WORKSHOP TECHNOLOGY - III

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Mechanical Engineering Department
GDGP HISAR

Lesson Plan

Name of the faculty	**:**	**AMIT JANGRA**
Discipline	**:**	**Mechanical Engineering**
Semester	**:**	**4th**
Subject	**:**	**Workshop Technology - III**
Lesson Plan Duration	**:**	**15weeks**
Work Load	**:**	**Lecture (3 Periods/Week)**

For full syllabus please visit here

Attendance
Minimum 70%.

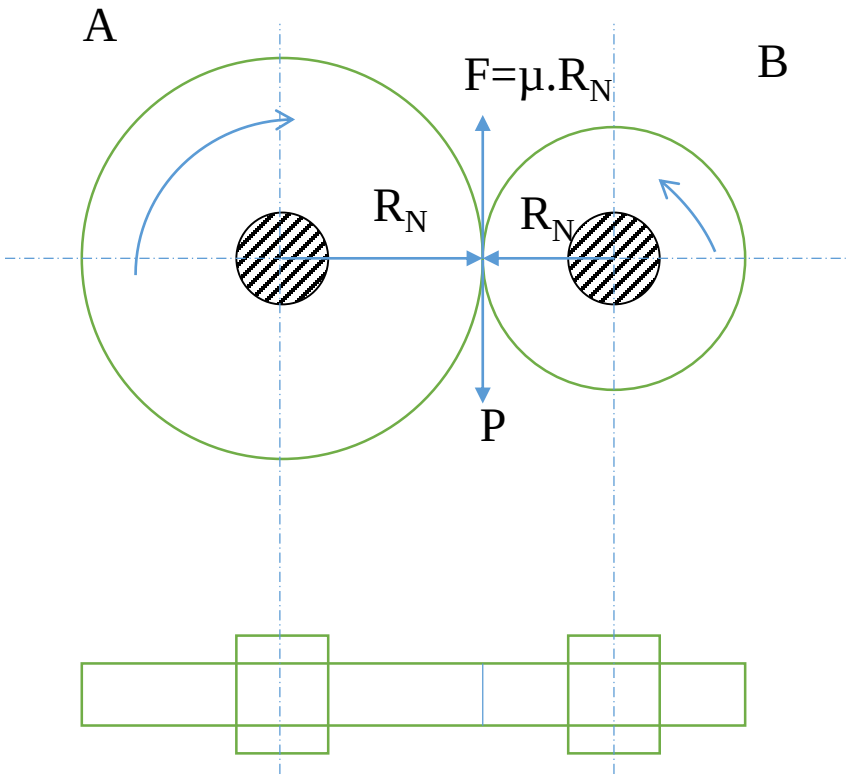
Grading policy
3 Sessional each carry 40 marks (Best of 2 will be considered)
3 Assignments must be submitted

Internal Assessment			External Assessment		
Th	Pr	Total	Th	Pr	Total
40	-	40	60	-	60

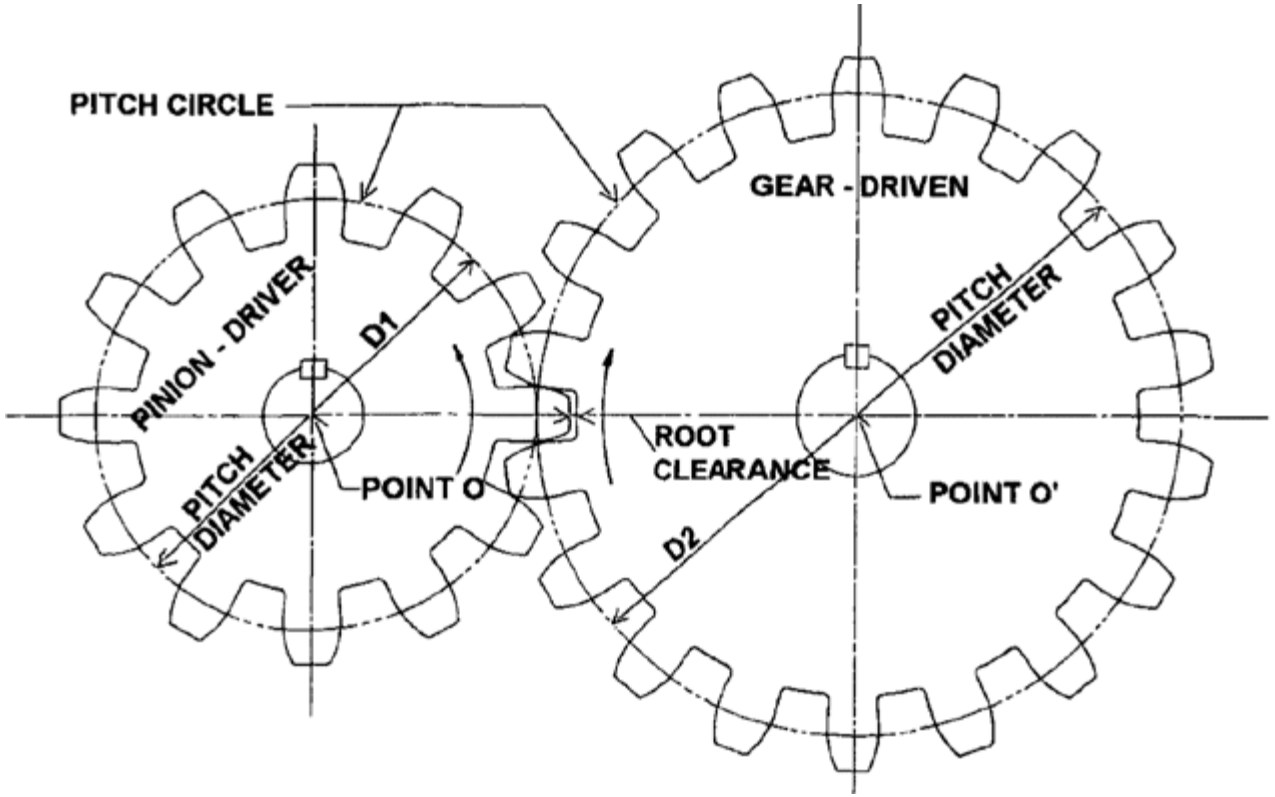
Chapter 1
(Gear Manufacturing and Finishing Process)

Introduction

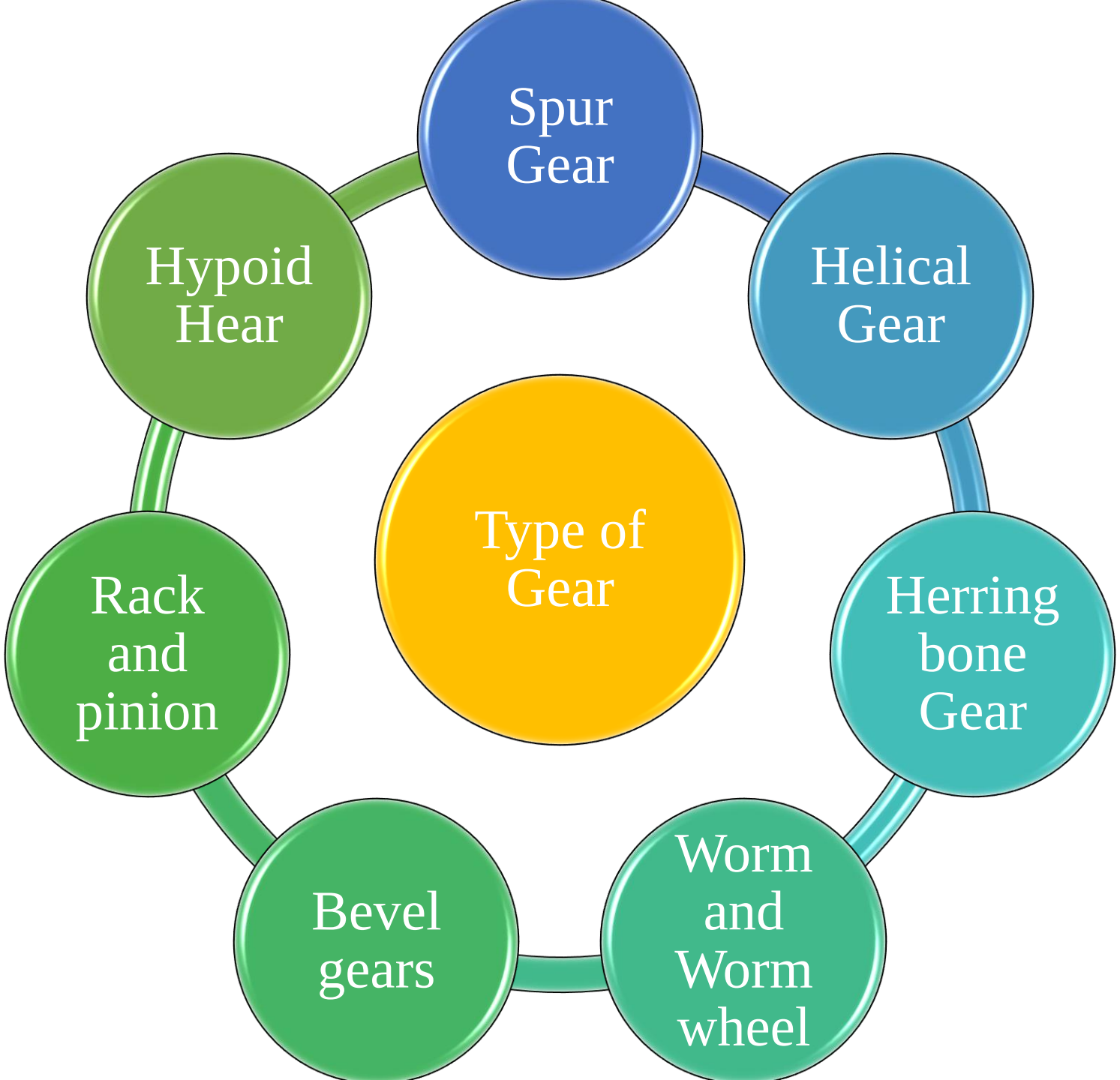
A gear is an important machine element for the transmission of power or rotary motion from the driving shaft to the driven shaft. It is a round blank with teeth on its circumference to have positive drive.



a) Friction wheels



b) Toothed wheels


Spur Gear
Helical Gear
Herring bone Gear
Worm and Worm wheel
Bevel gears
Rack and pinion
Hypoid Hear
Type of Gear

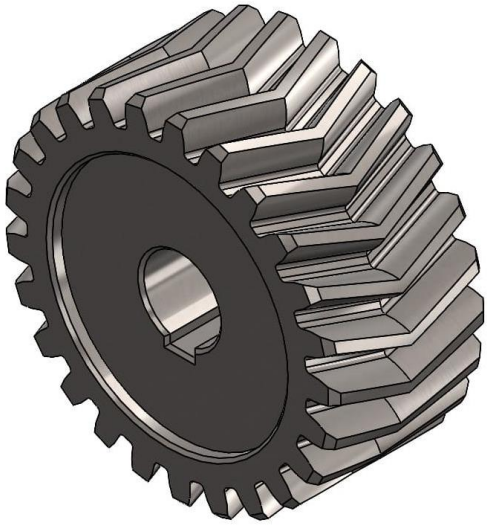
Spur Gear

- Simple
- Teeth are parallel to the axis of gear
- Transmit power between parallel shafts
- Mounting using ball bearing
- 95-99% efficiency
- Washing machine, blender, dryer, railway engines, ball mills, sugar mills etc.

Helical Gear

- Teeth are inclined to the axis of gear (spiral gear or helical)
- Stronger and quieter
- Difficult to make so it is expensive
- Transmit power between parallel and non-parallel shafts
- Mounting using thrust bearing
- Gearbox for automobile, printing industry etc

Herring Bone Gear



- Two single helical gear placed side by side.
- Difficult to make so it is more expensive
- No thrust produced so either to use smaller thrust bearing or eliminate it totally

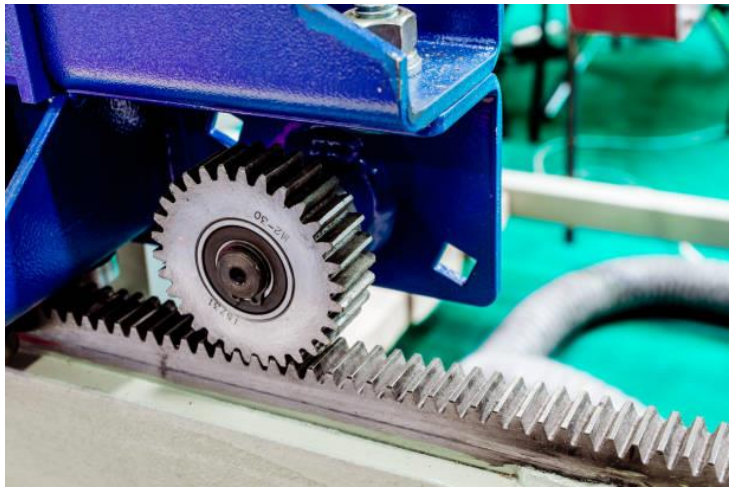
Worm and Worm wheel

- Used to connect
- Teeth are parallel to the axis of gear
- Transmit power between two non-parallel and non-intersecting shafts at 90 degree.
- Worm drives the worm wheel and drive is not reversible.
- Used for high speed reduction. (20:1 or higher)

Bevel Gear

- Simple
- Teeth are parallel to the axis of gear
- Transmit power between two shafts at right angle or at an angle other than right angle but in the same plane.
- Mounting using ball bearing
- 95-99% efficiency
- Cone crushers and sand mixtures, cooling towers, air preheaters, aircrafts etc.

Rack and Pinion



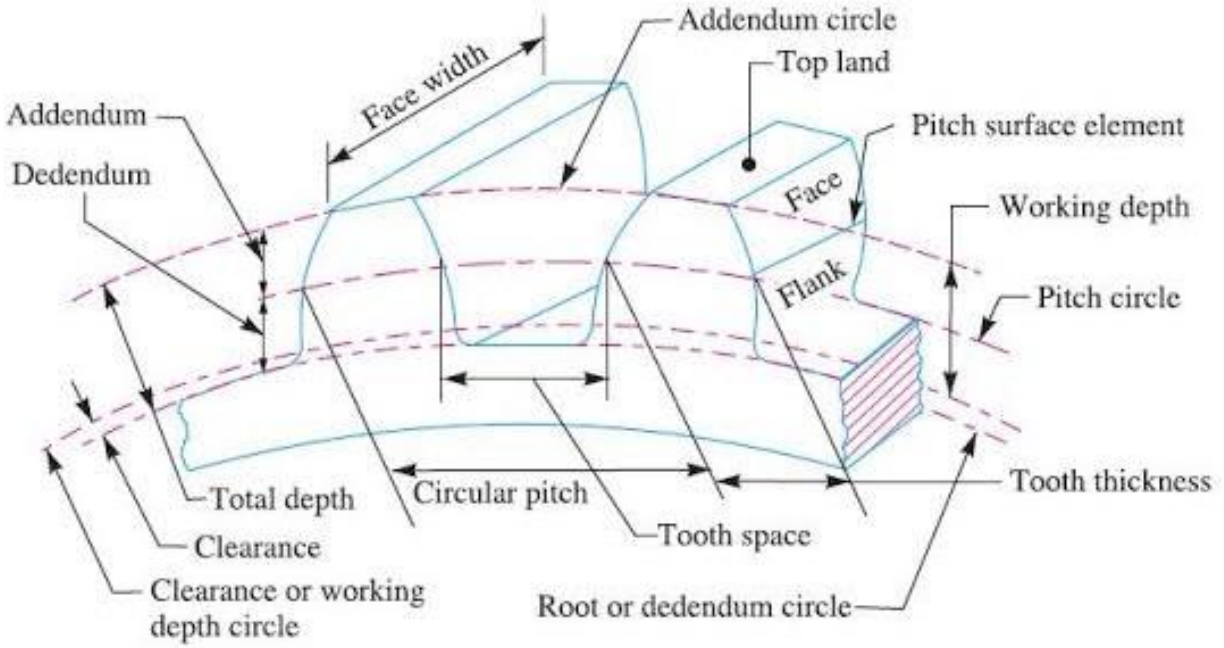
- Rack teeth are cut straight and mesh with ordinary spur gear.
- Convert the reciprocating motion into rotary motion or vice-versa.
- Steering system of cars.

Hypoid Gear

- Similar to bevel gears but the axis of two shafts do not intersect.
- Teeth are curved and stronger than common bevel gears
- Used in automobile rear axle drives.

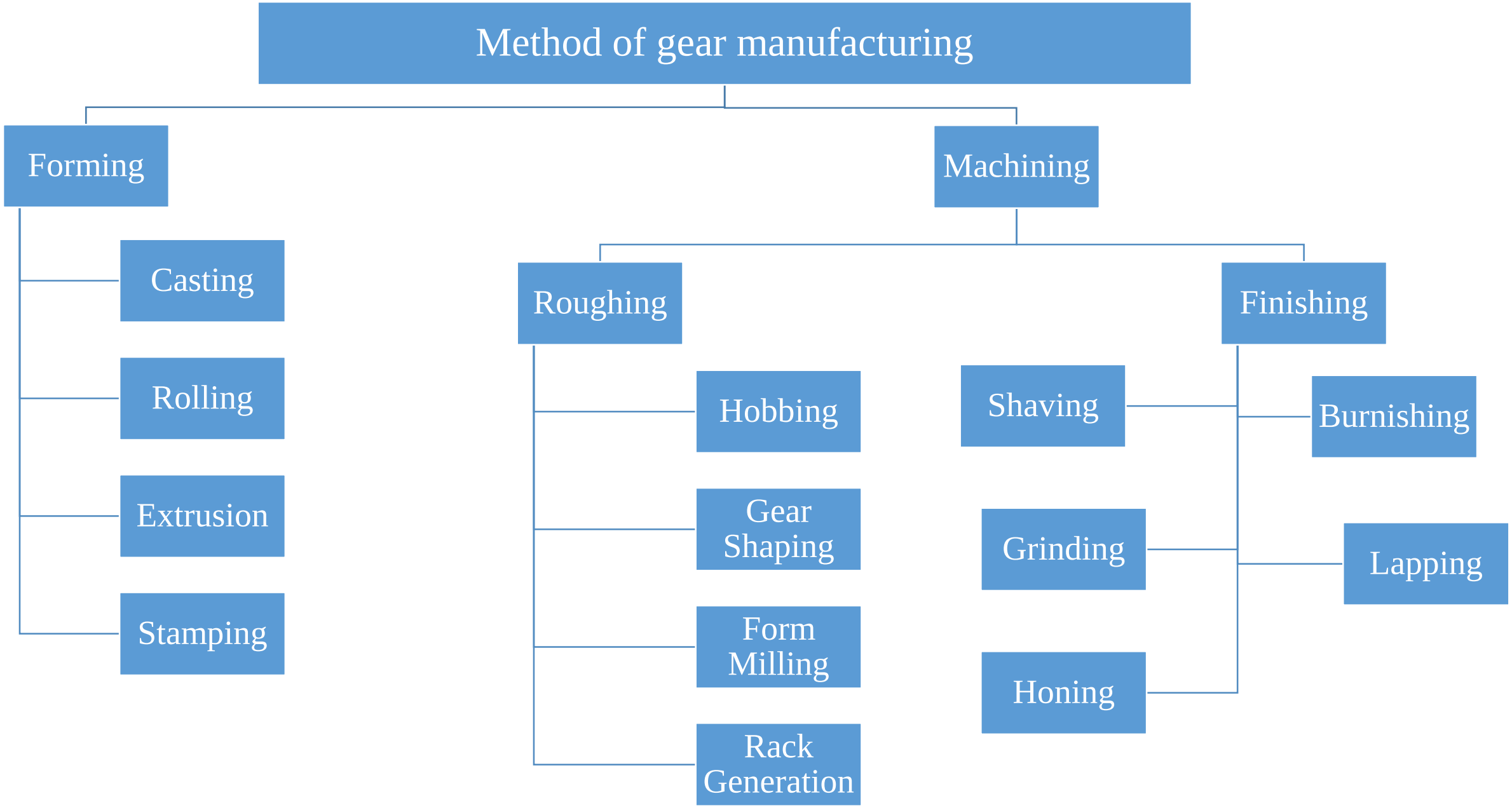
Gear Terminology

A gear is an important machine element for the transmission of power or rotary motion from the driving shaft to the driven shaft. It is a round blank with teeth on its circumference to have positive drive.



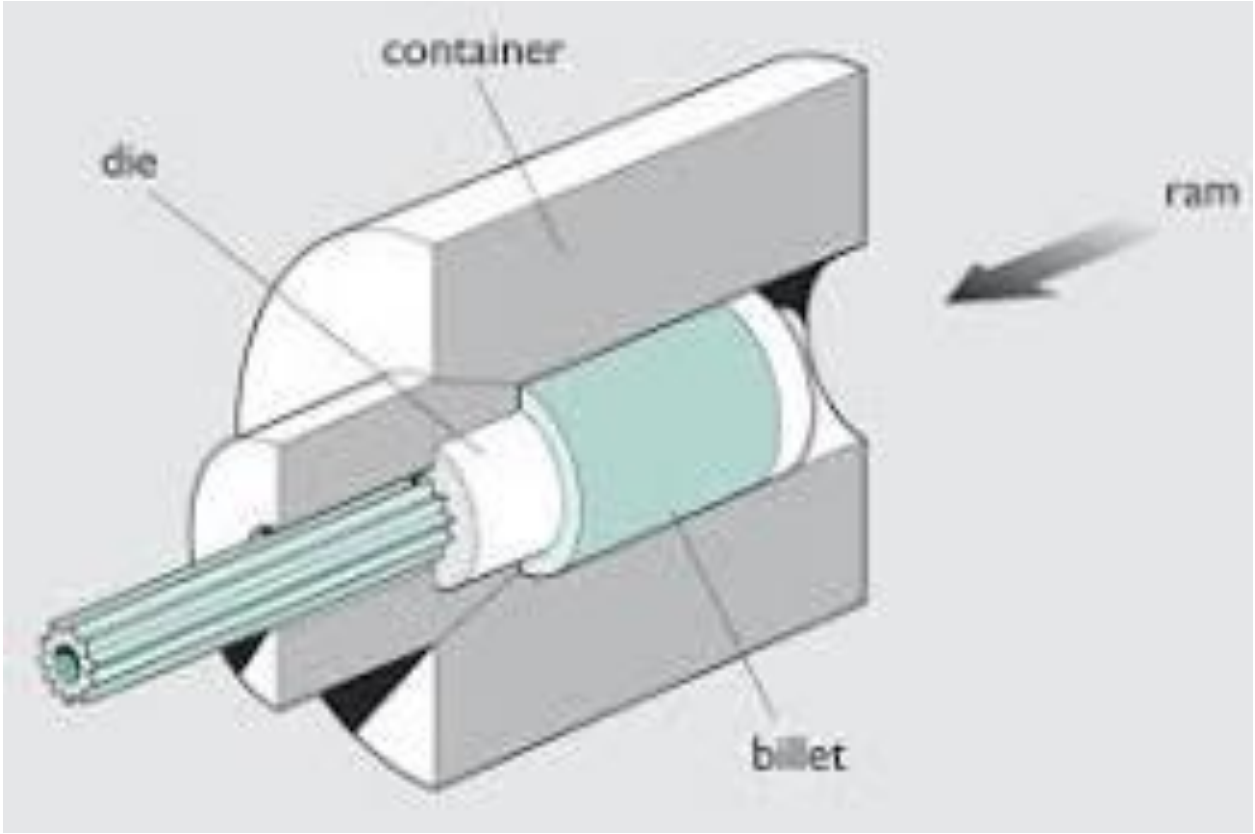
Gear Terminology

To be discussed in detail in the class


Method of gear manufacturing
Forming
Casting
Rolling
Extrusion
Stamping
Machining
Roughing
Hobbing
Gear Shaping
Form Milling
Rack Generation
Finishing
Shaving
Grinding
Honing
Burnishing
Lapping

Gear Casting

Gear Extrusion

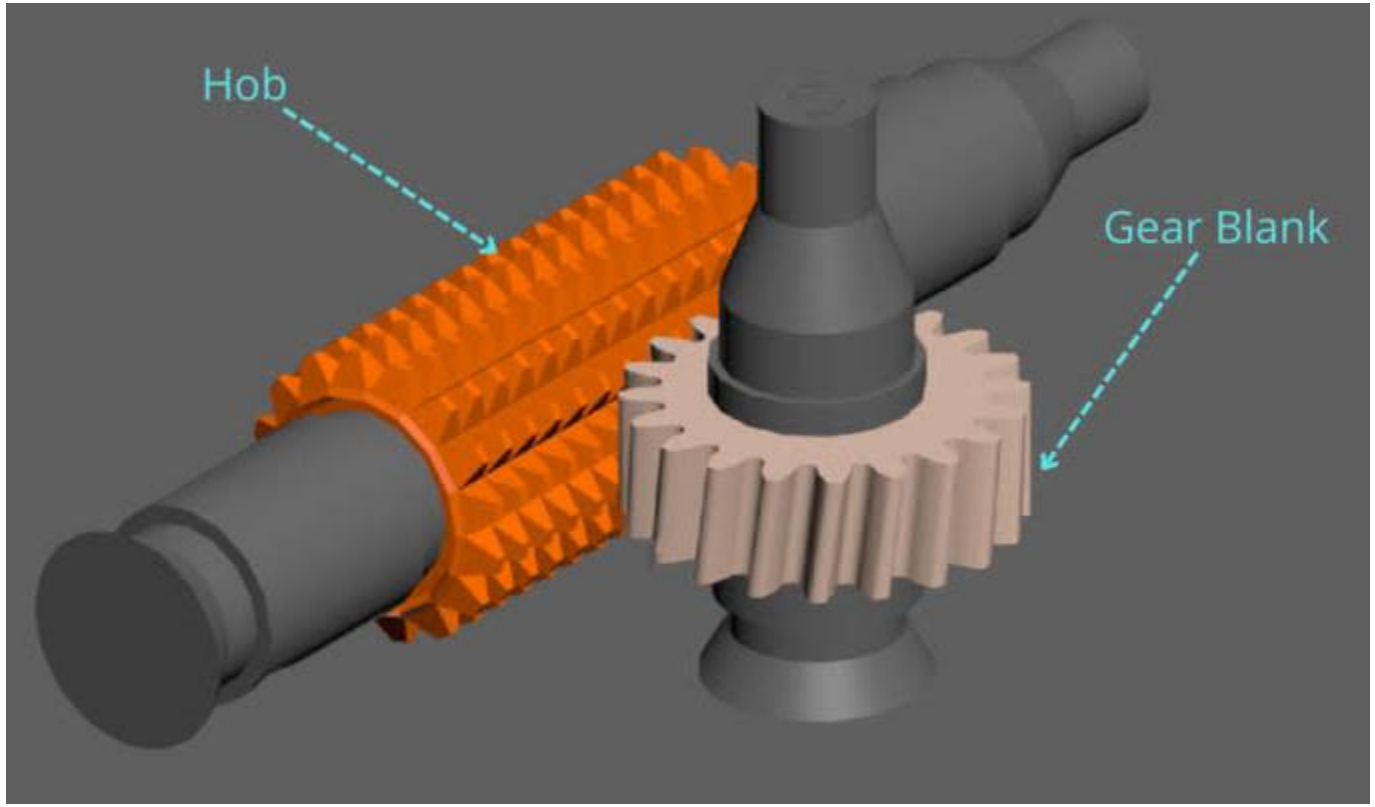


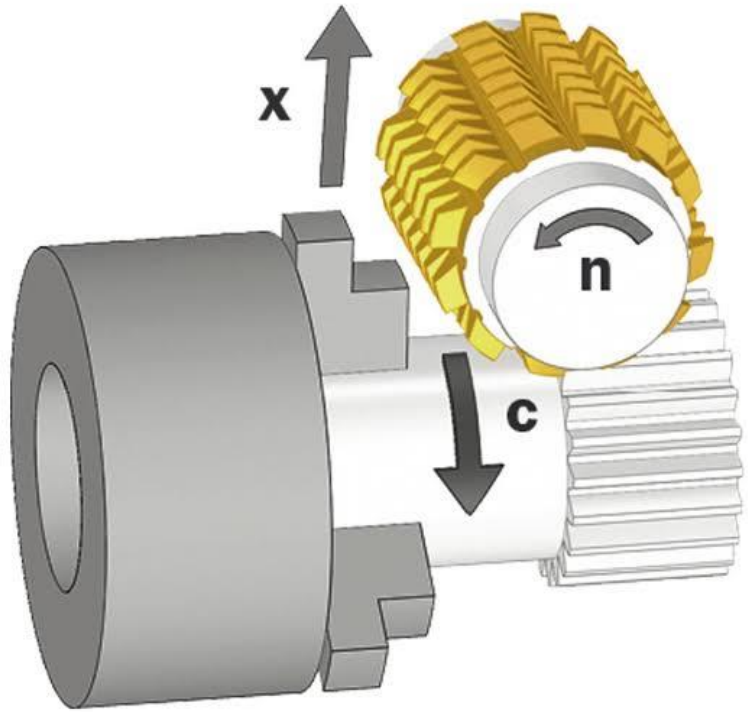
Gear Forging

FIGURE 6. Simulation of part production, (a) raw material, (b) reduction of height, (c) final formation, (d) flashing.

Gear Hobbing

It is a process to generate gear by rotating a cutter called a hob. The revolving cutter cuts like a milling cutter.





Gear Hobbing

Advantage

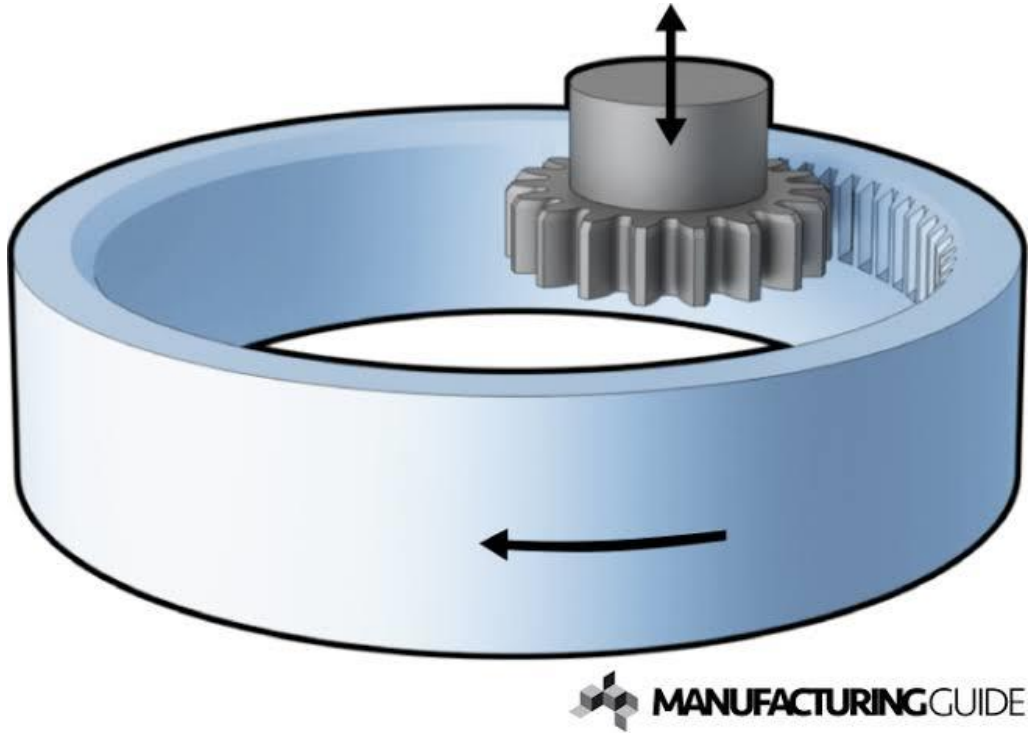
i) It is faster, continuous and economical as compared to other gear generating process
ii) It enables high rate of production and can generate different type of gear
iii) Irrespective of number of teeth same hob is used.
iv) It is an accurate process and adopted for medium and large batch production.

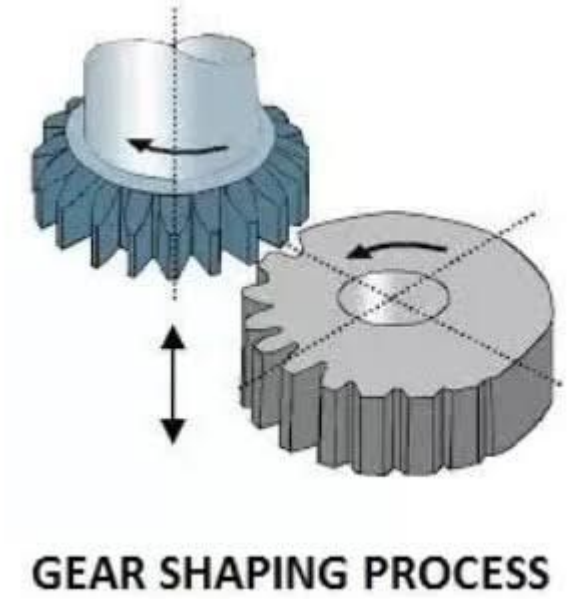
Disadvantage

i) It is not suitable for cutting internal gears.
ii) It is not suitable for cutting cluster gears.
iii) It does not produce unsymmetrical shapes like interrupted gears.

Gear Shaping

This method is based on action which is achieved due to the movement of two meshing gear. One of them is pinion which is cutter while the other is a blank.

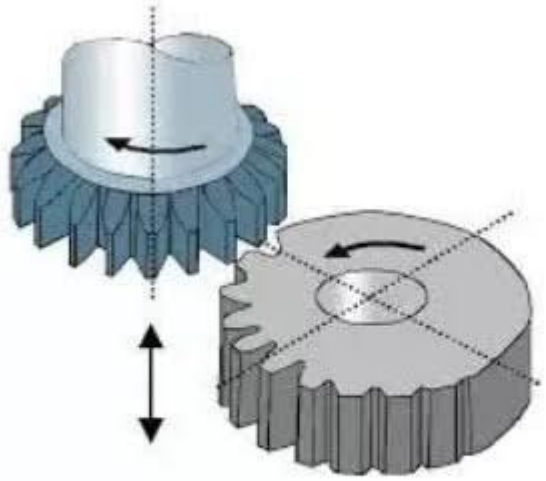




Gear Shaping

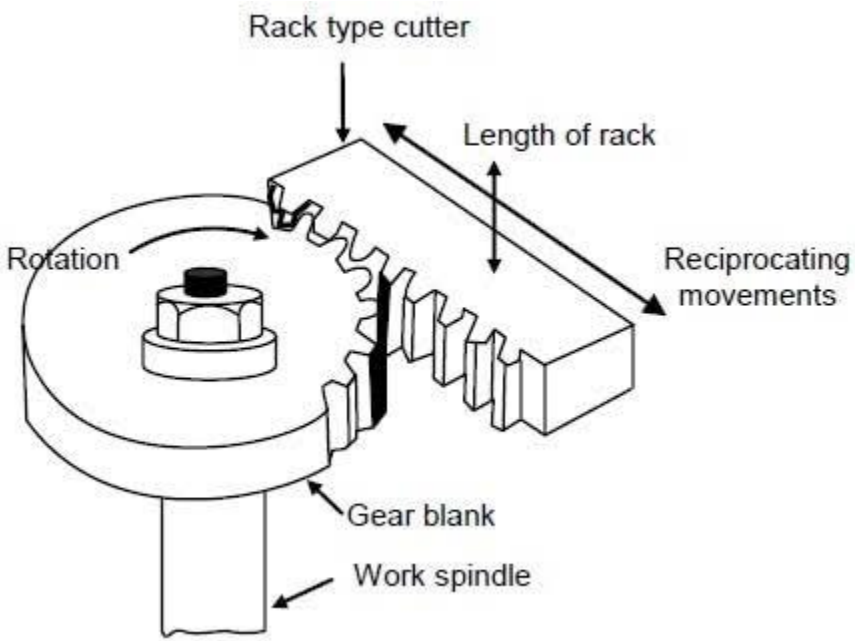
Type of Gear shaping Cutter

Rotary Gear Shaper cutter



GEAR SHAPING PROCESS

Rack type Shaper cutter



Gear Shaping

Advantage

i) Very High accuracy.
ii) Used for medium and large sized gears
iii) Used to cut both internal and external gears.
iv) It can generate different type of gear except worm and worm wheels
v) Irrespective of number of teeth same cutter is used as long as their module is same.

Disadvantage

i) Worm and worm wheels cannot be cut by gear shaping process.
ii) Single cutting takes place during the cutting stroke, thus the time spend in return stoke is a waste.

Hobbing versus Shaping

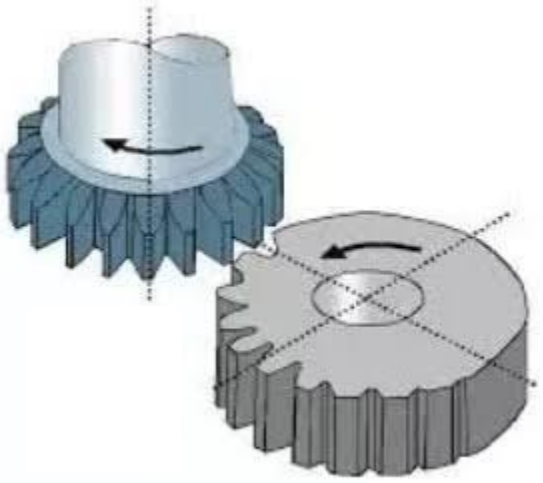
1. Due to continuous process of cutting and indexing and non-reciprocating motion of the hob, the hobbing process is faster as well as more accurate. The hear liberated during cutting is uniformly distributed on the cutter and the work; therefore the distortion of the gear tooth is never a problem with hobbing. Hobbing machines are much simpler and more rigid in construction because of few motions.
2. Shaping enjoys wide popularity for one simple reason that it can cut internal types of gear at a very fast rate. Because of shorter stroke of the cutter, it is possible to cut those gear which have flanges and shoulders in close proximity. A large number of identical and accurate teeth are difficult to manufacture on a shaper cutter,

Gear Finishing Methods

i) Eliminating the after effects of heat treatment
ii) Rectifying the tooth profile and the pitch
iii) Maintaining the concentricity of the pitch circle and the central hole.

Gear burnishing

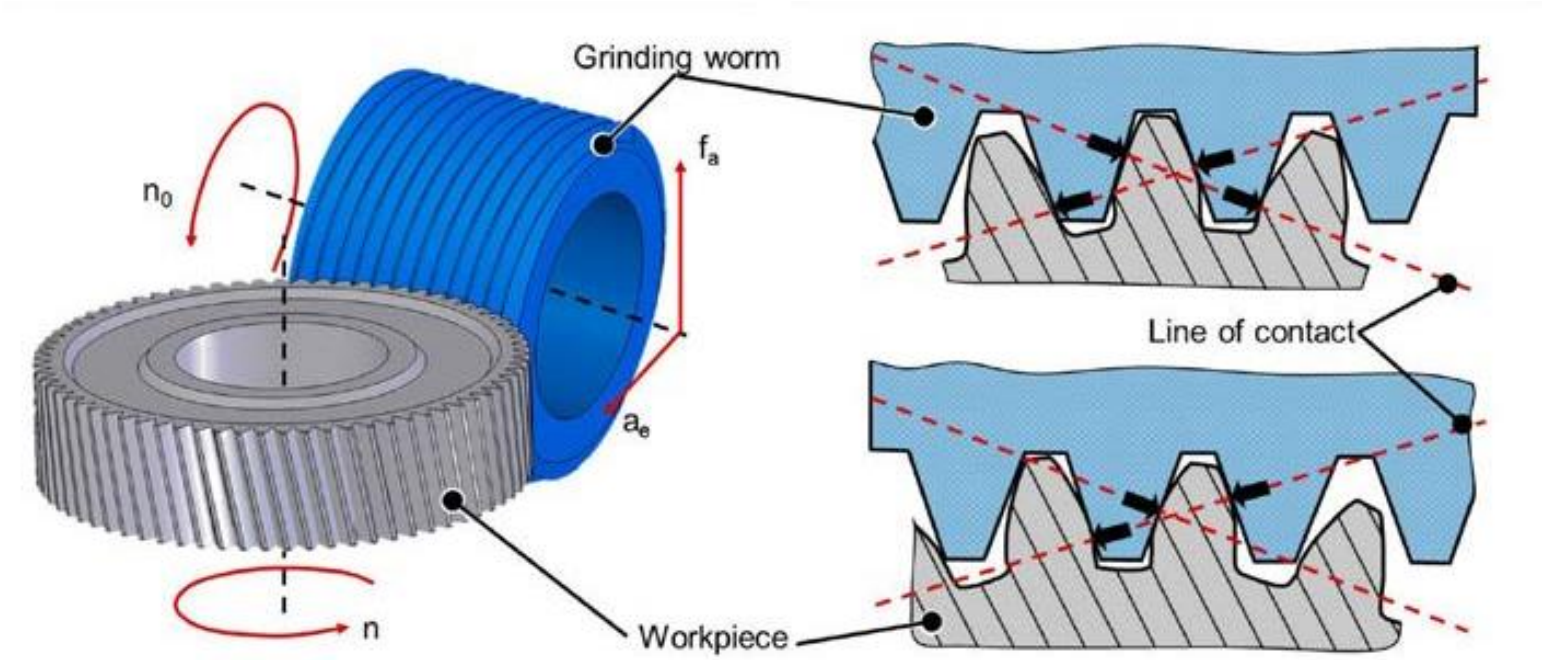
i) Cold working process for unhardened gears
ii) Standard and highly hardened gear is rolled around work gear.
iii) Both rotate in perfect alignment
iv) Not advisable for precision gears due to localized residual stresses.



Gear Finishing Methods

Gear grinding

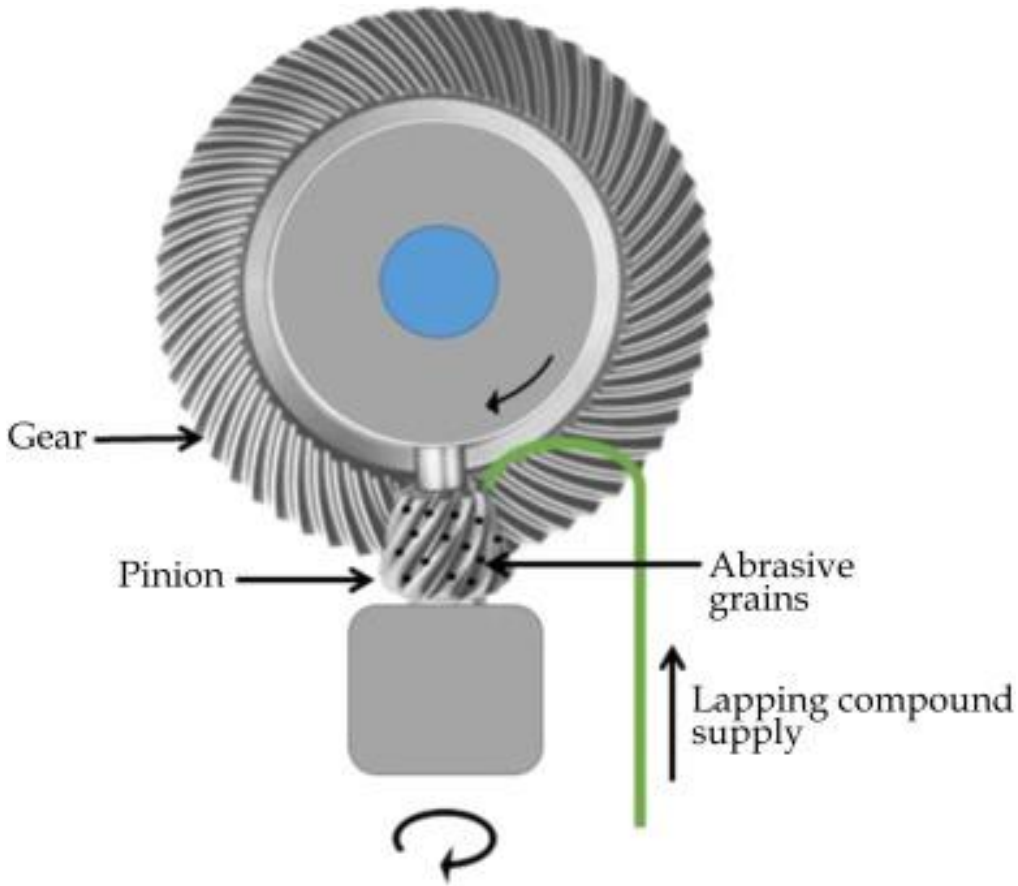
i) Used for hardened gears
ii) Heat treatment may caused severe distortion and oxide film formed on teeth require removing of material.
iii) Grinding method is used to finish the heat treated gears.
iv) This is slower and expensive.
v) Provide highest quality gears.



Gear Finishing Methods

Gear Lapping

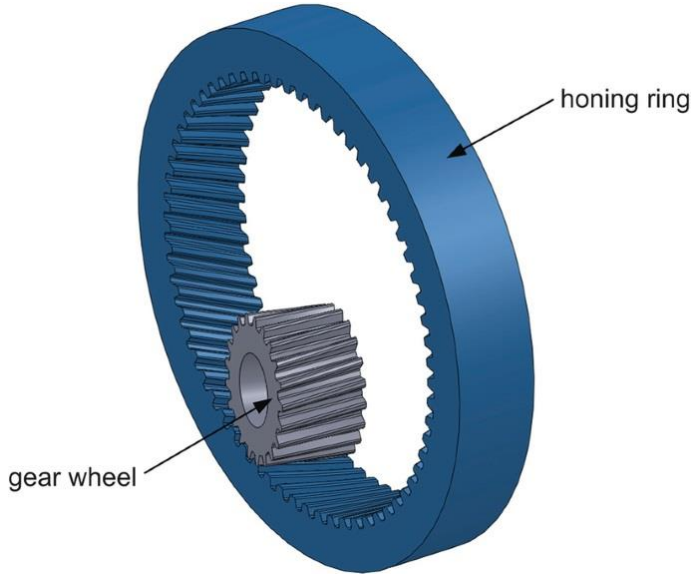
i) Used to achieve very high degree of finish.
ii) It is done after burnishing.
iii) Performed with the help of **cast iron gears** which carry abrasives.
iv) Cast iron gears are made to run in contact with the gear and a flow of very fine abrasive is maintained.
v) Can correct small errors upto 0.05mm.



Gear Finishing Methods

Gear honing

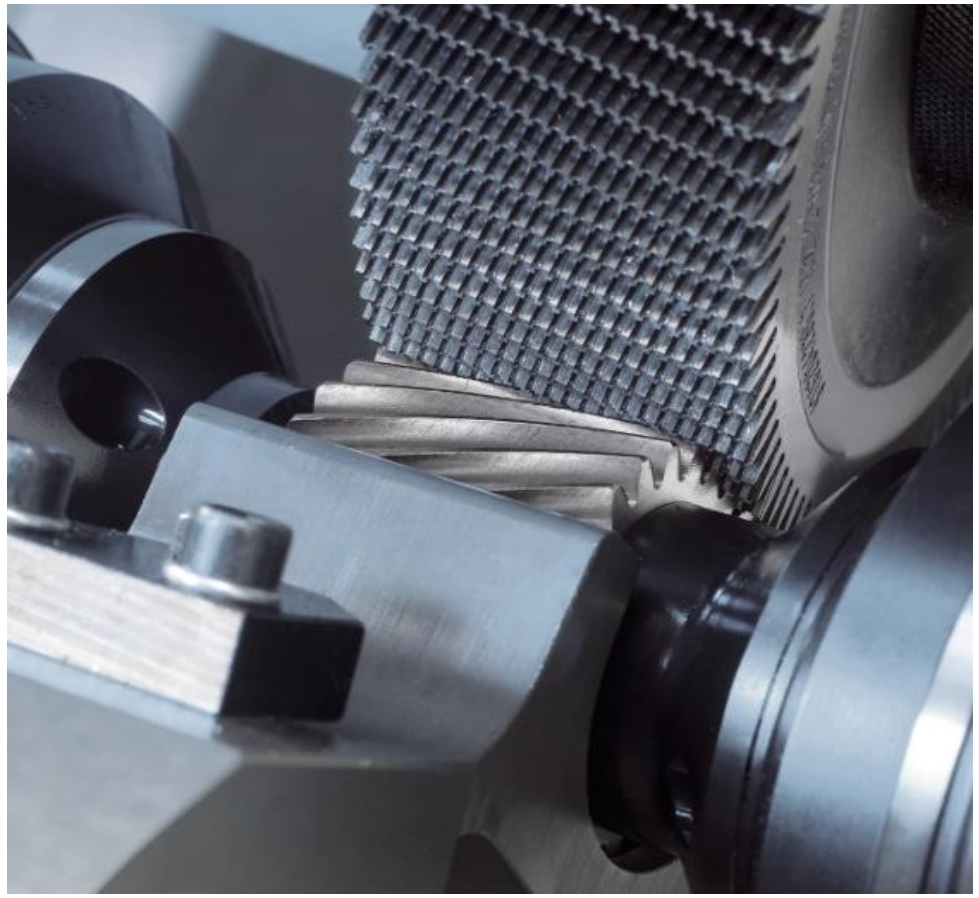
i) Last operation performed on hardened gears
ii) Also correct gear errors.
iii) Remove minor nick and burrs and gives fine surface finish.
iv) Helps in achieving low level of noise emission required in many application.
v) Honing materials can be corundum, silicon carbide, cubic boron nitride, and diamond



Gear Finishing Methods

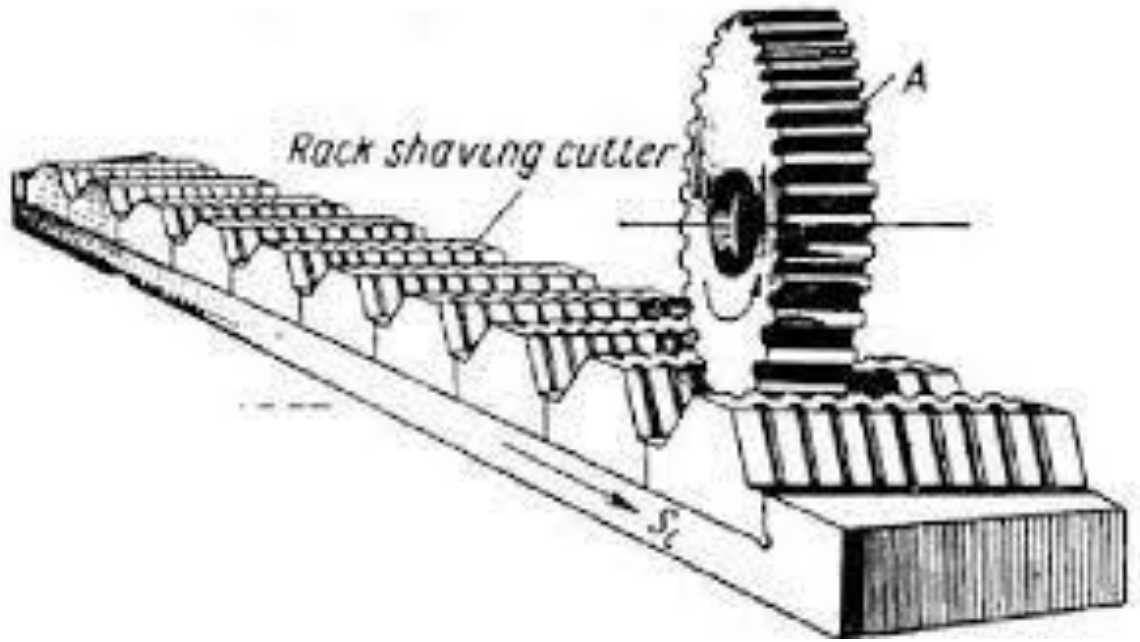
Rotary gear shaving method

i) Extensively used method where a rotary shaving cutter meshes with a work gear.



Rack gear shaving method

i) Gear shaving is done by gear rolling on the rack type cutter.
ii) Also reciprocates back and forth across the face of the cutter



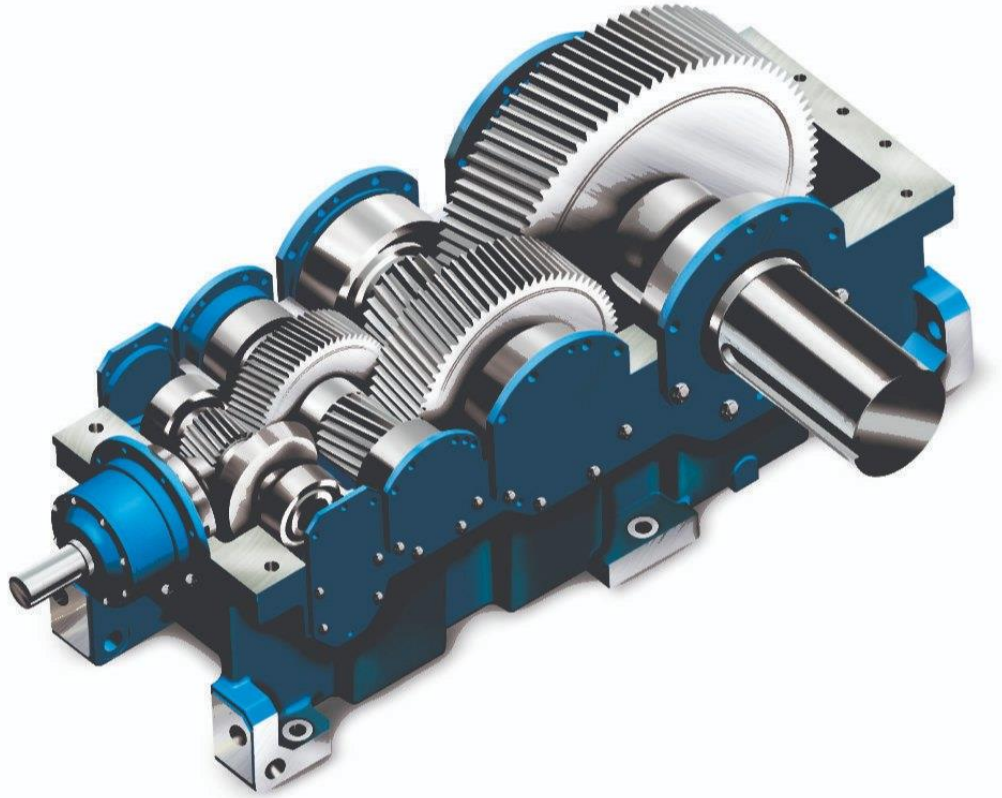
Comparison of rotary shaving with rack shaving methods

S. No.	Points	Rotary shaving method	Rack shaving methods
1.	Initial cost of cutter	It is less expensive.	It is more expensive.
2.	Design of machine	Machine design is simple and smaller in size.	Machine design is complex and larger in size.
3.	Chip disposal	Satisfactory	Unsatisfactory
4.	Scope	Shaves both external and internal spur and helical gears	Shaves only external type spur and helical gears
5.	Cost of grinding of tools	It has lower grindings cost of tool	It has higher grindings cost of tool
6.	Tool life	Low	high
7.	Tool replacement	Separate teeth of cutter cannot be replaced	Separate teeth of cutter can be replaced
8.	Machining allowance removal	0.10 to 0.20 mm	0.14 to 0.30 mm

Materials for Gears

Gears are made from metals and non-metals.

Metals
- Cast iron
- Cast steel
- Structure steel
- Gun metal and brass



Case Hardening: - Low carbon steel gear teeth are hardened by carburizing process
Flame Hardening: - High carbon steel gear teeth are hardened by heating with flames and quenched in water.

Materials for Gears

Non-Metals
- Synthetic plastics fibres
- laminated

Selection of material for a gear

i) Peripheral speed required
ii) Amount of power to be transmitted.
iii) Size and weight of the drive.
iv) Mode of drive i.e. continuous or intermittent
v) Expected degree of accuracy.
vi) Method of manufacture to be used
vii) Resistance to wear and shock.
viii) Permissible stresses
ix) Type of drive i.e. open or enclosed.
x) Service requirements i.e. a noiseless drive or light drive etc.

Please refer to your book for details

Thank You