$$Nd = l$$

$$\frac{N}{l} = \frac{1}{d}$$

d = diameter of Cross-sectional wire

$$\boxed{n = \frac{1}{d}}$$
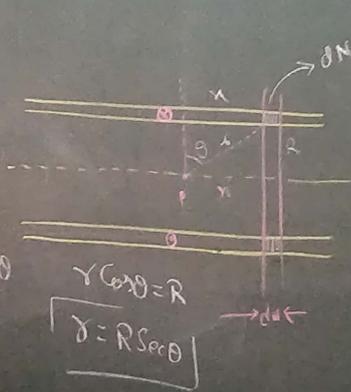
N = Total No. of turns

n = Turns per unit length

$$\boxed{n = \frac{N}{l}}$$

$$\tan\theta = \frac{x}{R}$$

$$x = R\tan\theta$$

$$dx = R\sec^2\theta \, d\theta$$

$$dN = n\,dx$$

$$r\cos\theta = R$$

$$\boxed{r = R\sec\theta}$$

$$\boxed{B = \frac{\mu_0 n i}{2}(\sin\alpha + \sin\beta)}$$

$$dB = \frac{\mu_0}{2}\frac{(dN)iR^2}{r^3} = \frac{\mu_0}{2}\frac{(n\,dx)iR^2}{R^3\sec^3\theta}$$

$$dB = \frac{\mu_0}{2}\frac{n(R\sec^2\theta \, d\theta)iR^2}{R^3\sec^3\theta}$$

$$\int dB = \frac{\mu_0}{2}ni\int_{-\beta}^{\alpha}\cos\theta \, d\theta$$