Theory of Textile Structures

TXL371 Major Test
Fabric Structure

5 May 2016 Weightage: 35%

1. A square 70:30 P:V fabric is made from 40 tex yarns with 20 threads per cm. How much fabric will contract in weft direction when it is extended in warp direction to the maximum extent possible, assuming circular yarn cross-section? **No approximation** in Peirce's geometry should be used. Polyester fibre density is 1.38 and viscose fibre density is 1.52 and yarn packing density is 0.65. (10)

2. Using Peirce's equations of circular thread geometry, for a square plain woven fabric with weave angle θ, $\frac{p}{\ell}$ is given by

$$\frac{2 - \cos\theta}{2\theta\sin\theta + 2\cos\theta - 1}$$

and for elastica model, this ratio is given by

$$\frac{2k\cos\phi_B}{F_{\phi_B}}$$

For 21° weave angle, calculate the value of crimp percentage based on elastica model and compare it with % Crimp Value obtained for a square plain woven fabric with the same weave angle using Peirce's circular thread geometry. (7+3)

Θ (deg)	F(k, π/2)	F(k, ϕ_B)	E(k, π/2)	E(k, ϕ_B)
0	1.854075	1.854075	1.350644	1.350644
8	1.917998	1.387662	1.314730	1.074198
16	1.992670	1.234482	1.277574	0.968538
20	2.034715	1.180000	1.258680	0.929660
24	2.080358	1.134367	1.239661	0.896640
32	2.184213	1.062236	1.201638	0.843650
40	2.308787	1.007953	1.163828	1.803159

3. A plain woven polyester fabric made from 60 tex warp and 50 tex weft yarns of 0.6 packing coefficient has 8.5% warp and 12.2% weft crimp with minimum warp and weft radii of curvatures of 0.12 and 0.10 mm respectively. Calculate the fabric thickness, assuming degree of flattening of 0.9 for warp and 0.8 for weft yarns. (10)

4. For a fabric, using a saw tooth model with forces F_1 and F_2, value of strain in warp direction is given by

$$\frac{\ell_1.\ell_2.h_1.p_1\,(F_1.h_1.p_1 - F_2.h_2.p_2)}{12B_1.B_2.p_2\left(\frac{\ell_1.p_2^{\,2}}{B_1} + \frac{\ell_2.p_1^{\,2}}{B_2}\right)}$$

Derive an expression for Poisson's ratio for an unidirectional tensile test in weft direction.