This thesis is concerned with a comprehensive study of spirality and low stress mechanical properties of weft-knitted fabric knitted from ring, rotor modified rotor spun, all from cotton fibres and silk yarns.

As there had been rather limited published work in the literature on knitting modified rotor spun yarns, firstly, the yarns were produced to study their various properties which affect the characteristics of knitted fabrics. The modification involved the introduction of roving prepared from the cottons varying in fibre length and the other is a regular cut staple of viscose. The properties and performance characteristics of yarns have been evaluated, including hairiness, friction, evenness, tensile properties and twist liveliness of yarns. It has been found that the tenacity of the rotor spun yarns produced from the 80s mixing is significantly higher than those made from 40s and viscose staple fabrics.

Knitted fabrics produced from these roving introduced rotor spun yarns have displayed a low spirality compared to the ones made from regular rotor and ring spun yarns. The effects using modified rotor regular rotor and ring spun yarns on the low stress mechanical properties and handle were investigated. It was found that the fabrics knitted from ring spun yarns had exhibited good handle. It is pointed out that by giving suitable finishing treatments to the fabrics knitted from rotor spun cotton yarns, it is possible to improve their handle. The effects of fabric structural parameters on the mechanical properties and handle were investigated. It was found that there were significant differences in fabric mechanical properties due to changes in fabric structure. Generally the introduction of miss and tuck stitches had led to an increase in bending and shear rigidities obviously due to an increase in fabric weight.
Shrinkage values determined at all directions for the first time have shown that they are similar in certain particular directions, and this trend has been attributed to fabric mechanical properties.

A novel technique of determining the structure of the knitted fabric by measuring the withdrawal force of the yarn from the fabric has been described.

This technique is capable of disclosing inter yarn friction, degree of set and the pattern of stress distribution inside the fabric. Also, the structural differences can be studied.

Fabric properties such as bagginess, bursting strength air-permeability, wicking and specific handle force of all knitted fabrics were evaluated. It has been found that most of these were affected by yarn structure, fabric structural parameters and yarn mechanical properties.

With a view to simulating the configuration of knitted fabrics in the garment, the mechanical properties of knitted fabrics in bias direction were investigated. Whereas tensile and bending properties show a general reduction, shear parameters show a decrease. Also, in bias testing the differences between the low stress mechanical properties narrowed down indicating that fabrics tended become isotropic. This directionality and its effect will have far reaching implications in garment manufacture.

The effect of detwisting of a ring spun cotton yarn on the spirality and mechanical properties was investigated, and it was found that a removal of 16% twist had led to a significant reduction in spirality. On the basis of the low stress mechanical properties of knitted fabrics, it was apparent that there was an improvement in the handle of these fabrics.
It has been found that the modification of a ring spun yarn structure by means of the untwisting process has exerted significant influences on yarn and fabric performance. On the positive side, knitted fabric spirality was greatly reduced or completely eliminated by the modification. In addition, fabric handle is improved when compared with the existing fabric sample without modification. On the negative side, yarn tensile strength and fabric bursting strength show deterioration by the modification process.

This thesis has adequately demonstrated that directly spinning yarns with a low twist multiplier, and controlling fabric tightness may not produce fabrics within acceptable spirality limits. Thus, the current method is probably more effective in the cases, of medium and coarser yarns, and thus it is recommended that these techniques be used in the industry for achieving zero spirality.

The final part of thesis focuses on the classification of 42 knitted fabrics by cluster analysis on the basis of their low stress mechanical properties. It was found that four clusters were formed which adequately provided the classification which seems to be logical.

The industrial implications of the study have been fully discussed.