1. A 30 Nm yarn is made from 30% wool, 30% nylon and 40% polyester fibres has packing density similar to a cotton yarn with specific volume of 1.1 cm^3/g. Find the maximum square plain sett of the blended yarn fabric. ....(6 marks)

$\rho = \frac{1}{1.1} = 0.909\ g/cm^3$.

$d = 4.44 \times 10^{-3} \times \sqrt{\frac{tex}{\rho}}$

$\frac{\pi d^2}{4} \times 10^5 \times \rho_y = tex$

$Nm = Ne \times 1.69$

$Ne = 17.7514$

$tex = \frac{590.5}{17.7514}$

packing density $= \frac{0.909}{1.55} = \frac{909}{1550}$

$\frac{\mu}{\text{density/yarn}} = \frac{\mu}{\rho_y} = \frac{0.3}{1.31} + \frac{0.3}{1.34} + \frac{0.4}{1.39}$

$\rho_y = 0.75292\ g/cm^3$

$\frac{\pi d^2}{4} \times 10^5 \times \rho_y = tex$

$\Rightarrow d^2 = 5.6444\ cm^2$

$d = 0.023758\ cm$

For max plain sq sett,

$p = \sqrt{3}\, d$

$p = 0.04115\ cm$

$\Rightarrow$ pick distance is 0.04115 cm

picks $= \frac{21.3}{0.04115}\ cm$.

$\therefore$ cloth sett $= 24 \times 24$ threads/cm

$= 0.04531$

2. A cotton plain woven fabric made from 40 tex warp and 60 tex weft yarns has 22 ends/cm and 18 picks per cm. with 8% warp and 12% weft crimp. Calculate the fabric thickness after fabric is stretched in weft direction by 3%. (9 marks)

$t_1 = 40$ tex $\quad p_1 = \frac{1}{22} \quad c_1 = 0.08$

$t_2 = 60$ tex $\quad p_2 = \frac{1}{18} \quad c_2 = 0.12$

$= 0.022776$

$d_1 = 4.44 \times 10^{-3} \times \sqrt{\frac{40}{1.52}}$

$d_2 = 4.44 \times 10^{-3} \times \sqrt{\frac{60}{1.52}}$

$= 0.022555\ cm$

$l_1 = p_2 \times (1 + c_1) = 0.06$

$l_2 = p_1 \times (1 + c_2) = 0.050901$

$h_1 = \frac{4}{3} p_2 \sqrt{c_1} = 0.020951312047$

$h_2 = \frac{4}{3} p_1 \sqrt{c_2} = 0.025660$

$\Rightarrow B = h_1 + h_2 = 0.046611$

Fabric is stretched in weft direction by 3% $\Rightarrow$ ↑in warp spacing by 3%.

$\therefore \quad 0.03 = \frac{p_1' - p_1}{p_1}$

$\Rightarrow p_1' = 1.03\, p_1 = \frac{1.03}{22} = 0.046818$

$\therefore \quad c_2' = \frac{l_2}{p_1'} - 1 = \frac{0.050901}{0.046818} - 1 = 0.087721$

Applying crimp interchange eqn^n

$$\frac{l_1 \sqrt{c_1'}}{1 + c_1'} + \frac{l_2 \sqrt{c_2'}}{1 + c_2'} = \frac{3}{4} B$$

$$\frac{(0.06)\sqrt{c_1'}}{1 + c_1'} = \frac{3}{4} \times 0.046611 - \frac{0.050901 \times \sqrt{0.087721}}{1.087721}$$

$= 0.034958125 - 0.013825$

$\frac{\sqrt{c_1'}}{1 + c_1'} = \frac{0.021133225}{0.06}$

$\frac{\sqrt{c_1'}}{1 + c_1'} = 0.35220 \Rightarrow 8.0616\, c_1' = 1 + c_1^2 + 2c_1'$

$\Rightarrow c_1^2 - 6.0616\, c_1' + 1 = 0$

$c_1' = \frac{6.0616 \pm \sqrt{(6.0616)^2 - 4}}{2} \Rightarrow c_1' = \frac{6.0616 \pm \sqrt{(6.0616)^2 + 4}}{2}$

$c_1' = \frac{6.0616 - 5.722149947}{2} = 0.169725$

$= \frac{6.0616 \pm \sqrt{4.067449021}}{2}$