1. What is the length of cord AC in the figure so that the 8-kg lamp is suspended in the position shown? (The undeformed length of spring AB is \( l'_{AB} = 0.4 \) m, and the spring has a stiffness of \( k_{AB} = 300 \) N/m)? (5%) 

![Diagram of a lamp suspended by a cord with a spring](image)

**Question 1**

2. What is the force in member EB of the roof truss shown in the figure? Please indicate whether it is tension or compression. (5%) 

![Diagram of a roof truss](image)

**Question 2**

3. The uniform stone in the figure has a mass of 500 kg and is held in the horizontal position using a wedge at B. If the coefficient of static friction \( \mu_s = 0.3 \) at the surfaces of contact, what is the minimum force \( P \) needed to remove the wedge? (10%) 

![Diagram of a stone and a wedge](image)

**Question 3**

4. A simple beam \( AB \) having a rectangular cross section (width \( b \) and height \( h \)) and span length \( L \) is loaded by a force \( P \) acting at the end of an arm of length \( a \). (A) Determine the maximum tensile and compressive stresses in the beam. (B) Draw the moment diagram and shear force diagram of the loaded beam. (10%) 

![Diagram of a beam loaded with a force](image)

**Question 4**

5. For a vibration of a single degree of freedom, 
   (a) Derive the governing differential equation (i.e. equation of motion) for the mass-spring-damper system. (5%) 

![Diagram of a mass-spring-damper system](image)
(b) Find the natural frequency and the critical damping of the system. (5%)
(a) Find the stress distribution in the pile (5%)  
(b) Find the elastic deformation of the pile. (5%)  

9. (a) Explain "plane strain condition" and give an example in civil engineering problems. (5%)  
(b) Explain "plane stress condition" and give an example in civil engineering problems. (5%)  

10. 請以簡單的例子說明多個向量的線性相關 (linear dependence) 及線性獨立 (linear independence) 的條件。 (5%)  

11. 求取通過下面三點的平面方程式  
    (1, 6, 1), (9, 1, -31), (-5, -2, 25). (5%)  

12. 求取在點 (3, 4, 5) 上，曲線 \( z = \sqrt{x^2 + y^2} \) 的單位垂直向量。 (5%)  

13. 計算 \( \int_0^\infty e^{-x} \sin nx \, dx \) 的值，其中 \( n=1,2,3,... \). (5%)  

14. 求取下式的傅立葉積分 (Fourier Integral)  
    \[ f(x) = \begin{cases} 1, & |x| < 1 \\ 0, & |x| > 1 \end{cases} \]  
    (5%)  

15. 計算 \( \oint_C \frac{7z - 6}{z^2 - 2z} \, dz \) 的值，其中 \( z = x + iy \) ，且以 \( C \) 為單位圓，逆時針方向。 (5%)