1) Sketch a Section through a Sliding type gear box with four forward and one reverse Speeds and explain clearly how the different Speed ratios will be obtained. in the following cases.

Gear on the top gear = 1:1
Gear ratio on third gear = 1:38:1
Gear ratio on Second gear = 2.24:1
Gear ratio on First Gear = 3.8:1
Gear ratio on Reverse gear = 3.8:1

Assume counter Shaft or layshaft Speed is half that of the engine Speed and the Smallest gear is not to have less than 15 teeth.

Given:

$G_1 = 3.8:1 \Rightarrow 3.8$

$G_2 = 2.24:1 \Rightarrow 2.24$

$G_3 = 1.38:1 \Rightarrow 1.38$

$G_4 = 1:1 \Rightarrow 1$

$G_R = 3.8:1 \Rightarrow 3.8$

$N_B = \frac{1}{2} N_A$

Smallest Gear not less than = 15 teeths

Do design

Four Speed Gearbox

Solution:

WKT

$$G_1 = \frac{T_B}{T_A} \times \frac{T_D}{T_C}$$

$$\boxed{3.8 = \frac{T_B}{T_A} \times \frac{T_D}{T_C}} \rightarrow (1)$$

from general expression

$$\frac{N_A}{N_B} = \frac{T_B}{T_A}$$

$$\frac{N_A}{\frac{1}{2} N_A} = \frac{T_B}{T_A}$$

$$\boxed{\frac{T_B}{T_A} = 2} \Rightarrow \boxed{T_B = 2T_A}$$

Apply in (1)

$$3.8 = 2 \times \frac{T_D}{T_C}$$

$$\boxed{T_D = 1.9\, T_C}$$

(4) → (5)

W.K.T

$$T_A + T_B = T_C + T_D$$

$$T_A + 2T_A = T_C + 1.9T_C$$

$$3T_A = 2.9T_C$$

$$\frac{T_A}{T_C} = \frac{2.9}{3}$$

↓ converting it to ratio

$$T_A : T_C = 2.9 : 3$$

Considering this gear ratio, we get

$$T_A = 29 \text{ teeths}$$

$$T_C = 30 \text{ teeths}$$

$$T_B = 2T_A = 2 \times 29$$

$$T_B = 58 \text{ teeths}$$

$$T_D = 1.9T_C$$

$$= 1.9 \times 30$$

$$T_D = 57 \text{ teeth}$$

"Actual" → $G_1 = \frac{T_B}{T_A} \times \frac{T_D}{T_C} = \frac{58}{29} \times \frac{57}{30}$

$$G_1 = 3.8 : 1$$

$$G_2 = \frac{T_B}{T_A} \times \frac{T_f}{T_E}$$

$$2.24 = 2 \times \frac{T_f}{T_E}$$

$$\boxed{T_f = 1.12\, T_E}$$

$$T_A + T_B = T_E + T_f$$

$$29 + 58 = T_E + T_f$$

$$87 = T_E + 1.12\, T_E$$

$$\boxed{T_E = 41 \text{ teeth}}$$

$$T_f = 1.12 \times 41$$

$$\boxed{T_f = 46 \text{ teeth}}$$

$$G_3 = \frac{T_B}{T_A} \times \frac{T_H}{T_G}$$

$$1.38 = 2 \times \frac{T_H}{T_G}$$

$$\boxed{T_H = 0.69\, T_G}$$

Actual

$$G_2 = \frac{T_B}{T_A} \times \frac{T_f}{T_E}$$

$$= \frac{58}{29} \times \frac{46}{41}$$

$$\boxed{G_2 = 2.24 : 1}$$

Actual G_3

$$G_3 = \frac{T_B}{T_A} \times \frac{T_H}{T_G}$$

$$= \frac{58}{29} \times \frac{36}{52}$$

$$\boxed{G_3 = 1.385 : 1}$$

4 → 6

$$T_A + T_B = T_G + T_H$$

$$29 + 58 = T_G + 0.69 T_G$$

$$\boxed{T_G = 52 \text{ teeth}}$$

$$T_H = 0.69 \times 52$$

$$\boxed{T_H = 36 \text{ teeth}}$$

$$GR_a = \frac{T_B}{T_A} \times \frac{T_{I_2}}{T_C} \times \frac{T_D}{T_{I_1}}$$

$$3.8 = 2 \times \frac{T_{I_2}}{30} \times \frac{57}{T_{I_1}}$$

$$\frac{T_{I_2}}{T_{I_1}} = 1$$

$$\boxed{T_{I_2} = T_{I_1}}$$

Actual

$$GR = \frac{T_B}{T_A} \times \frac{T_{I_2}}{T_C} \times \frac{T_D}{T_{I_1}}$$

$$= \frac{58}{29} \times \frac{15}{30} \times \frac{57}{15}$$

$$GR = 3.8 : 1$$

So, the minimum teeth that a gear must have is 15, so

$$\boxed{T_{I_1} = T_{I_2} = 15 \text{ teeth}}$$

Result:

T_A = 29 teeths

T_B = 58 teeths

T_C = 30 teeths

T_D = 57 teeths

T_E = 41 teeths

T_F = 46 teeths

T_G = 52 teeths

T_H = 36 teeths

T_{I_1} = 15 teeths

T_{I_2} = 15 teeths

Actual

G_1 = 3.8 : 1

G_2 = 2.24 : 1

G_3 = 1.385 : 1

G_4 = 1 : 1

G_R = 3.8 : 1