9. SPUR GEAR DESIGN

GEAR: It's a toothed wheel used for transmission of power from one shaft to another.

TOOTH DIRECTION	In the direction of axis of wheel	**SPUR GEAR**
	Tooth is inclined with the axis of wheel	**HELICAL GEAR**

Gear Pair is made of **GEAR** and **PINION**.

$m = \frac{d_p}{Z_p} = \frac{d_g}{Z_g}$ $d = \frac{d_p + d_g}{2} = \frac{m(Z_p + Z_g)}{2}$	m = Module of Gear, d = Centre to centre Distance between two gears,	Z_p = No. of tooth on Pinion, Z_g = No. of tooth on Gear, d_p = Pinion Diameter (PCD), d_g = Gear Diameter (PCD),

ASSUMPTIONS IN WILFRED LEWIS EQUATION:

1. At any point of time there will be only one pair of teeth in contact.
2. The tangential load (F_t) is distributed uniformly throughout the width.
3. The effect of radial load is neglected.
4. Consider Tooth as Beam of uniform strength.
5. Stress concentration effects are neglected.

$Circular\ Pitch\ (p_c) = \pi m$ $M_{max} = F_t h$ $\sigma_{max} = \left(\frac{M_{max}}{I}\right) y_{max} = \frac{6 F_t h}{b t^2}$ $\boldsymbol{F_t = \sigma_{max} p_c b y = \sigma_{max} m b Y}$ $y = \frac{t^2}{6 h p_c}\ and\ Y = \frac{t^2}{6 h m}$ $Y = \pi y$	Lewis Factor depends on No. of tooth and profile of teeth. **Y IS CLOSER OR GREATER THAN 0.3** F_t = Uniform Tangential load, σ_{max} = Maximum bending Stress,	M_{max} = Maximum bending moment, h = Depth of teeth base, t = Thickness of teeth base, b = Width of teeth base, $\boldsymbol{Y}$ **= Modified Lewis Form factor,** $\boldsymbol{y}$ **= Lewis Form factor,**

EQUIVALENT LOAD ON TEETH:

$Power\ P = \frac{2\pi N T}{60}$ If $C_v \leq 1$, $\boldsymbol{T_{max} = \frac{C_s T}{C_v}\ And\ F_{eq} = \frac{C_s F}{C_v}}$ If $C_v > 1$, $T_{max} = C_s C_v T\ And\ F_{eq} = C_s C_v F$	C_s is used to incorporate Fluctuation of power transmission. C_v is used to incorporate Impact Load Due to power transmission	T = Mean Torque = $F r$ N = Mean Speed, F = Mean Tangential Load, T_{max} = Maximum Torque, C_s = Service Factor, C_v = Velocity Factor, F_{eq} = The Max. Tangential Load,

DESIGN CONDITION:

$\sigma_{max} = \sigma_{yt} / FOS\ And\ F_{eq} = F$ $\boldsymbol{\frac{C_s F}{C_v} = \frac{\sigma_{yt}}{FOS} m b Y}$	σ_{max} = Maximum bending Stress, σ_{yt} = Yield Strength of material,

WEAR STRENGTH (HERTZ THEORY):

Pitting: Surface Fatigue Failure due to repetitive loads.

Failure Condition: $\boldsymbol{\sigma_c > \sigma_e}$ $F_w = K d_p b Q$ $K = \frac{\sigma_e^2 \sin \emptyset}{1.4}\left[\frac{1}{E_p} + \frac{1}{E_g}\right]$ $Q = \frac{2Z_g}{Z_g - Z_p}, for\ External\ Gear$ $Q = \frac{2Z_g}{Z_g - Z_p}, for\ Internal\ Gear$	K = Load Stress Factor, E_p = Young's Modulus of Pinion, E_g = Young's Modulus of Gear, Q = Ratio Factor, σ_c = Contact Stress, σ_e = Surface Endurance Strength of tooth material, F_w = Wear Strength = Maximum tangential load that can be applied to avoid pitting failure, $\emptyset$ = Pressure Angle,