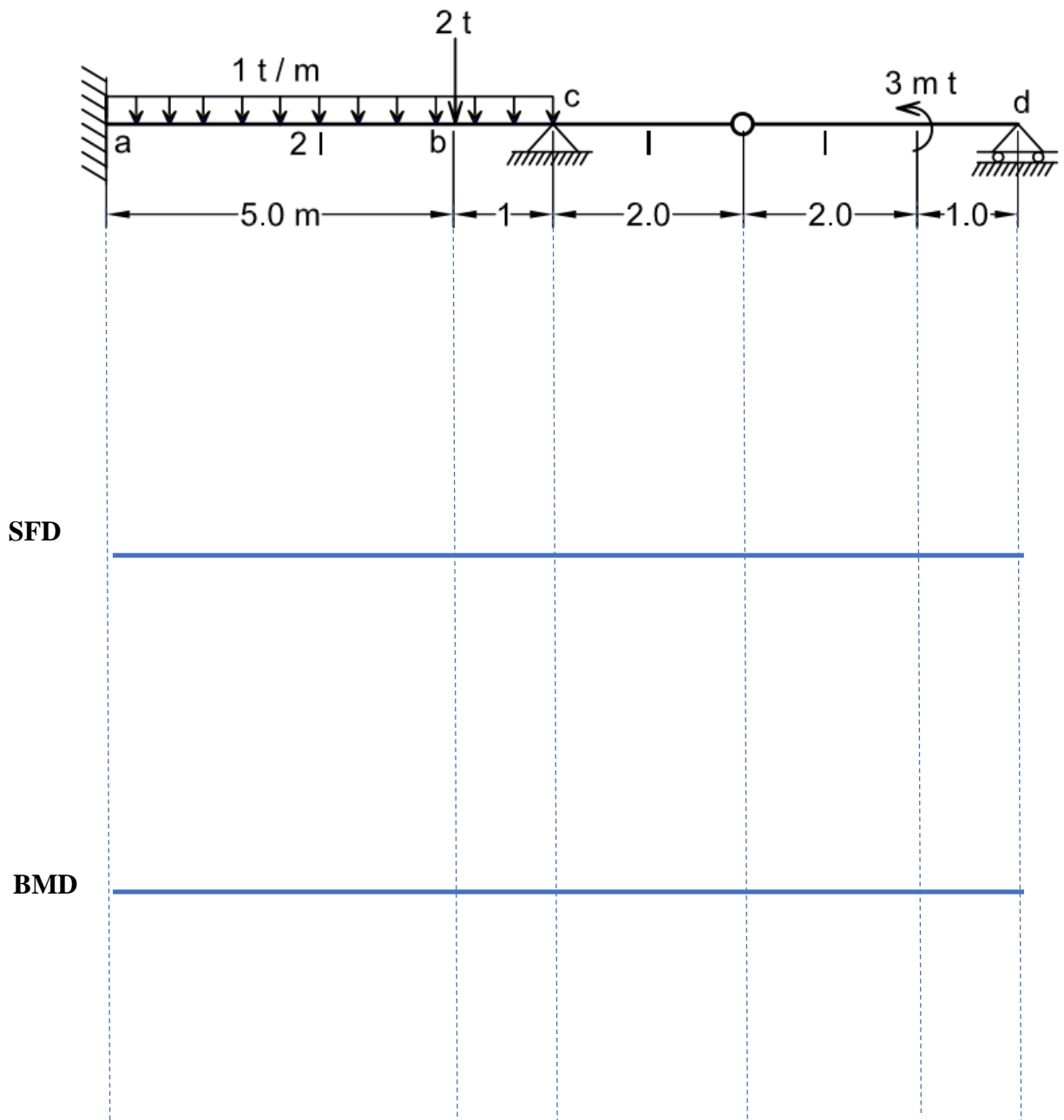
**2\*10 = 20 Marks.**

**a) Solve the following simple beam structure using SAP2000:**

1. Find the following actions and straining actions:

$M_a =$  \_\_\_\_\_ ,  $M_b =$  \_\_\_\_\_ ,  $M_c =$  \_\_\_\_\_ ,  $Q_a =$  \_\_\_\_\_  
 $Q_{c\ left} =$  \_\_\_\_\_ ,  $Q_{c\ right} =$  \_\_\_\_\_ , *deflection at b =* \_\_\_\_\_ , *slope at d =* \_\_\_\_\_

2. Draw SFD & BMD (you may use a capture SAP2000 output figure with values)





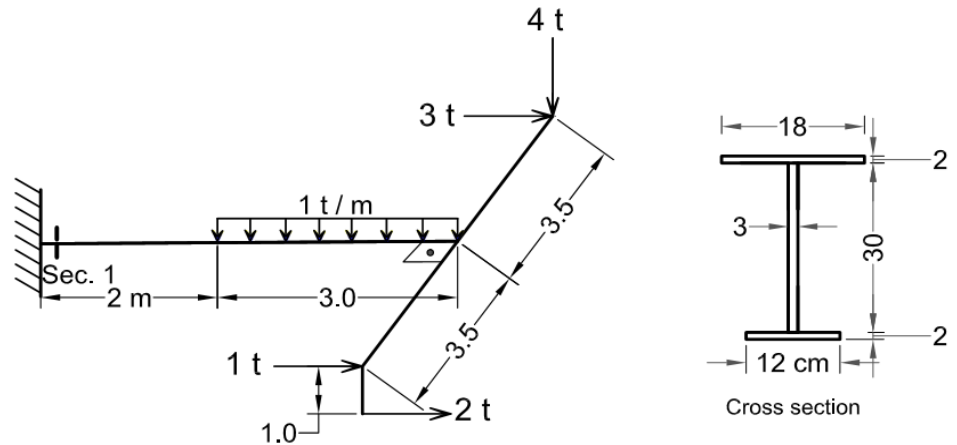
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b) Solve the following simple beam structure using SAP2000: Find the required straining actions at sec 1, then find the maximum normal stress for the same section

$N =$  \_\_\_\_\_ ,  $M_{2-2} =$  \_\_\_\_\_ ,  $M_{3-3} =$  \_\_\_\_\_  
 $Q_{2-2} =$  \_\_\_\_\_ ,  $Q_{3-3} =$  \_\_\_\_\_ ,  $M_{torsion} =$  \_\_\_\_\_  
 maximum normal tensile stress,  $\sigma_{tension} =$  \_\_\_\_\_  
 maximum normal Compressive stress,  $\sigma_{compression} =$  \_\_\_\_\_





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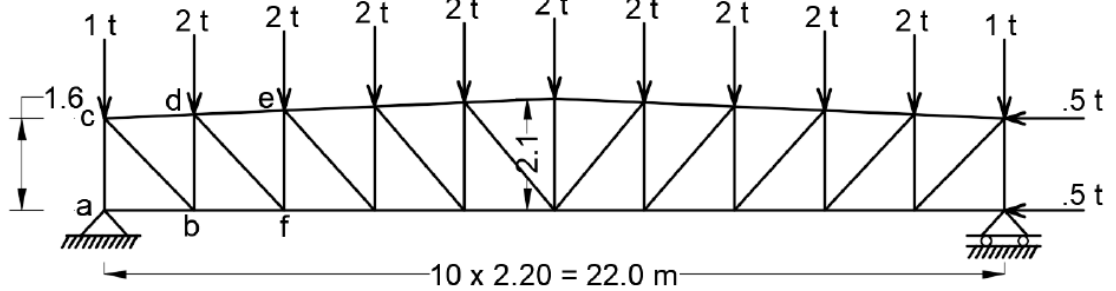
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**Question no. 4**

**2\*10 = 20 Marks.**

a) It is required to solve the shown truss using SAP 2000 program then, get the required unknowns



**Data:**

Young Modulus of used material,  $E = 2 * 10^7 \text{ ton} / \text{m}^2$ . For top and bottom chord members use 2L 70 x 6 /10, For diagonals and verticals use 1L 80 x 6.

**It is required to get the followings:**

- a) Reactions at left support
- b) The vertical and horizontal deflection at mid-span.
- c) Axial forces for members: ac, bd, fe, ab, bf, cd, de, cb and df

**Solution:**

- a) Reactions at left support:  $R_z =$  \_\_\_\_\_ ,  $R_x =$  \_\_\_\_\_
- b) Vertical deflection = \_\_\_\_\_ , Horizontal deflection = \_\_\_\_\_
- c)  $F_{ac} =$  \_\_\_\_\_ ,  $F_{bd} =$  \_\_\_\_\_ ,  $F_{fe} =$  \_\_\_\_\_ ,  $F_{ab} =$  \_\_\_\_\_ ,  $F_{bf} =$  \_\_\_\_\_  
 $F_{cd} =$  \_\_\_\_\_ ,  $F_{de} =$  \_\_\_\_\_ ,  $F_{cb} =$  \_\_\_\_\_ ,  $F_{df} =$  \_\_\_\_\_



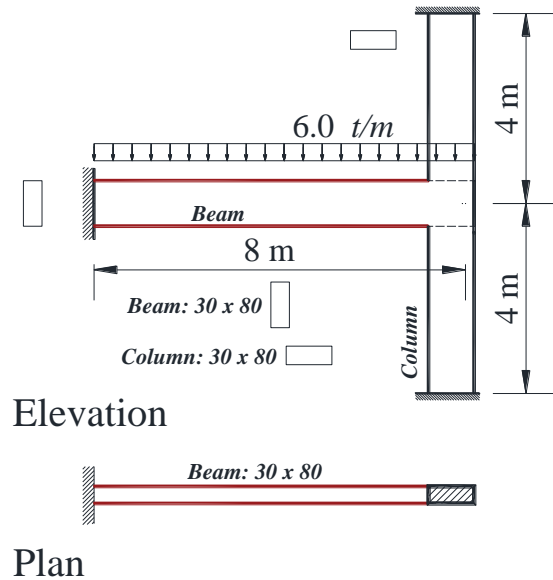
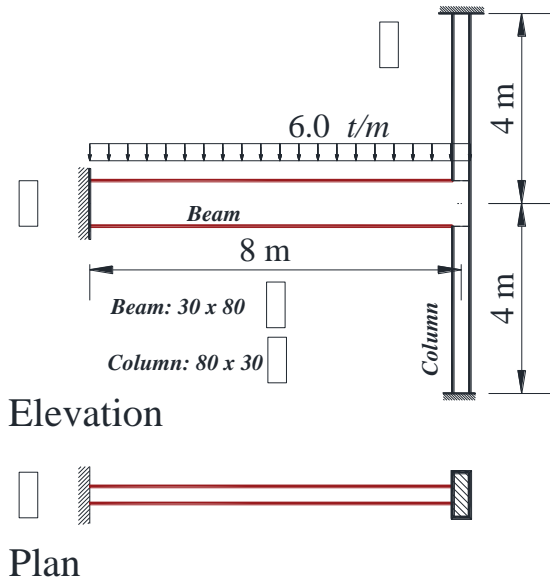
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b) For the following Beam-column system (Frames), using SAP2000, solve the frame structures, draw NFD, SFD, BMD, and deformed shape under the given load.

The column has the same dimensions but different orientation, Comment the results?







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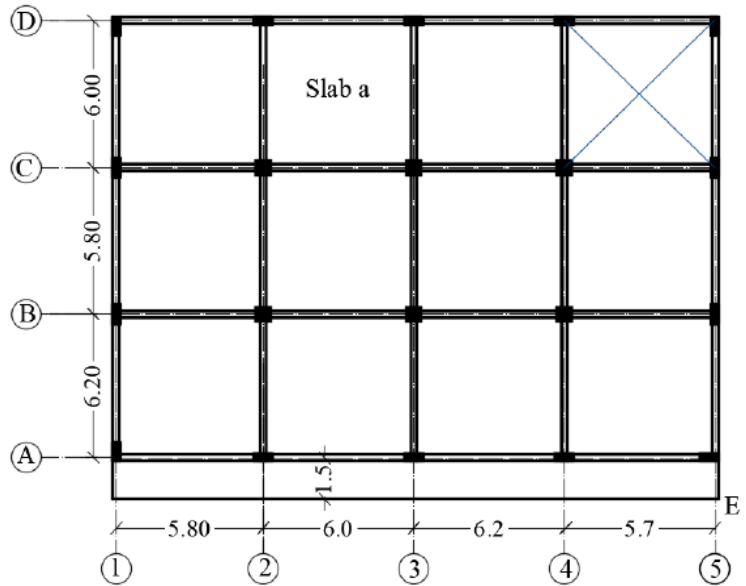
**Question no. 5**

**2\*15= 30 Marks.**

- a) For the shown solid slab system is to be solved using SAP 2000 program. **Given Data:** Beams are 0.25 x 0.70 m, slabs are 0.12 m. Wall loads (on all beams) = 6 kN/m. Cover loads = 1.5 kN/m<sup>2</sup>, LL = 2.0 kN/m<sup>2</sup>.

**It is required** (total loading; D+L) >>>

1. Draw SFD and BMD of beam on B-axis.
2. Find the vertical deflection of point E.
3. Find  $M_x$  and  $M_y$  in the middle point of slab a.
4. Vertical reaction of column on axis C, 2.





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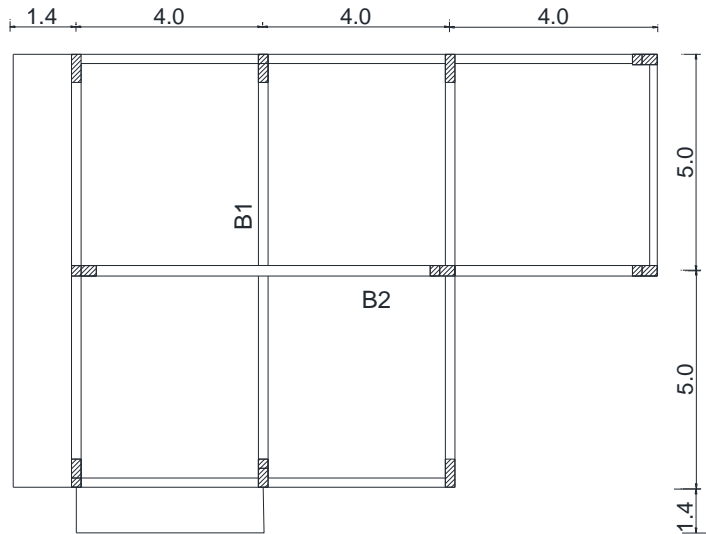
For the given Structural system

1. Assume the Design Initial Dimensioning for structural elements: slab ( $t_s=12$  cm), beams (30\*70), column (30\*70)

2. Build SAP2000 Analysis Model

- Draw Autocad, Import from AutoCad to SAP2000
- Define code/Units
- Define Materials, and Define Sections
- Define Loads
- Define Restraints for hinge supports
- Define Modifiers
- Define diaphragms

5. Run Analysis



**Given Data**

- Concrete compressive strength 28 MPa, Concrete density 24 kN/m<sup>3</sup>, Steel yield strength 420 MPa, Live load 4 kN/m<sup>2</sup>, Number of stories 5, Story height 4 m, Seismic Zone 3
- For seismic loads: Use equivalent lateral horizontal force with 8% of the total load (DL+0.5 LL) applied at the center of mass (CM) distributed as (33%, 27%, 20%, 13%, 7%) in x-direction and y-direction

**It is required** (total loading; D+L) >>>

1. Draw SFD and BMD of beam on B1 and B2 and compare to the hand calculation.
2. Find the vertical deflection of intersection point of beam B1 and B2.
3. Find  $M_x$  and  $M_y$  for the slab plan.
4. The Vertical reaction of all column at the base.
5. Story drift in x- and y-direction (due to seismic load in x- and y-direction)



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