Kafrelsheikh University Faculty of Engineering		
Final Examination of Academic Year 2019 / 2020		
Department: Civil Engineering	Year: Third	Total Marks: 125
Course Title: Theory of Structures	Course Code: CES3114	Term: First
Date: 19 / 1 / 2020	ILOs: a_1, a_5, a_{11}, b_1, b_2, b_{10}, c_2, c_6, d_1, d_2, d_5, and d_6	Allowed Time: 4 hrs

Answer as much as you can

Question No. 1: **(10 Marks)**

Discuss the stability and determinacy of the following structures in Fig. 1?

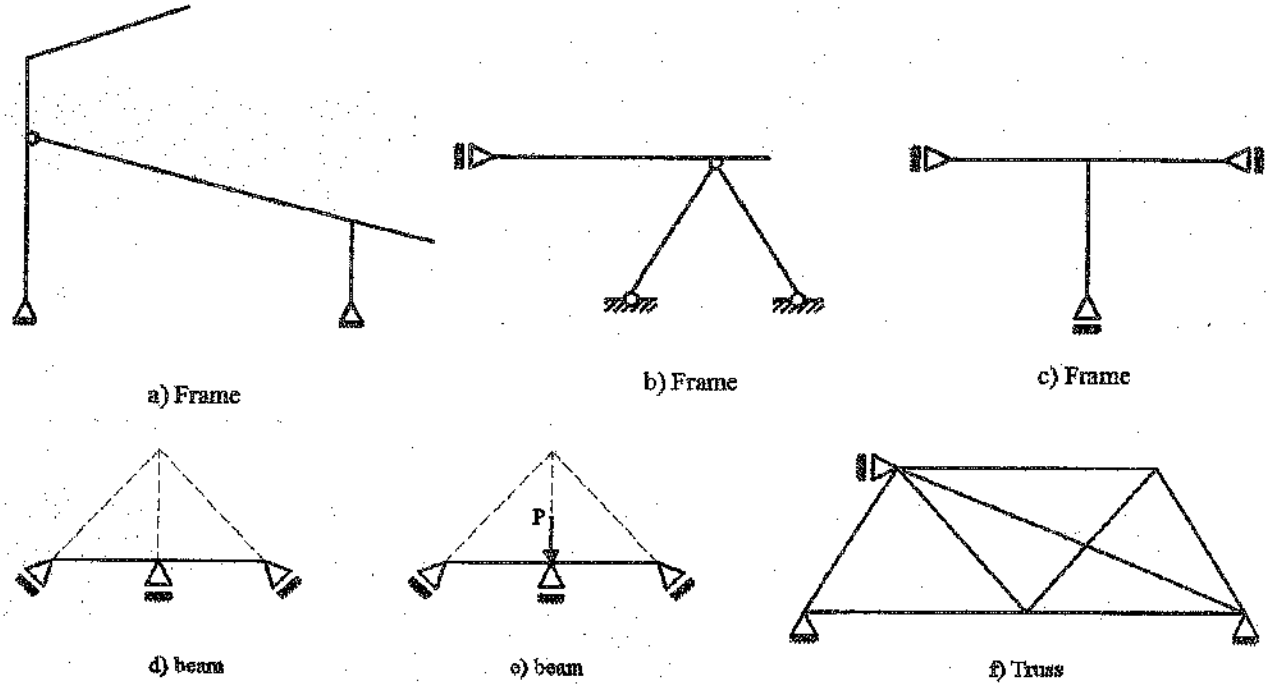

Fig. 1

Question No. 2: **(20 Marks)**

Draw B.M.D for the frame shown in Fig. 2 using the moment distribution method.

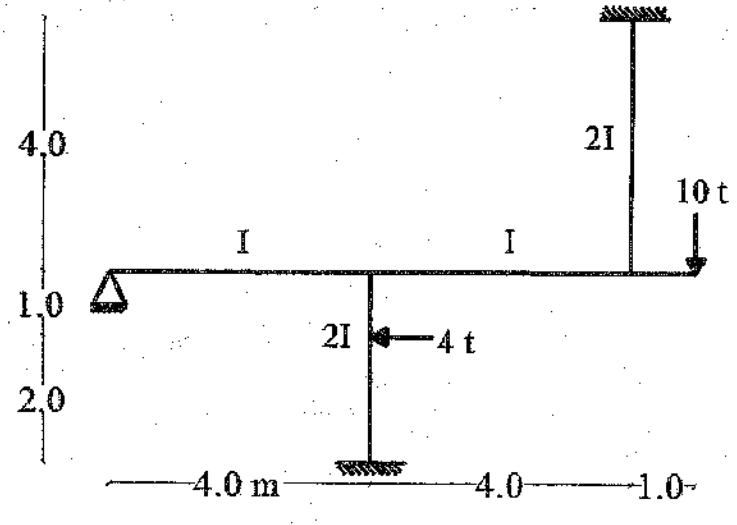

Fig. 2

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Question No. 3: **(20 Marks)**

Draw B.M.D for the frame shown in Fig. 3 using the slope deflection method.

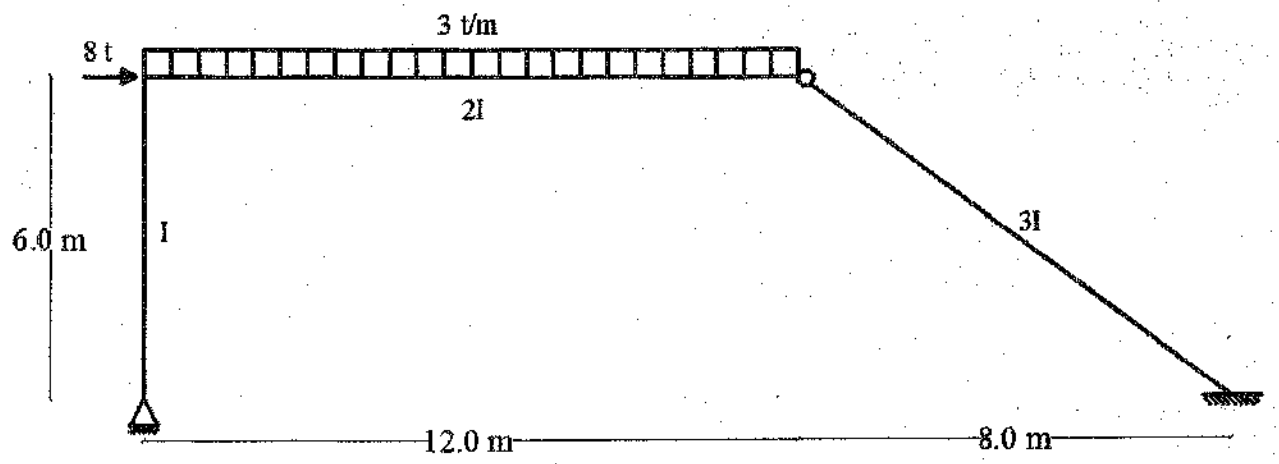

Fig. 3

Question No. 4: **(20 Marks)**

a) For the undamped free vibration system, prove that: **(10 Marks)**

$$y_t = y_o \cos wt + \frac{v_o}{w} \sin wt$$

b) Find the unknown weight (W) to have the same natural period of vibration for the two beams shown in Fig. 4 if E=2000 t/cm^2 **(10 Marks)**

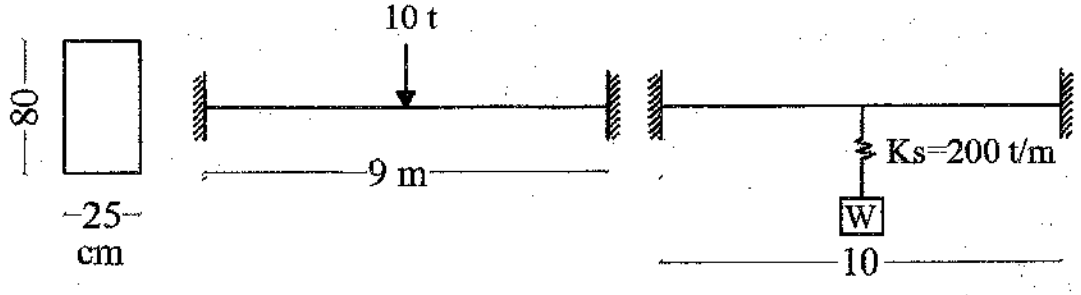

Fig. 4

Question No. 5: **(20 Marks)**

For the frame shown in Fig. 5 the column section is 35x75 cm and the modulus of elasticity, E= 220 t/cm^2. If the frame subjected to a harmonic force and the damping ratio is 18 % determine:

1. The natural frequency and time period of vibration **(3 Marks)**
2. The damping coefficient **(3 Marks)**
3. The steady state amplitude **(4 Marks)**
4. The maximum dynamic shear force in the columns **(3 Marks)**
5. The maximum dynamic moment in the columns **(3 Marks)**
6. The maximum dynamic normal stress in the columns **(4 Marks)**

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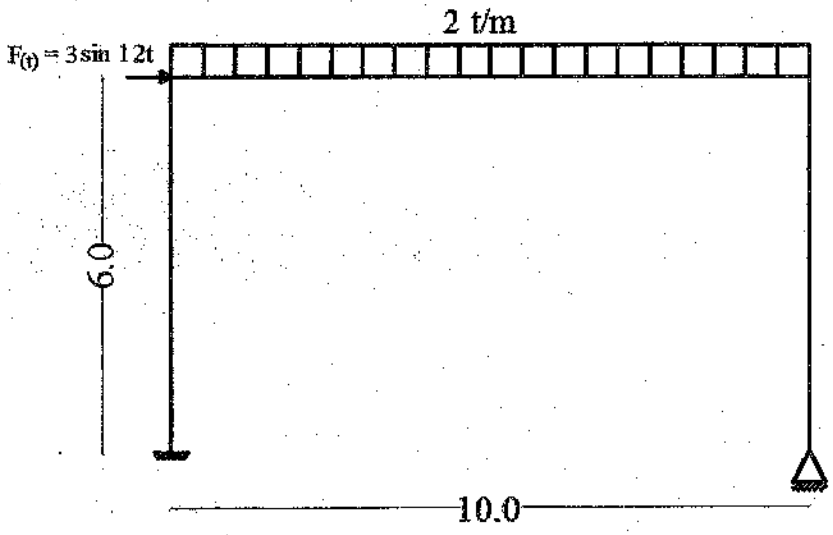
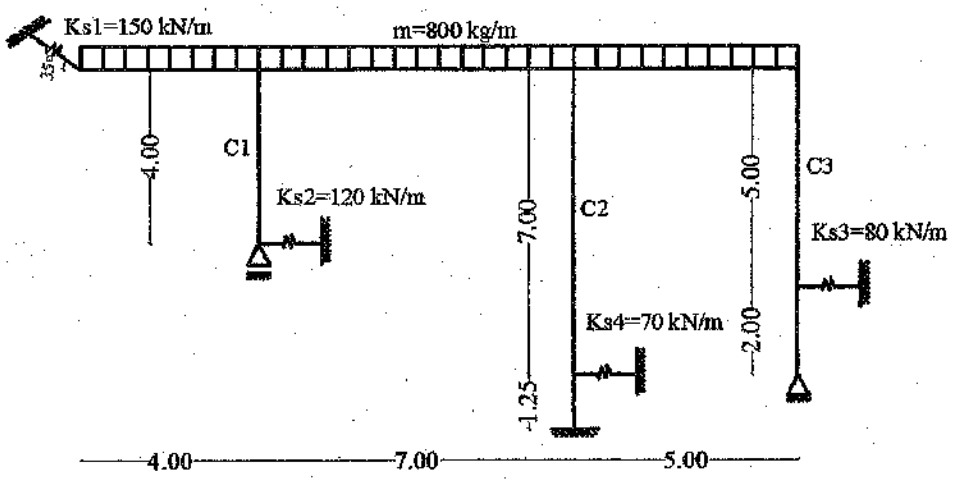


Fig. 5

Question No. 6: **(20 Marks)**

For the frame shown in Fig. 6 with initial displacement = 10 cm, initial velocity = 15 cm / sec, and damping ratio = 18%. It is required to:

1. Draw mathematical model and free body diagram **(3Marks)**
2. Write the equation of motion and its solution **(3Marks)**
3. Compute the natural and damping time period of the frame **(4Marks)**
4. Draw the displacement curves from t=0 to 3T. **(4Marks)**
5. Compute the maximum displacement. **(3Marks)**
6. Find the logarithmic decrements using two methods **(3Marks)**



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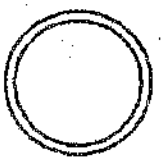
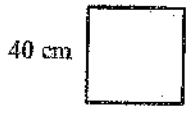


C1
r internal =14.5 cm
r external =15 cm
E=2000 t/cm2



C2
E=210 t/cm2

C3
E=230 t/cm2

Fig. 6

Question No. 7: **(20 Marks)**

A free vibration test is conducted on an empty elevated tank. A cable is attached to the tank which applies lateral horizontal force equal to 16.4 Kips and pulls the tank horizontally by 2 in. The cable is suddenly cut and the resulting free vibration is recorded. At the end of four complete cycles, the time is 2.0 sec and the amplitude is 1 in determine:

1. The logarithmic decrement **(2 Marks)**
2. The damping ratio **(2 Marks)**
3. The natural period of undamped vibration **(2 Marks)**
4. The stiffness **(2 Marks)**
5. The weight of the tank **(2 Marks)**
6. The damping coefficient **(3 Marks)**
7. Number of cycles required for the displacement amplitude to decrease to 0.2 in. **(3 Marks)**
8. If the weight of the water which required to fully fill the tank is 80 Kips. Determine the natural vibration period and the damping ratio of the fully tank. **(4 Marks)**

Question No. 8: **(20 Marks)**

For the two stories shear building shown in Fig. 7, E=2000 t/cm^2 and I=0.001 m^4 calculate:

1. The natural frequencies and corresponding normal modes **(10 Marks)**
2. Verify the orthogonality conditions **(10 Marks)**

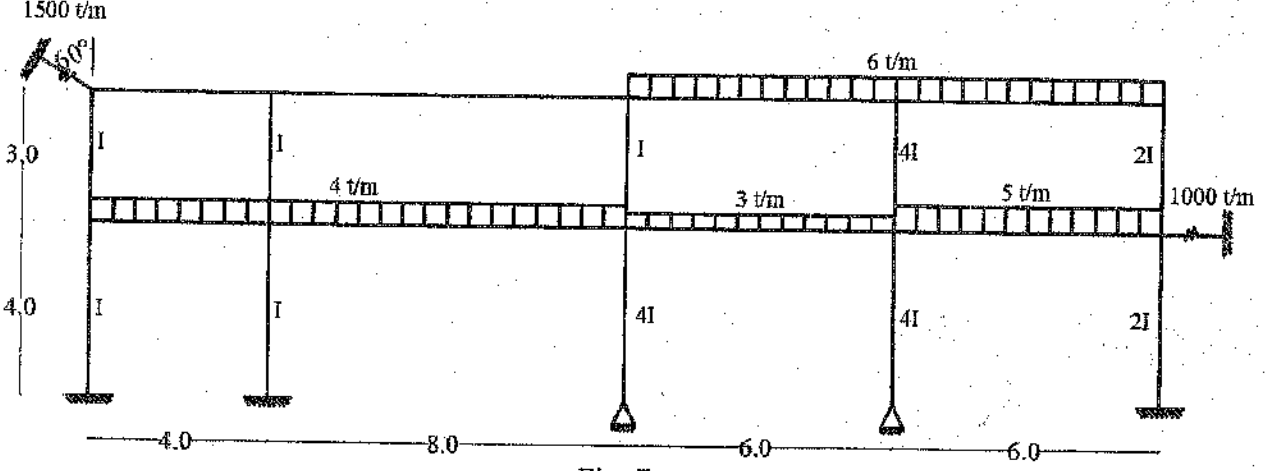


Fig. 7

Good Luck

Assis. Prof. Walid Mansour