(1) 20% A fix-fixed steel beam in an ice cream factory, shown in Fig. 1(a), will experience a uniform temperature variation of ± 35°C from normal condition. The stress-strain diagram of steel is shown in Fig. 1(b). Calculate axial force created by the temperature change at both extreme. The thermal expansion coefficient of the beam is 10^{-5}/°C. The cross section of the beam is 10 cm². E = 200 GPa.

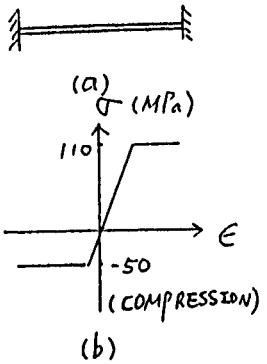

Fig. 1

(2) 20% Explain the following phrases:
(a) "Plane Remains Plane" in beam bending.
(b) Shear Flow
(c) Principal Stresses
(d) Slenderness Ratio

(3) 20% A space frame, shown in Fig.2(a), is composed of two perpendicular segments rigidly connected at joint B. All members are made of round bars with diameter D. A vertical load P is applied at joint K as shown in Fig. 2(b).
(a) Draw free-body diagrams of ABC and BK for possible internal force components.
(b) What difference will it make if joint C is changed to a fixed end and supports at L and A are removed?

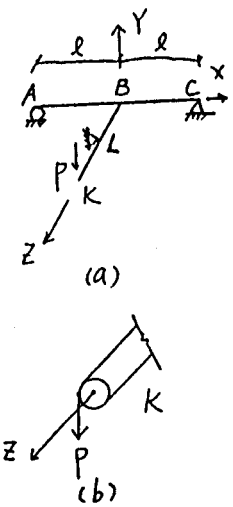

Fig. 2

(4) 20% A simply supported beam has a 6 meter span length. A triangular uniform load of 12 KN/m at one end and 0 KN/m at the other is applied vertically on the whole beam as shown in Fig 3. Assuming the rectangular cross section is 30 cm by 30 cm:
(a) Draw the shear and moment diagram of the beam.
(b) Calculate the horizontal shear stress located 10 cm from bottom of the beam at the center of the span.

Fig. 3

(5) 20% (a)Two vectors A and B, A=2i - 3j - k and B = i + 4j - 2k. Calculate A X B.
(b) Calculate the inverse matrix of

$$\begin{bmatrix} 2 & 4 & 5 \\ 5 & 4 & 6 \\ 1 & 3 & 2 \end{bmatrix}$$