

Q1. A petrol engine valve regulated by a spring needs to be designed. Essentially following parameters to be determined (wire diameter, coil diameter, number of active coil, free length, pitch of coil) for the following specifications:

- Spring load when the valve is open is 400 N and corresponding length of spring 40 mm
- Spring load when the valve is closed is 260 N and corresponding length of spring 48 mm
- Minimum permissible inside diameter of spring coil is 25 mm
- Maximum allowable shear stress in spring is 400 MPa
- Modulus of rigidity of spring is 85 GPa
- Clearance between coils of unloaded spring is 0.5 mm

[5X4=20]

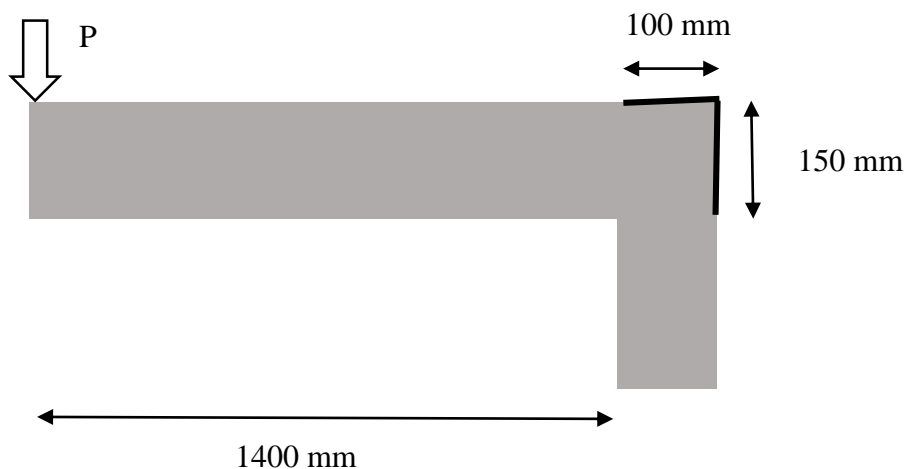
Q2. A welded joint with identical throat fillet on the horizontal bar which supports a load of 3kN as shown in Figure Q2 is to be designed. The welding is carried out employing an automated robot using standard E60xx welding rod with a factor of safety 2.2. Find the required weld size 'h' in the joint. Show all steps worked out in details.

[20]

Q3. A screw jack having Acme thread profile of outer diameter 30 mm has quadruple start thread, with pitch 4 mm. It is used to lift a load of  $P = 6$  kN. The coefficient of friction at thread and collar are 0.12 and 0.09 respectively. Find

- Lead of screw, Mean diameter of screw and Helix angle
- Evaluate and write clearly whether the screw is self-locking or over-hauling.
- Considering mean coil diameter 40 mm, find the starting torque for lifting and lowering the screw.
- If an operator can conveniently apply a force of 150 N with hand, what is the minimum length of the crank for the screw jack?

[4X5=20]



**Figure Q2**