

## TUTORIAL SHEET 7: GEARS

1. A 15-tooth spur pinion has a module of 3 mm and runs at a speed of 1600 rev/min. The driven gear has 60 teeth. Find the speed of the driven gear, the circular pitch, and the theoretical centre-to-centre distance. [400 rev/min; 9.42 mm; 112.5 mm]
2. A spur gearset has a module of 6 mm and a velocity ratio of 4. The pinion has 16 teeth. Find the number of teeth on the driven gear, the pitch diameters, and the theoretical centre-to-centre distance. [64, 96 mm, 384 mm, 240 mm]
3. Show that the length of the line of action is given by:

$$L = \sqrt{(r_p + a_p)^2 - (r_p \cos \phi)^2} + \sqrt{(r_g + a_g)^2 - (r_g \cos \phi)^2} - C \sin \phi,$$

where  $r_p$  and  $r_g$  are the pitch circle radii of the pinion and gear, respectively;  $a_p$  and  $a_g$  are the addenda of the pinion and gear, respectively; and  $C$  is the centre-to-centre distance of the pinion and gear.

4. A 21-tooth spur pinion mates with a 28-tooth gear. The diametral pitch is 3 teeth/in and the pressure angle is  $20^\circ$ . Make a drawing of the gears showing one tooth on each gear. Find and tabulate the following results: the addendum, dedendum, clearance, circular pitch, tooth thickness, and base circle diameters; the base pitch; the length of the line of action; and the contact ratio.

$$[a = 0.333 \text{ in}, d = 0.417 \text{ in}, c = 0.083 \text{ in}, p = 1.047 \text{ in}, t = 0.524 \text{ in}, d_{1b} = 6.578 \text{ in}, d_{2b} = 8.770 \text{ in}, p_b = 0.984 \text{ in}, L = 1.578 \text{ in}, m_c = 1.604 \text{ in}]$$

5. A 1000 W electric motor runs at 1200 rev/min. Keyed to the motor shaft is an 18 tooth helical pinion having a normal pressure angle of  $20^\circ$ , a helix angle of  $30^\circ$ , and a normal module of 3.0 mm. What are the forces acting on the pinion?

$$[W^t = 255 \text{ N}, W^r = 107 \text{ N}, W^a = 147 \text{ N}]$$

6. A steel spur pinion has a module of 1.25 mm, 18 teeth cut on the  $20^\circ$  full-depth system, and a face width of 12 mm. At a speed of 1800 rev/min, this pinion is expected to carry a steady load of 0.5 kW. Determine the bending stress. [to be filled]
7. A steel spur pinion has 16 teeth cut on the  $20^\circ$  full-depth system with a module of 8 mm and a face width of 90 mm. The pinion rotates at 150 rev/min and transmits 6 kW to the mating steel gear. What is the bending stress? [to be filled]
8. A steel spur pinion has a module of 1 mm and 16 teeth cut on the  $20^\circ$  full-depth system and is to carry 0.15 kW at 400 rev/min. Determine a suitable face width based on an allowable bending stress of 150 MPa. [to be filled]

9. A  $20^\circ$  full-depth steel spur pinion is to transmit 1.5 at a speed of 900 rev/min. If the pinion has 18 teeth, determine suitable values for the module and face width. The bending stress should not exceed 75 MPa. [\[to be filled\]](#)