1. A pair of parallel helical gears shown in Figure:1. A 5 kW power at 720 rpm is supplied to the pinion A through its shaft. The normal module is 5 mm and the normal pressure angle is 20°. The pinion has right-hand teeth, while the gear has left-hand teeth. The helix angle is 30°. The pinion rotates in clockwise direction when seen from the left side of the page. Determine the components of the tooth force and draw a free-body diagram showing the forces acting on the pinion and the gear.
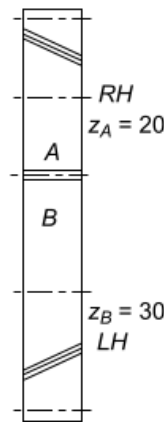

Figure 1: Helical gear pair

2. A pair of helical gears consists of 24 teeth pininion rotating at 5000 rpm and supplying 2.5 kW power to a gear. The speed reduction is 4 : 1. The normal pressure angle and helix angle are 20° and 23° respectively. Both gears are made of hardened steel ($Sut = 750 N/mm^2$). The service factor and the factor of safety are 1.5 and 2 respectively. The gears are finished to meet the accuracy of Grade 4.

   (a) In the initial stages of gear design, assume that the velocity factor accounts for the dynamic load and that the face width is ten times the normal module. Assuming the pitch line velocity to be $10 m/s$, estimate the normal module.

(b) Select the first preference value of the normal module and calculate the main dimensions of the gears.

(c) Determine the dynamic load using Buckingham's equation and find out the effective load for the above dimensions. What is the correct factor of safety for bending?

(d) Specify surface hardness for the gears, assuming a factor of safety of 2 for wear consideration.

3. A pair of helical gears transmits 37.5 kW at 1750 rpm to the pinion. The speed reduction ratio is 4.25, the helix angle is 15°, $E_p = 2.15 * 10^5 N/mm^2$. The service is continuous, and the normal pressure angle is 20°. Assume the number of teeth on the pinion is 20 , and the life of the gears is $10,000$ hrs. Surface hardness is $55RC$ and Brinell hardness $> 350BHN$. The materials are the same, and the gears are closed type.