

FACTFILE: GCE TECHNOLOGY & DESIGN

1.47 MECHANICAL COMPONENTS AND SYSTEMS



Gears

Learning outcomes

Students should be able to:

- demonstrate knowledge and understanding of:
 - gears to include pitch circle diameter, pitch point, metric module, pinion wheel, simple and compound gear trains;

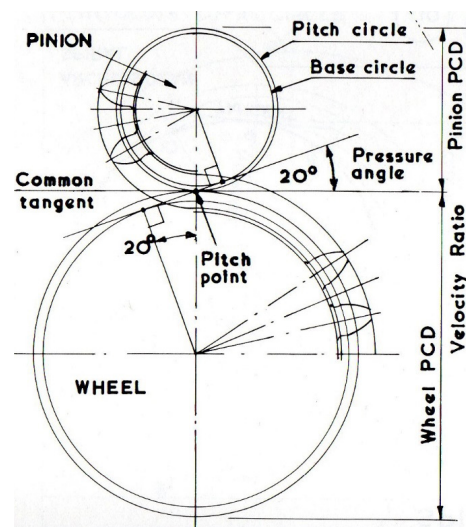
Course content

A gear is a toothed wheel that works together with other gears to alter the speed of the driven gear wheel (driven gear is perhaps powered by a motor). Students need to understand the theory of gears and gear trains and understand their various applications. They need to understand the terminology of gears and how that terminology is applied. They need to understand both simple and compound gear systems and their applications.

What do gears do?

Gears are used in numerous machines. They are put into machines to provide an increase or decrease of speed (RPM). In a car, for example, the engine will run at a very fast speed, perhaps hundreds of revolutions per minute. The vehicle would not drive if the engine was run directly to the wheels as high speeds provide insufficient torque to move the vehicle. In order to reduce the speed from the high revolutions of the engine to more manageable speeds in the road wheels, reduction gears are employed. Another issue is to do with torque.

For example, a small very fast spinning motor can provide power but not enough torque. Gear reduction can reduce the speed but increase the torque.



Gear nomenclature

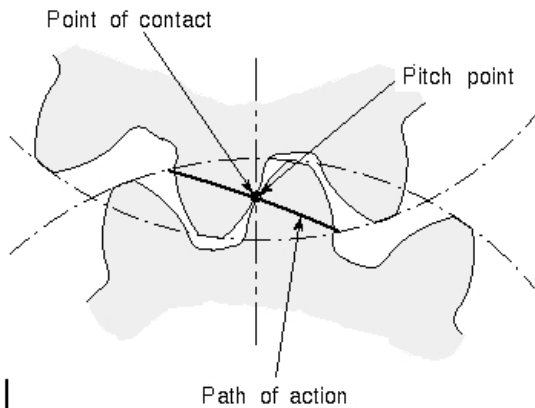
Definitions of the following gear nomenclature or names of the various parts of gears:

Pitch Circle Diameter:

In a gear train, the pitch circles of the gears are the imaginary circles that would turn without slipping if the gears were simple wheels. The best way of imagining a pitch circle is to think of the gear wheels without teeth, just a series of wheels. Those wheels rotate without any slippage. The pitch circle diameter is the diameter of these wheels.

Pitch Point:

The Pitch Point is the point where two gears meet on their pitch circles.



Metric Module:

The Metric Module is the ratio of the pitch circle diameter to the number of teeth in the gear.

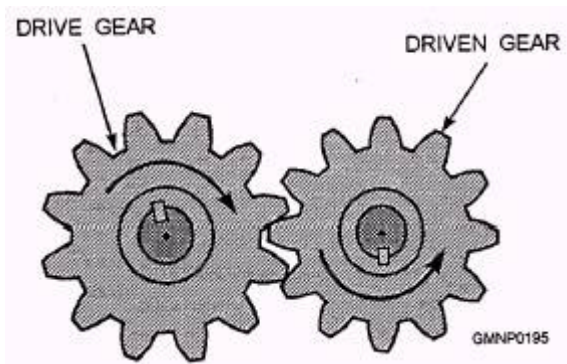
$$\text{Module} = \frac{\text{Pitch Circle Diameter}}{\text{Number of Teeth}}$$

Pinion Wheel:

A pinion wheel is a gear wheel that is usually the smaller gear in a gear train.

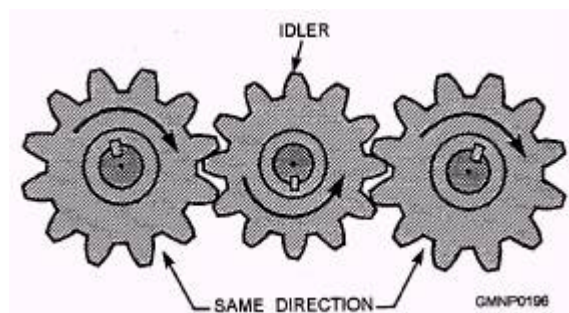
Simple and compound gear trains

A simple gear train consists initially of two gears of different sizes. (To have gears of the same size with the same number of teeth would be pointless as there would be no advantage in the system). One of these gears is usually attached to a motor. This is referred to as the driver gear. The second gear is referred to as the driven gear.



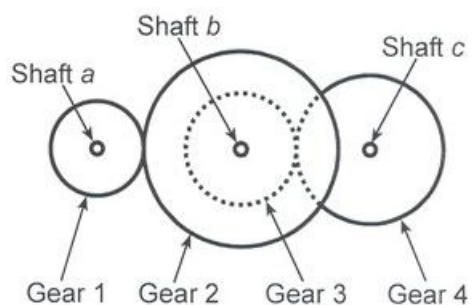
Simple gear train

Sometimes a simple gear train contains three gear wheels. The gear between the driver gear and the driven gear is referred to as an idler gear. The purpose of the idler is usually to change the direction of the output gear. In the simple gear train with two gears, the input and output gear wheels move in opposite directions. In the gear train with an idler gear, the input and output gears move in the same direction. It is important to remember that the idler gear does not affect the gear ratio between the driver gear and the driven gear.



Simple gear train with idler

A compound gear train is more complex. They contain several pairs of meshing gears. Compound gear trains have two or more gears meshing with some gears on the same shaft. They are used in complex situations where large speed changes are required. The advantage of a compound gear train over simple gear trains is twofold. Firstly, much larger speed reduction is possible from the driver to the final driven shaft. Secondly, the space taken up by the gear train would be greatly reduced.



Compound Gear Train

