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# STRENGTHENING OF THE COLLEGE OF TEXTILE TECHNOLOGY, DHAKA

DP/BGD/82/047

BANGLADESH

## Technical report: Visit to the College of Textile Technology, Dhaka* 17-30 April 1986

Prepared for the Government of Bangladesh
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of Ivan Wroe, Steven McMahon and Trevor Rowe

United Nations Industrial Development Organization
Vienna

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## 1. INTRODUCTION

This visit to the College of Textile Technology, Dhaka, 17-30 April 1986 follows from a previous mission by Ivan Wroe during September 1985. The September visit has been reported by Wroe (Report on a visit to the College of Textile Technology, Dhaka, Bangladesh; Bolton Institute of Higher Education, October 1985) and documented by UNIDO as a technical report, DP/ID/SER.A/647, 31 October 1985.

The major objectives of the visit were:

(i) assistance to the college staff in the revision, development and documentation of an appropriate curriculum for the four-year B.Sc. course in textile technology;

(ii) assistance to the college staff in the preparation of neutral specifications for those items of equipment and machinery, identified by the college principal, required for up-grading of the college resource base.

The schedule of meetings, visits and activities during the visit is given as Appendix I.

The authors' sincere and grateful thanks are due to Dr. Mustafizur Rahman, principal of The College of Textile Technology, Dhaka, who gave up much of his valuable time and energies in order to ensure an efficient and effective program. Thanks are also due to the teaching and technician staff of the college, and to collegues in UNDP and UNIDO, both in Vienna and Dhaka, for their interest, enthusiasm and assistance.

## 2. CURRICULUM DEVELOPMENT

Following lengthy discussions with the principal and his teaching staff, a broad curriculum model has been proposed, by the authors, which would offer an alternative to the current, more traditional one in use at the college. The new model indicates the overall inter-relationships of the individual subject areas and their progression from year to year; the model is shown in diagramatic form in Figure 2.1.

As a result of the variations in the college academic year, it is not appropriate to indicate the relative weightings of the subject areas, or groupings, by the usual method of study-time allocation. Thus, an alternative method has been adopted involving the use of relative study values which could be interpreted as relative study hours, mark allocation, percentage weightings etc. The use of a 1000 unit aggregate for each academic year would be feasible, and would be similar to the current use of mark-weightings (approx. 900 marks per year) by the college and the nominal yearly study-time in hours (197 working days at 6 hours per day).

It can be seen from a comparison of the current curriculum, illustrated as Figure 2.1, that the general study-themes, for example, textile technology, science, engineering aspects, management etc, are broadly similar in both schemes. Table 2.1 shows the relative weightings of the main study-themes of the two schemes expressed as a percentage by mark allocation for the current curriculum and percentage relative study-value for the proposed scheme.

**Table 2.1 Comparison of current and proposed curriculum study-themes**

| Study-theme | % Weighting | |
|---|---|---|
| | Current scheme | Proposed Scheme |
| Management/Communications | 12 | 12 |
| Science | 20 | 18 |
| Textile Technology | 43 | 35 |
| Testing | 6 | 7 |
| Mathematics | 6 | 7 |
| Engineering | 13 | 21 |

It was agreed with the principal and his staff that the course assessment should, where possible, for each subject, be in the form of:

(i) a final examination having a pass mark of 40%;

(ii) a continuous assessment component involving, where possible, both practical and theoretical skills and having a pass mark of 40%;

(iii) an average mark for(i) and (ii) of 45% being required for a pass grading.

However, this may require amendment to the Ordinance and Regulations for the Degree of Batchelor of Science in Textile Technology of the University of Dhaka.

Assuming that such a proposal would be acceptable to the university authorities, discussions have taken place with the principal and his staff, covering both general and/or specific aspects of the syllabii for the majority of subject areas covered in the degree program.

Within the time period scheduled for the visit, it has obviously not been possible to finalise the detail and documentation for a four-year curriculum. Thus, it has been agreed that, on the basis of the discussions held so far,

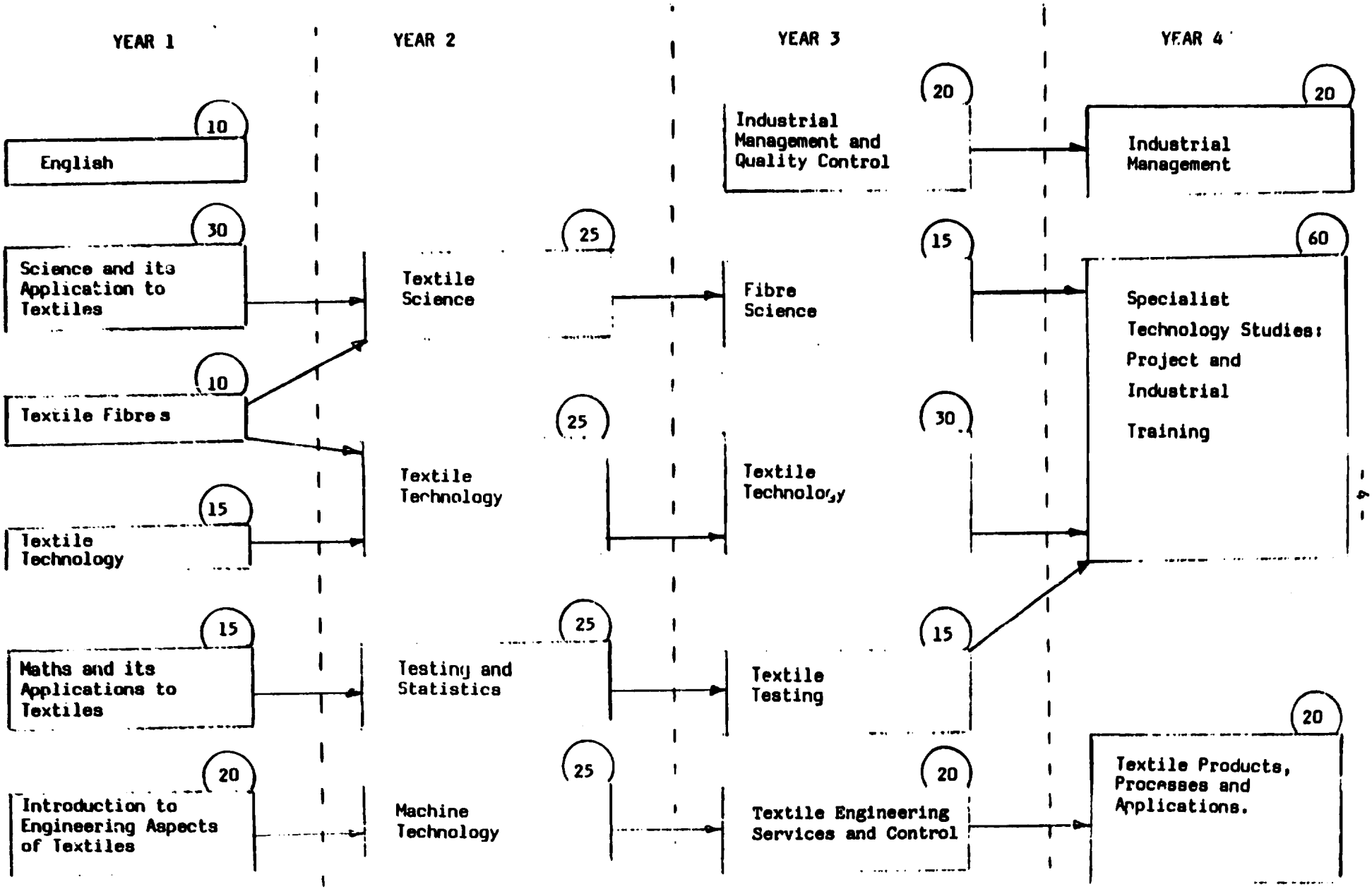



FIGURE 2.1 Proposed curriculum model for four-year B.Sc. course in Textile Technology

syllabii will be prepared in draft format at Bolton and then forwarded, for examination, comment and possible revision, to collegues at the Dhaka college. On receipt at Bolton of comments from Dhaka staff, the curriculum will be amended as appropriate and then duplicated and returned, as multiple copies, to Dhaka, Mr. Robert Petri, of UNIDO office at Dhaka, has suggested that such documents be routed through UNDP to ensure safe arrival at the relevant destination.

In order to give an indication of the content of the subject areas in the proposed curriculum, outline syllabii for the course are given as Appendix II.

Appendix III illustrates the difference between the outline format and the detailed format that will be produced for the final document.

## 3. EQUIPMENT SPECIFICATION

The items listed under Yarn Production, Fabric Production, Wet-processing and Testing in the draft Project document have been examined in detail and neutral specifications for these are proposed in Appendices IV, V, VI and VII respectively.

It was decided that consideration of the items appertaining to the textile science and related studies laboratories should be defered for the time being. It is intended to effect such specification during the next stage of the project implementation.

## 4. REPAIR AND RENOVATION OF MACHINERY AND EQUIPMENT

Considerable attention has been given to the feasibility of repairing or renovating the machinery and equipment already available at the college.

The major items of equipment in the jute, cotton, wet-processing and testing sections have been examined and, where possible, assessment has been made of the operational condition. In some instances it has been possible to identify specific faults or problems, and a summary of the findings and recommendations is given as Appendix VIII.

## 5. MACHINE ROOM AND LABORATORY SERVICES

5.1 Jute processing shed: In general, the condition of this machine room is quite good; it is relatively clean, well organised and the machines are obviously regularly oiled and cleaned etc. However, some of the older electrical installations are showing signs of deterioration, and the newer connections are technically inadequate. Selected re-wiring, to IEEE standards, by a competent electrical technician is recommended.

5.2 Cotton processing shed: This machine room is not to the same standard as the jute shed but, again, only selected re-wiring is required.

5.3 Wet-processing shed: The major problem in this machine room is the absence of an adequate water supply; at present there is virtually none, apart from that water brought into the shed in containers. Obviously, for a wet-processing facility to function to any level of effectiveness whatsoever, a supply of water is required. An over head reservoir is available but not in use, as the mains pressure from WASA, the water supply authority, is not

sufficient to fill the tank. It is recommended that consideration be given to the provision of an adequate water supply to the wet-processing shed, possibly in the form of an underground reservoir or tube-well in combination with a pump system to allow use of the overhead tank.

If an adequate supply of water could be made available to the wet-processing shed, it would also allow the steam-raising boiler to be brought into use, so that those items of equipment that use steam for heating purposes could also be fully utilised. However, with the current shortage of fuel oil to fire the boiler, it would probably be necessary to consider conversion of the boiler from fuel oil to gas fired.

The older electrical installations require selected re-wiring and the newer connections are technically inadequate in general.

It was not possible to examine the condition of the drainage system, as a sufficient quantity of water was not available to carry out such an exercise.

5.4 Testing laboratory: Well serviced with electrical installations and requires only minor re-wiring.

The water supply is inadequate for the wet-section of the laboratory to function with any degree of effectiveness, and would benefit from the recommendations made in relation to the wet-processing shed.

5.5 Engineering workshop: Minor re-wiring of installations required.

5.6 Chemistry laboratory: Adequate water supply required.

5.7 Physics laboratory: Adequate water supply and mains electrical sockets required.

## 6. INTERNATIONAL EXPERTS

Provision has been made in the project budget to allow an international expert facility in yarn manufacturing technology for the latter six months of 1986. A proposal has been made by The Department of Textile Studies, Bolton Institute of Higher Education, to provide three experts for a duration of two months each to complete the six month provision.

During discussions in Dhaka, the director-general of technical education, the assistant director-general and the college principal have agreed that this proposal is satisfactory to them.

APPENDIX I

## SCHEDULE FOR VISIT TO COLLEGE OF TEXTILE TECHNOLOGY, DHAKA

| | | |
|---|---|---|
| Thursday 17th April: | Depart Manchester for Dhaka. | |
| Friday 18th April: | Arrive Dhaka. | |
| Saturday 19th April: | i) Meeting with college staff and principal. | College of Textile Technology. |
| | ii) Tour of college with principal and staff. | " |
| | iii) Work on curriculum for B.Sc. course. | Sheraton Hotel. |
| | iv) Meeting with college principal. | " |
| Sunday 20th April: | i) Meeting with Mr. Robert Petri, UNIDO. | UNIDO Office. |
| | ii) Meeting with college principal. | College of Textile Technology. |
| | iii) Meeting with Mr. Ibrahim Ali, British Airways, Dhaka. | B.A. Offices, Dhaka. |
| | iv) Work on curriculum for B.Sc. course. | Sheraton Hotel. |
| Monday 21st April: | i) Mr. Khalid Bin Huder, UNDP. | UNDP Offices. |
| | ii) Meeting with college principal. | College of Textile Technology. |
| | iii) Meeting with the manager, British Airways, Dhaka. | B.A. Offices, Dhaka. |
| | iv) Meeting with teaching staff and college principal. | College of Textile Technology. |
| | v) Work on curriculum for B.Sc. course. | Sheraton Hotel. |

| | | |
|---|---|---|
| Tuesday 22nd April: | i) Work in Laboratories and machine-rooms, College of Textile Technology. | College of Textile Technology. |
| | ii) Discussions with college principal. | " |
| | iii) Meeting with Mr. Shah and Mr. Aziz, Directorate of Technical Education. | Directorate of Technical Education Offices, Dhaka. |
| | iv) Meeting with Dr. S.S.M.A. Khorasani, Bangladesh Council for Scientific and Industrial Research, Dhaka. | BCSIR Officer, Dhaka. |
| | v) Discussions with college principal. | College of Textile Technology. |
| | vi) Collect lost baggage from Airport. | British Airways Office, Dhaka Airport. |
| | vii) Work on curriculum for B.Sc. course. | Sheraton Hotel. |
| Wednesday 23rd April: | i) Work in laboratories and machine-rooms. | College of Textile Technology. |
| | ii) Discussions with college principal. | " |
| | iii) Work on curriculum for B.Sc. course. | Sheraton Hotel. |
| Thursday 24th April: | i) Discussions with college principal. | College of Textile Technology. |
| | ii) Visit to Saatrang Mill, BTMC. | Dhaka. |
| | iii) Visit to Olympia Mill, BTMC. | Dhaka. |
| | iv) Visit to Artex Fabrics. | Dhaka. |
| | v) Discussions with college staff and principal. | College of Textile Technology. |
| | vi) Work on curriculum | Sheraton Hotel. |

| | | |
|---|---|---|
| | for B.Sc. course. | |
| Friday 25th April: | i) Work on curriculum for B.Sc course. | Sheraton Hotel. |
| | ii) Social activities with Mr. & Mrs. Robert Petri, UNIDO. | |
| Saturday 26th April: | i) Discussions with college staff and principal; work on curriculum for B.Sc. course. | College of Textile Technology. |
| | ii) Work on curriculum etc. | Sheraton Hotel. |
| Sunday 27th April: | i) Discussions with college staff and principal. | College of Textile Technology. |
| | ii) Visit to college sports-day activities | College sports ground, Dhaka. |
| | iii) Discussions with college staff and principal. | College of Textile Technology. |
| | iv) Work on curriculum etc. | Sheraton Hotel. |
| Monday 28th April: | i) Discussions with college staff and principal. | College of Textile Technology. |
| | ii) Ms. Ewans, British Council. | B.C. Offices, Dhaka. |
| | iii) Discussions with college staff. | College of Textile Technology. |
| | iv) College students Union Annual Prize Giving Ceremony. | " |
| | v) Work on curriculum etc. | Sheraton Hotel. |
| Tuesday 29th April: | i) Discussions with college staff and principal. | College of Textile Technology. |
| | ii) Visit to Dhaka | Dhaka |

shops with principal.

iii) Farewell meeting with principal and college staff. — College of Textile Technology.

iv) Depart Dhaka for Manchester.

Wednesday 30th April: Arrive Manchester.

APPENDIX II

PROPOSED NEW CURRICULUM FOR FOUR-YEAR B.Sc. COURSE IN TEXTILE TECHNOLOGY

(FIRST YEAR STUDIES)

## SCIENCE AND ITS APPLICATION TO TEXTILES

An introductory study of physics and its application to textiles.

Review of units of measurement.

Introduction to mechanics and heat.

Understanding of some important properties of matter.

Outline of electromagnetic radiation.

Comparison of a.c. and d.c. electricity.

Practical experiments in physics associated with the above topics.

An introductory study of chemistry and its application to textiles.

Review of the concepts of mass and concentration.

Explanation of atomic structure and bonding.

Explanation of the periodic table.

Introduction to intermolecular forces.

Understanding of pH and relevant calculations.

Discussion of the principles of chemical reactions.

Introduction to organic chemistry and the concept of functional groups.

Practical experiments in chemistry associated with the above topics.

Application of the above to textile products and processes etc.

## TEXTILE FIBRES

Study of the characteristics of a textile fibre.

Classification of textile fibres.

Study of the various types of vegetable fibres, growth, distribution, grading, properties.

Study of the main animal/protein fibres.

Brief study of the properties/use of Asbestos.

Introduction to man-made fibres.

Discussion of the importance of specific fibre types in terms of world volume usage.

Introduction to fibre structure.

## TEXTILE TECHNOLOGY : YARN PRODUCTION TECHNOLOGY I

Study of the basic principles involved in yarn manufacture irrespective of production system.

Outline of the production stages to convert fibrous stock to yarn using short staple fibres.

Outline of the production stages to convert jute and flax into a yarn.

Outline of the production stages to convert wool into a yarn on the worsted system.

Outline of the cotton condenser/woollen system for waste/remanufactured fibres.

Outline of the processes to convert raw silk to yarns.

Introduction to yarn counting systems.

Discussion of classification of yarn types and end uses of various yarn types.

## TEXTILE TECHNOLOGY : FABRIC PRODUCTION TECHNOLOGY I

Appreciation of the appearance and uses of fabrics made by various methods.

Outline of the structure, classification, ornamentation, parameters and uses of plain weave fabrics.

Understanding of the basic principles of the drive and primary motions of a shuttle loom.

Outline of the construction, parameters and uses of plain weft knitted, half tricot and full tricot fabrics.

Understanding of the basic principles of loop formation, yarn supply and fabric take down on single jersey, straight bar and tricot (compound needle) knitting machines.

Outline of the objectives, processes and packages produced during yarn preparation.

Appreciation of the main methods of fabric conversion.

## TEXTILE TECHNOLOGY : WET PROCESSING TECHNOLOGY I

Appreciation of ways in which the preparation, coloration and finishing sectors of the textile industry are inter-related, and the types of organisation that exist in the industry.

Understanding of the reasons why preparation, coloration and finishing processes are carried out.

Outline of the objectives of the major preparatory, coloration and finishing processes.

Understanding of the need for cloth stability and for special effects in finishing.

Outline of the various states/forms in which textiles can be wet-processed.

Appreciation of processor-customer relationships.

## MATHEMATICS AND ITS APPLICATION TO TEXTILES

Revision of basic aspects of algebra, geometry and trigonometry.

Derivation and application of trigonometrical formulae.

Consideration of three-dimensional triangulation problems.

Introduction to complex numbers and their use.

Explanation of differentation and series, and their use.

Introduction to integration and application of the technique.

Solution of differential equations.

Introduction to elementary statistics.

Discussion of aspects of numerical methods and digital computation.

Explanation of vectors and their use.

## INTRODUCTION TO ENGINEERING ASPECTS OF TEXTILES

Introductory study of mechanical engineering principles.

Appreciation of force, energy and power.

Appreciation of the properties of materials.

Discussion of the important aspects of motion.

Theoretical and practical study of engineering technology.

Appreciation of safety aspects.

Explanation of primary forming processes, fitting and machining.

Techniques of measurement and gauging.

Explanation of heat treatments.

Outline of metal joining processes.

Practice of engineering drawing.

Introduction to plane and solid geometry.

Types and uses of projections.

Consideration of components and assemblies.

## ENGLISH AND COMMUNICATIONS

A description of language and language usage.

Practical study of effective communication.

(SECOND YEAR STUDIES)

## TEXTILE SCIENCE

Study of the physical properties of textile fibres, yarns and fabrics.

Study of the chemical properties of textile fibres, yarns and fabrics.

Investigation into the mechanical aspects of fibre, yarn and fabric structure.

Understanding of the detection of damage in textile structures.

Understanding of the methods of estimation of damage.

Understanding of measurement techniques used in textile processing.

Understanding of the need for, and properties of, fibre blends.

Study into the effect of moisture on textile structures.

Study of fibre identification techniques.

Investigations into the causes and effects of static electricity in textile processing.

Study of fibre friction.

## TEXTILE TECHNOLOGY : YARN PRODUCTION TECHNOLOGY II

Discussion of the physical properties of fibres to be processed into yarns.

Cotton Processing:

Understanding of the theoretical and practical aspects of blending fibres.

Explanation of the principles and practices of cotton mixing, opening and cleaning and preparation for carding.

Understanding of the theories and techniques of carding short staple fibres.

Outline of the theory of preparing carded material for cotton combing and the techniques of combing.

Explanation of the importance of a thorough understanding of roller drafting principles.

Appreciation of the functions of drawframes.

Jute Processing:

Explanation of the preparation of jute/flax for subsequent processing.

Discussion of reasons and methods of application of emulsions in preparation for jute processing.

Explanation of softening process.

Understanding of the theories and techniques of the carding of jute and flax fibres.

Appreciation of the functions of the jute drawing processes.

A theoretical study of the causes of yarn irregularity.

## TEXTILE TECHOLOGY : FABRIC PRODUCTION TECHNOLOGY II

Understanding of the construction and uses of simple and developed simple weaves including the function and construction of drawing in, denting and lifting plans.

Explanation of the principles of shuttleless weft insertion.

Understanding of the purpose and principles of operation of secondary motions, weft replenishment, stop motions, and cam and dobby shedding motions.

Outline of the function, construction and formation of selvedges.

Understanding of the construction and uses of rib, purl, tuck and miss, and fully set two guide bar fabrics.

Explanation of the principles of loop formation on latch and bearded needle warp and weft knitting machines.

Appreciation of the effects of relaxation shrinkage.

Explanation of the operation of cam systems and drive to the elements on weft and warp knitting machines.

Outline of the methods of forming dry laid webs.

Outline of adhesive, needle and stich bonding.

Comparison of the properties and uses of fabrics produced by the methods above.

Explanation of machine and package parameters and faults produced in winding.

Outline of the principles and applications of section warping.

## TEXTILE TECHNOLOGY : WET-PROCESSING TECHNOLOGY II

(including revision of material already covered in first year)

Understanding of the commercial and technical implications of the wet-processing sector in relation to the textile industry as a whole, and to the wider society in national and international terms.

Understanding of the range of preparatory processes, of the objectives and principles of those processes.

Understanding of the range of coloration processes, and the objectives and principles of those processes.

Explanation of the selection of colouring matters and their fastness properties.

Understanding of objectives and principles of some major finishing processes.

Development of desirable attitudes towards safety.

Experiments relating to the principles of preparation, coloration and finishing processes.

Experiments to demonstrate wet-processing procedures.

Experience of experimental-work report preparation.

Appreciation of machinery and processes observed in works locations.

## TEXTILE TESTING I

Appreciation of the reasons for testing textile materials and for the use of standard test procedures.

Presentation and analysis of test results on a statistical basis.

Understanding of the effect of moisture on textiles.

Understanding of the significance of fibre testing and the basic principles of the instruments used.

Understanding of the significance of yarn testing, the basic types of tests, and the principles of the instruments used.

Understanding of the main fabric dimensions tested and the principles of the instruments used.

Introduction to simple fibre identification techniques.

## STATISTICS

Understanding of the basic principles of probability.

Explanation and use of binomial distribution.

Explanation and use of the Poisson distribution.

Explanation and use of the normal distribution.

Discussion of point and interval estimates.

Introduction to simple hypothesis tests.

Understanding of correlation and regression.

## MACHINE TECHNOLOGY

Outline of the principles and application of mechanics to machine technology, including a study of friction, bearings and lubrication.

Understanding of linear and angular motion.

Understanding of the mechanisms and transmission of motion including rotary motion, reciprocating motions and stop/start mechanisms.

Outlines of the principles and application of dynamics to machine technology, including a study of momentum, mechanical and strain energy, angular dynamics, circular motion and balance.

Study of simple harmonic motion.

Application of electricity to machine technology including the generation of direct and alternating current, A.C. and D.C. motors, inductors and capacitors, three-phase current.

Outline of simple electrical and electronic equipment.

Introduction to the principles and application of heat to machine technology.

Introduction to control theory and the use of computers in textiles.

(THIRD YEAR STUDIES)

## INDUSTRIAL MANAGEMENT AND QUALITY CONTROL I

Introduction to the principles and practice of management.

Appreciation of the concept of motivation.

Understanding of the concept of leadership.

Explanation of the work of the personnel department.

Introduction to effective communication, and the barriers to good communications.

Understanding of the organisational implications of communications.

Appreciation and development of communications skills and techniques.

Appreciation of training as a management function.

Appreciation of planning as a management function.

Outline of planning activities in relation to new systems, change and evaluation, and the use of computers in planning.

Understanding of the function and organisation of inspection departments.

Understanding of the application of Q.C. schemes in textile factories.

Understanding of the application of statistical Q.C.

Understanding of various levels of standards used in the textile industry.

Appreciation of the effect of Q.C. on production costs and sales.

Understanding of the importance of sampling.

## FIBRE SCIENCE

Review of fibre classification with particular reference to man-made fibres.

Understanding of the chemical aspects of fibre structure.

Understanding of the physical aspects of fibre structure.

Study of the qualitative data available and methods used in structural analytical techniques.

Study of factors of growth, harvesting and marketing which influence quality of natural fibres.

Understanding of polymerisation and production of spinning fluid.

Understanding of fibre extrusion techniques.

Evaluation of the technical and economic factors of commercial extrusion and subsequent processes which influence properties, quality and use of the main man-made fibres.

Appreciation of the importance of fibre physical properties in determining their end use.

Understanding of the need for and effect of physical modifications of fibres.

Understanding of the need for and effect of chemical modifications.

Appreciation of the nature of speciality textile fibres.

## TEXTILE TECHNOLOGY : YARN PRODUCTION TECHNOLOGY III

Review of the processes of yarn production up to the drawing stage.

Cotton Processing:

Discussion of the reasons for the reducing stage and the types of machinery used.

Discussion of the fundamentals of the conventional spinning processes.

Outline of the mode of operation and principles of rotor spinning.

Discussion of the reasons for folding yarns.

Outline of the main methods used in production of folded yarns.

Brief review of current developments in short staple processing.

Jute Processing:

Study of the principles of jute spinning systems.

Discussion of the reasons for twisting jute yarns.

Outline of the principles of producing folded jute yarns.

Outline of a process control/quality control scheme for the production of cotton and jute yarns.

A study of the various types of fancy yarns and blended yarns available.

## TEXTILE TECHNOLOGY: Fabric Production Technology III

Understanding of the construction and uses of combined weaves, colour and weave effects, simple fancy weaves and jute fabrics.

Knowledge and comparison of warp and weft patterning systems, including jacquard shedding, and shuttleless weft insertion systems.

Appreciation of the relationships between shed geometry, sley design and cloth formation and their effects on fabric appearance and productivity.

Explanation and use of production calculations essential to weaving, knitting and yarn preparation.

Understanding of the construction, properties and uses of laid in, plated, pile, lace and eyelet weft knitted fabrics, and of 3 and 4 guide bar tricot structures.

Understanding of the machine specifications, knitting action and fabric types of circular machines and of multi-bar tricot machines.

Understanding of quality control in knitting.

Understanding of the formation, properties and uses of thermally-bonded and spun-bonded fabrics.

Explanation of machine and package parameters and faults produced in warping, sizing, drawing in and knotting.

## TEXTILE TECHNOLOGY: Wet-Processing Technology III

Understanding of typical preparatory processes and their sequences.

Understanding of typical coloration processes and their sequences.

Explanation of simple aspects of coloration theories.

Understanding of typical finishing processes and their sequences.

Appreciation of methods of dyehouse organisation and the impact of automation on organisations.

Appreciation of water quality and its influence on textile processing.

Understanding of the need for colour fastness etc. tests; the principles of test procedures, the expression and application of test results.

Appreciation of the nature of faults liable to be produced in wet-processing and how they may be rectified.

Practical assessment and use of dye characteristics.
Production of dyed and finished materials on laboratory machines.

Preparation of experimental work reports.

## TEXTILE TESTING II

Fibre testing:

Understanding of the mechanical methods of measuring fibre length.

Understanding of the principle of measuring fibre length by optical and capacitance methods.

Understanding of cotton fibre maturity and its measurement.

Description of the methods used to assess fibre fineness.

Understanding of fibre strength measurements.

Description of test procedures for cotton impurity levels.

Yarn testing:

Review of different counting systems and discussion of methods of assessing yarn count.

Description of the test methods for assessing the level of twist in single and plied yarns.

Discussion of the causes and effects of yarn irregularity and description of the methods of testing.

Classification of yarn faults and discussion of the assessment of yarn faults.

Fabric testing:

Understanding of the test procedures and apparatus used for assessing the following fabric parameters:

- fabric strength;
- tear resistance/tear strength;
- bursting strength;
- wear and abrasion;
- dimensional stability;
- pilling/snagging;
- associated fabric properties.

Tensile testing:

Understanding of tensile testing, stress/strain and associated concepts.

Chemical testing:

Understanding of the test methods for assessment of colourfastness, and other tests relating to wet-processing.

Specialised testing:

Understandidng of the test methods used to assess:

- flammability;
- carpet wear;
- waterproofing;
- oil/finish content.

## TEXTILE ENGINEERING SERVICES, PRODUCTION AND CONTROL

Study of the supply and use of electricity in industrial locations.

Study of the heating, ventilation and air-conditioning of the factory environment.

Discussion of steam services.

Appreciation of the forms and use of industrial lighting.

Outline of the uses of compressed air.

Understanding of production techniques, and means of planning and control of production.

Understanding of O & M in offices.

Understanding of the quantitative techniques available for problem solving.

Understanding of the application of planned maintenance in industry.

Understanding of the importance of the application of ergonomics to the work area.

Appreciation of computer systems and their application to textiles.

Appreciation of the use of computers in textiles.

Development of textile-related software.

(FOURTH YEAR STUDIES)

## INDUSTRIAL MANAGEMENT II

Understanding of the need for works study.

Understanding of the concepts, technique and application of method study.

Outline of work measurement.

Understanding of the purpose and procedure of activity sampling, production studies, and check studies.

Understanding of the value of frequency studies.

Understanding of the concept and appreciation of allowances.

Appreciation of effective materials handling.

Outline of general, financial and cost accounting.

Outline of the Bangladesh textile industry and the companies/organisations within it.

Appreciation of industrial relations, negotiating procedures and practices.

## SPECIALIST TECHNOLOGY STUDIES: YARN PRODUCTION TECHNOLOGY IV

Discussion, in detail, of the selection of raw materials for processing, with particular reference to jute and cotton.

Description of modern blowroom layout and discussion of aspects of beating e.g., free/grip beating; description of the use of computer controlled opening lines.

Description of the method and use of chute feed systems for carding.

Description of the developments in carding, both for long and short staple, and the use of card autolevellers.

Discussion of the development and use of high production drawing and the use of autolevellers.

Description of the development in high draft systems for speedframes.

Discussion of the theory of ring spinning, balloon theory, forces on traveller etc.

Discussion of the development of ring and traveller design to overcome production limitations and the development of automation in ring spinning.

Discussion of the development of new yarn production techniques; outline of the advantages and disadvantages of the new systems in relation to ring spinning.

Outline of the principles of tow to top conversion and its use in yarn production.

Discussion of the development of texturing of continuous filament yarns.

Outline of the developments taking place in the preparation of jute and similar fibres for subsequent processing.

Discussion of the development of new spinning systems for the production of jute yarns.

Theoretical study of blending and the use of man-made fibres.

Discussion of aspects of yarn quality.

Project studies in an appropriate specialist topic area.

Industrial training in an appropriate specialist area.

## SPECIALIST TECHNOLOGY STUDIES: FABRIC PRODUCTION TECHNOLOGY IV

Understanding of the construction, properties and uses of jacquard and compound woven fabrics including special mechanisms required for their production.

Analytical treatment of loom design.

Critical comparison of the dynamics and application of weft insertion systems.

Understanding of selected aspects of applied weaving management.

Understanding of the principles and use of geometric and mechanical models of fabric structure.

Understanding of the construction, properties and uses of advanced rib structures and raschel structures.

Explanation of jacquard selection in weft knitting.

Analytical treatment of cam design.
Understanding of the principles of raschel machines.

Comparative study of the various techniques for the manufacture of nonwoven fabrics and the properties and uses of the resulting fabrics.

Analytical and mathematical treatment of processing parameters in yarn preparation.

Review of recent developments in sizing.

Project studies in an appropriate specialist topic area.

Industrial training in an appropriate specialist topic area.

## SPECIALIST TECHNOLOGY STUDIES: WET PROCESSING TECHNOLOGY IV

Discussion of purification processes and test methods for water for textile use.

Understanding of effluent content from wet-processes and purification processes.

Understanding of the chemistry of surface active agents.

Understanding of washing and drying processes.

Discussion of modern-day machines and processes for preparation processes with particular respect to cellulosic fibres, and including man-made fibres.

Understanding of the reasons for choice of dyeing processes for particular materials.

Understanding of different types of process systems and dyeing machinery.

Understanding of colour, shade matching, colour measurement and specification.

Discussion of dyeing faults and their correction.

Understanding of the application properties and dyeing technology of the major dye-fibre systems.

Understanding of the principles and use of colour fastness tests.

Understanding of printing systems, processes and design.

Appreciation of modern developments in printing.

Understanding of theoretical aspects of coloration processes.

Discussion of dyehouse organisation and control systems.

Appreciation of the principles and practice of blend dyeing.

Understanding of the principles and practice of the major finishing processes, with particular reference to cellulosic substrates, and including man-made fibres.

## TEXTILE PRODUCTS, PROCESSES AND APPLICATIONS

Discussion of the influence of psychological and physiological factors upon consumer requirements and choice.

Appreciation of the performance properties that require evaluation to enable textile producers to satisfy consumer needs.

Understanding of the economics of textile production.

Appreciation of aspects of textile design.

Discussion of the influence of fibre and fibre aggregate properties in relation to product performance.

Understanding of the influence of finishing processes and design features on product performance.

Discussion of the influence of product end-use on performance requirements.

Appreciation of the use of specification for textile products; the importance of test procedures and the development of standard tests.

Development of specification for particular textile products.

# APPENDIX IIIa

## MACHINE TECHNOLOGY

Example of a syllabus in abbreviated general format

Outline of the principles and application of mechanics to machine technology, including a study of friction, bearings and lubrication.

Understanding of linear and angular motion.

Understanding of the mechanisms and transmission of motion including rotary motion, reciprocating motions and stop/start mechanisms.

Outlines of the principles and application of dynamics to machine technology, including a study of momentum, mechanical and strain energy, angular dynamics, circular motion and balance.

Study of simple harmonic motion.

Application of electricity to machine technology including the generation of direct and alternating current, A.C. and D.C. motors, inductors and capacitors, three-phase current.

Outline of simple electrical and electronic equipment.

Introduction to the principles and application of heat to machine technology.

Introduction to control theory and the use of computers in textiles.

APPENDIX IIIb

MACHINE TECHNOLOGY

Example of a syllabus in detailed semi-objective format

Unit Objectives:

a. To develop in the student an understanding of how machines perform rather than how the machines handle the material being processed.

b. To acquaint the student with the principles involved in the operation of a particular mechanism.

c. To revise and put into perspective principles which may have been introduced in other units.

d. To enable the student to apply the principles to new problems and situations.

## MACHINE TECHNOLOGY

| TOPIC AREA | WEIGHTING | ASSESSMENT % | | |
|---|---|---|---|---|
| | | CONTINUOUS | EXAMINATION | TOTAL |
| A | 6 | | | |
| B | 6 | | | |
| C | 6 | | | |
| D | 20 | | | |
| E | 6 | | | |
| F | 6 | | | |
| G | 6 | | | |
| H | 6 | | | |
| I | 20 | | | |
| J | 6 | | | |
| K | 6 | | | |
| L | 6 | | | |
| **TOTAL** | 100 | 50 | 50 | 100 |

## MACHINE TECHNOLOGY

### A. MECHANICS

#### 1. Machines

1.1 Application of the principles of moments to mechanical structures and systems in equilibrium using examples from textile machines.

1.2 Application of the principles of torque transmission to calculations involving shafts, levers, pulleys, gears and other mechanisms.

1.3 Definition of a machine as an arrangement which changes energy from one form to another.

1.4 Characteristics of mechanical machines, based on either 'incline' or 'lever'.

1.5 Definition and calculation of mechanical advantage, velocity ratio, mechanical efficiency.

1.6 Application of the principles of work, energy and power to machines, e.g. pulley blocks, gear trains, screw traverse.

#### 2. Friction

2.1 Definition of the classical friction Laws of Plane Solid Friction.

2.2 Explanation of mechanisms which depend on friction, i.e. clutch, brake,and calculations involving simple friction in these mechanisms.

2.3 Discussion of situations in which friction is a nuisance.

2.4 Simple calculations of friction on an inclined plane.

2.5 Understanding of friction on a screw thread and how it relates to torque.

2.6 Determination of angle of friction in a simple friction system.

3. Bearings

3.1 Explanation of different forms of bearings, sliding pairs and rotating pairs.

3.2 Description of the materials used and construction of plain journal bearings.

3.3 Description of the construction of rolling element bearings.

4. Lubrication

4.1 Description of the action of a lubricant in separating sliding surfaces.

4.2 Explanation that, with separated surfaces, resistance to motion depends on the viscosity of the lubricant.

4.3 Definition of viscosity as a measure of fluid friction.

4.4 Description of the relationship of speed of movement and loading to viscosity of lubricant.

B KINEMATICS

5. Linear and Angular Motion

5.1 Application of graphical techniques to illustrate displacement/time,velocity/time and acceleration/time relationships of machine elements, e.g. cams, cranks, shedding, reciprocating mechanisms, linkages.

5.2 Application of angular motion equations to problems associated with textile machines.

C MECHANISMS AND TRANSMISSION OF MOTION

The following items are understood to be prefaced by the additional learning outcome that the student is able to describe the mechanisms, perform simple calculations associated with mechanisms, knows the purpose of the mechanisms, gives typical applications of the mechanisms and states their virtues and defects:

6. Rotary Motion

6.1 Gear wheels and gear trains.
6.2 Belt drives, both flat and vee groove.
6.3 Chain drives.

7. Stop/Start Mechanisms

7.1 Clutches.
7.2 Fast and loose pulleys.
7.3 Brakes.

8. Reciprocating Motions

8.1 Cranks.
8.2 Eccentrics.
8.3 Link Mechanisms.
8.4 Cams.

D DYNAMICS

9. Momentum

9.1 Definition of momentum as the quantity of motion; mv having the unit kg m/s or Ns.
9.2 Explanation from Newton's 2nd Law that force = momentum generated per second.
9.3 Explanation of the principle of conservation of momentum.
9.4 Application of the statement in 9.3 to bodies in collision, e.g. impact of shuttle with picker or buffer.
9.5 Derivation of the dynamic equation, impulse = change in momentum.

## 10. Energy

10.1 Definition of three forms of mechanical energy :
- (i) energy of motion, Kinetic energy = $\frac{1}{2} mv^2$;
- (ii) gravitational potential energy due to position relative to some datum, P.E. = mgh;
- (iii) strain energy, energy stored in a deformed elastic body (without calculation).

10.2 Explanation of the principle of conservation of energy.

10.3 Derivation of the dynamic equation: work done = change in K.E.

10.4 Application of energy principles to solve problems associated with textile machines and processes.

## 11. Strain Energy

11.1 Application of force/distance diagrams in the solution of strain energy problems.

11.2 Understanding of the meaning of coefficient of restitution.

## 12. Angular Dynamics

12.1 Definition of Moment of Inertia (I) as the equivalent in angular motion to mass in linear motion.

12.2 Derivation of the relationship $I = mk^2$, where k is the radius of gyration.

12.3 Explanation of the angular dynamic equations for :
- (i) angular 'force';
- (ii) angular momentum;
- (iii) angular kinetic energy.

12.4 Application of the angular dynamic equations to the solution of machine problems.

## 13. Motion in a Circle

13.1 Definition of centripetal force.

13.2 Derivation of the formula for centripetal acceleration.

13.3 Explanation that centripetal force equals $mv^2$ or $\frac{mv^2}{r}$.

13.4 Definition of centrifugal force as equal and opposite to centripetal force.

13.5 Application of the equations in 13.2 and 13.3 in calculations relevant to textile mechanisms (i.e. radial forces on bearings, ring travellers, centrifugal clutch etc.).

## 14. Balancing

14.1 Description of typical procedures for static balancing (e.g. card cylinder).

14.2 Description of typical procedures for dynamic balancing (e.g. card cylinder).

14.3 Application of principles in 13.1 to 13.4 to calculations of balancing of revolving masses.

# E FRICTION

## 15. Coil Friction

15.1 Definition of coil friction as the resistance to sliding of a flexible band on a curved surface.

15.2 Explanation, without proof, of $\frac{T_T}{T_S} = e^{\mu\theta}$

15.3 Application of the formula in 15.2 to the solution of textile and mechanical problems.

16. Belt Driving

16.1 Calculation of the transmission of power by flat belts.

16.2 Appreciation of the limiting factors determined by the coil friction of a belt and, loss of tension due to centripetal force.

16.3 Explanation of $\frac{T_T - T_C}{T_S - T_C} = e^{\mu\theta}$, where $T_C$ is centrifugal tension = mass/unit length multiplied by $v^2$.

16.4 Explanation of loss of velocity ratio in belt drive due to creep.

16.5 Derivation of the formula for tension ratio of vee groove pulley.

16.6 Discussion of the virtues and defects of both flat belts and belts in vee grooves.

F. SIMPLE HARMONIC MOTION

17.1 Definition of S.H.M. as the motion of the projection onto its diameter of a particle moving in a circular track.

17.2 Explanation of amplitude as the diameter of the circle.

17.3 Explanation that acceleration is always directed towards the centre of oscillation and proportional to its distance therefrom.

17.4 Explanation that periodic time = $2\ \frac{\text{displacement}}{\text{acceleration}}$

17.5 Calculations involving S.H.M.

G LUBRICATION

18. Lubrication of Plain Journal Bearings

18.1 Description of the stages in the run up of a plain bearing from rest to running speed.

18.2 Explanation of boundary and hydrodynamic lubrication zones.

18.3 Explanation of the laws of fluid friction.

18.4 Plots of typical graphs of resistance against journal speed.

18.5 Use of $\frac{ZN}{P}$ curve as a means of understanding the effect on bearing performance of alterations in working conditions (without calculation).

18.6 Explanation of the effect of temperature on viscosity and on the value of $\frac{ZN}{P}$.

18.7 Discussion of the general nature of different lubricants and additives.

19. Lubrication of Rolling Element Bearings

19.1 Explanation of what is meant by rolling resistance.

19.2 Discussion of the purpose of lubricants.

19.3 Appreciation of factors influencing life of rolling bearings.

H MECHANISMS AND TRANSMISSION OF MOTION

20. Speed Variators and Adjusters

Explanation of :

20.1 Stepped pulley and gear changers.

20.2 Cone drums.

20.3 Expanding vee pulleys.

20.4 Variable chain drives, slotted chain and roller chain.

20.5 Friction variators, bowl and discs.

# I ELECTROTECHNICS

## 21. Application of Electricity

21.1 Application of the principles of Ohm's Law to simple circuits.

21.2 Solving of problems involving power and energy consumption in resistive circuits.

21.3 Description of the use of electromagnets in electrical and mechanical relays.

## 22. Generation of Direct Current - The Dynamo

22.1 Sketches of a single loop conductor rotating in a magnetic field delivering current to an external circuit through a commutator, and indication of the relative directions of current, field and rotation.

22.2 Explanation that the magnitude of the induced emf is proportional to the rate at which the conductor cuts the magnetic flux.

22.3 Explanation that the rate of cutting of magnetic flux depends on the length of the conductor, the strength of the field and the velocity of the conductor at right angles to the field.

22.4 Description of the following features of a practical d.c. dynamo :

(i) Single loop becomes a coil of many turns of wire to increase conductor length.

(ii) The armature is made of soft iron to complete the magnetic circuit.

(iii) The armature carries many successive coiled loops each connected to separate armature segments to provide steady output.

(iv) The magnetic field is produced by an electro-magnetic, the field coil.

22.5 Explanation of a field coil which is separately excited.

22.6 Explanation of a self excited shunt connected field coil.

22.7 Explanation of the regulation of output emf by means of a field rheostat.

## 23. D.C. Motor

23.1 Explanation of how an external d.c. voltage to a dynamo causes it to run as a motor.

23.2 Explanation that the direction of motion is such that the current flow in the armature coils relative to the field polarity is oposite to that for the dynamo.

23.3 Explanation that an emf is induced in the armature which opposes the applied voltage.

23.4 Explanation that the motor runs at such a speed that this induced emf balances the applied voltage.

23.5 Derivation of the relationship for motor speed.

23.6 Explanation that motor speed varies inversely as field flux for a fixed power output.

23.7 Explanation that speed depends on applied voltage if field flux is constant.

23.8 Explanation that field flux is practically adjusted by a rheostat in the field circuit.

23.9 Explanation that field windings can be connected either in shunt or in series, or a combination of both (compound).

23.10 Discussion of the applications of shunt and also series connected motors.

23.11 Sketches of the connections of a typical starter for a shunt motor.

23.12 Explanation of the safety hazard if a series motor runs without load or if a field winding is disconnected.

## 24. Generation of Alternating Current

24.1 Description of the construction of a simple a.c. generator.

24.2 Description of the operation of a simple a.c. generator.

24.3 Explanation of the waveform of a.c.

24.4 Identification of the frequency of a.c. from waveform.

24.5 Calculation of the effective value of current and voltage.

## 25. Inductors and Capacitors

25.1 Description of the construction of a parallel plate capacitor.

25.2 Understanding of the meaning of phase angle.

25.3 Description of the effect of inductance and capacitance on phase angle in a.c. circuits.

25.4 Calculation of the effect of inductance, capacitance and resistance in series circuits (RC, RL and RCL without reference to phasors).

25.5. Calculation of the power factor in a circuit in 25.4.

25.6 Understanding of the economic consequences of a low power factor in a textile factor.

25.7 Understanding of the use of capacitors for power factor correction.

25.8 Description of the construction of a single phase transformer.

25.9 Understanding of the effect of primary and secondary turns of the supply and output voltages.

25.10 Calculations to find primary, secondary turns, input and output currents and voltages for a transformer.

## 26. Three-phase Alternating Current

26.1 Description of the principle of operation of a three-phase generator.

26.2 Appreciation of the use of 4-wire systems and three-wire systems with balanced load.

26.3 Explanation of star and delta connections.

26.4 Calculation of line and phase voltages and currents for a three-phase supply.

27. The Squirrel Cage Induction Motor

27.1 Explanation of how a rotating magnetic field can be produced using three-phase supply.

27.2 Description of the construction of an SCI motor.

27.3 Description of how an SCI motor produces rotation.

27.4 Description of the operating characteristics of an SCI motor.

27.5 Calculation of the speed of an SCI motor.

27.6 Appreciation of the benefits of using SCI motors and the problems associated with their use.

28. Electrical and Electronic Equipment

28.1 Description of the general principles behind the operation of examples of amplifiers, rectifiers and transistors.

28.2 Appreciation of the reasons for using transistors and rectification of any limitations involved in their use.

28.3 Description of different forms of photoelectric cell, their construction and mode of operation.

28.4 Appreciation of the use of photoelectric cells for quantitative measurement of radiation.

28.5 Appreciation of the use of photoelectric cells in switching systems.

28.6 Appreciation of the operation of photoelectric cells in light activated and dark activated switching systems.

## J HEAT

29.1 Explanation of the basic quantities associated with measurement of heat.

29.2 Calculations involving heat transfer in mixtures.

29.3 Explanation of the meaning of the different quantities used in steam tables.

29.4 Use of steam tables for calculations.

## K CONTROL THEORY

### 30 Outline of the Basic Principles of Automatic Control and their Application in Textiles

30.1 Understanding of the meaning of open and closed loop systems.

30.2 Differentiation between digital, proportional and integral control.

30.3 Identification of control loops in different control systems in textiles.

30.4 Comparison of the desired operation of control systems actual performance and indication of reasons for variation.

## L COMPUTERS IN TEXTILES

### 31. Outline of the Basic Principles of Computers and their Applications in the Textile Industry

31.1 Understanding of the differences in operation and use of digital and analogue computers.

31.2 Appreciation of the different applications of computers in management, production, research and development in the textile industry.

APPENDIX IV

SPECIFICATIONS FOR YARN PRODUCTION TECHNOLOGY MACHINERY AND EQUIPMENT

1. Rotor Spinner

One four head rotor spinning machine with the following features:-

Two spinning heads to be fitted with trash extraction unit; opening roller to be covered with wire suitable for cotton processing.

Two spinning heads to be fitted with units suitable for processing man made fibres and cotton.

Variable speed motor and controls for rotor, opening roller and yarn delivery.

Digital display of rotor, opening roller and delivery speed.

Full range of draft change and appropriate spare parts kit.

50 empty packages of appropriate size.

2. Comber Lap Preparation

Manually doffed lap winder to assemble drawframe slivers into laps for combing; compatible with item 3.

Full range of appropriate spare parts.

50 formers forproducing laps to be supplied.

3. Comber

Six or twelve head cotton comber to operate on a range of staple lengths within the range 22mm-38mm, with variable waste extraction from 5 to 30%; two zone drafting at drawbox.

Full range of appropriate spare parts.

4. Short Staple Drawframe

Single head two delivery machine with a table type extended creel with positively driven assisting roller.

Pressure bar drafting system to process a full range of cottons and man-made fibres.
Over centre coiling supplied for 14" (356mm) cans.
Drawframe to be fitted with an electromechanical autoleveller unit.
Full range of appropriate spare parts and change wheels to be supplied.
30 x 14" drawframe cans to be supplied.

5. Speedframe

Short staple roving frame for the production of rovings in the range 1100 tex - 400 tex.
Roving bobbin size 356 x 178mm.
3 roller double apron drafting system with top arm weighting, primarily for staples up to 65mm.
16 spindle machine.
Guage: 273mm ($10^3/4$ in).
PIV unit to control winding speed.
Telescoping spindles.
Full range of appropriate spare parts and change wheels to be supplied.
50 empty roving bobbins to be supplied.

6. Ringframe

Short staple ringframe for processing cotton, blends and 100% synthetic fibres with the following specifications.

| | | |
|---|---|---|
| No. of spindles: | 48 | |
| Guage: | 3" with 8" lift | |
| Drafting system: | i) | 3 line double apron for processing fibre up to 40mm |
| | ii) | 3 line double apron for processing fibres up to 65mm |

Rings: i) 51mm diameter; Black velvet, anti-wedge
ii) 51mm diameter; SU

Creel: Umbrella type

Balloon control rings to be fitted.

Vacuum end waste collector system to be fitted.

Full range of appropriate spare parts and change wheels for draft and twist to be supplied.

Range of travellers to be supplied.

250 empty ring tubes to be supplied.

7. Jute Spinner

An apron draft jute spinner (plate/apron arrangement) with the following features:

| | |
|---|---|
| Guage: | $4\frac{3}{4}$" pitch (120.65mm) |
| Flyer type: | Tubular flyer |
| Drafting system: | Apron drafting zone (plate/apron arrangement) |
| Bobbin size: | $7\frac{1}{2}$" x $3\frac{1}{2}$" |
| No. of spindles: | 24 |
| Yarn count range: | 278 - 625 tex |

Full range of appropriate spare parts and change wheels to be supplied.

50 bobbins of appropriate size to be supplied.

8. Miniature spinning system

Miniature spinning system comprising card, drawframe and ring spinning frame for the quick assessment of spinning qualities of small fibre samples (min 40g).

Card: small card with stationary flats comprising of a feed apron, feed roller, feed plate, taker in, cylinder, doffer, stationary flats and oscillating doffing comb.

**Drawframe:** single delivery machine with a 4 roller, 2 zone drafting arrangement for medium staples (24mm - 32mm).

**Ringframe:** 8 spindle ringframe,76mm(3in) guage with 152mm (6") lift.

Two zone apron drafting system enabling up to 64mm (2½ in) fibre to be processed.

Three set of rings, to cover a wide count range, to be supplied.

A full range of appropriate spare parts and accessories to be supplied.

APPENDIX V

SPECIFICATION FOR FABRIC PRODUCTION TECHNOLOGY (MACHINERY AND EQUIPMENT)

1. One 220cm reed width, single colour, projectile weaving machine with cam shedding and weft accumulator. To include : supply of a sized polyester/cotton warp, an essential spare parts package, and provision of comprehensive technician training of a minimum of five weeks duration.

2. Two battery powered, hand held, electronic single thread tensiometers; capable of measuring tension up to 100cN, with damping facilities.

3. Two battery powered, narrow strip (12½cm), warp tensiometers for weaving.

4. One electronic single thread tensiometer; with high speed pen recorder capable of recording over 100 tension fluctuations per second, at tension levels of up to 100cN, with variable damping facilities. The tensiometer should be protected against fluctuations in power supply and supplied with 24 rolls of chart paper.

5. One stroboscope for use in spinning and weaving; with external photoelectric pick-up and flash delay unit (1/500s to ½s delay). The stroboscope should be protected against fluctuations in power supply.

6. One bench mounted electronic balance; capable of weighing up to 10g in increments of 1mg. The balance should be protected against fluctuations in power supply.

7. One crimptester for woven fabrics.

8. One set of rigid taper line gratings.

9. 15 single lens piece glasses (linen testers); either 2cm square or 1 inch square, graduated in millimeters.

10. One warp tension balance.

11. One course length tester for knitted fabrics.

12. One yarn speed meter.

13. One yarn length counter.

14. One 8 or 10 spindle, fully automatic, pirnwinder; suitable for staple and filament yarns, complete with a package of essential spares.

15. One two-guide-bar tricot sampling warp knitting machine; with a package of essential spare parts and pattern links allowing pattern chain assembly for a range of fully set two-guide-bar structures.

16. Two bench mounting, hand powered, Griswold type, cylinder and dial circular knitting machines.

17. One four-feed, floor mounting, band powered, 8 gauge, V-bed knitting machine.

18. One four-feed, floor mounting, hand powered, 5 gauge, flat bed, purl knitting machine.

19. One 18's gauge, 8 feeder, 26 inch diameter, single jersey knitting machine; with sinkers, equipped with positive feed devices.

20. One 16's gauge, 8 feeder, 18 inch diameter, cylinder and dial knitting machine; with non-electronic pattern selection system.

21. One 18's gauge, 8 feeder, 30 inch diameter interlock knitting machine.

(Small variations from the specified machine gauges and diameters should be permissible, but each machine must be supplied with a package of essential spare parts.)

APPENDIX VI

SPECIFICATIONS FOR WET-PROCESSING TECHNOLOGY (MACHINERY AND EQUIPMENT)

1. Laboratory oven; front opening, fan-assisted, maximum internal volume of 150 litres, facility for at least 4 shelves (to be supplied), maximum temperatures (within 90 minutes) of 300°C with control to ±0.25°C, stainless steel interior, over-load/safety cut/out, 220/240V.

2. pH meter; analogue display, 0 to 14 pH range, ±1400mV range to ±2% descrimination, 0 to 35°C temperature range with compensator, to be supplied with combination electrode with support rod and holder, 220/240V.

3. Spin dryer; top-loading, minimum spin speed of 1200 r.p.m., minimum wet-load of 2Kg, 220/240V.

4. Laboratory flat-bed screen printer; automatic print paste spreading, minimum table size of 60 x 30cm, 220/240V.

5. Two laboratory pad-mangles; minimum 25cm nip width, variable nip pressure and speed, multi-purpose low-stain rubber rollers, 500cm³ minimum for liquor trough, stainless steel external construction, 220/240V.

6. Laboratory print paste mixer; variable speed, integral stand, 220/240V.

7. Four sets of K-bar hand-coating rods, with rubber base plates of minimum size 20 x 10cm.

8. Four rotary, sample-dyeing machines; minimum facility of 8 x 200cm³ dyeing tubes (to be supplied) per machine, dyeing temperature control from 20 to 140°C within ±1°C, variable rate of temperature rise facility, stainless steel construction and tubes, 220/240V.

9. Laboratory jig dyeing machine; minimum of 20cm working width, manual or automatic reversal, dyeing temperature control from 20 to 100°C within 1°C, variable rate of temperature rise facility, stainless steel construction, 220/240V.

10. Colour matching cabinet; minimum size of 100 x 50 x 50cm, incorporating hours-usage timer, multi-tube facility including standard daylight/u.v./tungsten sources (to be supplied in duplicate), 220/240V.

11. Laboratory winch dyeing machine; operating volume from 2 to 10 litres, dyeing temperature control from 20 to 100°C within 1°C, variable rate of temperature rise facility, stainless steel construction, 220/240V.

12. Laboratory hank dyeing machine; single and double stick facility, forward and reverse flow, dyeing temperature control from 20 to 100°C within 1°C, variable rate of temperature rise facility, stainless steel construction, minimum 10 litre liquor volume, to include supply of appropriate hank-winder, 220/240V.

13. Laboratory high temperature steamer unit; front loading, temperature range from 100 to 180°C within 1°C, sample support facility of a minimum of 25 x 25cm, stainless steel construction, 220/240V.

14. High temperature sample dyeing machine; minimum of 10 x 200cm³ dyeing tubes (to be supplied in duplicate) agitator devices usable with loose fibre, yarn and fabric samples, dyeing temperature control from 20 to 140°C, variable rate of temperature rise facility, safety valve, stainless steel construction, 220/240V.

15. Laboratory rotary screen printer; automatic print paste spreading, to give minimum print size of 30 x 30cm, single screen capability only, 220/240V.

16. Two laboratory steamer units; atmospheric steam, to take samples up to 60 x 30cm on suitable support system, 220/240V.

17. Laboratory transfer printing unit; minimum of 40 x 20cm print capability, top and bottom beds to allow temperature control within 1°C, 220/240V.

18. Laboratory high temperature baking unit; temperature control up to 300°C within 1°C, support system for samples up to 60 x 30cm, preferably with option for dimension control on smaller samples, 220/240V.

19. Laboratory single-package dyeing machine; to take package up to 500g, in/out and out/in flow reversal control, dyeing temperature and rate of temperature rise control, stainless steel construction, liquor heating system to 100°C, 220/240V.

20. Laboratory jet dyeing machine; up to 500g load minimum, dyeing temperature and rate of temperature rise control, stainless steel construction, liquor heating system to 130°C, 220/240V.

21. Six colorimeters; wavelength range 400 to 700nm through minimum of eight filters (to be supplied), analogue reading to $\pm$2% for same cuvette, sample holder for standard 10mm cuvettes (to be supplied), including essential spares kit for each instrument, 220/240V.

22. Two light fading test units; simple bench mounting, hours-usage timer, sample mounting facility, each unit to be supplied with duplicate light source, 220/240V.

23. Crockmeter; ISO/AATCC standard test equipment.

# APPENDIX VII

## SPECIFICATIONS FOR TEXTILE TESTING EQUIPMENT

### Twist Tester

Hand driven, Quadrant twist tester (twist contraction) with adjustable test length up to maximum 250mm (10 inch) with resettable mechanical counter.

### Rapid Regain Tester

Rapid regain tester with maximum capacity 50 grams; based on the principle of controlled high pressure air flow with temperature regulator 220/240V.

### Fibre Bundle Strength Tester

Fibre bundle strength tester for cotton; for testing small flat bundles of parallel fibres, loading device being a beam balance.

### Tetrapod Walker Carpet Tester

Carpet wear testing apparatus based on tetrapod walker principle, 220/240V.

### Comb Sorter Apparatus

51mm (2 inch) comb sorter complete with all necessary accessories.

### Crease Recovery Tester

Crease recovery apparatus; to test crease recovery angle, using samples 40mm x 15mm using a load on 10N.

### Vernier Microscope

Vernier microscope with facility for linear measurements to 0.1mm; kinematically mounted carriage with locking screw and line adjustment control; microscope body to be capable of 360° movement with horizontal or vertical mounting.

Grey Scales

(i) ISO/AATCC grey scales; assessment of change of shade.

(ii) ISO/AATCC grey scales; assessment of staining on adjacent material.

Bursting Strength Tester

Hand operated bursting strength tester utilising a plunger and large diameter handwheel. With measuring capacity 0-70Kg/ square metre.

APPENDIX VIII

OPERATIONAL CONDITION OF EQUIPMENT AND MACHINERY AVAILABLE IN THE COTTON, JUTE AND WET-PROCESSING SHEDS AND TEXTILE TESTING LABORATORY

COTTON YARN PRODUCTION

| | |
|---|---|
| Opening and Cleaning: bale breaker; step cleaner; twin opener; hopper feeder (1); porcupine opener; hopper feeder (2); scutcher. | all in reasonable working order. |
| Carding: 2 Platt cards; fitted with flexible wire | In good order, but perhaps 1 card should be reclothed with rigid metallic wire. |
| Drawing: 3 MDF drawing frames, 4/4 roller drafting. | One in working order; the others required some electrical repair. An instruction manual is available. |
| Reducing: MS2 Speed frame; MS2 Roving frame, 4/4 Roller drafting. | Both have electrical problems, but are in reasonable condition. An instruction manual is available. |
| Spinning: 3 MRS ring frames. | Electrical problems; drive belt missing. An instruction manual is available. |
| M1 | In working order. |
| MDC ring doubler. | Runs but no spindle tapes. |

The machines installed are fairly representative of the equipment used in the local production units and, with care and attention, could be brought up to an acceptable standard. Improvement could be affected in the form of a new drafting system for the M1 ringframe.

## JUTE YARN PRODUCTION

OD batchmixer; )
Mackie softener; )
jute breaker card (Mackie); )
jute finisher card (Fraser); )
1st jute drawing frame; )
2nd " " " ; )
3rd " " " ; )
jute spinning frame. )

All are in good working order and manuals are available at the college.

## TESTING LABORATORY EQUIPMENT

In Working Order:

Goodbrand Martindale abrasion tester (problems with standard cloths)

Reynolds & Branson rapid regain tester

Essdiel autowrap reel

Shirley tube test

Hydrostatic head-tester

Wrap reel

Winding drum

6 Microscopes (rather old)

Shirley Comb Sorter

Essdiel thickness guage

HATRA Lateral stretch device

Shirley crimp tester

Ballist. ear tester

Wrapping machine

Roving wrap reel

Jute wrap reel

Cotton wrap reel

2 WIRA Cotton fineness meters

Goodbrand moisture testing oven.

Motorised twist tester

Several twist testers

Shirley thickness tester

Soxhlet extracter and water bath

Numerous quadrant balances

Precision torsion balance (5 mg)

5 Tachometers

3 Uster AQUARIOUS moisture meters

WIRA tuft withdrawal tensometer

Shirley stiffness tester

Moisture monitor (yarn probe)

In need of repair:

| | |
|---|---|
| ICI snag tester | Electrical problems |
| Shirley hairiness meter | Winding drum functioning but measuring head/ digital display faintly |
| IIC fineness/maturity tester | |
| CSIRO regain tester | Drying element functioning but balance and compumoist faulty |
| Goodbrand tensile tester | |
| Shirley air permeability | Electrical floats missing |

FABRIC PROCESSING AND YARN PREPARATION

A fairly wide selection of equipment has been installed, mainly under the Columbo plan. Most of this equipment is basically sound and with appropriate repair and refurbishment could form an important part of the college resource base. The equipment is installed in two locations, the jute shed and the cotton shed, plans of which are shown in the accompanying figures. The items can be grouped as yarn preparation equipment, looms, knitting machines, and miscellaneous equipment; each have been numbered in the figures for ease of reference.

**Yarn Preparation Equipment**

**Jute shed:**

| | |
|---|---|
| (15) Maquinoria 4 spindle conewinder ) | Sound mechanically, |
| (16) " " copwinder ) | electrical maintenance |
| (17) " " " ) | required |

**Cotton shed:**

| | |
|---|---|
| (30) Sizing machine ) | Electrical problems. |
| (31) High speed beaming ) | Useful as static models but probably not worth repairing as raw material requirement is large |
| (32) Section warper | Functioning |
| (35) Muschamp manual copwinder | Functioning, minor refurbishment needed |
| (36))Beyond repair | could be scrapped |
| (37)) | |
| (38) Holt 10 spindle conewinder (M86) | Electrical problems; mechanically sound, some minor refurbishment needed |
| (39)) Hankwinders | Functioning |
| (40)) | |

**Looms:**

**Jute shed:**

| | |
|---|---|
| (1) Wilson & Longbottom jutelooms ) | |
| (2) " " " ) | |
| (3) " " " ) | Functioning, with warps |
| (4) " " " ) | |
| (5) " " " ) | |
| (6) " " " ) | |
| (7) " " " ) | Duplicates of 1-6, |
| (8) " " " ) | without warps, could be retained as static models |
| (9) " " tape loom ) | Minor refurbishment needed |
| (14) Textima loom | Could be scrapped |
| (10) Hand loom (empty) ) | |
| (11) " " (functioning) ) | See comments on hand |
| (12) " " ( " ) ) | looms in cotton shed |
| (19) Hand tapestry (empty) ) | |

Cotton shed:

Whilst the power looms in the jute shed are similar, those in the cotton shed show considerable diversity but require more repair and refurbishment. Twelve looms could be identified for complete repair and refurbishment (suggestions to allow a wide variety of practical, demonstration and project work are proposed).

(3) single shuttle, non-automatic )
(4) " " , " )
(5) " " , " )
(18) " " , " )

Loom 18 could be drawn in with a coarse (approximately 5's cotton count) warp as follows: one half one end/dent; one half two ends/dent, dent missed; to facilitate investigation of the effects of backrest setting and shed timing on cover.

(16)1/4 cams, spring easing motion )
(20)1/2 cams, roller reversing )

Cam assembly examination

(5) Redrawn 12 shafts straight draft )
(15) " 10 " " " )

pattern weaving capability for 2, 3, 4, 5, 6, 10 and 12 end weaves

(12)Redrawn, for colour and weave effects, as:

| 1/4 | 1/4 | 1/4 | 1/4 |
|---|---|---|---|
| white<br>white | 1 coloured, 1 white | 2 coloured, 2 white | 4 coloured, 4 |

(6) 400's DLDC jacquard.

(7) 200's DLSC jacquard.

(17)Towel Loom

This loom requires considerable work and its repair could be regarded as a long term aim.

(2) ) Could be utilised as static models
(13))

(1)) Could be utilised as static models or broken for spares
(11)

(19) Probably could be scrapped

(14) Could be utilised as static model of box and pirn change.

(9) Could be utilised as static model, fitted with two heald shafts, no warp, to show operation of undermotion.

(8) Loom could be broken for spares and the Jacquard retained as a floor mounted model.

| | |
|---|---|
| (22) Hand loom ) | Probably worth retaining |
| (23) " " ) | |
| (24) " " ) | Could be retained if demand is foreseen by teaching staff, and if the space is not required (comment also applies to the hand looms in the jute shed). |
| (25) " " ) | |
| (26) " " ) | |
| (27) " " ) | |
| (28) " " ) | |
| (29) " " ) | |

Knitting Machines:

The flat V-bed, single jersey, cylinder and dial, and sock machines are housed in a small room adjoining the cotton shed. All are functioning, except the latter for which parts are unlikely to be readily available. However, it could be retained as a model.

Miscellaneous Equipment:

Jute Shed:

| | |
|---|---|
| (13) Hand rope machine ) | |
| (18) Sewing macnine ) | Functioning, some minor refurbishment needed |
| (20) Hemming machine ) | |

Cotton Shed:

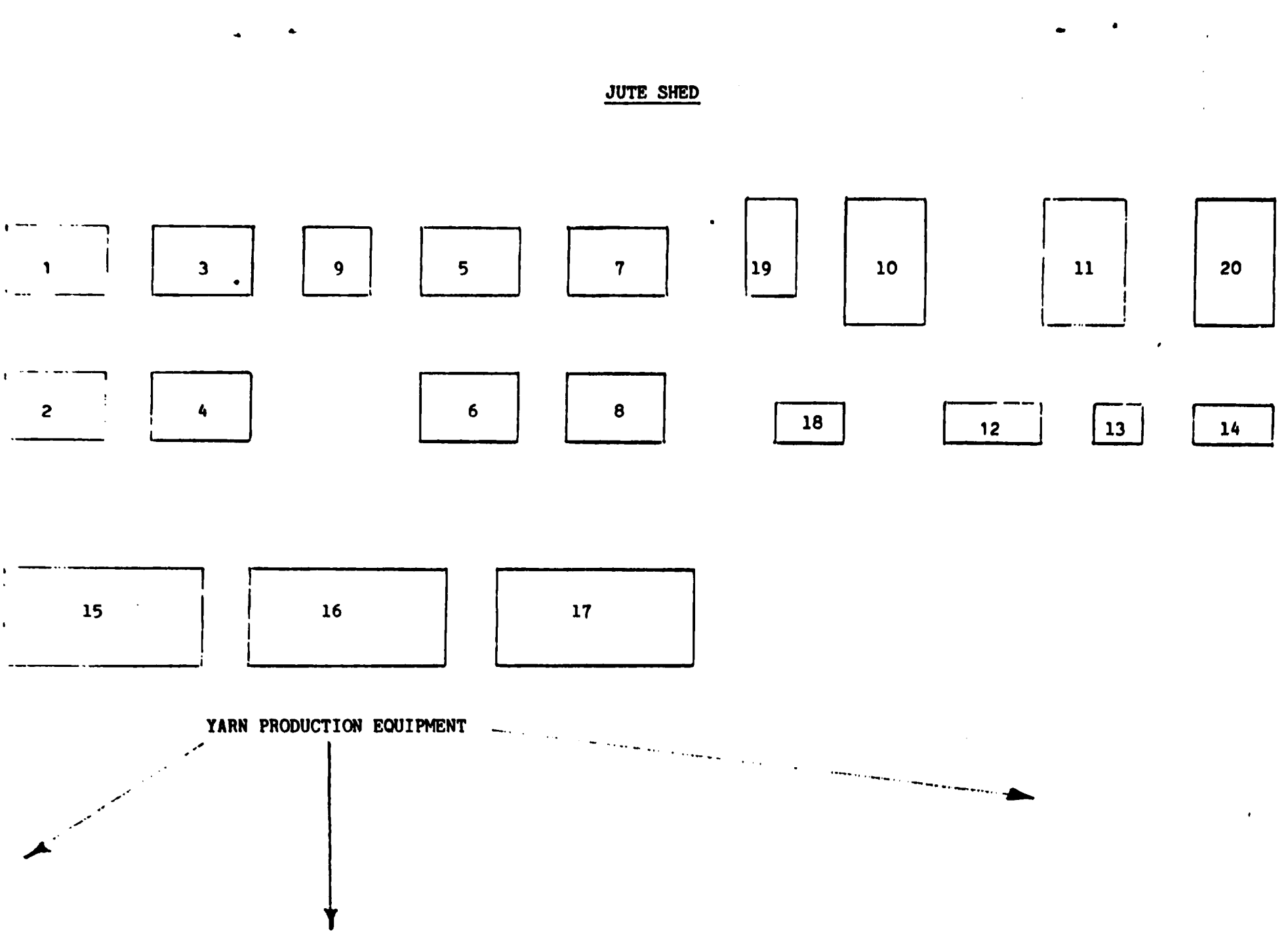
| | |
|---|---|
| (33)Piano cardcutter ) | Routine maintenance is required |
| (34) " " ) | |
| (21) Hand drawing-in frame | Functioning. |

## WET-PROCESSING

Without an adequate supply of water, and some provision for steam or other heating medium, it is not feasible to consider the majority of the equipment and machinery in the wet-processing shed as being functioning or otherwise. Appearances suggest that with the exception of a laboratory-scale roller-printing machine and a few other laboratory-sized pieces of equipment, none of the machines has ever been run in such a way as to effect any technological process on any substrate.

The reasons for this lack of utilisation, whether they be as a result of lack of water, materials, power, fuel, effluent disposal facility, operator skills etc., are not clear. However, the range and magnitude of the problems that would need to be overcome, in order to take practical advantage of the machinery and equipment in the wet-processing shed, are probably of such an extent that successful re-commissioning must be considered as being of low viability, within the short- to medium-term future.

Following from this conclusion, no attempt has been made to audit the wet-processing facilities in detail.


JUTE SHED
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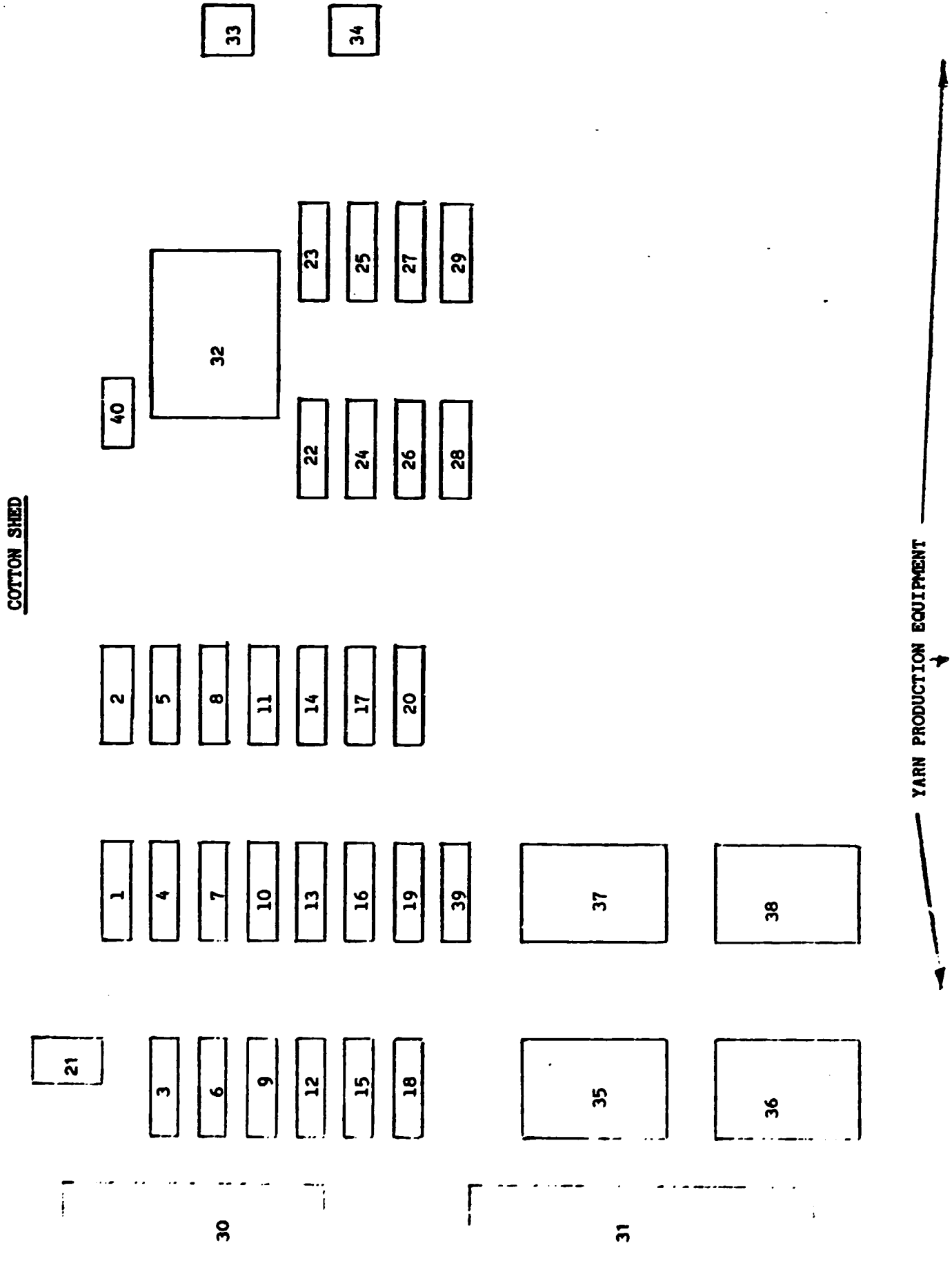
YARN PRODUCTION EQUIPMENT


COTTON SHED
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