Assignment#1 Solution

Q1)

Cutting Speed: $V_c = 165\,\frac{mm}{s}$

Feed Speed: $Feed = 0.25\,\frac{mm}{rev}$

Depth of cut: $d = 5\,mm$

Efficiency: e =0.85

Specific Cutting Energy: $SCE = 1.6\,\frac{J}{mm^3}$

$MRR = V_c.Feed.d = 206.25\frac{mm^3}{s}$

$P = \frac{MRR.SCE}{e} = 388.24\,W$

Q2)

$\alpha = 10°$ Rake angle

$t_0 = 0.5mm$ Chip thickness before the cut (depth of cut)

$t_c = 1.25mm$ Chip thickness

$SCE = 0.7\,\frac{J}{mm^3}$

$V_c = 120\,\frac{m}{min}$

$F_c = 1550\,N$

$r = \frac{t_0}{t_c} = 0.4$

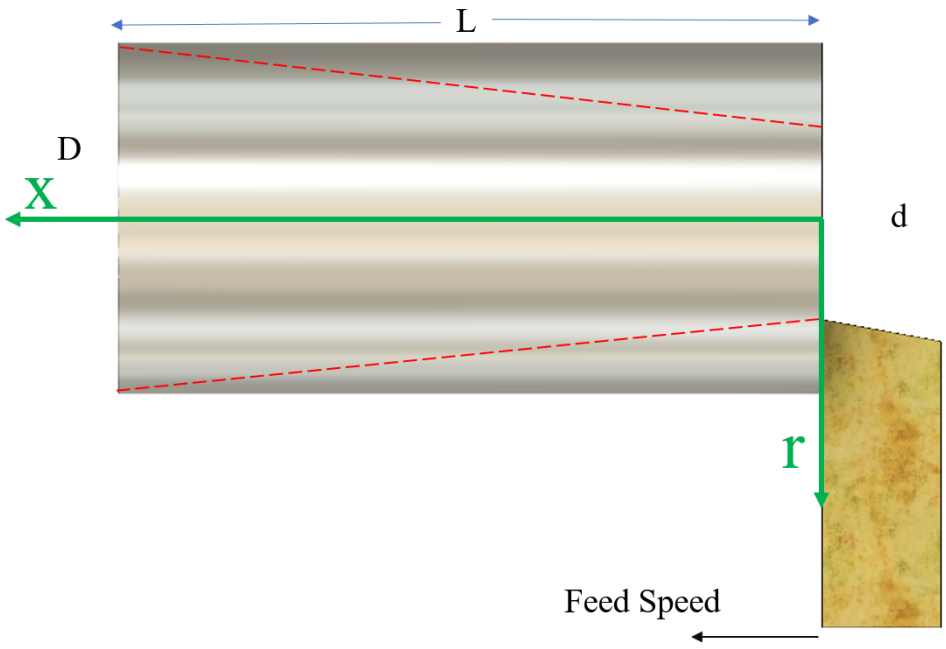
Shear angle $\emptyset = tan^{-1}\left(\frac{rcos(\alpha)}{1-rsin(\alpha)}\right) = 22.94°$

$\emptyset = \frac{\pi}{4} - \frac{\beta}{2} + \frac{\alpha}{2}$, $22.94 = 45 - \frac{\beta}{2} + 5$, $\beta = 54.12°$

$\mu = \tan\beta$=1.382

$P = F_c.V_c = 1550 \times \frac{120}{60} = 3100\,W$

Q3)



$MRR = V_c.(Feed).(depth\ of\ cut)$

$r = \frac{D-d}{2L}x + \frac{d}{2}$ (the red dash-line)

$Feed = \frac{V_a}{N}$, V_a is the axial tool speed (dis/sec)

$V_c = 2\pi.r.N$

$depth\ of\ cut = \frac{D}{2} - r$

$MRR = 2\pi.r.N.\frac{V_a}{N}.\left(\frac{D}{2} - r\right) = 2\pi V_a\left(\frac{D-d}{2L}x + \frac{d}{2}\right)\left(\frac{D}{2} - \frac{D-d}{2L}x - \frac{d}{2}\right) = 2\pi V_a\left(\frac{D-d}{2L}x + \frac{d}{2}\right)\left(\frac{D-d}{2} - \frac{D-d}{2L}x\right)$

$P = SCE.MRR$

At x=0, $P = SCE.MRR = SCE.2\pi\frac{d}{2}.V_a.(\frac{D-d}{2})$

At x=L, $P = 0$