CHAPTER 2

GEAR
Introduction

• Problem- How to transmit power?
• Gear train- 2 or more gear made to mesh other
• Gear is attached to shaft
• Objective/reason- transit power
Type of Gear

Spur

• Simplest type of gear
• Teeth parallel to gear axes
Helical Gear

• Teeth are cut on helices instead of straight cross
• 2 mating parts must have same helix angle
• Application- impact, less noise
Rack and pinion

- Can be considered as spur gear
- Convert motion - linear to rotary
Gear Train

• Type of gear train;
  – Simple gear train- fixed shaft
  – Compound gear train- fixed shaft
  – Reverted gear train- fixed shaft
  – Epicyclical gear train- non-fixed shaft
Type of Gear

Figure 10.3 Gear types.
Simple Gear Train

Speed ratio: \[ \frac{N_1}{N_2} = \frac{T_2}{T_1} \]

Train value: \[ \frac{N_2}{N_1} = \frac{T_1}{T_2} \]
Compound Gear Train

• When there are more than one gear on a shaft

\[
\frac{N_1}{N_2} = \frac{T_2}{T_1} \quad \text{...(i)}
\]

Similarly, for gears 3 and 4, speed ratio is

\[
\frac{N_3}{N_4} = \frac{T_4}{T_3} \quad \text{...(ii)}
\]

and for gears 5 and 6, speed ratio is

\[
\frac{N_5}{N_6} = \frac{T_6}{T_5} \quad \text{...(iii)}
\]

The speed ratio of compound gear train is obtained by multiplying the equations (i), (ii) and (iii),

\[
\therefore \quad \frac{N_1}{N_2} \times \frac{N_3}{N_4} \times \frac{N_5}{N_6} = \frac{T_2}{T_1} \times \frac{T_4}{T_3} \times \frac{T_6}{T_5} \quad \text{or} \quad \frac{N_1}{N_6} = \frac{T_2}{T_1} \times \frac{T_4}{T_3} \times \frac{T_6}{T_5}
\]

* Since gears 2 and 3 are mounted on one shaft B, therefore \(N_2 = N_3\). Similarly gears 4 and 5 are mounted on shaft C, therefore \(N_4 = N_5\).
Gear Kinematic

\[ \frac{\omega_1}{\omega_2} = \frac{r_1}{r_2} = VR \]
Example

Grocery checkout conveyor

\[ N_2 = 45 \text{ teeth} \]

\[ \omega_1 = 1800 \text{ rpm} \]

\[ N_1 = 15 \text{ teeth} \]
**Example**

**Note:** The gears which mesh must have the same circular pitch or module. Thus gears 1 and 2 must have the same module as they mesh together. Similarly gears 3 and 4, and gears 5 and 6 must have the same module.

**Example 13.1.** The gearing of a machine tool is shown in Fig. 13.3. The motor shaft is connected to gear A and rotates at 975 r.p.m. The gear wheels B, C, D and E are fixed to parallel shafts rotating together. The final gear F is fixed on the output shaft. What is the speed of gear F? The number of teeth on each gear are as given below:

<table>
<thead>
<tr>
<th>Gear</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of teeth</td>
<td>20</td>
<td>50</td>
<td>25</td>
<td>75</td>
<td>26</td>
<td>65</td>
</tr>
</tbody>
</table>

![Fig. 13.3](image-url)
or

\[
\frac{N_A}{N_F} = \frac{T_B \times T_D \times T_F}{T_A \times T_C \times T_E} = \frac{50 \times 75 \times 65}{20 \times 25 \times 26} = 18.75
\]

\[\therefore\]

\[
N_F = \frac{N_A}{18.75} = \frac{975}{18.75} = 52 \text{ r. p. m. Ans.}
\]