BASIC DESIGN STUDY REPORT

ON

THE PROJECT FOR PROVISION OF EDUCATIONAL EQUIPMENT

FOR

THE UNIVERSITY OF MORATUWA

IN

THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

MARCH 1988

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

In response to the request of the Government of the Democratic Socialist Republic of Sri Lanka, the Government of Japan has decided to conduct a basic design study on the Project for Provision of Educational Equipment for the University of Moratuwa and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent to Sri Lanka a study team headed by Dr. Akira Shinohara, Dean, Faculty of Textile Science and Technology, Shinshu University, from December 5 to December 25, 1987.

The team had discussions on the project with the officials concerned of the Government of Sri Lanka and conducted a field survey in the Colombo and Moratuwa areas. After the team returned to Japan, further studies were made and the present report has been prepared.

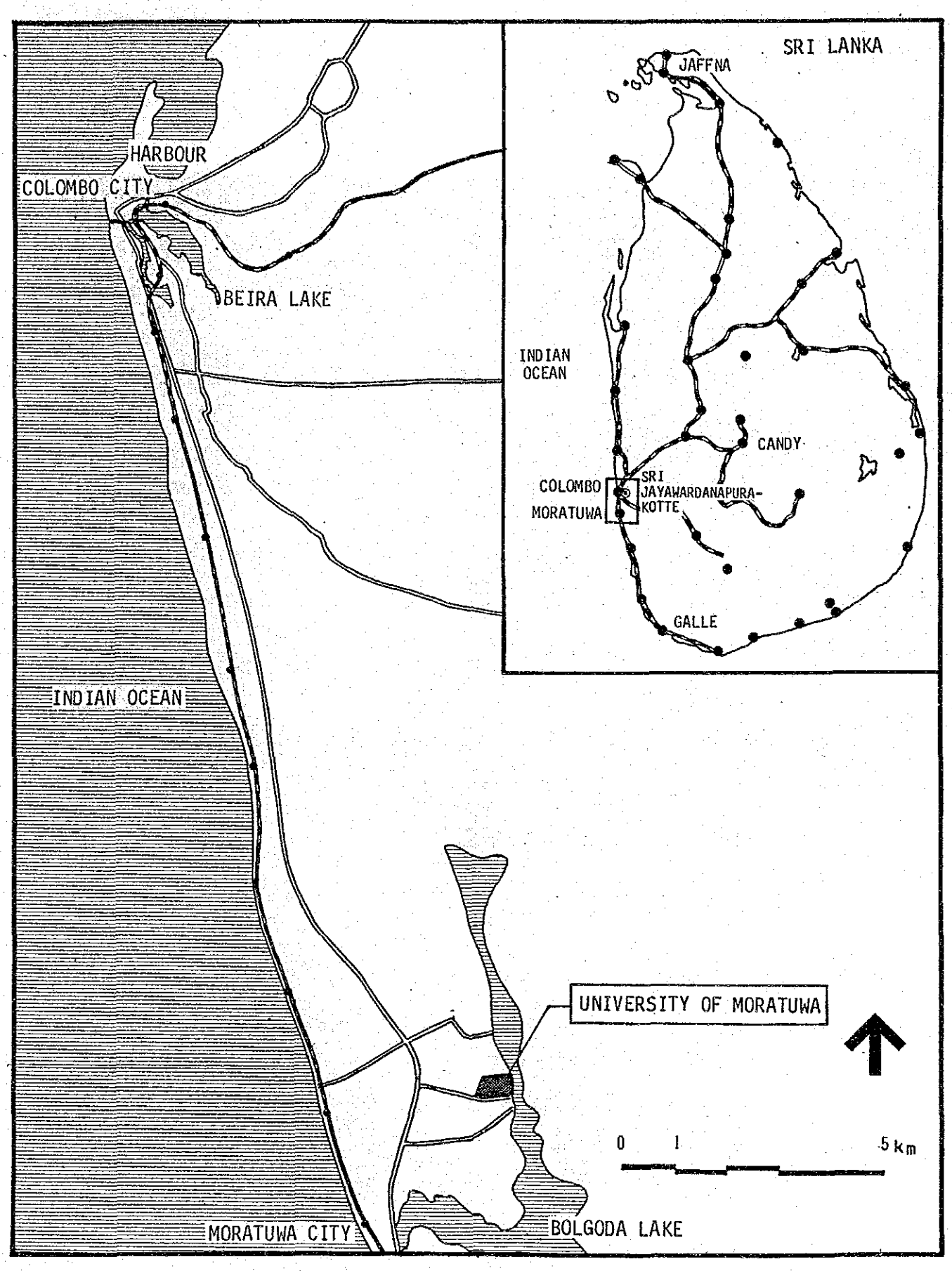
I hope that this report will serve for the development of the project and contribute to the promotion of friendly relations between our two countries.

I wish to express my deep appreciation to the officials concerned of the Government of the Democratic Socialist Republic of Sri Lanka for the close cooperation extended to the team.

March, 1988

Kensuke Yanagiya

President
Japan International Cooperation Agency



MAP OF SRI LANKA AND COLOMBO AND MORATUWA AREAS

UNIVERSITY OF MORATUWA

(Departments of Electrical Engineering, Electronic & Telecommunication Engineering and Computer Science & Engineering)

SUMMARY

SUMMARY

The economy of the Democratic Socialist Republic of Sri Lanka (hereinafter referred to as Sri Lanka) is characterized by the predominant position held by three traditional agricultural products - tea, rubber, and coconuts-which collectively account for about half the export value. These products are very vulnerable to price fluctuations in the international market, which, in turn, makes the economy of Sri Lanka very unstable. The volume of imports is close to 1.5 times that of exports. The major import commodities are petroleum, machinery, vehicles, and textile raw materials. The chronical deficit in the balance of payments has caused the Government to take a policy of liberalization and economic development which aims to promote employment, to raise living standards and improve the balance of payments situation on a long-term basis. As a priority policy in this direction, the Government has intensified the policy of strengthening manufacturing industry particularly to promote export and import substitution. The Government places particular emphasis upon the development of human resources both in quality and quantity in the field of engineering, in full recognition of the fact that without sufficient supply of qualified engineers industrial development is impossible.

The University of Moratuwa was established in 1960 as a technical institute under Canadian assistance and became a full-fledged technical university in 1978. With the Department of Computer Science and the Department of Textile Technology established in 1986, the University has now become a leading institute for advanced technical education consisting of two faculties and 13 departments. The University, however, lacks the sophisticated educational equipment necessary to conduct diversified, specialized and advanced education and research appropriate to a university. The University is thus unable to provide effective education or adequately cope with an increased number of students.

Against such a background, the Government of Sri Lanka has requested the Government of Japan for a grant aid for provision of educational equipment to the University of Moratuwa. In response to this request the Japan International Cooperation Agency (hereinafter referred to as JICA) sent a basic design study team to Sri Lanka from December 5 to December 25, 1987 to conduct a field survey. During the period, the team had a series of meetings with Ministry of Finance & Planning, Ministry of Higher Education and the University of Moratuwa to discuss the present state of the University, background and content of the request, implementing organization, maintenance system of the University and other relevant matters to evaluate the effectiveness and adequacy of this project as a Japanese grant aid project. After the field survey, the basic design study team analyzed the project and developed the list of the equipment to be provided, estimated the cost and worked out a maintenance plan of the equipment to be donated.

The equipment will be provided to seven departments of the University of Moratuwa, i.e., the Departments of Electrical Engineering, Electronic & Telecommunication, Computer Science & Engineering, Chemical Engineering, Materials Engineering, Mathematics, and Texitile Technology, and also to the common facilities comprising the Engineering Library, Language Laboratory and Physical Education. This reflects the increasing demand from the nation's manufacturing industries such as textile and garments, chemicals, rubber, and plastics for upgrading the higher education and also a mounting need for specialists in computer and information processing in modern industry.

The request has been evaluated in terms of the present situation, the numbers of the teaching staff versus students, curricula, experimental plans, etc. The basic design study finally selected 383 items as necessary and adequate out of 489 items originally requested, as shown in the following:

DEPARTMENT	ITEM	CONTENTS
Electrical Engineering	43	Measuring Instruments, Electric Apparatus, Electric Power Testing Equipment, etc.
Electronic & Telecommunication Engineering	82	Measuring Instruments, Experimental Trainer for Digital Circuit, etc.
Computer Science & Engineering	60	Computers, Experimental Apparatus for Digital Circuit, etc.
Chemical Engineering	27	Analyzer, Experimental Reactor, etc.
Material Engineering	7	Electron Microscope, Fatigue Tester
Mathematics	1	Microcomputer
Texitile Technology	99	Fiber Tester, Spinning Machine, Knitting Machine, Dyeing Machine, etc.
Common Facility	64	Library Desk, Shelf, LL Equipment, Sporting Equipment
Total	383	

The University of Moratuwa will be the implementing agency of this project on the Sri Lankan side under the supervision of the Ministry of Higher Education.

The project cost is estimated approximately at ¥10,980 thousand (Rs. 2,400 thousand) for the Sri Lankan portion. The project will take 10.5 months to complete after the conclusion of the Exchange of Notes between the two Governments through detailed design (1.5 months), tendering (2 months), manufacturing (4 - 5.5 months), transportation (2 months) to installation (3 months).

The University of Moratuwa will organize an effective maintenance system in addition to mobilizing its existing procurement and maintenance systems to properly maintain the equipment to be provided under this project. Sufficient spare parts for two years will be included with the equipment; however, in the long term the University will have to procure

its own spare parts. The University will have to contract maintenance of sophisticated equipment like computers to a dealer. The cost of the spare parts and maintenance is estimated at Rs. 4.2 million, or ¥19.2 million approximately. The Ministry of Higher Education will allocate a special budget for the maintenance and repairs of the equipment.

To implement this grant aid project effectively, the Ministry of Higher Education is expected to procure the necessary funds to carry out the Sri Lankan portion of the project smoothly as well as to maintain the equipment in good condition after implementation. The University of Moratuwa, for its part, is expected to fully utilize the equipment and make efforts for the improvement of the curricula and development of human resources.

The University of Moratuwa will be far better equipped with educational equipment in quality and quantity with the implementation of this project. Particularly, the University will be greatly strengthened in its ability to give practical technical training. The students will be able to better understand theories supported by practical experience. As a result, education standards in the University of Moratuwa will be greatly improved, which will result in greatly upgrading higher education and also facilitating the development of the economy and industry. In this respect, this grant aid project can have a profound impact on educational and economic progress in Sri Lanka.

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CHAPTER 1 INTRODUCTION

CHAPTER 1 INTRODUCTION

The economic structure of the Democratic Socialist Republic of Sri Lanka (hereinafter referred to as Sri Lanka) has long been one of exporting some given agricultural products and importing manufactured products. The industrialization is lagging, causing a chronic deficit in the balance of foreign currency payments.

The present administration which came to power in 1977 has taken a series of measures of liberalization and put special emphasis on the policies of economic development which could lead to 1) expanding employment opportunities, 2) improvement of living standards, and 3) improvement of balance of foreign currency payments on a long-term basis. More specifically, the Government has greatly devaluated Sri Lanka rupee, relaxed import restrictions and exchange controls, liberalized foreign currency allocation system, established the Investment Promotion Zone and launched Renovation Plan of Colombo City. The industrial sector has a high potential for export and import substitution; therefore, the Government takes advantage of their potential and encourages the industry to strengthen the corporate capacity and improve operation. The Government also has provided a variety of preferential treatments, rationalized customs system, invited foreign private capitals and promoted export. The manufacturing industry accounts for about 15 percent of Gross Domestic Product (GDP). Textiles and garments have been quite successful recently, exceeding the time-honored tea in export volume. The petroleum products also fare well. The Government's policy for industrialization promotes employment in such sectors as manufacturing, services, and tourism.

In the above situation, the Government of Sri Lanka considers it vitally important for the industrialization of Sri Lanka to improve the quality of the higher education and training of engineers and technicians.
Among the nine universities in Sri Lanka, higher technical education is provided only by two institutes, the University of Peradeniya and the University of Moratuwa; the latter is highly expected of by the society and industry as a professional technological education institute.

The University of Moratuwa incorporated 10 departments in the Faculty of Engineering and 3 departments in the Faculty of Architecture. However, the educational equipment in the laboratories has become obsolete, making it difficult to pursue education and training in modern technology. The enhancement in quality of education is an urgent issue for the University. Under these circumstances and background, Sri Lanka made a request to the Government of Japan for cooperation in upgrading the educational equipment both in quality and quantity.

In response to the request of the Government of Sri Lanka, the Government of Japan decided to conduct a basic design study on the Project for Provision of Educational Equipment for the University of Moratuwa (hereinafter referred to as the Project) and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent to Sri Lanka a study team headed by Dr. Akira Shinohara, Dean, Faculty of Textile Science and Technology, Shinshu University, from December 5 to December 25, 1987.

The objectives of the Basic Design Study were to clarify and evaluate the contents and backgrounds of the request through investigations in Sri Lanka and Japan, and to appraise the Project in view of adequacy as Japan's Grant Aid Program. The names of the survey team members, schedule and names of those who participated in the discussions are shown in the APPENDICES.

The major subjects discussed during the survey are as follows:

(1) Explanation of Japan's Grant Aid System
(2) Confirmation of the background of the request
    Present conditions of the education & research in the field of engineering in relation to the state of the industrialization and also of the roles expected of the higher educational institutions
(3) Objectives of the Project
    Clarification of the objectives and plan for the Project to enhance education and research in the University of Moratuwa

(4) National Development Project

(5) Educational project

Confirmation of educational and research projects and their problem area, assistances from foreign countries, budget, employment situation of graduates, etc. in higher education

(6) Justification for requested equipment

Confirmation of educational programs, carricula, syllabi, experimental plans, existing equipment, equipment layout, etc. in each department of the Univerity of Moratuwa

(7) Managerial plan and budget for the maintenance of equipment in the University of Moratuwa

(8) Existing supporting and utility facilities

(9) Inland transportation, etc.

The report entitled "Basic Design Study Report on the Project for Provision of Educational Equipment for the University of Moratuwa in the Democratic Socialist Republic of Sri Lanka" is thus, prepared incorporating all the results of discussions.

CHAPTER 2 BACKGROUND OF THE PROJECT

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2.1 Present Situation of the Country and Education

2.1.1 Present Situation of Sri Lanka

Sri Lanka is an island country in the Indian Ocean located to the south-east of the Indian subcontinent. The country has a population of 15.9 millions and an area of 65.6 thousand square meters. The capital city is Sri Jayawardanapura-Kotte adjacent to Colombo city. This country is the shape of a pear with the longer distance in north-south direction. The south-central area is a plateau zone with its peripheries forming the bases of mountains and plains which lead to the shoreline with a gentle slope. The south-west area forms a humid zone created by abundant rainfall brought by the south-west monsoon of the Indian Ocean. Annual rainfall in Colombo records some 2,400 millimeters. The north-east area in the back of mountains forms a dry and rather barren zone owing to insufficient rainfall. Such a dry and barren zone stretches about three-fourths of the island. Under these geographical conditions, about 70 percent of the population is living in the humid zone, the south-west area of the island.

As for the economy and industries of the nation, the productive sector next to services is agriculture, forestry and fishing. These sectors represent about 25 percent of the total GDP as indicated in Table 2.1.1. tea, rubber, and coconut are the three big exportable products of the country. Sri Lanka exports these products and imports petroleum, industrial products and raw materials for the textile industry. The economy of Sri Lanka depends on the export of these three products, a sort of inflexible mono-cultural economy, vulnerable to outside influence. Breaking itself away from this mono-cultural economy is considered one of the priority policies of the country.

Table 2.1.1 Composition and Growth of G.N.P. (1984-1986)

Sector	Amount (Rs. Million)			Growth Rate (%)	
	1984	1985	1986	1983	1986
1. Agriculture, Forestry and Fishing	26,113	28,366	29,106	8.6	2.6
1.1 Tea	2,681	2,759	2,723	2.9	-1.3
1.2 Rubber	878	851	856	-3.1	0.6
1.3 Coconut	2,513	3,828	3,935	52.3	2.8
1.4 Paddy	6,166	6,783	6,613	10.0	-2.5
1.5 Other (Other Agriculture, Forestry & Fishing)	13,875	14,145	14,979	1.9	5.9
2. Mining and Quarrying	2,449	2,486	2,615	1.5	5.2
3. Manufacturing	15,390	16,193	17,558	5.2	8.4
3.1 Tree Crop Processing	2,983	3,222	3,225	8.0	0.1
3.2 Other	12,407	12,971	14,333	4.5	10.5
4. Construction	8,030	8,070	8,191	0.5	1.5
5. Services	52,413	54,455	56,791	3.9	4.3
6. G.D.P.	104,395	109,570	114,261	5.0	4.3
7. Net Factor Income from Abroad	-2,996	-2,829	-2,696	-	-
8. G.N.P.	101,399	106,741	111,565	5.3	4.5

(Source: Central Bank of Sri Lanka)

Under the situation that about two-thirds of the arable land is used for the production of tea and rubber, the country is faced with a problem of insufficient food production. More than 80 percent of the population are engaged in the farm production. Plantations on a large scale are still preserved and are under operation. On the other hand, small subsistence household farms coexist.

The declining export market prices of tea and rubber, together with unseasonable bad weather, have deteriorated the economy of the country for the past several years.

Under the above situation, the Government of Sri Lanka took various measures, laying emphasis on economic growth based on market mechanism, with the prime targets of 1) Enhancement of employment, 2) Improvement of livelihood, and 3) Improvement of foreign currency balance. The following measures undertaken by the Government remarkably improved the recent economic situation:

(1) Relaxation of import restrictions and exchange controls and other measures to enhance economic growth

(2) Project creation and implementation;
   1) Establishment of Investment Promotion Zone
   2) Development of Mahaweli Ganga River
   3) Renovation plan of Colombo City

As for economic development, the Government announces "Revised Development Programmes" every year based on the original 5-year plan established in 1979. The "Revised Development Programmes, 1985-1989" envisages total investment of 155.3 billion rupees which is 50 billion rupees higher than the plan of the previous year. The Government clarifies its policy that the priority of development is given to investments meeting the following criteria:

1) The projects which are difficult to be undertaken by private sectors that are relatively easy to commence in terms of production and which enhance exports and/or substitution of imported goods
2) Infrastructure projects which could contribute to public welfare in the fields of power generation, irrigation, transportation, and communication
3) Investment which are urgently needed to improve situations in such fields as health and sanitation, education, housing, under-nourishment problem, etc.

Of utmost importance for the country is the implementation of practical steps toward industrialization, moving away from the inflexible economic situation peculiar to a mono-cultural economy. In this sense, the industrial sector has a high potentiality to grow and to contribute to the economy of Sri Lanka through export and import substitution. In line with this philosophy, various measures are being taken by the Government.

- Improvement of public utilities
- Encouragement of investment by private sector
- Incentives for investment
- Rationalization of tariff policy
- Introduction of foreign investment and export promotion

These measures would show prompt and steady effects. "Textile and Garments" became the leading export commodity, taking the place formerly held by tea, in the trade statistics of 1986 (as discussed later).

2.1.2 University Education in Sri Lanka

(1) Educational System

The educational system in Sri Lanka consists of 6 years of primary education, 5 years of junior secondary education, 2 years of senior secondary education, and higher education. Education is compulsory for 6 years in primary and 5 years in junior secondary, or 11 years in total. The educational system of Sri Lanka is shown in Figure 2.1.2. There were overall 9,500 public schools which conducted the compulsory education and 140,000 teachers as of 1981. The literacy rate of the population was relatively high, 87 percent in 1981.

At present 75 percent of those who graduate from junior secondary schools do not have opportunities for further training, more than 80 percent of the unemployed are those young people. The Ministry of Education puts particular emphasis on technical and vocational trainings for these young unemployed people in order to meet increasing demands for skilled technicians prompted by economic

problem. Presently, the number of technical/vocational schools for training of technicians is some 600. The number will be increased to 1,000 within the course of 4 years from 1987.

The total enrolment in universities increased by 19 percent during the period from 1973 to 1986. This increase was concentrated in science-based courses, where total enrolment increased by 30 percent. In contrast, the total enrolment for arts-based courses increased only by about 4 percent. This indicates the change of needs on higher education brought about by the development of the country.

Figure 2.1.2 Educational System of Sri Lanka

<table>
<tr><td>Age</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td><td>19</td><td>20</td><td>21</td></tr>
<tr><td rowspan="2">Type of Education</td><td colspan="6">Primary Education (6 years)</td><td colspan="5">Junior Secondary Education (5 years)</td><td colspan="2">Senior Secondary Education (2 years)</td><td colspan="4">Higher Education (3 or 4 years)</td></tr>
<tr><td>Compulsory Education</td><td colspan="11">11 years</td><td colspan="6"></td></tr>
</table>

(2) Administrative Organization

The University Grants Commission (UGC), established under the provisions of the Universities Act, governs university education in Sri Lanka and aims to achieve the following objectives:

1) the planning and coordination of university education so as to conform to national policy
2) the apportionment to higher educational institutions, of the funds voted by Parliament in respect of university education, and the control of expenditure by each such higher educational institutions.
3) the maintenance of academic standards in higher educational institutions

4) the regulation of the administration of higher educational institutions, and
5) the regulation of the admission of students to each higher educational institution.

Specifically, the UGC is authorized to prepare annual and triennial budgets for each higher educational institution, determine the courses provided by each university and wage/salary of different grades of the staff, apportion the number of students, and admit students to the universities every year.

The UGC set up the Research and Planning Unit under the Director for planning and coordination of university education. The Unit undertakes a continuous process of collecting, analysing and evaluating the necessary statistical data and advises the results of its investigations to the UGC. The Unit also prepares a Corporate Plan indicating the future development of universities.

(3) Higher Educational Institutions

Modern university system of Sri Lanka might be under the influence of the British pattern and is of very recent origin with a short history of just over six decades. From 1921 to 1959 there was one university (the University of Ceylon). The present Higher Education in Sri Lanka is conducted by all national institutions consisting of 9 universities and 6 institutes. Table 2.1.2 shows the structure of faculties and the number of department of these universities.

The Open University in the table provides various kinds of educational programs through multi-media learning systems, by correspondence course or by radio, to the general public aged 18 years and above. The institute is affiliated with a university and institute's students who successfully complete their courses can receive the same degree as university graduates. Those six institutes are:

1) Post-Graduate Institute of Medicine (University of Colombo)
2) Post-Graduate Institute of Agriculture (University of Peradeniya)
3) Post-Graduate Institute of Pali and Budhist Studies (University of Kelaniya)
4) Institute of Aesthetic Studies (University of Kelaniya)
5) The Institute of Workers' Education (University of Colombo)
6) Institute of Indigenous Medicine (University of Colombo)

(4) Educational Expenditure

Total educational expenditure in Sri Lanka was Rs. 4,276 million in 1984, 8.5 percent of total government expenditure or 2.9 percent of Gross National Product (GNP).

The budget for higher education in 1985 was Rs. 292 million for recurrent expenditure, Rs. 366 million for capital development and Rs. 35 million for rehabilitation and maintenance of assets. Unit recurrent costs of students are from Rs. 3,000 to Rs. 7,000 for arts and social-science-based courses; from Rs. 15,000 to Rs. 26,000 for Engineering-based courses; and from Rs. 3,000 to Rs. 7,000 for medical-based courses. The budgetary allocation for capital development in 1987 is estimated about Rs. 478 million.

It is forecast that by 1988 university enrolments will increase to 22,000 from 16,000 in 1984. In particular, enrolment of science-based students has been remarkably increasing in recent years. It is also expected that the enrolment of science-based students exceeds that of arts-based students in 1987, constituting 55 percent of the total enrolment. There is a strong social demand for professionals such as doctors, engineers, agriculturalists, etc.

Student intake into the universities of engineering education during the period 1985/86 is about 530, or 9 percent of the total intake. On the other hand, student output during the same period was about 320 and does not meet the projected annual demand of 530.

The domestic demand has been increasing in parallel with economic development. Internationally, in particular from the Middle-East, the demand is increasing. It is foreseen that this demand for engineers will increase to about 700 by 1990. The output is unlikely to meet this demand.

Table 2.1.2 Structure of Faculities and Departments of Universities

University	Number of Departments in the Faculty												Number of students	
	Arts	Law	Education	Medicine	Science	Agri-culture	Engi-neering	Humani-ties	Social Science	Applied Science	Management Studies	Archi-tecture	Under-graduate	Post-graduate
Colombo	7	1	4	14	6								3,400	400
Peradeniya	14			21	6	7	7						3,600	270
Kelaniya					6			8	8				2,500	80
Sri. Jayewardenepra	7							8		5	3		3,200	149
Moratuwa							10					3	1,040	137
Jaffna	11			10	5								2,300	15
Ruhuna	4			10	5	3		4					1,459	
Eastern					6	3							210	
Open University													16,300	
Total	43	1	4	55	34	13	17	20	8	5	3	3	34,009	1,051

(Source:The University Grants Commission & Universities of Sri Lanka 1985)

Source for the University of Moratuwa is based on the survey of Dec. 1987

2.1.3 Needs for Technical Education and Government Policy

(1) Sri Lanka economy depends largely upon the traditional agricultural exports: tea, rubber and coconuts. The prices of the primary products have been generally on the downward trend recently; therefore, Sri Lanka is in an urgent need to shift out of its traditional mono-cultural economy that depends on these three agricultural products. With no other promising exportable natural resources, Sri Lanka has to develop export industries other than those three traditional agricultural products as a means of improving the balance of payments position. With a well-educated and highly literate population, Sri Lanka is eager to develop its manufacturing industry, an industry which processes imported raw materials to value-added exportable finished products. The Government has prepared a series of attractive preferential treatments to encourage foreign and domestic capital to invest in export-oriented industries, with the result that these new types of industries have been successful in supplementing the traditional export products and also substituting for imported goods. It is worth nothing that the textile industry has been growing recently at such a rapid rate that it outstripped, in volume terms, exports of tea, rubber and coconuts.

Table 2.1.3 Exports of Major Commodities and Balance of Payments

(Million SDR)

	1982	1983	1984	1985	1986
Tea	276.0	329.8	604.5	434.5	281.2
Rubber	101.1	113.4	126.6	92.9	79.7
Coconuts	65.1	76.4	81.2	111.9	72.6
Textile and Garments	152.4	188.3	290.2	288.1	292.7
Balance of Payments	-892	-813	-391	-646	-624

(Source: Review of the Economy, Central Bank of Sri Lanka)

(2) For developing countries to promote manufacturing industries, it is usually necessary to exercise a policy of encouraging industrial ventures with attractive preferential assistance. It is all the more necessary to have a well-disciplined body of technical graduate engineers who could work for industries in planning, construction or operation and management of the facilities. These engineers must be supplied on a stable and steady basis to maintain pace with the progress in industrial development. In full recongnition of such a need, the Government of Sri Lanka has taken various practical measures to improve the level of the higher technical education. One is to increase the number of technical students. Below are the numbers of past and prospective engineering graduates from the University of Peradeniya and the University of Moratuwa, compiled by University Grants Commission(UGC), the only two universities in Sri Lanka with engineering courses.

Table 2.1.4 Output of Engineering Graduates (Past and Future)

Year	Univ.of PDN	Univ.of MOR	Total	Demand	Output/Demand(%)
1980	111	98	209		
1981	103	102	205		
1982	138	103	241		
1983	114	139	253		
1984	158	182	340		
1885	90	157	247		
1986	154	162	316	525	60.2
1987	179	167	346	600	57.7
1988	197	156	353	650	54.3
1989	191	164	355	700	50.7
1990	185	193	378	700	54.0
1991	223	194	417		

(Source: Corporate Plan for University Education 1986-1990)

NOTE: PDN and MOR stand for Peradeniya and Moratuwa, respectively.

(3) It may be noted from Table 2.1.4 that over the six years from 1980 to 1986 the output increased at an average annual rate of 7.1 percent and is forecast to increase over the five years from 1986 to 1991 at an average annual rate of 5.7 percent. Thus, UGC has a policy of increasing the number of university students as a whole, while increasing engineering students at the expense of arts-based students.

(4) To upgrade the quality of the technical education at the university level, the Government promotes a technical cooperation program known as a "link-program" between universities and research institutes of Sri Lanka and those of developed nations to introduce advanced technologies. There have already been 36 link-programs successfully implemented. The link-programs so far concluded covered such areas as natural science, agriculture, arts but little engineering. Department of Civil Engineering of the University of Moratuwa, which has had two link-programs, is an exception.

Given the present conditions of economy and level of science and technology of Sri Lanka, there seems to be no equally effective alternative but to make use of the assistance from advanced countries and international organizations if improvement of technical education and research at university level is to be achieved efficiently. Major types of assistance given to the universities of Sri Lanka are shown in Table 2.1.5.

Table 2.1.5 Major Assistance to Sri Lankan Universities

Donor	Period	Beneficiary	Area
1. ODA	1986-1991	University of Moratuwa	The implementation of degree level courses in textile technology in order to provide the requirements of the country's expanding textile industry
2. IDRC	1987-1989	University of Ruhuna	The overall objective of the research project is to study the severity and prevalence of soil transmitted helminths in rural communities in Southern Sri Lanka with a view to improving the well-being of the community.
3. JAPAN	1987-1990	University of Colombo	Institute of Computer Technology Project of the University of Colombo under Japanese Government Technical Cooperation
4. IDRC	1986-1988	University of Colombo	The overall objective of the research project is to develop appropriate strategies to improve the nutritional status of weaving age children in rural Sri Lanka.
5. UNDP	1987-1991	University of Colombo	Postgraduate Course in Computer Science
6. UNDP	1987-1991	University of Peradeniya	Veterinary Faculty
7. UNDP	1987-1991	University of Moratuwa	Computer-Aided-Design and Computer-Aided-Manufacturing (CAD/CAM)
8. UNDP	1988-1991	Open University	Assistance to the Technical Education Programme

(5) The industry urgently needs well-trained engineering university graduates. In sharp contrast to the graduates of arts who have difficulty finding appropriate employment upon graduation, the graduates of the University of Moratuwa easily find employment in industry and Government offices. However, the assessment of the capability of the graduates of the University of Moratuwa is not totally satisfactory, because although the graduates generally have good theoretical knowledge they are not trained enough in practical application of their knowledge to machines and facilities. This is presumably because they did not have enough opportunities for experiments in the University; the necessity of experiments is emphasized. The plastics moulding industry is obliged to import not only the raw material plastics but metal moulds too. To redress such a situation Sri Lanka needs engineers capable of handling CNC machines. In the textile industry, which has seen a spectacular growth in recent years, the positions of middle management and engineers are occupied mostly by foreigners. Under such circumstances, qualified Sri Lankan engineers are urgently required. Although the present Government is more keen in encouraging private industries than establishing new public corporations to heighten Government activity, the Government is very active in investment in areas where the Government should play the leading role. The Government plans to add 700 MW of power capacity by the year 2000 which would nearly double the present capacity. It is also planned to intensify and improve the telecommunication facilities. In private industry scene the textile industry has been the most spectacular, successfully increasing the production by 50 percent by volume from 1980 to 1987. Against such a background there will be in the future even greater demand for capable engineers.

As is stated above, it is a national policy as well as the desire of the industry to develop human resources, particularly capable engineers. Especially, those engineers who can handle computers as well as computerized machines are needed. Public Investment 1985-1989 compiled by National Planning Division, Ministry of Finance and Planning states that new academic disciplines likely to be of

importance to Sri Lanka such as computer science, will be encouraged in all universities and the centres of excellence in this discipline will be at the Universities of Colombo, Peradeniya and Moratuwa. These are already well underway. The 1986-1990 plan states, "The rapid growth of computer utilization in the country has precipitated the need for more trained personnel in areas such as computer programming, systems analysis, etc. The Universities of Moratuwa, Peradeniya and Colombo have started their degree programs in computer technology recently. -- A recent survey carried out by the Ministry of Textile Industries has indicated a manpower requirement of several hundred graduates at the level of technical managers. However, no university has provided opportunities for the training of undergraduates in Textile Technology who could form the core of technical managers required in the industry. It was against this background that the University Grants Commission approved the creation of a separate Department of Textile Technology at the University of Moratuwa." The computer technology and textile technology are both priority technologies. The 1987-1991 plan indicates nuclear medicine, irrigation engineering, microbiology, textile technology, computer science, etc. as new departments to be established in the nation's universities. Both the Government and the industry, wishing to cultivate capable university graduate engineers, have steadily taken the necessary steps towards realizationof this goal.

2.2 Present Situation of the University of Moratuwa

2.2.1 Profile of the University of Moratuwa

(1) Brief History

1) The University of Moratuwa has its origin in the Ceylon Technical College of Maradana, which was established in 1893.

2) In 1960, the Institute of Practical Technology was founded at Katubedda with aid from the Government of Canada. The primary aim of the institute was to provide full-time courses for technicians of sub-professional grades, which included architects, junior technical officers, surveyors and levellers and draughtsmen apprentices. It also offered part-time courses in engineering studies.

3) The Ceylon College of Technology was established in 1966 utilising the resources of the Institute of Practical Technology.

4) In 1972, under the provisions of the Universities Act No.1, the Ceylon College of Technology was incorporated to the University of Ceylon (later the name was changed to the University of Sri Lanka) as the Katubedda Campus of the University. The technician, undergraduate and postgraduate courses were introduced at that time.

5) In 1978, under the provisions of the Universities Act No.16, the Katubedda Campus of the University of Sri Lanka acquired the status of an independent university with its present name of the University of Moratuwa, Sri Lanka.

(2) Structure and Composition

The University of Moratuwa offers undergraduate, postgraduate, and National Diploma in Technology (NDT) courses. The undergraduate course is of four years duration; in the fourth year, the students have research activities and industrial practice called in-plant training. The NDT is a three year course and the third year is set aside for in-plant training.

The undergraduate and postgraduate courses are composed of the following two faculties and thirteen departments:

1) Faculty of Engineering
   (10 Departments)
   - Electrical Engineering
   - Electronic & Telecommunication Engineering
   - Computer Science & Engineering
   - Chemical Engineering
   - Materials

2) Faculty of Architecture
   (3 Departments)
   - Architecture
   - Building Economics
   - Town and Country Planning

Figure 2.2.1 outlines the organization of the University of Moratuwa. All educational equipment and facilities requested from the University are for seven departments in the Faculty of Engineering with the exception of three departments, Civil Engineering, Mechanical Engineering, and Mining and Minerals Engineering.

(3) Number of Teaching Staff and Students

Table 2.2.1 The Number of Teaching Staff by Department (1987)

Department	Prof./ Assist. Prof.	Lecturer	Assistant
1)The Faculty of Engineering			
- Electrical Engineering	1	15	2
- Electronic & Telecommunication Engineering	1	19	2
- Computer Science & Engineering (Note)	4	0	0
- Chemical Engineering	1	10	2
- Materials Engineering	1	5	2
- Mathematics	1	8	4
- Textile Technology	1	5	1
- Civil Engineering	5	31	13
- Mechanical Engineering	2	22	9
- Mining & Minerals Engineering	0	7	2
2) The Faculty of Architecture			
- Architecture	1	12	1
- Building Economics	1	1	0
- Town and Country Planning	1	3	0
Total	20	138	38

Note: There are three system engineers/programers in the Computer Science & Engineering in addition to the numbers shown.

Table 2.2.2 Enrolment and Student Intake (Dec. 1986)

(1) Enrolment

NDT	520
Undergraduate	1,040
Postgraduate	137
Total	1,697

(2) Student Intake

Department	Post Graduate	Under Graduate	NDT
1)The Faculty of Engineering			
- Electrical Engineering	14	56	64
- Electronic & Telecommunication Engineering		29	
- Computer Science & Engineering		16	
- Chemical Engineering	6	28	76
- Materials Engineering	1	10	
- Textile Technology	4	16	
- Civil Engineering	28	100	100
- Mechanical Engineering		20	
- Mining & Minerals Engineering	1	10	
2)The Faculty of Architecture			
- Architecture	20	10	
- Building Economics	12	18	
- Town and Country Planning	11	10	
Total	97	323	240

It is noted from Table 2.2.2 that the ratio of student intake to total enrolment is high at 39 percent, because the promotion rate of students at each grade is between 60 and 90 percent.

(4) Educational and Research Facilities

The University of Moratuwa is located approximately 18 km to the south of Colombo city and possesses the campus of 23 hectares. Educational facilities are divided into the following seven buildings:

- Dep't of Chemical Engineering and Physics Laboratory
- Workshops of Mechanical Engineering
- Dep't of Materials Engineering, Mining & Minerals Engineering and (a part of) Chemical Engineering
- Dep't of Electrical Engineering, Electronic & Telecommunication Engineering, and Computer Science & Engineering
- Language Laboratory and basic subject courses
- Dep't of Civil Engineering
- Dep't of Textile Technology

Master Development Plan was made in 1983 for the University. The Plan states that the total enrolment of students would increase from 1,600 to 2,000 by 1986 and the educational facilities would be expanded to cope with the increase. These facilities are for the Department of Computer Science & Engineering, Textile Technology and Civil Engineering. The graduates from these departments are urgently needed by the industries. Construction of the Civil Engineering building had been already completed when the field survey was made in December 1987. Construction of the new building for the Textile Technology will be completed on August 1988 by the University to meet with the progress of the Grant Aid Project . Meanwhile, the existing building for the Textile Technology, where relatively old equipment is installed will be maintained as it is.

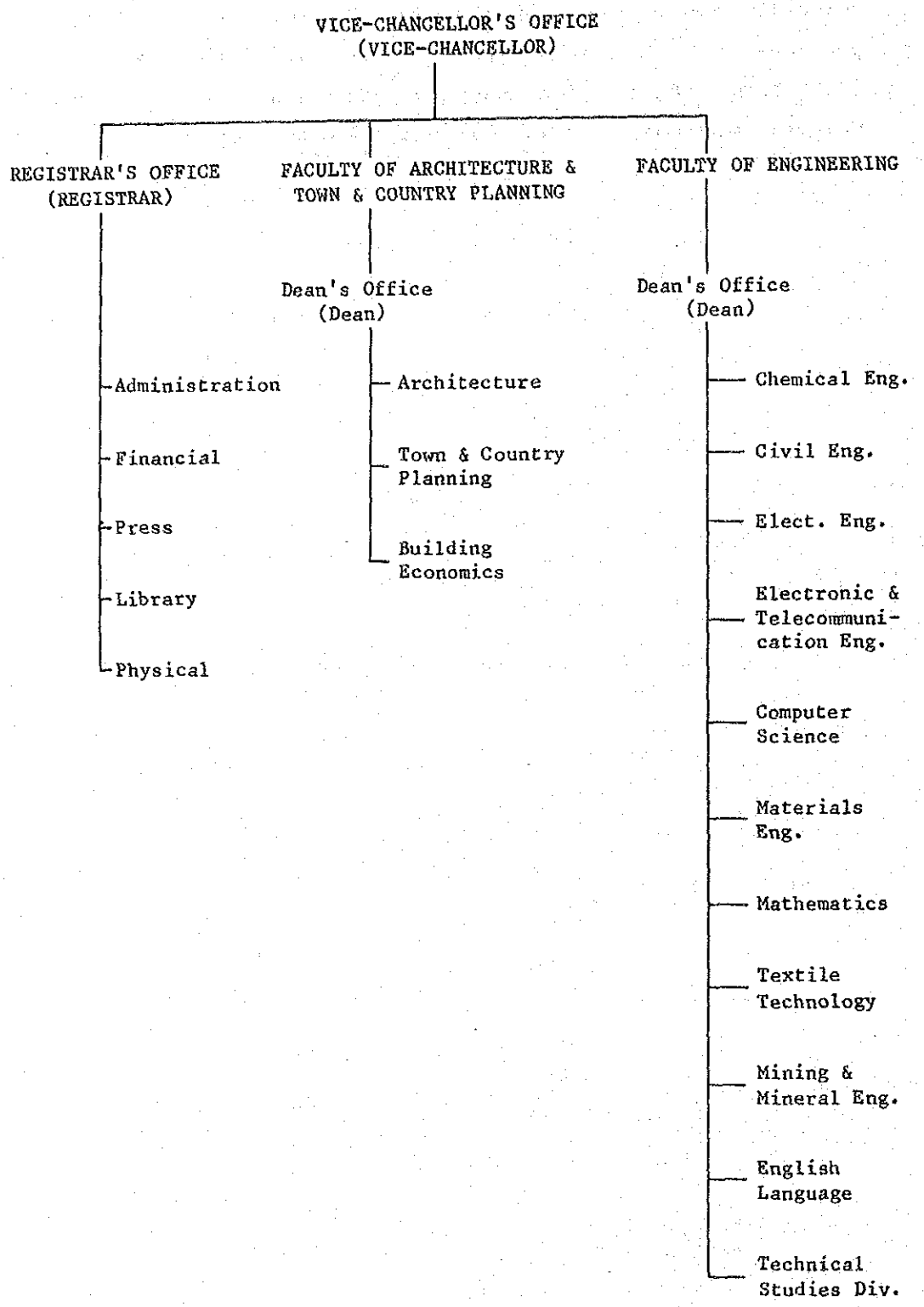
(5) Position of the University of Moratuwa in Higher Education

There are nine universities and six institutes for higher education in Sri Lanka as explained in Section 2.1.2. Among them, only the University of Moratuwa and the University of Peradeniya conduct engineering courses. It is recognized that the University of Moratuwa plays an important role in providing engineering education in Sri Lanka because the University of Peradeniya maintains only seven

departments in the Faculty of Engineering.

The Department of Textile Technology established in 1986 in the University of Moratuwa is the only institution in Sri Lanka which provides a four-year course in textile technology. The only insitutions which offer computer education are the University of Colombo, the University of Peradeniya and the University of Moratuwa.

Figure 2.2.1 Organizational Structure of the University of Moratuwa



2.2.2 Education in the University of Moratuwa

Table 2.2.3 to 2.2.5 attached at the end of this Chapter shows curriculum lists, experimental plans and major existing educational equipment for each department. The curriculum of a department in the University of Moratuwa consists of subjects of its own discipline, general education courses and subjects of disciplines of other departments. All the subjects are coded for identification of the course. Lectures and experimental works of a given department are provided not only for the students of that department alone, but also for the students of other departments.

(1) Department of Electrical Engineering

The curriculum of the Electrical Engineering comprises a number of subjects peculiar to electrical engineering per se but it includes a few basic and widely applicable subjects such as circuit theory, electromagnetism, etc. In addition, the curriculum contains Wiring Diagrams & Electrical Construction course. It is also noted that relatively fewer lessons are involved in the first and second years. The curriculum calls for experiments/workshops 21 times a year for either the first or second year and 10 times for the third year. Contents of the experiment work are well made reflecting the curriculum and syllabus through the first to third year.

Student enrolment is 56 per each year in undergraduate and 14 in postgraduate course, whereas there are 16 registered teaching personnel with grades of lecturers or above. The ratio of the students to the teaching staff is 5.3 : 1, excluding post-graduate students.

A life of ten years is generally accepted as durable life of experimental equipment in Japan. Approximately one half of existing educational equipment has been under utilization over 10 years; what is more, some have been in use more than 30 years since installation. The existing educational equipment is classified into testing and measuring devices, motor testing equipment, generator testing equipment and high-voltage testing equipment. There is a

lack of testing and measuring instruments such as bridge-circuit, potentiometer, shunt/voltage devider, etc. Most of the motor/generator testing equipment have been employed almost 15 years and those are under unsatisfactorily operational conditions. High-voltage testing equipment, particularly an impulse voltage generator, is old, damaged or cannot be repaired.

The students, divided into 12 groups, practice the different kinds of experimental work at the same time. There are more than 20 desks well arranged in the Electrical Engineering Laboratory. Other laboratories are provided with enough space for the experiments.

(2) Department of Electronic & Telecommunication Engineering

The curriculum of this department contains relatively fewer subjects of electronics, communication and basic electricity for the first and second years, but on the other hand the curriculum contains more of them for the third and fourth year. The physics laboratory belongs to this department and students study basic electricity and electronics as subjects of physics. Thus, the basic subjects are taught during the first and second years to the students.

Twenty-two experiments are assigned for the first semester of the second year, 13 in second semester of the second year and 18 in the third year, and 15 are given for studying physics. The experimental plan also includes frequent workshops of physics, drafting, chemical, mechanical and so forth.

Student enrolment is approximately 30 per one year, whereas there are 20 registered teaching personnel with grades of lecturers or above. Existing educational equipment is as old as those in the Department of Electrical Engineering and about one half, they are mainly measuring instruments and several circuit testing trainers and devices, and have been in use more than 15 years. Particularly there is almost no equipment for physics education. It is understood that several types of circuit testing trainers and measuring instruments (circuit testers, oscilloscopes, etc.) are lacking in terms of the

curriculum and experimental plan. Several experiments are not actually possible for these reasons.

(3) Department of Computer Science & Engineering

The Department of Computer Science & Engineering was established in 1986. Computer education before the establishment had been done in the Department of Electrical Engineering. The Department offers computer education for students of both undergraduate and postgraduate courses and students of NDT courses of other departments.

There are few subjects on electricity and electronics for the first and second years but the curriculum is well balanced on the whole. The experimental plan rationally allocates electronics and logic circuits, which are basic to the study of computer operations, to the first and second years and computer programming and application to higher degrees.

In the Department, there is one senior lecturer, three assistant lecturers, two system engineers and one Japanese engineer dispatched by Japan Overseas Cooperation Volunteers of JICA.

The student enrolment in this department is 16 per one grade and total enrolment is 32 at present, two years after the establishment. It is anticipated that the number of students will increase with the expansion of facilities on computer education. The ratio of the number of students to the total teaching staff is apparently reasonable. The teaching staff of the department however seems overloaded at present since they provide computer education in NDT course too. However, four teaching posts for the NDT course will be filled by other staff members.

Present computer equipment is constantly used by 20 teaching personnel and 700 students, once they registrer for its use. There are a number of users because with this equipment they can develop their own programs by themselves once a programming language is studied.

The existing testing and measuring instruments and training boards are not enough. Accordingly, some of the experiments and workshops can not be done according to the plan. Specifically, major equipment consists of only two oscilloscopes, two signal generators and one frequency counter, etc.

(4) Department of Chemical Engineering

1) Chemical Engineering Division

Chemical engineering is a basic engineering covering a wide range of fundamental science. On such a concept, the University of Moratuwa includes in the curriculum of this department a variety of subjects to impart to the students the broad knowledge and technology of chemical engineering. The number of students is 30 per one year and the teaching staff is 13 including the professor, lecturers and teaching assistants. Curriculum of the Department of Chemical Engineerig contains a whole range of chemical engineering, mathematics, physics and chemistry; it also contains basic civil engineering, basic mechanical engineering and basic electrical engineering related to the chemical engineering.

Experiments, which are particularly important in the field of chemical engineering, are planned in accordance with the curriculum of the Department. Approximately two-thirds of the weekly load is spent on lectures and the remaining one-third devoted to the experiments. Existing equipment is provided chiefly in Chemical Engineering Laboratory and Unit Operation Laboratory. In the Chemical Engineering Laboratory, various kinds of measuring apparatus and experimental equipment - flow meters, viscosimeters, extraction apparatus - are provided. Many of them were provided at around 1975, and so are over 10 years old.

2) Polymer Technology Division

Polymer Technology Division studies chemical and physical properties and manufacturing processes of polymeric materials

such as rubber and plastics. Approximately two-thirds of the total working hours are spent on lectures, practicals, seminars and factory visits and the remainig one-third devoted to the research projects.

Curriculum of the Polymer Technology Division is divided broadly into five main groups as follows:

i) Polymeric Materials
ii) Polymer Technology
iii) Polymer Process Engineering
iv) Engineering Design and Testing of Polymer
v) Industrial Economics and Management

These are further divided and lectures and experiments are given accordingly. The experiments focus on properties of polymers, polymer mixing test, experiments with the extruder and the injection moulding machine, etc. The greater parts of existing equipment are measuring apparatus and extruders. Injection moulding machines, comparatively large machines, are indispensable to the planned experiments.

(5) Department of Materials Engineering

Department of Materials Engineering studies all kinds of materials, such as metals, wood, plastics and ceramics, etc. And the contents of this research and education ranges from the relatively simple study of materials properties to the research of atomic or molecular level by using the quantum mechanics. In the first and second years, the students learn mathematics, physics, chemistry and thermodynamics which are necessary for the higher level of studies. From the third year, special lectures and experiments on materials engineering are included. Weekly load of lectures including tutorials is 3 hrs and that of experiments is 1.5 hrs for the each curriculum.

Major existing equipment of the Department are microscopes, muffle furnance and other testing apparatus; these are not enough for implementing the above curriculum. For the high level study such as

structure analysis at the atomic or molecular level, equipment of high quality and comparatively large-scale is necessary.

(6) Department of Mathematics

The Department of Mathematics offers mathematics to all the departments at different levels as part of general subjects. These subjects are indispensable to engineers. The curriculum includes applied calculations and operations research (a method to find using computers the most effective projection for demand perspective of a firm), production planning, and economic and political evaluation, etc. under given conditions. These subjects however have not been realized due to necessary computers being not supplied.

(7) Department of Textile Technology

The textile industry of Sri Lanka has been growing very fast. In 1986, textile and garments became the largest export item in value, overtaking tea. Against such a background, it is very much demanded to raise the level of textile engineering and to produce qualified textile engineers. The University of Moratuwa is instituting new chemical processing laboratories, clothing and sewing, spinning, knitting and weaving laboratories, to expand the field and scale of studies. The new buildings of the Department of Textile Technology are under construction now.

The purpose of the curricula of the Department is to study the basic subjects, which are mathematics, physics and chemistry, and basic textile technology in the first year, to study subjects peculiar to textile technology in the second and third year, and in the fourth years to study quality control, personnel management and case studies, and specialized subjects of textile technology. The first and second years give the common courses, and the third and fourth year give specialized courses of textile technology. The curriculum covers the whole range of textile technology, which are spinning, weaving, knitting, dyeing and testing. A great deal of time is allocated to experiments and exercises designed to acquire practical knowledge and technology. In regard to "Yarn Manufacture" and "Fabric Manufacture"

which are main curricula of the Department of Textile Technology - 1.5 hours or 2 hours per week is allocated to each experiment as compared to 2 hours per week for lectures. The experimental plan is divided into three main groups: "Yarn Manufacture", "Fabric Manufacture" and "Colouration & Finishing". In regard to "Yarn Manufacture" and "Fabric Manufacture", practices designed to understand the mechanism of various kinds of textile machines and the demonstration by using textile machines are planned. In regard to "Colouration & Finishing", a better understanding of the processes of Preparatory, Colouration and Finishing is emphasized. Practice by using the various kinds of sewing machines, knitting machines and testing machines are planned 2 or 3 hours per week with the clothing and the testing courses. As mentioned above, the curricula and the experimental plans contain a series of the processes of textile technology, from the spinning to the clothing process, and acquisition of the practical knowledge and technique is emphasized.

Most of the existing equipment is comparatively simple testing apparatus, spinning machines, knitting machines and weaving machines. Their variety and quantity are not enough, and some of them were obtained more than 20 years ago. It is difficult to perform the above mentioned curricula with such equipment. The number of the present teaching staff is 7 which is not enough to carry out the curricula and the experiments. A variety of spinning machines, weaving machines, knitting machines and testing apparatus which cover whole range of textile technology are necessary to carry out the above mentioned curricula and the experiments.

(8) Common Facility

The Library of the University of Moratuwa is divided into three divisions: Lending Division, Periodicals Division and Reference Division. The present stock of book amounts to about 70,000 volumes. The library does not have a reference system good enough for the current stock of books. The stock will increase even more in the future. Effective use of space by mobile shelving system or the like is also necessary to make better use of the available space.

There is a gymnasium and laboratories for physical education. But the existing equipment is not enough. Near the campus is located Lake Bolgoda where physical education using training boats is actively carried out.

The University of Moratuwa uses English in the classroom. But recently, Sinhalese has been used as official language. For this reason, there are some young people incapable of understanding English in class. This presents a real difficulty for education in the University; English education for some students is urgently needed. A language laboratory is therefore needed.

Table 2. 2. 3 Curriculum List (1)

Grade	Curriculum	Weekly load, hour Lecture	Tutorial	Laboratory
Dep't of Electrical Engineering				
First Year	-Basic Electricity	2	1	1.5
	-Electrical Measurement	2	1	1.5
	-Control Systems	2	1	1.5
Second Year	-Theory of Electricity	2	1	1.5
	-Electrical Measurements and Basic Electronics	2	1	1.5
	-Applied Electricity	2	1	1.5
Third Year	-Electrical Machines I	2	1	1.5
	-Power Systems I	2	1	1.5
	-Electrical Properties of Materials	2		
	-Circuits and Waves	2	1	
	-Electrical Measurements and Control System	2	1	
	-Wiring Diagrams & Electrical Construction	1		1
	-Electrical Technology	2	1	1.5
Fourth Year	-Electrical Machines	2	1	1.5
	-Power Systems II	2	1	1.5
	-High Voltage Engineering	2	1	1.5
	-Power Station Training	2	1	1.5
	-Control System II	2	1	1.5
	-Syllabus for Nuclear Power Engineering			
	. Introduction	2		

Table 2. 2. 3 Curriculum List (2)

Grade	Curriculum	Weekly load, hour Lecture	Tutorial	Laboratory
	. Atomic Structure & Nuclear Reactions	6		
	. Radiological Protection	6		
	. Radiation Detection & Measurement	6		
	. Nuclear Reactors	5		
	. Reactor Theory	15		
	. Reactor Control	10		
	. Nuclear Heat Transfer	2		
	. Fuel Cycles and Radio-active Waste Disposal	3		
	. Reactor Safety & Accidents	3		
	. Fusion	2		
Dep't of Electronic & Telecommunication Engineering				
First Year	-Mathematics I	2	1	
	-Mathematics II	2	1	
	-Physics	3	1	1.5
	-Engineering Chemistry	3	1	1.5
	-Building Construction	1		2
	-Surveying	1		1.5
	-Engineering Drawing	1		5
	-Workshop Technology	1		4
	-English	2		
Second Year	-Mathematics	3	1	
	-Strength of Materials	2	1	1.5

Table 2. 2. 3 Curriculum List (3)

Grade	Curriculum	Weekly load, hour		
		Lecture	Tutorial	Laboratory
	-Fluid Mechanics & Hydraulic Machines	3	1	1.5
	-Theory of Electricity	2	1	1.5
	-Applied Thermodynamics	2	1	1.5
	-Engineering Machines	2	1	1.5
	-Production Technology	2		1.5
	-Electrical Measurements & Electronics	2	1	1.5
Third Year	-Mathematics	3	1	
	-Industrial Economics & Management	2		
	-Electrical Machines	2	1	1.5
	-Power Systems	2	1	1.5
	-Electrical Properties of Materials	2		
	-Circuits and Waves	2	1	
	-Electrical Measurements & Control Systems	2	2	1
	-Wiring Diagrams & Electrical Construction	2		2
	-Electronics	2	1	1.5
	-Telecommunications	2	1	1.5
Forth Year	-Industrial Economics & Management	3		
	-Electronics	2	1	1.5
	-Telecommunications	2	1	1.5

Table 2. 2. 3 Curriculum List (4)

Grade	Curriculum	Weekly load, hour Lecture	Tutorial	Laboratory
	-Microwave and Radiation Engineering	2	1	1.5
	-Industrial Electronics	2	1	1.5
	-Mathematics	3	1	
	-Power Systems	2	1	1.5
	-Control Systems	2	1	1.5
	-Communications Theory and Systems	2	1	1.5
	-Synthesis of Electrical Circuits	2		1.5
	-Solid-state Electronics and Integrated Electronics	2	1	
	-Computer Systems	2	1	1.5
Dep't of Computer Science & Engineering				
First Year	-Mathematics I	3		
	-Mathematics II	3		
	-Physics	5.5		
	-Engineering Chemistry	5.5		
	-English	2		
	-Fundamentals of Computer Systems	6		
	-Engineering Drawing	6		
	-Workshop Tech.	5		
Second Year	-Mathematics	4		
	-Strength of Materials	4.5		
	-Engineering Mechanics	4.5		

Table 2. 2. 3 Curriculum List (5)

Grade	Curriculum	Weekly load, hour Lecture	Tutorial	Laboratory
	-Theory of Electricity	4.5		
	-Electrical Measurements & Basic Electronics	4.5		
	-Applied Thermodynamics	4.5		
	-Computer Organization & Logic Design	4.5		
	-Computer Languages & Data Structures	4.5		
Third Year	-Electrical properties of Materials	2		
	-Circuits & Waves	3		
	-Electronics	4.5		
	-Electrical Measurements & Control Systems	4		
	-Industrial Economics & Management I	2		
	-Discrete Structures & Stochastic Analysis	4		
	-Data Storage & Data Base Management	4		
	-Microprocessor Systems Design Laboratory	4		
	-Principles of Data Communication	4.5		
Forth Year	-Industrial Economics & Management II	3		
	-Computer Architecture & Hardware Design	3		

Table 2. 2. 3 Curriculum List (6)

Grade	Curriculum	Weekly load, hour Lecture	Tutorial	Laboratory
Subjects selected from the following options: (Block 1 : Software Engineering) -Mathematics -Control Systems -Software Engineering I, II, III -Computer Graphics & CAD/CAM -Operations Reserch I, II, III (Block 2 : Hardware Design Engineering) -Mathematics -Electronics -Control System -Very-Large-Scale Integration (VLSI) -Computer Hardware Design -Fault Tolerant Reliable Design (Block 3 : Communication Networks) -Mathematics -Electronics -Control Systems -Digital Data Communication -Computer Communication Networks I, II, III -Decision Support Systems I Operations Research I, II				

Table 2. 2. 3 Curriculum List (7)

Grade	Curriculum	Weekly load, hour Lecture	Tutorial	Laboratory
(Block 4 : Information & Decision Systems)	-Mathematics -Control Systems -Operations Research I, II, III -Decision Support Systems I, II, III -Software Engineering I, Computer Communication Networks I, II -Computer Modeling & Applications			
(Block 5 : Robotics & Automation)	-Mathematics -Control Systems -Artificial Intelligence -Robotics & Automation -Computer Graphics & CAD/CAM			
Dep't of Mathematics				
First Year	-Mathematics (Calculus, Algebra)	2	1	
	-Mathematics (Complex Vectors, Differential Equations Probability and Statistics)	2	1	
Second Year	-Mathematics (Calculus, Linear Algebra, Functions	3	1	

Table 2. 2. 3 Curriculum List (8)

Grade	Curriculum	Weekly load, hour Lecture	Tutorial	Laboratory
	of a complex Variable, Vector Analysis, Differential Equations)			
Third Year	-Mathematics (Boolean Algebra, Differential Equations, Statistics, Computing)	3	11	
Forth Year	-Mathematics (Operations Research, etc.)	4		
	-Mathematics	4		
Dep't of Chemical Engineering				
(Polymer Technology Div.)				
M. Sc. Course	-Polymeric Materials	3	1	2
	-Polymer Technology	3	1	2
	-Polymer Process Engineerig	3	1	2
	-Engineering Design and Testing of Polymer	3	1	2
	-Industrial Economics and Management	3	1	2
(Chemical Eng. Div.)				
First year	-Mathematics	2	1	0
	-Physics	2	1	1.5
	-Engineering Chemistry	2	1	1.5
	-Engineering Drawing	1	0	5

Table 2. 2. 3 Curriculum List (9)

Grade	Curriculum	Weekly load, hour		
		Lecture	Tutorial	Laboratory
	-Workshop Technology and Practice	1	0	4
	-Surveying	1	0.5	1.5
	-Process Engineering	1	0	3
	-English	2	0	0
Second Year	-Mathematics	3	1	0
	-Civil Engineering	1	0	1
	-Principles of Mechanical Engineering	1	0	1
	-Applied Electricity	2	1	1.5
	-Chemical Engineering and Fuel Science	2	1	1.5
	-Chemistry	2	0	0
	-Engineering Design I	2	1	0
	-Polymer Science and Technology	2	1	1.5
Third Year	-Mathematics	3	1	0
	-Heat and Mass Transfer	2	1	1.5
	-Unit Operations I	2	1	1.5
	-Fuels and Lubricants	2	1	1.5
	-Engineering Design II	2	1	0
	-Materials Engineering	4	0	0
	-Fluid Mechanics	2	1	1.5
	-Industrial Economics and Management	2	1	0
	-Particulate Systems	2	1	1.5
Fourth Year	-Unit Operations II	2	1	1.5

Table 2. 2. 3 Curriculum List (10)

Grade	Curriculum	Weekly load, hour Lecture	Tutorial	Laboratory
	-Reactor Engineering	2	1	1.5
	-Fuel Efficiency and Energy Conservation	2	1	1.5
	-Process Control	2	1	1.5
	-Polymer Engineering	2	1	1.5
	-Safety and Health	2	1	1.5
	-Industrial Economics and Management	3	1	0
	-Design Project	2	1	0
Dep't of Materials Engineering				
First Year	-Engineering Mathematics I	2	1	0
	-Engineering Mathematics II	2	1	0
	-Physics	2	1	1.5
	-Engineering Chemistry	2	1	1.5
	-Engineering Drawing	1	0	5
	-Workshop Technology	1	0	4
	-Surveying	1	0.5	1.5
	-Process Engineering	1	0	3
	-English	2	0	0
Second Year	-Mathematics	3	1	0
	-Principles of Thermodynamics and Hydraulics	2	0	2
	-Mechanics of Materials	2	1	1.5
	-Applied Electricity	2	1	1.5
	-Properties of Materials	2	1	1.5
	-Metallurgy	2	1	1.5
	-Ceramics	2	1	1.5
	-Plastics and Rubbers	2	1	1.5

Table 2. 2. 3 Curriculum List (11)

Grade	Curriculum	Weekly load, hour		
		Lecture	Tutorial	Laboratory
Third Year	-Physical Metallurgy	2	1	1.5
	-Industrial Metallurgy	2	1	1.5
	-Iron/Steel Making and Corrosion	2	1	1.5
	-Refractories	2	1	0
	-Polymer Engineering	2	1	1.5
	-Electrical and Magnetic Properties of Materials	2	1	1.5
	-Ceramic and Cement Manufacture	2	1	1.5
	-Mathematics	2	1	0
	-Industrial Economics and Management	3	1	0
Forth Year	-Project Studies	0	3	3
	-Progress of Materials	1	0	0
	-Microscopy and Selection of Materials	2	1	6
	-Metals and Alloy Systems	2	1	0
	-Special Materials	2	1	0
	-Mechanical Behaviour of Materials	2	1	0
	-Industrial Economics and Management	3	1	0
Dep't of Textile Technology				
First Year	-Mathematics	4	2	0
	-Physics	3	1	1.5
	-Engineering Chemistry	3	1	1.5

Table 2. 2. 3 Curriculum List (12)

Grade	Curriculum	Weekly load, hour		
		Lecture	Tutorial	Laboratory
	-Engineering Drawing	1	0	6
	-Workshop Technology	1	0	4
	-Fundamentals of Textiles	1	0	1.5
	-Textile Engineering	1	0	1.5
Second Year	-Yarn Manufacture I	1	0	1.5
	-Fabric Manufacture I	2	0	1
	-Fabric Structure	1	0	1
	-Fiber Properties Testing	2	0	4
	-Computing Electronics	3	0	3.5
	-Control Theory Pneumatics	2	0	1
	-Statistical Economics	2	2	0
	-Elements of Production	1	1	0
Third Year	-Garment Design & Seam Technology	2	0	2
	-Yarn Manufacture II	2	0	2
	-Fabric Manufacture II	2	0	2
	-Colouration & Finishing	2	0	1
	-Fiber Science	2	0	1
	-Plant Services, Maintenance and Engineering	2	0	1
	-Marketing, Costing and Accounts	1	1	0
Forth Year	-Personnel Management	1	1	0
	-Quality Control	2	1	0
	-Colouration & Finishing	2	0	1.5
	-Yarn & Fabric Mechanics	1	0	0

Table 2. 2. 3 Curriculum List (13)

Grade	Curriculum	Weekly load, hour		
		Lecture	Tutorial	Laboratory
	-Yarn Manufacture III	2	0	1.5
	-Fabric Manufacture III	2	0	1.5
	-Case Studies	0	2	0
	-Project	0	5	5

Table 2.2.4 Major Experimental Plans (1)

Department	Experiment
Electrical Engineering	First Year Simple AC circuits, Time constants of RC circuits, Measurement of power, Accuracy of measurement, RCL measuring bridge, Transistor characteristics, etc. (Total 21) Second Year Unbalanced systems, Test on a single-phase transformer, Test on a DC series motor, Study of an overcurrent relay, Measurement of earth resistance of electrode, Starting and speed control of induction motor, No load & blocked rotor test on induction motor, Study of a directional relay, Test on a DC shunt generator, Synchronous motor study, etc. (Total 21) Third Year High voltage, Impulse generator, etc.(Total 10)
Electronic & Telecommunication Engineering	Second Year (Telecommunication) Measurements using a Q-Meter at high frequencies of tank circuits, Operation of Amplitude modulators/demodulators, Measurement of parameters of an RF cable, Frequency characteristics of low pass & high pass filters, Study of time division multiplexing & pulse modulation, Determination of frequency response of loudspeakers, Measurement of the polar pattern & the gain of a wave-guide horn antenna, etc. (Total 11)

Table 2.2.4 Major Experimental Plans (2)

Department	Experiment
	Second Year/First Semester(Electronics) Study of transistor biasing circuits, Design aspects of a regulated DC power supply, Parameters & applications of a Field Effect Transistor, Study of RC coupled amplifier characteristics, Parameters & applications of a Uni Junction Transistor, Study of the effects of negative feedback, Principle & applications of oscillators, etc. (Total 11) Second Year/Second Semester(Electronics) Operational amplifiers, Study of analog-to-digital and digital-to-analog converters, Design and testing of an arithmatic logic unit using discrete components, Digital systems trainers, Electrical characteristics of basic logic elements, Study of a servo control system, System simulation on an analog computer, Logic circuit design, etc. (Total 13) Third Year (Microwave/Telecommunications) Measurement of the impedance and the field pattern of a monopole antenna, Characteristics of directional couplers and isolators, Field pattern and the polarization of a Helieal antenna, Troubleshooting of a black-and-white TV, Attenuation measurements using admittance meter, Measurement of the dielectric constants of pieces of wood using microwave measurement techniques, Measurement of attenuation of an optical fibre, Software and Hardware based digital signal processing, Basics of image processing, etc. (Total 18)

Table 2.2.4 Major Experimental Plans (3)

Department	Experiment
(Physics Laboratory)	Determination of acceleration due to gravity, Measurement of resistance, Determination of the time constant, Determination of the horizontal component of the earth's magnetic field, Determination of Young's modulus, Determination of the thermal conductivity, Diode characteristics & applications, Determination of the characteristics of a PNP transistor, Calibration of an ammeter, Determination of moment of inertia, Resonance in seriese and parallel circuits, etc. (Total 15)
Computer Science & Engineering	First Year (Fundamentals of computer systems) Logic gates, Adder circuits, Machine language instructions, Reset action, etc. (Total 6) Second Year (Computer organization & Logic design, Computer architecture and microprocessor, Computer languages and algorithms) The characteristics of the diode and transistor, Decorder-Encorder, Sequential logic, EP-ROM, Counter circuits, Interfaces, Programming/debag/test/evaluation, Data structure, etc. (Total 22) Third Year (Data structures & Data Base management) Data Base management system, File access method, Internal file structure, Knowledge representation and knowledge base system, etc. (Total 5) Research & Development projects planned for the future. Computer communications & networking, Automation of

Table 2.2.4 Major Experimental Plans (4)

Department	Experiment
	test and measuring instrument system, Use of 4th-generation languages, etc.
Mathematics	Heat flows across a corner wall, Heat exchange using numerical methods, Stress analysis, A computerised educational competition on artificial intelligence approach, etc. (Total 8)
Dept. of Chemical Engneering (Chemical Eng. Lab. Fuel Testing Lab.)	-Gas flow rates -A.S.T.M. distillation -Vacuum drying -Specific gravity of petroleum products -Flash points -Engler and saybolt viscosities -Aniline point of petroleum products -Fractional distillation -Solvent extraction (soxhlet) -Moisture content of solids by moisture balance -Melting point -Reaction rate constant - first order -Equilibrium constant from distribution measurements -Heat transfer in an agitated vessel -H.E.T.P. in a packed distillation column

Table 2.2.4 Major Experimental Plans (5)

Department	Experiment
	-Liquid - liquid extraction -Vacuum distillation -Extraction of aromatics using furfural -Catalytic reforming -Pyrolysis of L.N.G. -Orsat analysis -Pressure drop in a packed bed -Wetted wall column -Analysis of the decomposed products using the gas chromatograph
(Unit Operations Lab.)	-Fluidised bed -Screw conveyor -Vacuum filtration -Distillation column - pilot plant -Stirrer -Effects on various operating conditions on crystalizer performances -Determination of gas - Liquid mass transfer coefficient -Flow, pressure and temperature controlling using P, PI, PD, PID control modes -Appreciation of numerical control techniques in chemical eng. -Simulation of heat and mass transfer measurements in a cooling tower -Optimum lagging thickness -Rate of drying curves in a batch drier -Studies on catalytic materials

Table 2.2.4 Major Experimental Plans (6)

Department	Experiment
(Chemistry Lab.)	-Determination of heat transfer coefficients under different flow conditions -Training of the students on the use of a control panel in chemical industry using simulation equipments -Determination of metal concentrations in industrial effluents -Avogadoro number and radius of copper atom -Determination of the percentage of CO_3^{--} and HCO_3^- -Hardness of water -Detection of irons and elements in salts and organic compounds -Chloride percentage of a water sample -Enthalpy and free energy of formation of chemical reaction -Phase diagram of two-component system -Phase equilbrium in three-component system -Simpe distillation -Corrosion of metals
Dept. of Materials Engineering	1st Year Ceramic raw materials, Determination of the coefficient of thermal expansion, Heat treatment, Micro-examination of ferrous and non-ferrous metals, Tensile test (on metals) 2nd Year Determination of grain size using microstructures, Electrochemical corrosion, Observation of the structure

Table 2.2.4 Major Experimental Plans (7)

Department	Experiment
	of wood with the aid of the stereomicroscope, Tensile testing of metals II, Metallography I - steel, Metallography II - Cast Iron, Metallography III - Brases and bronzes, Determination of porosity of a ceramic body, Casting II. 3rd Year Hardenability testing, Heat-treatment of alloy steels, Making and testing cores, Making and testing moulds, The effects of plastic strain on recrystallisation, Electroplating (copper) 4th Year Crack detection (non-destructive testing), Thermo-electric effect, Identification of metals using spectroscopy, Mechanical properties of wood I, II, Advanced optical techniques.
Dept. of Textile Technology	(Yarn Manufacture) General study of the pre feeder to the card, Revolving flat card, Draw frame, Speed frame (Fly frame), Ring frame, Factory visit, Combing machine, Open end spinning, Fancy yarn spinner, Core winder (Fabric Manufacture) -Weaving -Knitting -Yarn Preparation

Table 2.2.4 Major Experimental Plans (8)

Department	Experiment
	(Colouration & Finishing) -Preparatory processes -Colouration processes -Finishing processes

Table 2.2.5 Major Existing Educational Equipment (1)

Department	Major Equipment	Manufacturing Year
Electrical Engineering	-Oscilloscope	1971-1985
	-DC power supply	1985
	-Function generator	1985
	-Galvanometer	1985
	-Wattmeter	1963-1986
	-Power factor meter	1975-1976
	-DC motor	1958-1975
	-Induction motor	1958-1986
	-DC generator	1975
	-Dynamo	1975
	-Motor generator set	1975
	-Rotary frequency changer	1975
	-AC generator	1975
	-Amplidyne	1975
	-Tachometer	1974
	-Variable transformer	1975-1987
	-Double Thyristor drive unit	1980
	-X-Y recorder	1979
	-Kilo watt-hour meter	1985-1986
	-Megger	1976-1979
	-Earth tester	1979
	-Bridge circuits	1985
	-Micro-computer	1980-1986
	-High-voltage DC testing unit	1972-1974
	-Impulse generator	1972
	-Others	
Electronic & Telecommunication Engineering	-Analog computer	1966
	-Bridge universal measuring	1959
	-Oscilloscope	1960-1985
	-Oscillators	1960-1985

Table 2.2.5 Major Existing Educational Equipment (2)

Department	Major Equipment	Manufacturing Year
	-Attenuator	1970
	-Transistor analyser	1970
	-Distortion meter	1970
	-Q meter	1970
	-Digital computer lab-kit	1970
	-TV circuitry master trainer	1970
	-Telephony circuitry master trainer	1970
	-Electronic circuitry trainer	1970
	-AD/DA conversion panel kit	1985
	-Logic circuit experimental equipment	1985
	-Digital IC tester	1985
	-Function counter	1986
	-Frequency meter	1987
	-Oscillation circuit experiment equipment	1985
	-Pulse modulation circuit	1985
	-Spectrum analyser	1981
	-Video camera, TV receiver, video recorder	1977
	-Gun oscillator	1985
	-Klystron oscillator and power supply	1977
Computer Science & Engineering	-32 bit computer	1986
	-16 bit computer	1986
	-8 bit computer	1982
	-Printer	1982-1986
	-Uninterruptible power supply	1985
	-Softwares	1982-1986
	-Oscilloscopes	1985
	-Signal generator	1985
	-Digital frequency counter	1985

Table 2.2.5 Major Existing Educational Equipment (3)

Department	Major Equipment	Manufacturing Year
	-Regulated power supplies	1985
	-Multimeter	1984
	-Eprom programmer/Eprom eraser	1986
	-Stepper motor control unit	1984
	-DC motor control unit	1984
	-A/D converter unit	1984
	-Temperature sensor kit	1984
Chemical Eng.		
(Chemical	-Aniline point apparatus	1972
Eng. Lab.)	-Moisture balance	1972
	-Saybolt university viscosimeter	1972
	-Sulphur determination apparatus	1972
	-Fractional distillation unit	1972
	-Gas meter, capacity 0.25 L, 2.5 L	1972
	-Calorimeter	1972
	-Flow meter	1972
	-Extraction apparatus	1972
	-Soxlet extractor 500 ml	1972
	-Engler viscosimeter	1974
	-Centrifuge	1974
	-Gas energy transfer apparatus	1974
	-Grinding mill	1978
	-Vapour pressure apparatus	1977
(Unit	-Multi effect evaporator	1985
Operation	-Wetted wall column	1985
Lab.)	-Batch reactor	1985
	-Distillation tray set	1985
	-Filter press	1983
	-Fluidised bed	1983

Table 2.2.5 Major Existing Educational Equipment (4)

Department	Major Equipment	Manufacturing Year
	-Screw conveyor	1983
	-Stirrer	1983
	-Hydrocyclone	1983
(Polymer	-Laboratory oven	1978
Tech. Div./	-Laboratory muffle furnace	1986
Physical	-Analytical balance	1986
Testing Lab.)	-Refractometer	1986
	-Two coloumns density tester	1986
	-Hardness tester	1978
	-Hardness tester	1985
	-Compression set apparatus	1983
	-Instron tensile tester	1979
	-Mooney viscometer	1979
	-Zwick abrasion tester	1978
	-Ross flexing machine	1979
(Polymeter	-Laboratory type variable ball mill	1981
Tech. Div. /	-Waterbath	1979
Latex Tech.	-Electronic top loading balance	1986
Lab.)	-Laboratory refrigerator	1986
	-PH meter	1979
	-Drying oven	1979
	-Laboratory centrifuge	1979
(Polymeter	-Rubber mixing mill	1979
Tech. Div./	-Electric steam generator	1978
Polymer	-Laboratory autoclave	1979
Processing	-Surface pyrometer	1978
Lab.)	-Hydraulic press for rubber Products moulding	1979

Table 2.2.5 Major Existing Educational Equipment (5)

Department	Major Equipment	Manufacturing Year
Materials Eng.	-Vickers fifty five microscope	1975
	-Table-top X-ray generator	1980
	-DVR 504 bench enlarger	1978
	-Horizontal thermal expansion apparatus	1979
	-Eseway hardness tester	1978
	-Muffle furnace	1979
	-Kiln (electrically operated)	1980
	-Gas determinator	1980
	-Total carbon recorder	1980
Textile Technology (Textile Wet Processing & Chemical Testing Lab.)	-Carbolite furnace	1986
	-Water repellency testing	-
	-Washweel	-
	-Washing machines	-
	-Laboratory winch beck	-
(Spinning Lab.)	-Carding machine	1958
	-Draw frame	1969
(Weaving Lab.)	-Power loom	1968
	-Power loom	1920
	-Power loom	1963
	-Pirn winder	1968
(Knitting Lab.)	-Warp Knitting M/C	1984
	-Circular knitter	-

Table 2.2.5 Major Existing Educational Equipment (6)

Department	Major Equipment	Manufacturing Year
(Physical Testing Lab.)	-Instron model 4301	1987
	-TKI-essdiel fibre blender	1989
	-Cusick drape tester	1986
	-Automatic type projection microscope	-
	-Abrasion tester	-
	-Hydrostatic head tester	-
	-Fineness maturity tester	-
	-Air permeability tester	-

2.3 Background of the Request on the Project

2.3.1 Background of the Request

The promotion of manufacturing industry is an important element in economic development policy of Sri Lanka. It is thus an essential issue for Sri Lanka, firstly to remove the constraints of mono-cultural economy that depends largely on the export of primary commodities, particularly tea, rubber and coconuts, and to strive for industrialization by producing commodities for import substitution and exportation, and eventually to improve the balance of payments.

The Government of Sri Lanka has been making strenuous efforts for improvement of the quality and expansion of the quantity of higher technical education with a policy to increase the number of qualified engineers to help effective development and promotion of industry. The technical institute established through the aid of Canadian government in 1960, and which later became the University of Moratuwa, is one example of this policy. The University of Moratuwa has become a leading higher technical and educational institution; the University now has 2 faculties, 13 departments and 37 laboratories. The existing educational equipment of the University is rather old and obsolete. The laboratories are not equipped well enough to undertake diversified, specialized, or highly qualified education and research works for recently established universities. It is difficult to produce good education under such a situation.

The following factors motivated the request with respect to the University of Moratuwa:

1) Obsolete and insufficient number of equipment causes difficulty in research and educational training.

2) The insufficient laboratory facilities act as a constraint to efforts at ensuring quality of education and research in the newly established courses (Computer Science, Textile Technology and Building Economics). The present equipment cannot cope with the increasing student intake by the existing facilities.

3) A large segment of industry and the community desire testing and consultancy services from the University.

Under such circumstances, the Government of Sri Lanka requested the Government of Japan the Grant Aid Program on the Project.

2.3.2 Outline of the Request

The request is to provide educational equipment for 7 departments of the Faculty of Engineering and for the Common Facility in the University. The outline of the requested items is shown in Table 2.3.1. The request does not contain the equipment for 3 departments in the Faculty of Engineering (Civil Engineering, Mechanical Engineering and Mining and Minerals Engineering) and the Faculty of Architecture and generally puts emphasis on the 3 departments of Electronic & Telecommunication Engineering, Computer Science & Engineering and Textile Technology. This implies that the nature of the University is to educate students to become useful and productive engineers for present society and industry. In other words, it reflects the need of industry for the increasing supply of computer engineers, information processing engineers and textile engineers.

Table 2.3.1 Major Requested Equipment

Department	Contents
Electrical Engineering	Electrical testing instruments, electric machines, motor testing equipment, etc.
Electronic & Telecommunication	Electronics testing instruments, digital circuit testing training boards, etc.
Computer Science & Engineering	Computers, digital circuit testing equipment, etc.
Chemical Engineering	Analysers, reactor testing equipment, etc.
Materials Engineering	Electron microscope, universal testing machine, etc.
Mathematics	Personal computers
Textile Technology	Textile material testing equipment, spinning, weaving, dyeing machines etc.
Common Facilities	Book stands and desks for library, language laboratory equipment, physical education equipment, etc.

The request has been studied taking the history, the number of teaching staff and students, curricula, etc. into account. The items requested were reviewed through confirmation of basic specifications. As a result of the review, the number has been reduced as follows:

1) Requested items by the Government of Sri Lanka at the beginning : 489
2) At the conclusion of Minutes of Discussions (Dec. 12, 1987) : 447
3) At the end of the field survey (Dec. 23, 1987) : 429
4) Final plan (Jan. 20, 1988) : 383

Department	At the beginning	Minutes of Discussion	At the end of field survey	Final Plan
Electrical Engineering	52	52	52	43
Electronic & Telecommunication Eng.	124	122	105	82
Computer Science & Eng.	64	69	69	60
Chemical Engineering	26	27	27	27
Materials Engineering	7	7	7	7
Mathematics	2	2	1	1
Textile Technology	128	104	104	99
Common Facility	86	64	64	64
Total	489	447	429	383

CHAPTER 3 CONTENTS OF THE PROJECT

CHAPTER 3 CONTENTS OF THE PROJECT

3.1 Objectives of the Project

The objectives of the project are to provide necessary equipment for the improvement of educational conditions of the University of Moratuwa in order:

1) to enhance the quality of training of undergraduate students
(Most of the educational equipment is old, having become technologically obsolete and not meeting the required quality of the present curricula. There is an insufficient amount of educational equipment to support the newly established Department of Computer Science & Engineering and Textile Technology.)

2) to provide facilities which would enable the training of an increased number of students
(With the increasing demand for qualified engineers accompanying the development of the country, equipment provision for the Department of Computer Science and Textile Technology is urgent in particular.)

3) to strengthen facilities for research and postgraduate teaching with a view to enhancing the University's current contribution to national development
(The University can, by the provision of equipment, offer testing and consultancy services desired by much of industry and the community.)

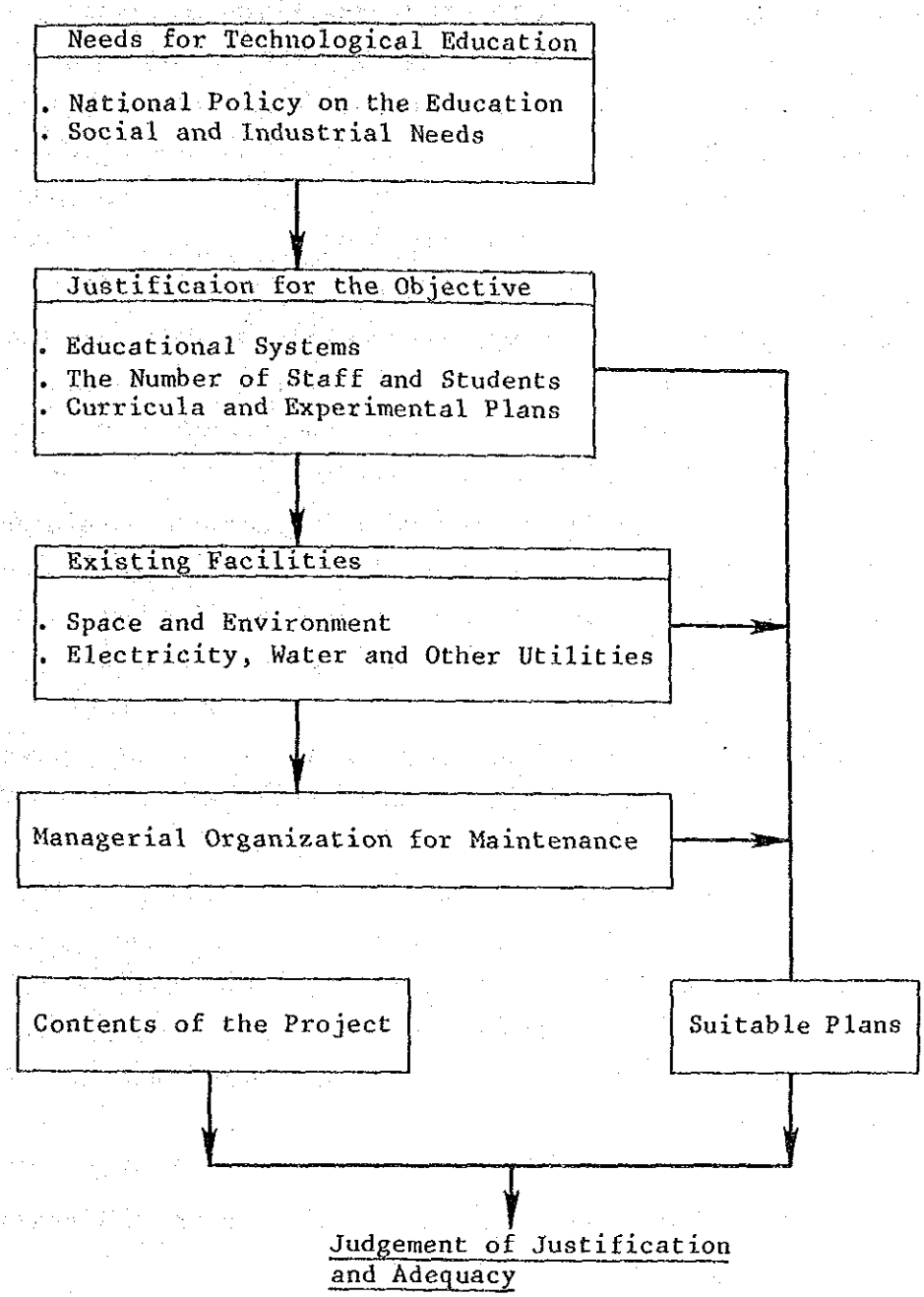
The contents of the requested equipment are reviewed through the subsequent procedures on the bases of the objectives described above.

3.2 Profile of the Project

3.2.1 Method of Equipment Selection

To evaluate consistency and adequacy of the Project, the basic design study reviewed the background and social needs behind the objectives of the Project. The request should match the intended purpose of the education.

The survey was made on the existing facility and the conditions of the University, in order to confirm whether enough space is maintained in each laboratory; requested equipment can be brought into the laboratory without any hindrance; and managerial plan is properly organized to maintain the equipment after provision. The justification on the Project is made with the procedure shown in the following figure; that is, review of national policy, needs of industry, curricula and experimental plans, present educational circumstances, the number of teaching staff and students, expected problem areas after the provision, and so forth.


Needs for Technological Education
. National Policy on the Education
. Social and Industrial Needs
Justificaion for the Objective
. Educational Systems
. The Number of Staff and Students
. Curricula and Experimental Plans
Existing Facilities
. Space and Environment
. Electricity, Water and Other Utilities
Managerial Organization for Maintenance
Contents of the Project
Suitable Plans
Judgement of Justification and Adequacy

3.2.2 Study of Requested Equipment for Each Department

Justification are made on the educational equipment and facilities studying consistency between the requested items and present conditions of the University such as curricula, experimental plans, the number of staff and students and existing equipment for every department. Major equipment requested from each department is clarified for use and objectives and also its relevancy with the curricula and experiments is studied.

(1) Department of Electrical Engineering

About one half of existing educational equipment in the Department is old and most has been serviced for longer than the usual durable life of 10 years. It is also understood that some measuring instruments, motor/generator testing equipment and high-voltage testing equipment are insufficient in number. Therefore, some of the experiments listed in the plans have not been practiced until now, despite the fact that the laboratories are well equipped. During the study, the number and kind of existing equipment still fit for use were first checked, then necessary equipment was selected to supplement existing equipment in both number and type giving due consideration to the curriculum and experimental plan.

Of the requested equipment, several items have been deleted because some were considered not essential for the curriculum and experimental plan (materials for wiring, an electrostatic voltmeter with very high range, a wind speed recorder, etc.), while there was not a suitable one on the market for educational purposes (a wind turbine generator).

The major equipment selected for the Department is listed as follows:

Name	Use/Objectives	Curriculum (Experimental Plan)
- 600KV impulse generator:	To analyse the waveforms and energy of high-voltage impulse generated with the equipment and check the effects	High-voltage engineering (Impulse voltage tests)
- Thyrister invertor system trainer :	To control speed of an induction motor by changing frequency and voltage	Electrical Machines, control systems (Speed control of moroea)
- Power electronics basic: demonstration set	To study application technology between electronics and electricity by using power semiconductor devices	Control systems (Voltage control by phase shift)
- 3-phase controlled DC: motor drive	to control the speed of DC motor with invertor function	Electrical machines, control systems (Speed control of DC motors)

(2) Department of Electronic & Telecommunication Engineering

Existing equipment of this Department are as old as the Department of Electrical Engineering itself; about half of it is more than 15 years old. There is also shortage of the equipment such as electronics circuit testing equipment and measuring instruments and for physics education there is almost no equipment. The Department has been unable to conduct appropriate education according to the curriculum or the experimental plans due to lack of equipment.

Suitable kinds of equipment needed for the Department are selected based on the studies of the circumstances described above in consideration of curriculum, experimental plans, the number of students and educational level. Several requested items were cancelled through discussions with the department head during the survey because some did not correspond to the needs of the Department, while others were deemed unnecessary in terms of the experimental plans. With further investigation into the number of students, the number of signal generators and DC power sources was reduced. Digital IC testers and transistor curve tracers were also deleted since they are not essential.

The major equipment selected for the Department are listed as follows:

Name	Use/Objectives	Curriculum (Experimental Plan)
- Microwave basic experimental equipment :	To study the circuits from oscillator to receiver and check the characteristics	Microwave and radiation, (Microwave communication tests and characteristics of Horn antenna)
- Network/spectrum analyser :	To measure intensity at different frequency band	Electronics and Telecommunications, (General use in a number of experiments)
- Optical fiber system :	To study propagation characteristics in optical communication system	Optical cable communication, (Measurement of attenuation of an optical fiber)

Name	Use/Objectives	Curriculum (Experimental Plan)
- Modulation/demodulation circuit trainer	: To study the modulation and demodulation circuits and analyse characteristics	Telecommunications (Modulation/demodulation characteristic tests)
- CNC vertical machining center and CNC teaching/training lathe	: To study the operations by Computer Numerical Control machines. Research to be made in collaboration with the Dep't of Mechanical and Computer Science.	Computer systems and Control systems (Computer Applications)

(3) Department of Computer Science & Engineering

This Department was established two years ago and the shortage of equipment is noticeable. For example, 8-bit personal computers are furnished as main computers but students are able to study only BASIC programs with them. In fact, the BASIC programs are no longer very useful on jobs even after the students master the programming and graduate from the University. Testing and measuring instruments are considerably lacking as well. The contents of curriculum and experimental plan are substantial and the teacher-student ratio is appropriate. It is necessary to expand the quality and quantity of equipment to be able to accept an increasing number of students to be educated in accordance with the curriculum and experimental plans.

This Project plans to have a Local Area Network (LAN) system within the Campus connecting the requested computers and peripherals. The requested computers will be installed in this Department and the computers in other departments will be connected to the network in future. The introduction of the network system is aimed at sharing and using in common data and information resources through the computers deployed widely at various departments. Staff and

students can therefore access from the terminals and utilize the main powerful computers and data and information resources. This is an economical way of education made possible by the introduction of the network system.
The University of Moratuwa puts special emphasis on this computer network system and is planning to connect other computers; purchasing is underway (projected supply date is on Feb. 1988) independent of this project.

A Japanese computer engineer from Japan Overseas Cooperation Volunteers of JICA stays at this department at present. The operation will be more effective if the engineer or his successor, if any, continues technical cooperation even after the equipment is installed.

Of the requested equipment, a video projector and screen were cancelled because these were not necessarily needed for educational purposes and because the installation required a delicate adjustment technique. A few ordinary measuring instruments and a copy machine were also cancelled for not being justifiable on the curriculum and experimental plans.

The major equipment and facilities selected for the Department are listed as follows:

Name	Use/Objectives	Curriculum (Experimental Plan)
- Computer system 1 & 2 :	The core of total computer system using large memory capacity and high-speed processsing function	General subjects relating to computers
- Personal computers :	To be used separately from ther computers or to be a terminal of above main computers	General subjects relating to computers

Name	Use/Objectives	Curriculum (Experimental Plan)
- Microcomputer software/hardware development system	: To study/research a basic program written in a microprocessor	Computer architecture & hardware design (Computer hardware design lab.)
- Image processing system	: To study image data processing. Camera, image scanner, etc. are equipped with a computer.	Computer graphics and CAD/CAM (Computer-Aided-Design/Computer-Aided-Manufacturing)
- Analog computer	: To study principles of an analog type computer	Analog computer simulations
- Uninterruptible power supply	: To be a power source for the computer system. Electric power can be supplied even during power failure.	
- Air conditioning equipment	: To be used in newly expanded computer laboratories	

(4) Department of Chemical Engineering

1) Chemical Engineering Division

Educational purpose of the Chemical Engineering Division is to have students acquire a broad range of knowledge and technique related to the chemical engineering which covers "Mass and heat transfer", "Distillation", "Absorption", "Reaction", etc. The curriculum and the experimental plans are prepared according to the above purpose. To carry out the experimental plan, a variety of experimental apparatus designed for particular unit operations are necessary. The experiments possible with the existing equipment are limited to a narrow range of chemical

engineering. Not all the experiments planned are possible with the existing equipment. The evaluation of the requested equipment of the Chemical Engineering Division is made considering the present insufficient condition of the existing experimental apparatus. Conformity with the curriculum and the contents of planned experiment is considered. Major items of equipment selected for the Chemical Engineering Division are shown as follows:

Name	Use/Objectives	Curriculum (Experimental Plan)
- Process simulation : equipment	To study the effect of temperature, pressure, flow rate, etc. on the chemical engineering process by using the simulation equipment	Process control, flow, pressure and temperature controlling, using P, PI,PD, PID control modes, etc.
- Continuous catalytic tublar reactor :	To study catalytic reaction under different conditions by using the continuous reactor	Reactor engineering, reaction rate constant, catalytic reforming, etc.
- Heat transfer teaching unit :	To study heat conduction of variety of materials and under the different conditions	Heat and mass transfer
- Gas chromatograph :	To study the qualitative and quantitaive analysis of organic compounds in gases. For experiment and research	Unit operation I, pyrolysis of L.P.G. etc.

Name		Use/Objectives	Curriculum (Experimental Plan)
- Atomic absorption spectrophotometer	:	To use for micro-analysis of metalic elements. For experiment and research	Safety and health, determination of metal concentrations in industrial effluents, etc.

2) Polymer Technology Division

Investigations and studies concerning the properties of melting polymers, and the thermal characteristic of polymers are the most important themes in the Polymer Technology Division. The studies of melting polymers are given particular importance of the curriculum and the experimental plan. The major existing items of equipment are testing apparatus such as refractometer, hardness tester and viscometer or oven and mixing mills. By using them alone, it is impossible to carry out the experiments needed for investigation of the properties of melting polymers which are the indispensable to the Polymer Technology Division.

In selecting the requested equipment of the Polymer Technology Division, the equipment which enables a series of experiments related to melting polymers are selected considering the existing equipment and curriculum.

The main equipment selected for the Polymer Technology Division are shown as follows:

Name		Use/Objectives	Curriculum (Experimental Plan)
- Capirograph	:	Investigation of the properties of the viscosity of polymers	Polymeric materials (Measurement of viscosity and welt strength, etc.)

Name		Use/Objectives	Curriculum (Experimental Plan)
- Extruder	:	Study on extruder line by making an extrudate with a given profile and the methods of solving common problems by changing the process parameters	Polymer technology (Investigation of the effects on the residence time distribution, cooling experiments of an extruder, etc.)
- Injection moulding machine	:	To study the injection moulding process and to solve the common problems associated with the product by varying the process variables	Polymer technology (Research projects on injection moulding, etc.)

(5) Department of Materials Engineering

Department of Materials Engineering studies the properties or characteristics of all kinds of materials. Therefore, the curriculum and the experimental plans cover a wide range of fields, ranging from studies of mechanical properties of materials to atomic or molecular level researches. Major items of equipment now owned by the Department of Materials Engineering are optical microscope, thermal expansion apparatus, hardness tester, muffle furnace and so on. The experiment is limited to elementary equipment far below the structural analysis of atomic or molecular level.

In selecting equipment for the Department of Materials Engineering, that which enables experiments of higher levels are selected considering the capacity of the existing equipment and the curriculum.

Major equipment selected for the Department are shown as follows:

Name	Use/Objectives	Curriculum (Experimental Plan)
- Scanning electron microscope :	To examine the lattice defects or to analyze the characteristics of materials by observation of microscopic structure of materials	Metallurgy, microscopy and selection of materials
- X-ray diffractometer :	To study mainly crystallography	Metallurgy, properties of materials, identification of metals using spectroscopy, etc.
- Universal testing machine :	Evaluation of physical quality of material such as tensile, compression, bending, strength.	Mechanics of materials, tensile test, etc.

(6) Department of Mathematics

Astronomical telescopes and a microcomputor were originally requested by this Department. The astronomical telescopes were cancelled and two more computers were added through discussions during the survey. These computers will be used for applied calculations, operations research, etc. by postgraduate students and staff.

(7) Department of Textile Technology

The requested equipment of the Department will be installed in the new laboratory building now under construction. The planned laboratory building covers the entire field of textile technology. Several pieces of equipment covering a varied areas of textile technology are necessary. At the Department, the main

educational purpose is to give the students practical experience in the textile technology rather than the basic research. The curriculum and the experimental plan contain a series of processes of the textile technology from the spinning process and weaving process to the final products of the sewing process. This requirement must be considered in selecting the equipment for the Department of Textile Technology. In selecting the requested equipment of the Department, the equipment which is useful for the practical work and enables the experiments and practice of a wide area of textile technology are selected considering the existing equipment and the curriculum.

Major equipment selected for the Department of Textile Technology are shown as follows:

Name	Use/Objectives	Curriculum (Experimental Plan)
(Chemical/Processing and Testing Laboratory)		
- High temperature steaming tester - Dyeing tester - Flammability speed tester - Tensile & shear tester	: To use the various kinds of tests for fiber or fabric, such as the colour fastness, flammability, etc.	Fiber Properties Testing
(Clothing Laboratory/Sewing Machines with Special Features)		
- Hemming machine - Bar tacker sewing machine - Lock stitch sewing machine	: To use for the various kinds of practices of sewing and clothing	Garment design & seam technology

Name	Use/Objectives	Curriculum (Experimental Plan)
(Spinning Laboratory)		
- Miniature Card	: The first process of spinning cotton into threads. Make the lie of threads uniform	Yarn manufacture I, II, III
- Drawing frame for cotton	: The second process of miniature card. To draw fiber to make threads	Yarn manufacture I, II, III
- Miniature ring frame	: The process subsequent to drawing frame. Machine to wind thread after twisting sliver	Yarn manufacture I, II, III
(Knitting Laboratory/Weaving Laboratory)		
- Flat knitting machine	: Various kinds of practice of knitting	Fabric manufacture I, II, III
- Circular weft knitting machine	: Various kinds of practice of knitting	Fabric manufacture I, II, III
- Rapier loom	: Loom to reciprocate Rapier with weft between Warp	Fabric manufacture I, II, III
- Air-jet loom	: Loom to insert weft between warp using air pressure	Fabric manufacture I, II, III
- Water-jet loom	: Loom to insert weft between warp using water pressure	Fabric manufacture I, II, III

(8) Common Facility

The Engineering Library requests book stock shelving, atlas and dictionary stands, microfilm readers and so on. These will be installed in the lending room, periodicals room and reference room. Considering the future increase of books and the necessity of effective reference system, the requested items of equipment are considered to be reasonable.

Those requested for physical education are parallel bars, vaulting boxes, sculling exercise machines, weighing machines and training boats. Considering the insufficiency of physical training machines, the supply of these kinds of equipment is essential.

An LL system is requested for the Language Laboratory. In Sri Lanka, Sinhalese is now used as official language and the English ability of the young generation is declining. English is used in the classroom; therefore, if students cannot follow lectures in English it presents a real problem. Considering these conditions, the LL system for Language Laboratory is necessary.