1. In the below figure, there are three solid cylindrical bars welded together. Each bar is assumed elastic, perfectly plastic in its behaviour having $E$ as $2 \times 10^{11}$ Pa and a yield point of $4.2 \times 10^8$ Pa. What tensile force is needed to move end B relative to A a distance 0.3mm? What tensile force is needed to move end B a distance of 1.8mm relative to end A?

2. A cylinder having nonlinear, elastic behaviour is shown in the fig (a) below, hanging by its own weight. If the stress-strain diagram for the material is as shown in fig (b), what is the deflection of end A of the cylinder? Take $γ$ as a constant equal to $5.76 \times 10^4$ N/m$^3$. Take $D = 0.15$m and $L = 1.5$m.

3. Consider a composite bar in the fig, made up of isotropic fibers $(E_f, ν_f)$ in an isotropic material called a matrix $(E_m, ν_m)$. If in the x-direction the cross-sectional area are $A_f$ and $A_m$ for the fibers and the matrix, respectively. Determine the effective elastic modulus of the composite in the x-direction.

4. A rigid beam $AB$ is supported by a steel rod and an aluminium rod as shown in fig. A load $P$ of 675,000 N is applied to $A$, causing $AB$ to deflect downward. Now the screw at $B$ is adjusted so that $B$ is depressed to a position where the rod is once again horizontal.

How much must the screw at B descend from its initial orientation to achieve this?
5. The fig shows a steel rod and an aluminium sleeve held between two immovable supports A and B. If the temperature is raised from 15°C to 38°C, what are the thermal stresses in the materials, and what are the forces developed on the supports? Take $\alpha$ to be $1.17 \times 10^{-5}/0$C for the steel rod and $2.16 \times 10^{-5}/0$C for the aluminium sleeve. $E$ for the rod is $2 \times 10^{11}$ Pa and for the sleeve is $7 \times 10^{10}$ Pa.

6. Determine the vertical movement $\delta$ of the 800 N block after it is carefully put in place (see the fig). This movement is due to the weight of the block. Both members have the same E and A. Neglect friction.

7. A steel hoop is to be shrink-fit onto a steel shaft. That is, the hoop will be heated so as to increase the internal diameter so that the hoop fits onto the shaft. Once on the shaft the hoop is cooled. If the diameter of the shaft is 50.000 mm and the initial internal diameter of the hoop before heating is 49.950 mm, how high a temperature is required to heat the hoop in order to have a clearance of 0.025mm when assembling the system? Take the co-efficient of linear expansion $\alpha$ to be a constant equal to $10 \times 10^{-6}/0$C.

8. A rigid plate A has three legs, as shown in fig. one leg is 0.025mm short. A force of 180,000N is placed on plate A. If it is placed so that A remains horizontal, what is the deflection of A? The cross-sectional area of the legs is 625mm$^2$, and the modulus of elasticity is $2 \times 10^{11}$Pa.

9. Consider the flexible rod with a rigid flange shown in fig. A ring-shaped slider is held at rest above the flange. Determine the stress in the rod when the slider impacts the flange and elongates the rod to its maximum displacement $\Delta$. (Hint: Use conservation of energy and let spring stiffness of the rod $K = AE/L$)

10. A load is to be supported as shown in figure. What angle $\theta$ will result in the least-weight design if both members are stressed to yield Y? Plot the normalized weight $WY/PL\rho g$ of the structure versus $\theta$, for $0^0 \leq \theta \leq 90^0$. 