No. 1

MINISTRY OF EDUCATION
REPUBLIC OF KENYA

BASIC DESIGN STUDY REPORT ON THE PROJECT FOR THE IMPROVEMENT OF EQUIPMENT FOR KENYA SCIENCE TEACHERS COLLEGE IN THE REPUBLIC OF KENYA

MARCH 1997

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PREFACE

In response to a request from the Government of the Republic of Kenya, the Government of Japan decided to conduct a basic design study on the Project for the Improvement of Equipment for Kenya Science Teachers College and entrusted the study to the Japan International Cooperation Agency (JICA).

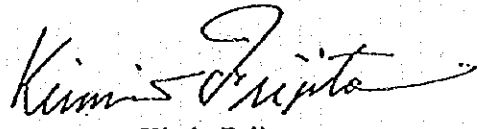
JICA sent to Kenya a study team from November 25 to December 19, 1996.

The team held discussions with the officials concerned of the Government of Kenya, and conducted a field study at the study area. After the team returned to Japan, further studies were made, and as this result, the present report was finalized.

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

I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Kenya for their close cooperation extended to the team.

March, 1997



Kimio Fujita
President
Japan International Cooperation Agency

March, 1997

Letter of Transmittal

We are pleased to submit to you the basic design study report on the Project for the Improvement of Equipment for Kenya Science Teachers College in the Republic of Kenya.

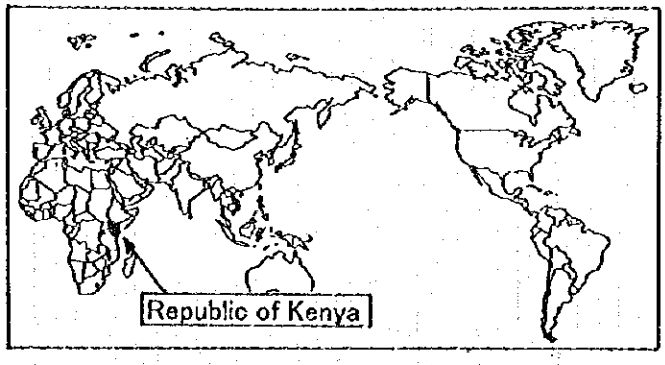
This study was conducted by UNICO International Corporation, under a contract to JICA, during the period from November 14, 1996 to March 31, 1997. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Kenya and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

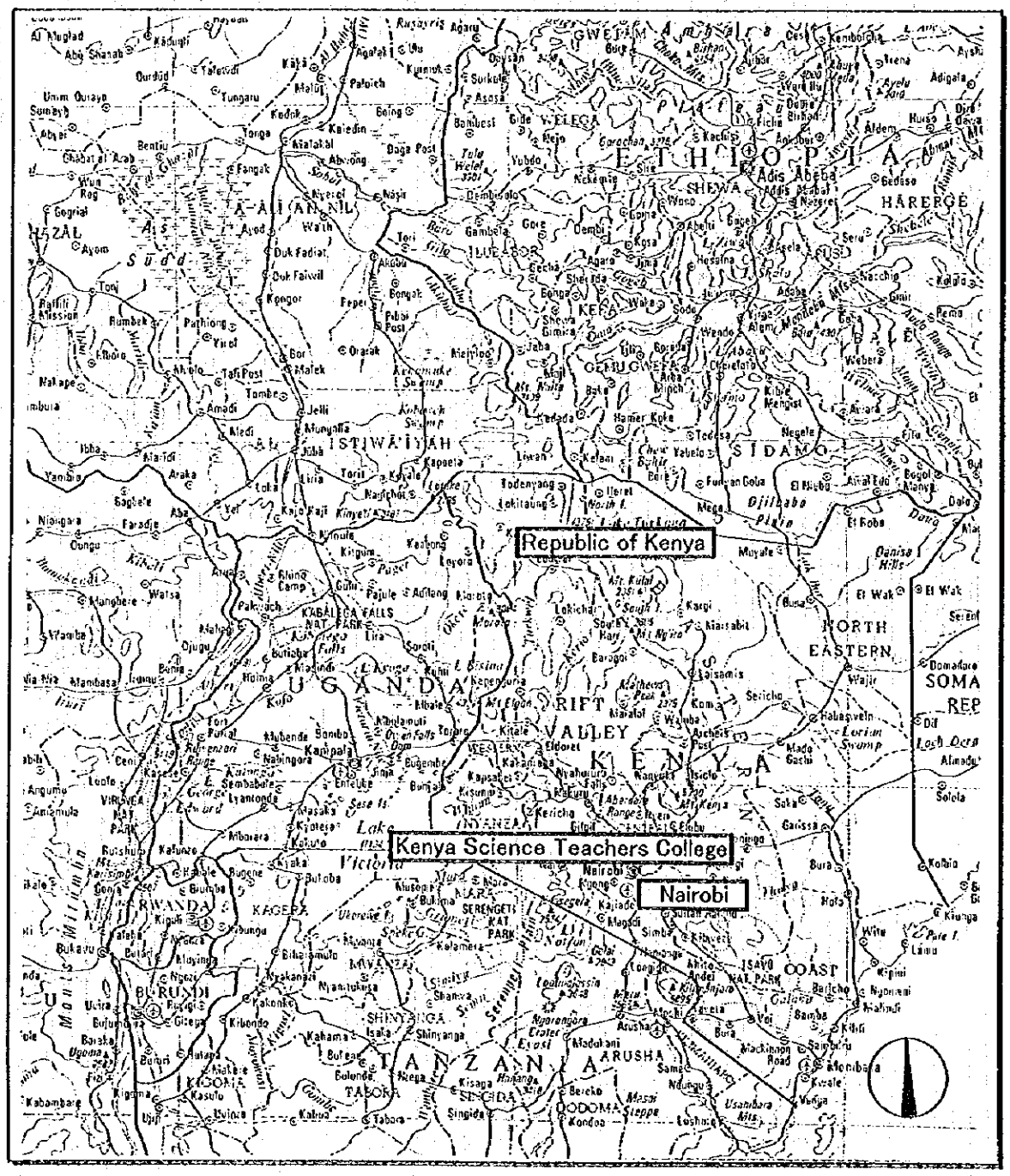
Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,

Jun Ikeda
Project manager,
Basic design study team on
the Project for the Improvement of Equipment for
Kenya Science Teachers College
UNICO International Corporation

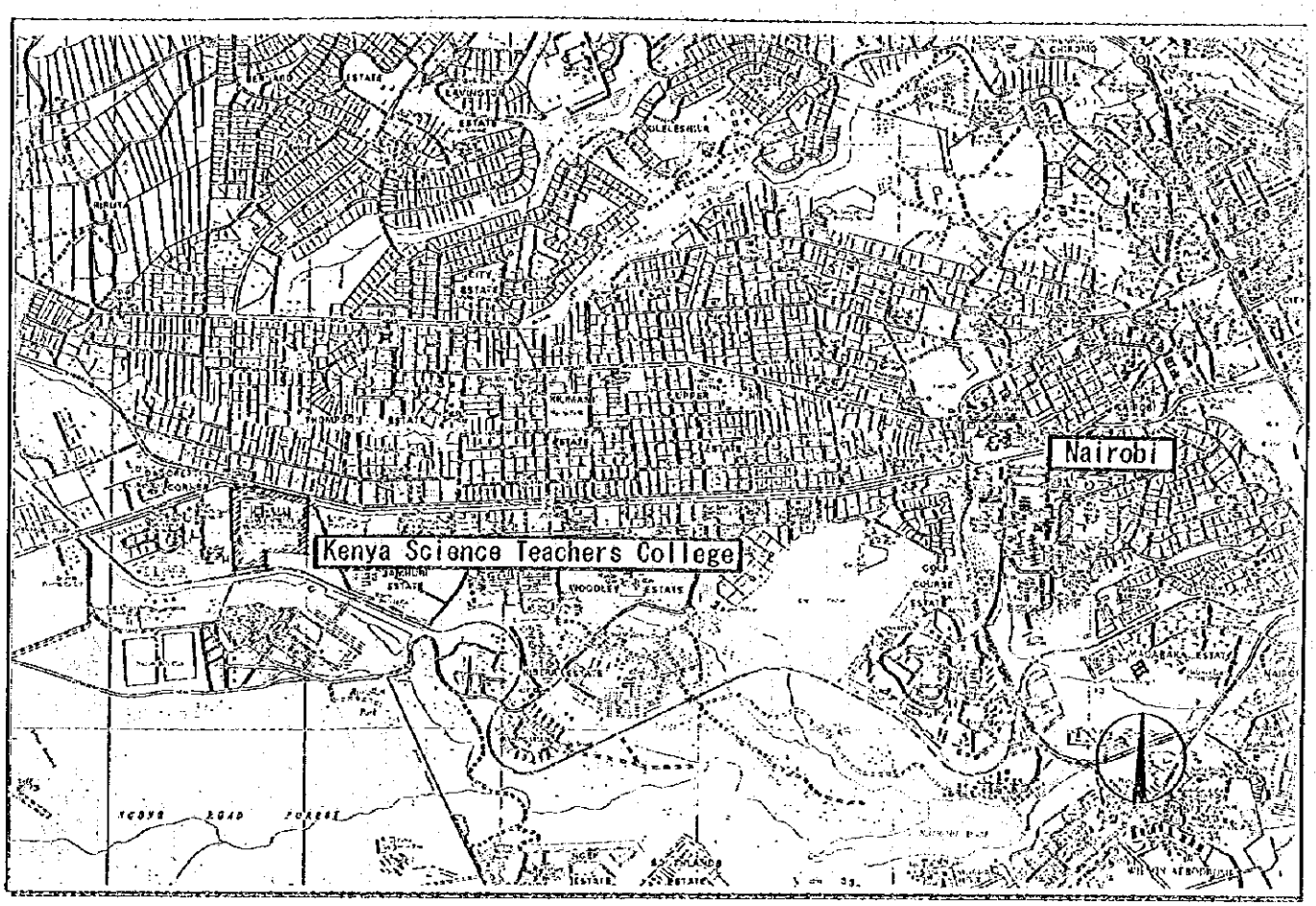
● LOCATION MAP



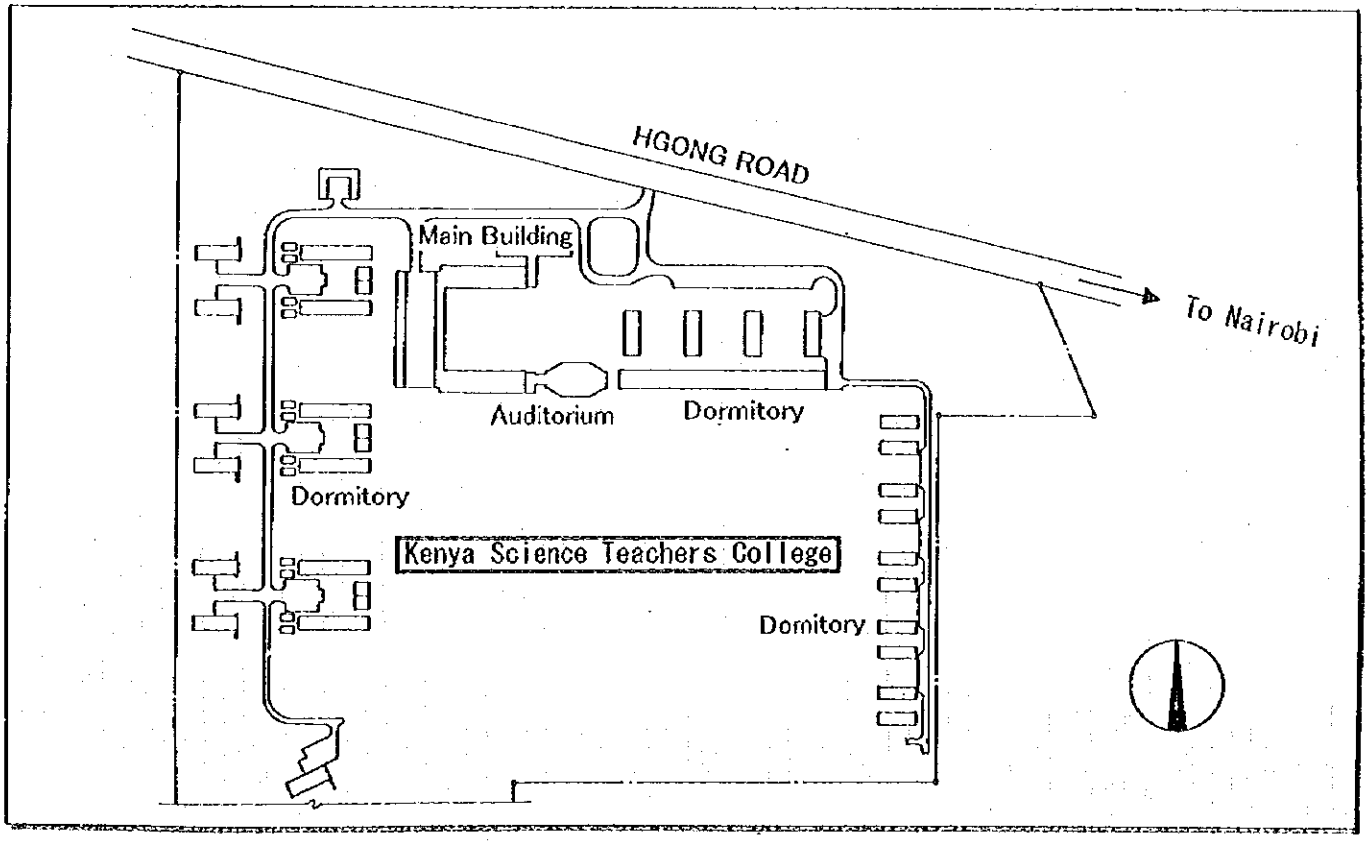


Republic of Kenya

● LOCATION OF THE SITE



● SITE PLAN Kenya Science Teachers College (KSTC)



Abbreviation

ASAL	:	Arid, Semi-Arid Land
ESAF	:	Enhanced Structural Adjustment Facility
IMF	:	International Monetary Fund
KCSE	:	Kenya Certificate of Secondary Education
KSTC	:	Kenya Science Teachers College
ODA	:	Overseas Development Administration
PFP	:	Policy Framework Paper
SECAL	:	Sector Adjustment Lending

TABLE OF CONTENTS

APPENDICES

Chapter 1 Background of the Project

Chapter 1 Background of the Project

When Kenya became an independent nation in 1963, education was at the low level that had been necessary up to that time for the administration of the colony. But after independence the educational goals were raised and the development of education was given priority so that the Kenyan people could build their own nation. Through this education, Kenya has been able to eliminate its shortage of skilled citizens and has been able to uniformly grant beneficial economic opportunities to all its citizens. The Ministry of Education oversees general education and the Ministry of Research, Technical Training and Technology supervises technical education, and because they have tackled education as the most pressing problem, the number of students enrolled in primary education has dramatically climbed from the 1960s level of 1 million students to 5.5 million students in 1994 (Table 1-1). Although primary education is not compulsory in the Kenyan educational system, tuition-free schooling is becoming available and the overall primary school enrollment ratio stands at 90%. However, the percentage of students that actually graduate from primary schools hovers around 50%, and lowering the dropout ratio has become a problem that primary education should solve. Notwithstanding, the ratio of students continuing on to secondary education has risen from approximately 20% in 1984 to the 30% range in the 1990s.

Table 1-1 Student Enrollment

(Number of persons)

	1964	1970	1980	1990	1991	1992	1993	1994
Primary Education	1, 014, 719	1, 427, 589	3, 926, 629	5, 392, 330	5, 455, 996	5, 539, 145	5, 553, 930	5, 511, 943
Secondary Education	35, 921	126, 855	399, 389	618, 461	614, 161	629, 062	531, 342	619, 839

Source : Statistical Abstract 1995

In the period immediately following independence, many of the teachers that had already received an education changed professions, becoming members of parliament, government employees, or employees in public enterprises. To cope with this shortage of teachers coupled with the sharp jump in population, along with climbing enrollment and the increase in the ratio of students continuing their education, the quantitative expansion of education was organized to the extent that the quality of the education was sacrificed, and many teachers lacking teaching certificates and training were hired. Through retraining, the number of untrained teachers has been decreasing each year, and in 1995 they comprised only 20% of the teacher population (Table 1-2).

Table 1-2 Number of Secondary teachers by Qualification

	1991	1992	1993	1994	1995
Trained teacher	24,471	27,219	23,776	31,593	33,443
Ratio (%)	69.7%	74.9%	73.1%	82.5%	80.6%
Untrained teacher	10,626	9,121	8,764	6,714	8,041
Ratio (%)	30.3%	25.1%	26.9%	17.5%	19.4%
Total	35,097	36,340	32,540	38,307	41,484

Source : ECONOMIC SURVEY 1996

Additionally, because of the shortage of science and mathematics teachers, instructors who teach other subjects have also been teaching these subjects, and foreign teachers are also being relied upon. Because of the education prioritization policy since achieving independence, Kenyan recurring expenditures earmarked for the Ministry of Education have risen to account for 30%, and total education-related expenditures account for 40% of total recurring expenses (Table 1-3).

Table 1-3 Ministry of Education Expenditures

(K £ million)

	1985	1986	1987	1988	1989	1990
Current Expenditure of MOE						
General Administration	16.4	19.2	18.5	19.3	26.1	26.1
Primary Education	138.8	181.2	214.4	243.2	271.8	287.5
Secondry Education	32.6	44.8	51.1	57.3	53.3	97.9
Technical Education	4.8	5.8	6.1	10.9	9.5	12.0
Teacher Training	9.8	11.4	12.8	13.9	14.4	14.3
Higher Education	25.0	29.8	38.1	54.8	59.0	91.9
Others	2.5	3.2	3.5	4.3	4.4	6.0
Subtotal	229.9	295.4	344.5	403.7	438.5	535.7
Ratio of Recurrent / Total Recurrent(%)	30.4	35.1	33.4	34.8	37.0	36.2
Development Expenditure of MOE						
General Administration	0.8	1.0	4.2	2.9	3.2	4.1
Secondry Education	1.7	1.6	1.7	2.2	2.5	4.3
Technical Education	0.3	0.3	1.6	0.4	5.7	7.4
Teacher Training	2.5	2.4	1.7	1.7	10.2	8.5
Higher Education	4.3	3.7	10.2	14.6	47.1	53.7
Others	1.3	2.1	1.7	1.3	1.7	10.5
Subtotal	10.9	11.1	21.1	23.1	70.4	88.5
Total	240.8	306.5	365.6	426.8	508.9	624.2

Source : ECONOMIC SURVEY 1996

However, it is recommended in the Structural Adjustment Program that government expenditures relating to education should be reduced, and the principle of cost sharing is being expanded in order to lighten the government's burden. To achieve this, all expenses (buildings, equipment, textbooks, teaching materials, uniforms, etc.) except teaching personnel expenses have already become the responsibility of the each student, but these expenses are heading toward additional increases. Until 1984 the Ministry of Education had been constructing educational facilities using a standardized designed, but since then the system has been revised whereby the maintenance and operation at each school's has become the responsibility of the students' parents. Urban and rural schools that have long and rich heritages receive donations both nationally and regionally from their many wealthy alumni. Accordingly, the school buildings, laboratories, and equipment are modern, providing an excellent educational environment that is sustained by equipment upgrades. However, at many of the schools which were formerly Harambee schools, where students commute from the surrounding areas and where many are from the impoverished classes, they are unable to gather sufficient class materials, refurbish the schools, do repairs and maintenance, nor purchase educational-use equipment, which places students in an extremely inadequate environment. The different categories of school administrations are shown in Table 1-4. However, the categories currently receiving funding support from the government are being phased out, and the national, provincial, and former Harambee schools are being unified and they are all moving toward a cost-sharing system.

Table 1-4 Administration of Secondary Schools (1992)

	National	Provincial	Harambee	Private	Total
Number of School	18	617	1,497	353	2,485
Ratio	0.7%	24.8%	60.3%	14.2%	100.0%

Schools constructed using standardized designs are having problems due to shortages of experiment and training equipment as well as the increasing age and obsolescence of the buildings, and many of the former Harambee school do not even have laboratories or science equipment. At these schools they have to borrow equipment from neighboring schools, or complete their science and math courses through lectures only.

In order to improve conditions such as these, the World Bank decided in 1990 to enact new financing and as requirements for this funding passed the following motions:

(1) Put the Brakes on Recurring Expenditures
Plan for greater efficiency without lowering the current quality of education, and control educational expenses.

(2) Expand Educational Opportunities
Expand enrollment opportunities in primary and secondary education.

(3) Improve Quality
Raise the efficiency of education at all educational stages and formulate qualitative improvements.

(4) Improve Administrative Competence
Improve the educational administration, management, and planning divisions, promote the information age, and carry out financial expenditures according to a plan.

Following these requirements and responding to the areas referred to by the World Bank and the IMF, the Kenyan government recognizes among other things the need to assign appropriate science and mathematics teachers to primary and secondary schools, to strengthen science and math education, to supply teaching materials and equipment at a low price, and to set up educational supply centers. Moreover, as one part of these improvements, the government is aiming to build new facilities at the Kenya Science Teachers College (KSTC) - where the majority of Kenya's science and math teachers are trained - that would serve to improve the quality of new teacher training and also provide retraining for current teachers. The Kenyan government has been requesting grant aid from the Japanese government for this equipment modernization.

KSTC was established in 1966 with the assistance of Sweden to serve as a school to retrain untrained teachers who had not completed their secondary education, and Sweden's financial aid continued until 1976. In 1980, the teaching level was elevated from S1 (7-4-2-3 system middle school teaching qualification) to diploma-level teacher training (8-4-4 system middle school teaching qualification), and this system continues today. The student enrollment capacity is 600, with 586 students attending in 1996. There are 126 instructors. Since producing a large number of diploma-receiving graduates in 1983, the college has as of 1993 produced 2,518 graduates.

Chapter 2 Contents of the Project

Chapter 2 Contents of the Project

2-1 Objectives of the Project

In the period immediately following its independence, many of the teachers that had already received an education changed professions, becoming members of parliament, government employees, or employees in public enterprises. To cope with this shortage of teachers coupled with the sharp jump in population, which was then combined with climbing enrollment and the increase in the ratio of students continuing their education, the quantitative expansion of education was organized to the extent that the quality of the education was sacrificed, and many teachers lacking teaching certificates and training were hired. Through retraining, the number of untrained teachers has been decreasing each year, and in 1995 they comprised only 20% of the teacher population. Because these untrained teachers do not possess sufficient specialized capabilities in the science and mathematics fields, there is a shortage of science and math teachers, and Kenya has had to resort to having teachers who instruct in other subjects also teach these areas as has also had to rely on foreign teachers. Accordingly, in these science and math classes where the training of teachers are not asked and more especially because students are taught by teachers who lack the skills necessary to carry out experiments or training, the numbers of students who have lost interest in science and math courses have increased and the science and math scores in the KCSE (the Kenya Certificate of Secondary Education Test) have fallen. The results of this can be clearly seen in the trend in higher education for students to drift from science and mathematics.

The Kenyan government recognizes the need to assign appropriate science and mathematics teachers to primary and secondary schools, to strengthen science and math education, to supply teaching materials and equipment at a low price, and to set up educational supply centers. Moreover, as one part of these improvements, the government is aiming to build new facilities at the Kenya Science Teachers College (KSTC) - where the majority of science and math teachers are trained - that would serve to improve the quality of new teacher training and also provide retraining for current teachers. The Kenyan government has been requesting grant aid from the Japanese government for this equipment modernization. This project is to be implemented at Kenya's sole science and mathematics teacher training college, and was devised to raise the quality of education at KSTC for KSTC's student body, which is at approximately 2/3rd of its capacity, by improving the training and

experiment equipment that is indispensable for their education. Moreover, this project aims to promote the retraining of current teachers and to strengthen secondary science and mathematics education in Kenya.

2-2 Basic Concept of the Project

In order to raise the quality level of science and math teachers in Kenya's secondary schools, this project's goal is to assist in strengthening science and mathematics education and, additionally, to promote the retraining of current teachers by improving the equipment and materials at KSTC, a college where the focus is on the education of science and mathematics teachers. The basic outline for the modernization of equipment is as follows:

1) This project is a part of a comprehensive cooperative effort working to achieve the bolstering of secondary science and mathematics education at KSTC. The Project-Type Technical Cooperation and the Japan Overseas Cooperation Volunteers have also targeted KSTC, dispatching groups to critical regions. Details relating to the inclusion of both cooperative groups in the scope of this project will be examined, but even working independently these organizations can be effective.

2) The requested equipment and materials are organized according to the 10 academic subjects and the administration. The core academic subjects are biology, physics, chemistry, mathematics and industrial education, and the support subjects are education, language, environmental science, library science, and physical education. However, industrial education at the secondary level requires a great deal of expenditures to cover facilities and operations, and under the current cost-sharing policy it is usually not included as part of the curriculum. Consequently, since industrial education is not cost-effective, it has been excluded from the targeted subjects in this project. Likewise, physical education has also been excluded since it was judged that it can be adequately accomplished with the existing equipment at the schools.

3) The main subjects within the science and mathematics curriculum - biology, physics, chemistry, and mathematics - will be given the highest priority. For the academic subjects of education, language, environmental science, and library science, together with the administration, frequency of usage and their

effectiveness will be examined, and the equipment deemed indispensable for a teacher training school will be provided.

4) Priority will be given to improving the equipment for training and experiments which follow the curriculum and syllabus set in secondary education. As for equipment for the science and mathematics teacher training at the college level, its compatibility to the curriculum and syllabus of KSTC will be verified and the requisite equipment will be provided, but equipment for the purpose of research is outside of the scope of this project. Moreover, types of machinery and equipment that have low operational repair and maintenance costs will be selected.

5) The basic equipment (e.g., laboratory tables, laboratory floors, fume chambers, water supply and drainage fixtures, and gas equipment) that are necessary prerequisites for utilizing the requested equipment have either been used for an extensive period or have been left in a state of disrepair, and this is a hindrance to the effective and efficient utilization of the equipment to be provided. This minimum basic equipment is included in this project because additional expenses for maintenance or supplies are low, meaning it will not increase the burden placed upon KSTC after the equipment is in place.

As a result of the above study, the basic concept behind this project is to maintain equipment for science and mathematics experiments and training as well as equipment for the college administration and to improve the quantity and quality shortfalls in the science and mathematics educational equipment. Recognizing the current deficiencies in the science and mathematics education capabilities in secondary schools in Kenya, this project is facilitating the training of specialized, qualified teachers in order to achieve qualitative increases in science and math education.

2-3 Basic Design

2-3-1 Design Concept

This project aims to upgrade the equipment and materials at KSTC - where the training of science and math teachers is the main focus - in order to raise the caliber of science and mathematics teachers in Kenya's secondary schools, thereby assisting in the strengthening of science and math education and this project is also promoting

the retraining of currently employed teachers. The basic approach of this equipment plan has been to investigate the necessity and appropriateness of the requested equipment, taking many things into account including how existing equipment is currently being used, the curriculum and syllabus, the current conditions at secondary schools, and the importance of science and math education within Kenya. The premises behind the educational system at KSTC are described below.

(1) Summary

KSTC was established with the assistance of Sweden in 1966, and Sweden continued to provide assistance until 1976. It was originally established as a 3-year science and mathematics teacher training college geared for 4-year graduates (0 level) within the 7-4-2-3 educational system. In 1980, the level of education was elevated to where graduates were able to receive diplomas instead of S1 qualifications. With this change, graduation from a 2-year school (A level) was a prerequisite for acceptance and the length of enrollment was changed to 2 years. Accompanying the 1992 switch to a new 8-4-4 education system, graduates of secondary schools were able to enroll in the college and the length of studies was increased to 3 years, and this is the current situation. The student enrollment capacity is 600 with 586 students attending in 1996, and there are 126 instructors. As of 1996 the college has produced 2,125 S1 graduates and 2,728 diploma graduates (Table 2-1).

Table 2-1 Student Enrollment

(Number of Persons)

Number of Student		1988	1989	1990	1991	1992	1993	1994	1995	1996
Intake	Male	225	278	261	146	0	148	165	124	83
	Female	75	92	86	48	0	52	55	40	82
	Total	300	370	347	*1 194	*2 0	200	220	164	165
Enrolmen	Male	219	216	280	156	0	166	183	92	118
	Female	52	48	70	38	0	52	45	64	87
	Total	271	264	350	194	*2 0	218	228	156	205
Graduate	Male	210	192	184	201	265	151	0	155	190
	Female	66	63	61	45	67	39	0	44	34
	Total	276	255	245	246	332	190	*3 0	199	224

Note *1: Because the length of education at KSTC increased from 2 to 3 years in the 1993 school year, the enrollment capacity was reduced.
Note *2: In order to adjust to the new length of education there were no new admissions.
Note *3: This was due to no new admissions in the 1992 school year.

Source: Report of the 8-4-4 diploma committee

(2) Education Curriculum

The objectives of teacher training education as stated in the education development plan include [1] raising the ability to communicate one's convictions, [2] developing an professional consciousness, [3] recognizing the necessity of educating students and developing them along with developing knowledge and capabilities, [4] recognizing in education its independent and contributory nature and [5] the development of adaptability as a teacher to respond to changes in the social environment. The educational curriculum at KSTC is also founded upon these objectives. The length of enrollment is 3 years and each year is divided into 3 terms. The education curriculum is organized into academic subjects and support subjects, and the support subjects are required subjects for all students as part of their general education. The academic subjects are divided into 11 elective courses, and the completion of a total of 2,376 hours is required. Table 2.2~2.5 show the Course Structure, the Subject Combination, the Main Topics, and the Time Allocation.

Table 2-2 Course Structure

Year	Term	Academic Subject = 2 choice of subjects	Support Subject
1st year	Term 1	Biology, Chemistry, Physics, Mathematics, Industrial Education	Physical Education, Education, Language, Environmental Science, Library Science, Workshop, Guidance and Couselling
	Term 2	Biology, Chemistry, Physics, Mathematics, Industrial Education	Physical Education, Education, Language, Environmental Science, Library Science, Workshop, Guidance and Couselling
	Term 3	Biology, Chemistry, Physics, Mathematics, Industrial Education	Physical Education, Education, Language, Environmental Science, Library Science, Workshop, Guidance and Couselling
2nd Year	Term 4	Biology, Chemistry, Physics, Mathematics, Industrial Education	Physical Education,Education,Language
	Term 5	Biology, Chemistry, Physics, Mathematics, Industrial Education	Physical Education,Education,Language
	Term 6	Biology, Chemistry, Physics, Mathematics, Industrial Education	Physical Education,Education,Language
3rd Year	Term 7	Teaching Practice Preparation,Education,Physical Education	
	Term 8	Teaching Practice	
	Term 9	Teaching Practice	

Table 2-3 Subject Combinations

	Mathematics	Chemistry	Physics	Biology	Industrial Education			intake	No.of class
					Woodwork	Metalwork	Drawing and Design		
1	○	○						30	1
2	○		○					50	2
3		○		○				30	1
4	○			○				30	1
5		○	○					30	1
6	○				○			10	1
7	○					○			
8	○						○	10	
9			○		○				
10	○						○	10	
11			○				○		
Total								200	7

Table 2-4 Main topics

Department	Topics
Biology	Cell Biology, Biochemistry, Plant Morphology, Plant Anatomy and Taxonomy, Evolution
	Plant Physiology, Animal Kingdom and Physiology, Ecology, Biostatistics, Genetics, Parasitology
Chemistry	General Chemistry: atomic structure, periodic table and theories of chemical bonding
	Physical Chemistry: introductory chemical thermodynamics, phase equilibria, chemical equilibria, etc
	Organic Chemistry: saturated and unsaturated hydrocarbons, aromatic hydrocarbons, alkylhalides,
	alkanols and phenols,carbonyl compounds, carboxylic acids and their derivatives,carbohydrate,etc
	Inorganic Chemistry: s-block elements, p-block elements and transition elements of the d-block
Mathematics	analysis and calculus, probability and statistics, mechanics, linear algebra and numerical methods
Physics	Dynamics: particle,rigid body fluid dyanmics, Mechanical oscillations and Gravitation, Materials and
	Crystalline structure, Gases and Thermodynamics, Waves and Optics, Electricity and Magnetism
	electrostatics, direct current, electromagnetism, electromagnetic induction and alternating currents
Industrial Edu.	hand and machine operation, foundary work, forge work, arc and gas welding, furniture making, etc

Table 2-5 Time Allocation

	1st Year			2nd Year			3rd Year			Total Hours	Ratio
	1	2	3	4	5	6	7	8	9	Except term 8,9	(%)
Academic Subject	16	16	16	18	18	18	20			1464	62
Education	3	4	4	4	4	4	4			324	14
Physical Education	2	2	2	3	3	3	3			216	9
Language	2	2	2	2	2	2	-	Teaching		144	6
Environmental Science	2	2	2	-	-	-	-	Practice		72	3
Workshop	2	2	2	-	-	-	-			72	3
Library Science	2	1	1	-	-	-	-			48	2
Guidance and Counselling	1	1	1	-	-	-	-			36	1
Total	30	30	30	27	27	27	27			2376	100

*Each term is 12 weeks.

1) **The Biology Department** (experiment groups: 15 groups of 2 students): This department received direction from a Swedish specialist, so its use of existing equipment and its administration is very competent. However, just as in other departments, its equipment had become old and there are many breakdowns, and the percentage of equipment that is now unusable has been growing. As this science is the study of life, there are many cases where equipment breakdowns make experiments especially impossible to perform and it has become difficult to hold effective classes. The requested types of equipment are basic types, and because many of them are upgrades of existing equipment most of the requests have high validity. However, because an automatic tissue processor is not especially important and actually doing the process by hand is even more effective from an educational standpoint, this item was changed to a biological slide-making set. Although a transparency stencil cutter, epidiascope and 16 mm projector are effective visually, they conflict with the requirements of the education department. By placing those items in the education department where they can be shared, more effective use can be attained.

2) **The Physics Department** (experiment groups: 6 groups of 2~3 students): Physics is the most elemental area of study in the natural sciences. The physics department provides a syllabus of study that aims to provide students with the necessary educational knowledge and skill acquisition in the field of physics to serve as secondary school science teachers. The curriculum is organized in a college-level curriculum that covers dynamics, the assorted fields of heat, light, sound, electromagnetism, etc., and the modern physics study of the atomic nucleus. The students study the various subjects in physics which together comprise the backbone of secondary science education. In the last year of study, students also study the actual experiments performed at secondary schools. Experiments constitute the most important elements in the syllabus. Most of the equipment used by the physics department was provided by Sweden 30 years ago, and it is aging rapidly and in need of continuous repair. The requested equipment is based upon the syllabus and covers most of the fields in the department. The equipment is adaptable to the dramatic progress and development in natural science techniques. There are no special problems with the requested equipment relating to administrative management or expenses. The physics department employs 10 instructors who divide the teaching load in each of the fields of study, and experiments are performed with the help of 1~2 experiment assistants and technicians who have been assigned to each of the fields of study.

3) **The Chemistry Department** (experiment groups: 5 groups of 2~4 students): Chemistry is only preceded by physics as the most elemental area of study in the natural sciences. The chemistry department provides a syllabus of study that aims to provide students with the necessary educational knowledge and skill acquisition in the field of chemistry to serve as secondary school science teachers. The curriculum covers the basic areas of most chemistry fields, including inorganic and organic chemistry, and physical chemistry. These are all taught at the college level, but students study the fields of chemistry that together form the backbone of secondary science education. Like the physics department, the last year of studies include study and research relating to chemistry experiments performed at the secondary school level. Experiments constitute the most important elements in the syllabus. Most of the equipment used in the chemistry department was provided by Sweden 30 years ago, and it is in the same condition as the physics department equipment. The requested equipment is based upon the syllabus and can be used in each of the department fields for studying physical properties, making compounds, for analysis, etc., and by providing this

equipment it makes effective education of students possible. However, the atomic absorption spectrophotometer was excluded since its function is considered too specialized for the teacher training level, and moreover, it has high maintenance costs and also high replacement costs for supplementary equipment. Additionally, there were multiple requests for equipment that had similar characteristics, including UV-visible spectrophotometers and electronic balances. The acceptance of these equipment requests was limited to types, thought suitable for the primary educational curriculum in the chemistry department. There were requests for many types and quantities of teaching material items for the secondary science level, and they can be considered essential for education. The extent of damage to the chemistry laboratories are most severe, necessitating the replacement of floors, laboratory tables, fume chambers, etc. The chemistry department has 11 instructors and 3 assistants/technicians administrating the department.

4) **The Mathematics Department** (experiment group: 1 group of 28~40 students): The mathematics department has as its goal the training of secondary school teachers, and it instructs and directs students based upon a college-level syllabus. The students start with numbers and then study other subjects including trigonometry, calculus, statistics, and probability. Because of subject matter, the mathematics department does not require much equipment for experiments. However, to keep apace with developments in scientific technology, the mathematics department has requested computers and simple calculators as indispensable equipment. Concerning the former, there is not even one computer within the department. They have requested 34 computers, which is the average number of students per class. Taking into consideration all the circumstances - that there have been no computers, that a number of the instructors can operate computers, and that a few of the teachers have personal computers in their homes - it is felt that it would be appropriate to supply 5 computers. They may also be able to share computers with other departments. The mathematics department has 13 instructors to teach and direct the students, one of whom is a specialist in computer science.

5) **The Environmental Science Department** (experiment groups: 15 groups of 2 students): The environmental science department was created to help teachers participating in science education to correctly understand environmental problems, and it is a basic subject which can be useful to them in future teaching. Like other departments, this department has requested experimental/training use equipment,

audiovisual equipment, and equipment for creating teaching materials, and the most of the requests are considered to be very appropriate. However, one of the requests is for a tractor for use in the college farm. Because the college farm is about 2~3 hectares and is situated on sloping ground, the tractor (30~40ps) currently being used there is sufficient and therefore this item was excluded.

6) **The Education Department** (experiment groups: 1 group of 28~60 students): In science education, science and education can be thought of as the two wheels on a vehicle. The syllabus of the education department not only contains subjects related to education (e.g., educational philosophy, educational psychology, and other education-related specialty subjects) but is also organized to include subject matter which is integrally related to all subjects in science, such as science education theory and training. Even in the classroom, when teaching a science education unit relating to physics, the education department brings in instructors from the physics department to participate in and help direct the class together with the education department instructor. The primary requested items are equipment for mock classes held by students in their college classes (video systems, etc.), equipment to use the many educational films that have been accumulated, both within and outside of classes (16mm projectors, etc.), and equipment (typewriters, stencil duplicator, etc.) for creating teaching materials. Among these requested materials, the college currently has some usable items, but they are mostly obsolete. The education department is divided between general education and education that helps build character in the students. Accordingly, equipment has been requested that is necessary for departmental general classes (e.g., public address system) and for making outside activities run smoothly (e.g., a portable generator). The education department is administered very well and has 10 instructors as well as assistants to run the audiovisual equipment.

7) **The Language Department** (experiment groups: 1 group of 15~20 students): In Kenya there is no national language shared by the entire populace, and English serves as a kind of national language. Accordingly, this department is essential for the people of Kenya. However, the teaching and study of science and mathematics subjects is conducted entirely in English beginning in primary school and continuing through college, so most of the textbooks and reference books are also written in English. For these reasons, English is a necessity in educational instruction and in the study of science and math-related subjects. The

syllabus is structured from the language department's unique position. Special emphasis is placed on promoting mutual comprehension through hearing and speaking. One example of this can be seen in the LL classroom equipment that was provided by Sweden 30 years ago. However, this equipment is so old that it can no longer be used. There are 7 instructors in the language department who supervise the English education and instruction for the entire student body.

8) **The Library Science Department:** Together with teaching students how to effectively utilize the books in the library by teaching them how to use the library (library science), this department also manages the library. The library currently possesses only 18,000 volumes, and in terms of both diversity and quantity the library is not adequate. Although by its very nature the library possesses audio-visual teaching materials and provides the important service of making them available, because no audio-visual equipment is available it cannot carry out this function. Accordingly, the requested equipment is mainly books, audio-visual equipment, and typewriters for making teaching materials, and the requests are very appropriate. However, those items which overlap with requests from other departments have been excluded.

9) **The Administration:** It is vital that the administration, which has the responsibility of managing and administrating the entire college, be able to utilize equipment that is equipped with sufficient functions to enable all the activities of the college to be actively administered. It is necessary for this department to manage the tremendous volume of work, which runs the gamut from managing and preserving personal data files, printing all types of materials (e.g., the college magazine, annual reports, textbooks, and graduation programs), to issuing all types of documents. However, the existing computers are so obsolete that they have almost no processing capacity, and the printing presses have become so old that it has become necessary to send printing orders off campus. Also, the college vehicles have been used for so many years that they frequently break down, which also makes teaching practice (*refer to next page) instruction extremely difficult. Consequently the requested items for printing, for copying, for computers, and for vehicles are all essential and are considered quite appropriate.

*Teaching Practice

1. Overview of Teaching Practice

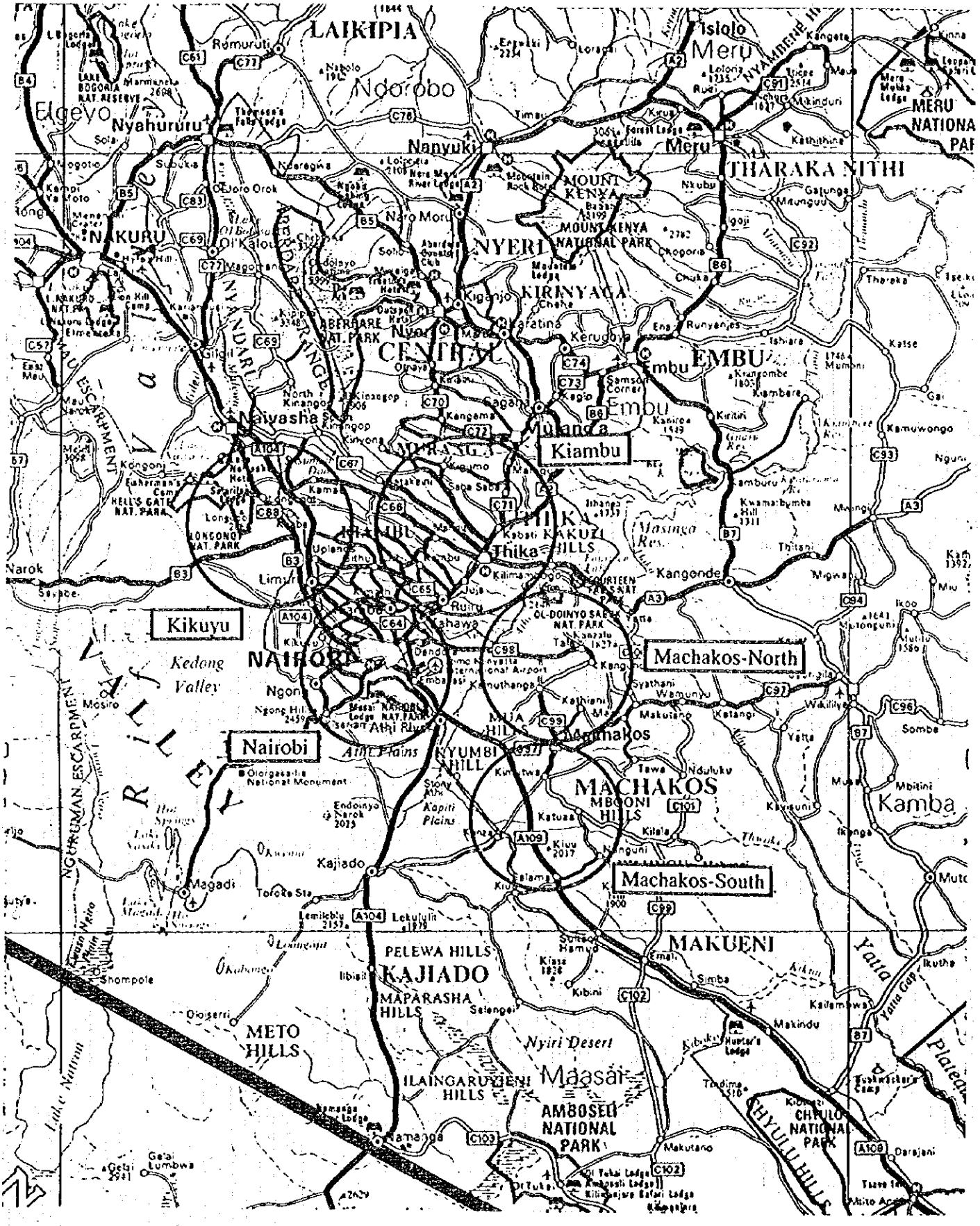
Heavy emphasis is placed on teaching practice at Kenya's teacher training college, with the final year of the 3 years of study being spent in this endeavor. After finishing their preparations for teaching practice in the 7th term of study, every year during their 8th and 9th terms 200 3rd-year students are assigned to approximately 80 secondary schools in 5 districts in the Nairobi area to engage in teaching practice. 4 instructors from the college are sent on a weekly rotating basis to supervise and instruct the students. In order for these instructors to oversee the students assigned to the many schools on an equal basis, it is necessary for each of the instructors to visit a different school every day according to a rigid schedule. This necessitates one vehicle in each district for a total of 5 vehicles, but because the breakdown rate for the old college vehicles are so high, it is often necessary to also rely upon local buses and matatus (small buses). For these reasons, this visiting supervision with its rigid schedule is very difficult to carry out.

(1) The Current State of Teaching Practice

1) Time frame
The 8th and 9th terms (May ~ August, September ~ November)

2) Participating Students
3rd-year students (200 or more each year)

3) Assigned Secondary Schools
In 1996, students were assigned to 86 schools in 5 districts. The 5 districts are as shown on the attached map.



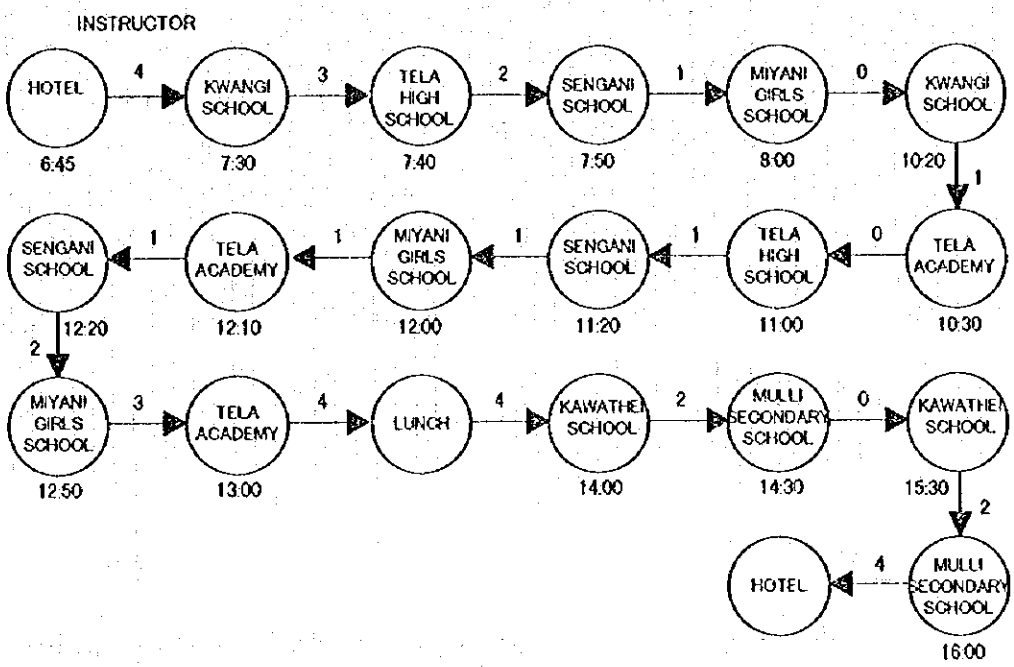
Teaching Practice School District Map

Table 2-6 Allocation of Students

Area	No. of Secondary School	No. of Students
Nairobi	20	49
Kiambu	21	56
Kikuyu	19	47
Machakos-North	12	38
Machakos-South	14	10

(2) Vehicle Use Schedules

An example of a vehicle use schedule for the Machakos-North district is shown below. This is an example of a single day during the term and a different schedule is created and followed every day in each district.



For the five districts collectively there are more than 500 daily vehicle use schedules such as this for the 24 week cycle of teaching practice.

(3) Existing Vehicles

The 4 operational vehicles are as follows:

Two Datsun 160Js (purchased in 1977 and 1978), a Toyota Corolla (purchased in 1984), and a Datsun 120Y (purchased in 1978).

Even when all 4 vehicles can be utilized they can only cover 4 districts, so the Nairobi district relies 100% on matatus and buses. Moreover, since 3 of these are old vehicles which have been in use for 18 years they often break down, which has made keeping the scheduled runs extremely difficult. For this reason, other districts also have to rely on matatus and buses.

2-3-2 Basic Design

(1) The Overall Plan

Concerning the requested equipment, the basic idea behind this equipment plan is to investigate the necessity and appropriateness of the equipment based upon such things as the usage of existing equipment, the curriculum and syllabus, the current conditions at secondary schools, and the status of science and mathematics education in Kenya. The basic policy for equipment selection is based upon the following evaluation criteria.

(A) High Priority Equipment

1)Appropriate equipment that is either extremely old or has become obsolete.
2)Equipment that from a standpoint of conducting experiments or hands-on training is deficient in quantity.
3)Equipment which from an educational standpoint is indispensable.
4)Equipment deemed necessary for the secondary education curriculum.

(B) Low Priority Equipment

1)Equipment used for advanced-level research.
2)Equipment that is difficult to install and/or manage.

3)High-priced equipment that would only be rarely used.

4)Equipment for which the procurement of supplies and spare parts is difficult.

5)Equipment which has high maintenance costs.

Besides the items listed above, at the time the equipment was selected for this project the condition of the infrastructure at the project site as well as the points listed below were taken into consideration.

(1) The existing laboratory floors, tables, and fume chambers of the biology, physics, and chemistry departments are extremely old, and in their present condition it would be difficult to effectively and safely use the modern equipment, so these items will be replaced.

(2) Appropriate basic equipment deficiencies recognized during the detailed coordination meetings after the minutes of discussions were signed will be included in the plan equipment as secondary education equipment and as basic equipment.

(3) For necessary equipment that is being requested by more than one departments, the use conditions have been taken into account and they are to be collectively administered.

(4) For major equipment, the spare parts necessary for approximately 2 years of usage are included.

Using the above equipment evaluation standards and considerations as a base, the rankings have been examined based upon each syllabus, the number of students, and the quantity and condition of existing equipment. These results are shown below.

Table 2-7 Evaluation of Equipment

1 Biology Department

Term	Subject	Experiment	No. of Group/ Students	Component	Necessary Q'ty	Existing condition					Requested Q'ty	Proposed Q'ty
						A	B	C	D	E		
1	Cell biology	1 Use of Microscope	15×2	Microscope(1-18)	30		11			12	20	20
		2 Sectioning and Staining		Microscope(1-18)	30		11			12	20	20
		3 Measurement of the cell		Rotary Microtome(1-1)	2					1	2	2
				Automatic Tissue Processor(1-2)	2	○					4	0
				Heating Plates(1-16)	3			1		2	3	3
		4 Osmosis of the cell		Microscope(1-18)	30		11			12	20	20
				Heating Plates(1-16)	3			1		2	3	3
1	Biochemistry	1 Carbohydrate		Heating Plates(1-16)	3			1		2	3	3
		2 Protein		Stopwatch(1-12)	15			4			15	15
		3 Lipids and vitamins		Water still(1-13)	3			1			2	2
		4 The action of various enzymes		Heating Plates(1-16)	3			1		2	3	3
		5 Factors affecting enzyme action		Magnetic Stirrer(1-19)	2					3	2	2
				pH Meter(1-20)	2					1	2	2
				Sand Bath(1-22)	3	○					3	3
				Deioniser(1-24)	1					1	1	1
				Spring Balance(1-26)	8					1	10	8
				Refrigerator(1-28)	2					2	2	2
				Precision Balance(1-11)	6			1		4	6	5
				Epidiascope(1-34)	1	○					5	0
2	Biochemistry	1 Respiration		Microscope(1-18)	30		11			12	20	20
				Rotary Microtome(1-1)	2					1	2	2
				Automatic Tissue Processor(1-2)	2	○					4	0
				Heating Plates(1-16)	3			1		2	3	3
2	Genetics	1 Mitosis and Meiosis		Models Showing Mitosis & Meiosis(1-33	1	○					1	1
				DNA Molecule Kit(1-31)	2	○					2	2
				RNA Protein Synthesis kit(1-32)	1	○					1	1
				Rotary Microtome(1-1)	2					1	2	2
				Automatic Tissue Processor(1-2)	2	○					4	0
				Microscope(1-18)	30		11			12	20	20
2	Plant taxonomy	1 Thallophyta-Algae		Microscope(1-18)	30		11			12	20	20
		2 Thallophyta-Fungi		Slide Viewer(1-5)	2	○					15	2
		3 Thallophyta-Bryophyte		Heating Plates(1-16)	3			1		2	3	3
				Stereo Microscope(1-8)	2	○					2	2
				Slide Projector(1-4)	2					2	2	2
				Magnifier(1-36)	15	○					2	15
				Film Projector(1-14)	2	○					1	0
				Camera(1-40)	2	○					1	1
		4 Pteridophyta		Rotary Microtome(1-1)	2					1	2	2
		Gymnosperm		Automatic Tissue Processor(1-2)	2	○					4	0
		5 Angiosperm		Slide Projector(1-4)	2					2	2	2
				Slide Viewer(1-5)	2	○					15	2
				Stereo Microscope(1-8)	2	○					2	2
				Heating Plates(1-16)	3			1		2	3	3
				Microscope(1-18)	30		11			12	20	20
				Refrigerator(1-28)	2					2	2	2
				OHP(1-29)	2			1		1	1	1

Term	Subject	Experiment	No. of Group/ Students	Component	Necessary Q'ty	Existing condition					Requested Q'ty	Proposed Q'ty
						A	B	C	D	E		
				Magnifier(1-36)	15	○					2	2
				Camera(1-40)	2	○					1	1
2	Animal Kingdom	1 Protozoa 2 Porifera 3 Coelenterata		Slide Projector(1-4)	2					2	2	2
				Slide Viewer(1-5)	2	○					15	2
				Stereo Microscope(1-8)	2	○					2	2
				Incubator(1-9)	3					1	2	1
				Film Projector(1-14)	2	○					1	0
				Heating Plates(1-16)	3			1		2	3	3
				Microscope(1-18)	30		11			12	20	20
				Magnetic Stirrer(1-19)	2					3	2	2
				Transparency Stencil Cutter(1-27)	2	○					2	0
				Refrigerator(1-28)	2					2	2	2
				Overhead Projector(1-29)	2			1		1	1	1
				Magnifier(1-36)	15	○					15	15
				Desktop Publishing Unit(1-38)	2	○					1	0
3	Animal Kingdom	1 Nematoda, Echinodamata, Mollusca, Annelida 2 Annelida	15×2	Rotary Microtome(1-1)	2					1	2	2
				Automatic Tissue Processor(1-2)	2	○					4	0
				Slide Projector(1-4)	2					2	2	2
				Slide Viewer(1-5)	2	○					15	2
				Film Projector(1-14)	2	○					1	0
				Microscope(1-18)	30		11			12	20	20
				Transparency Stencil Cutter(1-27)	2	○					2	0
				Epidiascope(1-34)	1	○					5	0
				Magnifier(1-36)	15	○					15	15
				Desktop Publishing Unit(1-38)	2	○					1	0
				Camera(1-40)	2	○					1	1
		3 Chordate, Fish, Insects, Aves		Film Projector(1-14)	2	○					1	0
				Microscope(1-18)	30		11			12	20	20
				Refrigerator(1-28)	2					2	2	2
				Overhead Projector(1-29)	2			1		1	1	1
				Magnifier(1-36)	15	○					15	15
				Slide Projector(1-4)	2					2	2	2
				Camera(1-40)	2	○					1	1
3	Micro-organism	1 Culturing bacteria and Fungi		Autoclave(1-6)	4			2		1	2	2
				Stereo Microscope(1-8)	2	○					2	2
				Incubator (Bacteria)(1-10)	2			1		1	1	1
				Heating Plates(1-16)	3			1		2	3	3
				Microscope(1-18)	30		11			12	20	20
				Magnifier(1-36)	15	○					15	15
3	Plant morphology Anatomy	1 Stems and roots (Morphology) 2 Stems (Anatomy) 3 Roots (Anatomy) 4 The Leaf (Anatomy) 5 The Flower 6 Dicho-flower,Graminae and Compositae flowers 7 Fruits and seeds		Rotary Microtome(1-1)	2					1	2	2
				Automatic Tissue Processor(1-2)	2	○					4	0
				Slide Projector(1-4)	2					2	2	2
				Slide Viewer(1-5)	2	○					15	2
				Heating Plates(1-16)	3			1		2	3	3
				Microscope(1-18)	30		11			12	20	20
				Deioniser(1-24)	1					1	1	1
				Transparency Stencil Cutter(1-27)	2	○					2	0
				Epidiascope(1-34)	1	○					5	0
				Refrigerator(1-28)	2					2	2	2

Term	Subject	Experiment	No. of Group/ Students	Component	Necessary Q'ty	Existing condition					Requested Q'ty	Proposed Q'ty
						A	B	C	D	E		
4	Plant physiology	1 Water relation and general composition of plant body 2 Photosynthesis, chlorophyll 3 Stomate 4 Effect of external environmental condition on the rate of photosynthesis		Waterstill(1-13)	3			1			2	2
				Water Bath(1-15)	4				2	1	4	4
				Microscope(1-18)	30		11			12	20	20
				Magnetic Stirrer(1-19)	2					3	2	2
				Spring Balance(1-26)	8					1	10	8
				Refrigerator(1-28)	2					2	2	2
				DNA Molecule Kit(1-31)	2	○					2	1
				Stopwatch(1-12)	15			4			15	15
4	Plant growth and development	1 Zone of growth 2 Growth hormones 3 Germination, Structure of seeds 4 Conditions necessary for germination 5 Tropism		Rotary Microtome(1-1)	2					1	2	2
				Automatic Tissue Processor(1-2)	2	○					4	0
				Electric Centrifuges(1-3)	4					1	4	4
				Drying Oven(1-30)	2					3	2	2
				Precision Balance(1-11)	6			1		4	6	5
				Deioniser(1-24)	1					1	1	1
				Microscope(1-18)	30		11			12	20	20
				Magnetic Stirrer(1-19)	2					3	2	2
				Refrigerator(1-28)	2					2	2	2
				Overhead Projector(1-29)	2			1		1	1	1
				Magnifier(1-36)	15	○					15	15
4	Animal physiology	1 Nutrition-Mouth parts of insects		Slide Projector(1-4)	2					2	2	2
		2 Nutrition-The beaks and feet of birds		Slide Viewer(1-5)	2	○					15	2
5		3 Nutrition-Teeth and dentition of mamals		Film Projector(1-14)	2	○					1	0
				Overhead Projector(1-29)	2			1		1	1	1
				Magnifier(1-36)	15	○					15	15
				Bomb Calorimeter(1-21)	2	○					2	2
5	Animal physiology	1 Histology of the digestive system		Rotary Microtome(1-1)	2					1	2	2
		2 Mammalian circulatory system		Automatic Tissue Processor(1-2)	2	○					4	0
		3 Dissection of the mammalian alimentary canal and urinary		Microscope(1-18)	30		11			12	20	20
		4 Sympathetic nervous system of a frog		Magnifier(1-36)	15	○					15	15
		5 Muscles	15×2	Stethoscope(1-17)	2					1	2	2
		1 Blood 2 Urine		Electric Centrifuges(1-3)	4					1	4	4
				Haemacytometer(1-7)	2					1	2	2
				Microscope(1-18)	30		11			12	20	20
				Magnetic Stirrer(1-19)	2					3	2	2
				pH Meter(1-20)	2					1	2	2
				Refrigerator(1-28)	2					2	2	2
6	Genetics	1 Chromosome		Microscope(1-18)	30		11			12	20	20
				Magnetic Stirrer(1-19)	2					3	2	2
				Heating Plates(1-16)	3			1		2	3	3
6	Ecology	1 Soil elements		Heating Plates(1-16)	3			1		2	3	3
				Microscope(1-18)	30		11			12	20	20
				pH Meter(1-20)	2					1	2	2
				Spring Balance(1-26)	8					1	10	8
				Drying Oven(1-30)	2					3	2	2
		2 Adaptation of organisms to terrestrial environment		Slide Projector(1-4)	2					2	2	2
				Slide Viewer(1-5)	2	○					15	2
				Film Projector(1-14)	2						1	0
				Sound Level Meter(1-23)	2	○					2	2
				Bomb Calorimeter(1-21)	15			1		8	15	15

Item	Subject	Experiment	No. of Group/ Students	Component	Necessary Q'ty	Existing condition					Requested Q'ty	Proposed Q'ty
						A	B	C	D	E		
				Overhead Projector(1-29)	2			1		1	1	1
				Magnifier(1-36)	15	○					15	15
				Camera(1-40)	2	○					1	1
7	Secondary education's Experiments	1 Observation of plant and animal organizations 2 Experiments on photosynthesis 3 Functions of soil		Secondary School Equipment(1-41)	1	○					1	1

Explanatory notes
A: not possess
B: operational
C: necessity of replacement in a few years
D: difficulty of use by deterioration
E: No possibility of repair, procurement of spare and consumables

Term	Subject	Experiment	No. of Group/ Students	Component	Necessary Q'ty	Existing condition A	B	C	D	E	Requested Q'ty	Proposed Q'ty
1	Simple measurement	1 Measurement of mass		Electronic Balance(2-3)	2				1	1	2	2
		2 Measurement of length, breadth		Micrometer(2-4)	6			2	2	2	6	6
				Vernier Caliper(2-5)	6			4		2	6	6
2	Mechanics	1 Addition of forces		Spring Balance(2-22)	12			2	14	4	20	12
	Force and motion	2 Newton's law		Cavendish's Torsion Balance(2-1)	2					1	1	0
2	Measurement of microdisplacement	1 Measurement of small angle of rotation and period of pendulum		Venire Caliper(2-10)	6			2	2	2	6	7
3	Heat	1 Specific heat		Joule Meter(2-19)	6			1	3	2	2	6
				Immersion Heater(2-20)	6			2	5	3	10	7
				Thermal Conductivity apparatus(2-21)	6			2		4	6	6
	(energy, heat)	2 Gasoline engine model		Demonstration Engine Model(2-29)	2			1	1	1	3	2
4	Optics	1 Spectrum		Spectrum Lamp apparatus(2-25)	6			2	1	1	4	6
		2 Diffraction experiment		Ultraviolet Lamp apparatus(2-26)	6					6	2	7
		3 Spectrometer		Spectrometer(2-30)	6			1		3	4	7
				Diffraction Gratings(2-31)	6		1	2		1	1	5
4	Wave	1 Damped oscillation and free oscillation		Stop Watch(2-2)	6			13	1	6	20	7
				Oscilloscope(2-6)	6			2	6	4	10	7
4	Static electricity	1 Discharge of capacitor		Capacitor(2-35)	12			2	2	6	10	12
		2 Insulator and conductor		Capacitance Meter(2-36)	6			2	1	3	2	7
5	Electromagnetics	1 Cell and potential difference	6×(2～3)	Voltmeter(2-7)	6			2	5	5	20	7
		2 Cell and potential difference and wheatstone bridge		Ammeter(2-8)	6			1	7	4	20	7
				Multimeter(2-9)	6			1	5	4	10	7
		3 Cell, potential difference and rectification		Power Supply(2-11)	6			4	2	4	11	7
		4 Biot-Savart's law		Transformer(2-16)	6			3		3	6	7
		5 Electromagnetic induction		High Voltage Power Supply(2-12)	2			1	3	2	2	2
		6 Rectification		Van de Graaff Generator(2-13)	1			1		2	1	1
		7 Wheatstone bridge		Rheostats(2-14)	6			6	2	2	10	7
		8 Resonance phenomenon		Signal Generator(2-17)	6			4		2	4	7
				Amplifier(2-18)	6			1	8	1	10	7
		9 Principle of simple radio receiver		Logic Circuit Experiment Apparatus(2-2	6			2	4	4	10	7
6	Structure of atom	1 Franck-Hertz Experiment		Franck-Hertz Experiment apparatus(2-27	12			1		1	2	2
7	Structure of atom and of molecule	1 Vacuum discharge		Geissler Tube apparatus(2-32)	3				1	1	2	3
		2 Analysis of crystal structure		Microwave Experiment apparatus(2-33)	3					1	1	3
		3 Radioactive decay		Geiger-Muller Counter(2-34)	6					2	2	7
7	Physical property	1 Linear expansion		Thermo Couple apparatus(2-23)	6			1	4	1	3	6
		2 Phase transition		Electric Oven(2-24)	1					1	1	1
8,9	Teaching practice	Circuit of D.C., Action of magnet Properties of light (refraction etc.) Action of semiconductor, experiment in mechanics (truck etc.) Phase transition of materials (water etc.)		Secondary School Equipment(2-37)	1	○					1	1
	General	General		Electronic Calculator(2-35)	6	○					18	7

Explanatory notes
A: not possess
B: operational
C: necessity of replacement in a few years
D: difficulty of use by deterioration
E: No possibility of repair, procurement of spare and consumables

Term	Subject	Experiment	No. of Group/ Students	Component	Necessary Q'ty	Existing condition A	B	C	D	E	Requested Q'ty	Proposed Q'ty
1	Base of chemistry	1 Weighing of material		Electronic Balance(3-7)	1			1		1	2	1
		2 Titration (acid-base, oxidation-reduction)		Electronic Balance(3-10)	1			2		1	2	1
		3 General		Water Still(3-15)	2			1		2	2	2
				Glass ware(3-38)	1			1			1	1
				Magnetic Stirrer(3-16)	5			2		3	5	7
				Drying Oven(3-18)	2			1		2	1	2
		4 Measurement of melting point of compound		Melting Point Apparatus(3-32)	5			2	2	1	5	5
		5 Measurement of temperature		Thermometer(3-33)	5			2	2	1	5	7
		6 Preparation of teaching material		Electronic Typewriter(3-39)	1					2	2	1
		7 Preparation of teaching material for demonstration		OHP(3-40)	1			1		1	1	1
		8 Analysis of data etc.		Computer(3-41)	1	○					1	1
2	Solubility	1 Dissolution of calciumhydroxide		Vacuum Pump(3-5)	2					2	2	2
2	Volumetric analysis	1 Titration of acid-base		pH Meter(3-26)	5			1		1	2	6
2	Thermochemistry	1 Pyrolysis/Measurement of heat of read-in	5×(2～4)	High Voltage Power supply(3-12)	2			1	1		2	2
		2 Measurement of heat of neutralization		Joule Meter(3-34)	5			2	3	5	10	6
		3 Measurement of heat of combustion		Bomb Calorimeter(3-25)	5			2	2	1	5	5
3	Electrochemistry	1 Measurement of electromotive force of cell		Power Supply(3-11)	5			1	2	2	5	6
		2 Measurement of electric conductivity of cell		Conductivity Cell(3-29)	5			1	3	1	5	6
		3 Measurement of electromotive force of two		Galvanometer(3-36)	3			1	1	1	3	4
		4 Potentiometric titration		Regulated Power DC Supply(3-37)	1			1			1	1
3	Organic synthesis	1 Nitration of benzene		Ice-maker(3-19)	1	○				1	1	1
		2 Preparation of alkenes by dehydration etc.		Hot Plate(3-21)	5			2		8	10	7
4	Titration	2 Titration by oxidation of nitric acid		Heating Mantle(3-20)	5			1		9	10	7
5	Stereo chemistry	1 Study for stereoisomer		Polarimeter(3-27)	5					1	3	5
5	Chemical equilibriur	1 Determination of equilibrium constant and Gibbs' free		Heating Mantle(3-20)	5			1	2	2	5	6
6	Rate of reaction	1 Decomposition of hydrogen peroxide		Waterbath(3-13)	3				1	4	2	3
7	Analysis of organic compound	1 Identification of organic compound		Gas Chromatograph(3-22)	1	○				1	1	1
		2 Identification of liquid organic compound		Abbe refractometer(3-24)	1			1		1	1	1
		3 Identification of functional group in organic compound		Infra-red Spectrophotometer(3-1)	1			1			1	1
				UV/Visible Spectrophotometer(3-3)	1				1	1	2	1
7	Project work etc.	1 Identification of cation		Centrifuge(3-17)	2				1	5	2	2

Explanatory notes
A: not possess
B: operational
C: necessity of replacement in a few years
D: difficulty of use by deterioration
E: No possibility of repair, procurement of spare and consumables

4 Mathematics Department

Term	Subject	Experiment	No. of Group/ Students	Component	Necessary Q'ty	Existing condition A	B	C	D	E	Requested Q'ty	Proposed Q'ty
1-7	Preparation of Educational materials		1×(28~40)	Electronic Typewriter(4-3)	1	○					1	1
				Overhead Projector(4-4)	2	○					4	2
1-7	General			Mobil Writing Board(4-7)	3	○					3	3
				Electronic Calculator(4-2)	30				5		30	33
				Bookbinding Machine(4-6)	1	○					1	1
				File Cabinet(4-5)	5				2		5	5
5-7	Computing and data processing	1 Statistics 2 Probability		Computer(4-1)	35	○					35	5
8,9	Teaching Practice			Geometrical Set(4-8)	3					1	3	3

5 Environmental Science Department

Term	Subject	Experiment	No. of Group/ Students	Component	Necessary Q'ty	Existing condition A	B	C	D	E	Requested Q'ty	Proposed Q'ty
1	Ecology and environ	1 Meteorological observations	15×2	Thermometer(5-12)	15			2			20	15
				Thermograph(5-13)	6			1			20	6
				Barometers(5-14)	15			2			20	15
				Barograph(5-15)	3				1		20	3
				Anemometer(5-16)	15			1			20	15
				Altimeters(5-25)	15			3			20	0
				Luxmeter(5-5)	15	○					20	15
		2 Measurement of pH of water in various kinds of		pH Meter(5-4)	15			2			20	15
2	Agriculture and envi	1 Agriculture in college farm		Tractor(5-17)	1		1				1	0
				Irrigation Pump(5-27)	1				1		1	1
3	Environmental pollu	1 Survey of water pollution		Water Test Kit(5-1)	15			1			20	15
				Dissolved Oxygen Meter(5-6)	15	○					20	15
		2 Survey of air pollution		Air Quality Test Kit(5-2)	15	○					20	15
		3 Survey of sound pollution		Sound Level Meter(5-3)	15	○					20	15
3	Practical method of environmental education	1 Field survey Method of survey of surroundings close to students in field		Binocular(5-19)	15		5				10	10
				Sleeping Bag(5-22)	60		10		20		50	50
				Tent(5-23)	10				8		10	10
				Cooking Stove(5-24)	10				2	2	10	10
				Electric Generator(5-18)	1				1		1	1
				Camera (5-10)	1	○					1	1
3	Environment and heal	1 Observation of living things closely related to human		Microscope(5-20)	15		5				10	10
3	Environment and ecosystem	1 Observation of microorganism in ecosystem		Microscope(5-20)	11		1				10	10
				Waterstill	1	○					1	1
1~3	General			Video Set(5-7)	1	○					1	1
				16mm film Projector(5-8)	1	○					1	0
				Slide Projector(5-9)	1	○					1	1
				Overhead Projector(5-26)	1	○					1	1
				Computer(5-28)	1	○					1	1
				Electronic Typewriter(5-29)	1	○					1	1
				Electronic Calculator(5-30)	10	○					10	10

6 Education Department

Term	Subject	Experiment	No. of Group/ Students	Component	Necessary Q'ty	Existing condition A	B	C	D	E	Requested Q'ty	Proposed Q'ty
1	Developmental psychology	1 Learning in education and psychology by films	1×(28~60)	Film Projector(6-3)	1					2	2	1
				Portable Screen(6-4)	2			1		1	2	2
1,2	Educational psychology	1 Teaching in education department		Overhead Projector(6-5)	4	2		2			2	2
				Slide Projector(6-7)	1			1			1	1
		2 Guidance and counseling		Cassette Dubbing Machine(6-12)	1	○					1	1
7	Micro-teaching	1 Learning of teaching practice		Video Set(6-1)	1			2			1	1
				Video Editing Control Unit(6-18)	1	○					1	1
				Television Set(6-2)	2			2			2	0
	General	1 Recording		Computer(6-9)	1	○					1	1
		2 Learning of typing skills		Manual Typewriter(6-10)	40			25		7	40	41
		3 Preparing teaching materials		Photocopier(6-14)	1	○					1	0
		4 Preparing teaching materials		Stencil Duplicator(6-15)	1			1		1	1	1
		5 Preparing teaching materials		Paper Cutter(6-21)	1	○					1	1
		6 Using for every teaching		Epidiascope(6-16)	1				1		1	1
		7 Teaching by guest lecturers		Public Address System(6-17)	1	○					2	1
		8 Schools radio broadcast		Radio Cassette(6-13)	1	○					1	1
		9 Administration		Electronic Typewriter(6-11)	1				1		1	1

7 Language Department

Term	Subject	Experiment	No. of Group/ Students	Component	Necessary Q'ty	Existing condition A	B	C	D	E	Requested Q'ty	Proposed Q'ty
1	Phonetics	1 Listening and speaking skills	1×(15~20)	LL Equipment for Teacher(7-1)	1					1	1	1
		2 Pronunciation, stress and intonation		LL Equipment for Students(7-2)	20					20	21	20

8 Library Department

Term	Subject	Experiment	No. of Group/ Students	Component	Necessary Q'ty	Existing condition A	B	C	D	E	Requested Q'ty	Proposed Q'ty
	General			Books(8-1)	1				1		1	1
				Photocopier(8-2)	1	○					1	1
				Wall Charts(8-3)	1				1		1	1
				Video Set(8-4)	1	○					1	0
				Electronic Typewriter(8-5)	2		1				1	1
				Headphones (Stereo)(8-6)	1	○					1	0
				Overhead Projector(8-7)	2	○					2	1
				Film Projector (35mm)(8-8)	1	○					1	0
				Display Screen(8-9)	1	○					1	0
				Slide Projector(8-10)	1	○					1	0
				Rotor Screen(8-11)	1	○					1	0

Explanatory notes
A: not possess
B: operational
C: necessity of replacement in a few years
D: difficulty of use by deterioration
E: No possibility of repair, procurement of spare and consumables

Term	Subject	Experiment	No. of Group/ Students	Component	Necessary Q'ty	Existing condition					Requested Q'ty	Proposed Q'ty
						A	B	C	D	E		
	General			Electronic Typewriters(9-1)	3			1	2	1	2	2
				Stencil Machine(9-2)	2			1		1	2	2
				Stencil Cutter(9-3)	1					1	2	0
				Offset Machine(9-4)	1		1				1	0
				Transparency Machine(9-5)	1					2	2	0
				Collector Machine(9-6)	1				1		1	1
				Photocopier(9-7)	3		1			1	2	2
				Computer(9-8)	1				1		1	1
				Software for Computer(9-9)	1				1		1	1
				Vehicles(9-10)	5		1	3			2	2

Explanatory notes
A: not possess
B: operational
C: necessity of replacement in a few years
D: difficulty of use by deterioration
E: No possibility of repair, procurement of spare and consumables

Table 2-8 Results of Evaluation

1 Biology Department

Ori.Code	New Code	Description	Req.Qty.	Priority	Decision	Final Code	Reference
5-1	1-1	Rotor Microtome	2	A -	○	BI-1	
5-2	1-2	Automatic Tissue Processor	2	A -	×	-	Possible to do by hand
5-3	1-3	Electric Centrifuges	4	A -	○	BI-2	
5-4	1-4	Slide Projector	2	B -	○	BI-3	
5-5	1-5	Slide Viewer	15	B -	○	BI-4	
5-6	1-6	Autoclave	2	A -	○	BI-5	
5-7	1-7	Haemacytometer	2	A -	○	BI-6	
5-8	1-8	Stereo Microscope	2	A -	○	BI-7	
5-9	1-9	Incubator	2	A -	○	BI-8	
5-10	1-10	Incubator (Bacteria)	1	A -	×	-	Included in BI-8
5-11	1-11	Precision Balance	6	A -	○	BI-9	
5-12	1-12	Stopwatch	15	B -	○	BI-10	
5-13	1-13	Water Still	3	A -	○	BI-11	
5-14	1-14	Film Projector	1	B -	×	-	Sharing with Education Dept.
5-15	1-15	Water Bath	4	A -	○	BI-12	
5-16	1-16	Heating Plates	3	A -	○	BI-13	
5-17	1-17	Stethoscope	2	A -	○	BI-14	
5-18	1-18	Microscope	20	A -	○	BI-15	
5-19	1-19	Magnetic Stirrer	2	A -	○	BI-16	
5-20	1-20	pH Meter	2	A -	○	BI-17	
5-21	1-21	Bomb Calorimeter	2	A -	○	BI-18	
5-22	1-22	Sand Bath	3	A -	○	BI-19	
5-23	1-23	Sound Level Meter	2	A -	○	BI-20	
5-24	1-24	Deioniser	1	A -	○	BI-21	
5-25	1-25	Binocular	15	A -	○	BI-22	
5-26	1-26	Spring Balance	10	A -	○	BI-23	
5-27	1-27	Transparency Stencil Cutter	1	B -	×	-	Sharing with Education Dept.
5-28	1-28	Refrigerator	2	B -	○	BI-24	
5-29	1-29	Overhead Projector	1	B -	○	BI-25	
5-30	1-30	Drying Oven	2	B -	○	BI-26	
5-31	1-31	DNA Molecule Kit	2	A -	○	BI-27	
5-32	1-32	RNA Protein Synthesis kit	1	A -	○	BI-28	
5-33	1-33	Models Showing Mitosis & Meiosis	1	A -	○	BI-29	
5-34	1-34	Epidiascope	5	A -	×	-	Sharing with Education Dept.
5-35	1-35	Spectrometer	2	A -	○	BI-30	
5-36	1-36	Magnifier	2	A -	○	BI-31	
5-37	1-37	Transformer	4	C -	×	-	Unnecessary due to equivalent on-site equipment
5-38	1-38	Desktop Publishing Unit	1	C -	×	-	Sharing with Education Dept.
5-39	1-39	Electric Typewriter	1	B -	○	BI-32	
5-40	1-40	Camera	1	B -	○	BI-33	
5-41	1-41	Secondary School Equipment	1	A -	○	BI-34	
5-42	1-42	Fundamental Facilities	1	A -	○	BI-35	

2 Physics Department

Ori.Code	New Code	Description	Req.Qty.	Priority	Decision	Final Code	Reference
6-1	2-1	Cavendish's Torsion Balance	1	C +	×	-	Very minimal usage
6-2	2-2	Stop Watch	20	A +	○	PH-1	
6-3	2-3	Electronic Balance	2	A +	○	PH-2	
6-4	2-4	Micrometer	6	A +	○	PH-3	
6-5	2-5	Vernier Caliper	6	A -	○	PH-4	
6-6	2-6	Oscilloscope	10	A +	○	PH-5	
6-7	2-7	Voltmeter	20	A -	○	PH-6	
6-8	2-8	Ammeter	20	A -	○	PH-7	
6-9	2-9	Multimeter	10	A -	○	PH-8	
6-10	2-10	Vernier Microscope	6	A -	○	PH-9	
6-11	2-11	Power Supply	10	A -	○	PH-10	
6-12	2-12	High Voltage Power Supply	2	A -	○	PH-11	
6-13	2-13	Van de Graaff Generator	1	C +	○	PH-12	
6-14	2-14	Rheostats	10	A -	○	PH-13	
6-15	2-15	Capacitor	10	A -	○	PH-14	
6-16	2-16	Transformer	6	A +	○	PH-15	
6-17	2-17	Signal Generator	4	B +	○	PH-16	
6-18	2-18	Amplifier	10	A -	○	PH-17	
6-19	2-19	Joule Meter	2	A +	○	PH-18	
6-20	2-20	Immersion Heater	10	A -	○	PH-19	
6-21	2-21	Thermal Conductivity apparatus	6	A -	○	PH-20	
6-22	2-22	Spring Balance	20	A +	○	PH-21	
6-23	2-23	Thermo Couple apparatus	3	A +	○	PH-22	
6-24	2-24	Electric Oven	1	A -	○	PH-23	
6-25	2-25	Spectrum Lamp apparatus	4	B -	○	PH-24	
6-26	2-26	Ultraviolet Lamp apparatus	2	B -	○	PH-25	
6-27	2-27	Franck-Hertz Experiment apparatus	2	B -	○	PH-26	
6-28	2-28	Logic Circuit Experiment apparatus	10	B -	○	PH-27	
6-29	2-29	Demonstration Engine Model	3	B -	○	PH-28	
6-30	2-30	Spectrometer	4	A -	○	PH-29	
6-31	2-31	Diffraction Gratings	1	B -	○	PH-30	
6-32	2-32	Geissler Tube apparatus	2	B -	○	PH-31	
6-33	2-33	Microwave Experiment apparatus	1	B -	○	PH-32	
6-34	2-34	Geiger-Muller Counter	2	B +	○	PH-33	
6-35	2-35	Electronic Calculator	16	B +	○	PH-34	
6-36	2-36	Capacitance Meter	2	B +	○	PH-35	
6-37	2-37	Secondary School Equipment	1	A +	○	PH-36	
6-38	2-38	Fundamental Facilities	1	B +	○	PH-37	

3 Chemistry Department

Ori.Code	New Code	Description	Req.Qty.	Priority	Decision	Final Code	Reference
7-1	3-1	Infra-red Spectrophotometer	1	B +	○	CH-1	
7-2	3-2	UV/Visible Spectrophotometer(1)	1	C -	×	-	CH-2 serves this purpose
7-3	3-3	UV/Visible Spectrophotometer(2)	2	B +	○	CH-2	
7-4	3-4	UV/Visible Spectrophotometer(3)	1	C -	×	-	CH-2 serves this purpose
7-5	3-5	Vacuum Pump(1)	2	B +	○	CH-3	
7-6	3-6	Vacuum Pump(2)	1	C -	×	-	CH-3 serves this purpose
7-7	3-7	Electronic Balance(1)	2	A +	○	CH-4	
7-8	3-8	Electronic Balance(2)	4	C -	×	-	CH-4 serves this purpose
7-9	3-9	Electronic Balance(3)	2	C -	×	-	CH-4 serves this purpose
7-10	3-10	Electronic Balance(4)	2	A +	○	CH-4	
7-11	3-11	Power Supply	5	B +	○	CH-5	
7-12	3-12	High Voltage Power supply	2	B -	○	CH-6	
7-13	3-13	Waterbath(1)	2	A +	○	CH-7	
7-14	3-14	Waterbath(2)	2	C -	×	-	CH-7 serves this purpose
7-15	3-15	Water Still	2	A +	○	CH-8	
7-16	3-16	Magnetic Stirrer	3	A +	○	CH-9	
7-17	3-17	Centrifuge	2	A -	○	CH-10	
7-18	3-18	Drying Oven	1	A +	○	CH-11	
7-19	3-19	Ice-maker	1	A +	○	CH-12	
7-20	3-20	Heating Mantle	10	A +	○	CH-13	
7-21	3-21	Hot Plate	10	A +	○	CH-14	
7-22	3-22	Gas Liquid Chromatograph	1	C +	○	CH-15	
7-23	3-23	Chart Recorder	2	C +	×	-	Included in CH-15
7-24	3-24	Abbe refractometer	1	A +	○	CH-16	
7-25	3-25	Bomb Calorimeter	5	A +	○	CH-17	
7-26	3-26	pH Meter	2	A +	○	CH-18	
7-27	3-27	Polarimeter	3	A +	○	CH-19	
7-28	3-28	Conductance Meter	5	A -	○	CH-20	
7-29	3-29	Conductivity Cell	5	B +	×	-	Included in CH-20
7-30	3-30	Potentiometer	5	B -	○	CH-21	
7-31	3-31	Standard Cell	5	C +	×	-	Included in CH-21
7-32	3-32	Melting Point apparatus	5	A +	○	CH-22	
7-33	3-33	Thermometer	5	A +	○	CH-23	
7-34	3-34	Joule Meter	10	B +	○	CH-24	
7-35	3-35	Atomic Absorption Spectrophotometer	1	C -	×	-	For research use. Maintenance costs high.
7-36	3-36	Galvanometer	3	B +	○	CH-25	
7-37	3-37	Regulated Power DC Supply	1	C +	○	CH-26	
7-38	3-38	Glass ware	1	B -	○	CH-27	
7-39	3-39	Electronic Typewriter	2	B -	○	CH-28	
7-40	3-40	OHP	1	A -	○	CH-29	
7-41	3-41	Computer	1	C -	○	CH-30	
7-42	3-42	Secondary School Equipment	1	A +	○	CH-31	
7-43	3-43	Fundamental Facilities	1	B +	○	CH-32	

4 Mathematics Department

Ori.Code	New Code	Description	Req.Qty.	Priority	Decision	Final Code	Reference
9-1	4-1	Computer	34	A -	○	MA-1	
9-2	4-2	Electronic Calculator	30	A -	○	MA-2	
9-3	4-3	Electronic Typewriter	1	B +	○	MA-3	
9-4	4-4	Overhead Projector	4	A -	○	MA-4	
9-5	4-5	File Cabinet	5	A +	○	MA-5	
9-6	4-6	Bookbinding Machine	1	A -	○	MA-6	
9-7	4-7	Mobil Writing Board	3	A +	○	MA-7	
9-8	4-8	Geometrical Set	3	A +	○	MA-8	
9-9	4-9	Secondary School Equipment	1	A +	×	-	MA-8 serves this purpose
9-10	4-10	Fundamental Facilities	1	B +	×	-	Unnecessary due to its small scale

5 Environmental Science Department

Ori.Code	New Code	Description	Req.Qty.	Priority	Decision	Final Code	Reference
4-1	5-1	Water Test Kit	20	A -	○	EN-1	
4-2	5-2	Air Quality Test Kit	20	A -	○	EN-2	
4-3	5-3	Sound Level Meter	20	A -	○	EN-3	
4-4	5-4	pH Meter	20	A -	○	EN-4	
4-5	5-5	Luxmeter	20	A -	○	EN-5	
4-6	5-6	Dissolved Oxygen Meters	20	A -	○	EN-6	
4-7	5-7	Video set	1	B -	○	EN-7	
4-8	5-8	16mm Film Projector	1	A -	×	-	Sharing with Education Dept.
4-9	5-9	Slide Projector	1	B -	○	EN-8	
4-10	5-10	Camera	1	B +	○	EN-9	
4-11	5-11	Water Still	1	A -	○	EN-10	
4-12	5-12	Thermometer	40	A -	○	EN-11	
4-13	5-13	Thermograph	20	A -	○	EN-12	
4-14	5-14	Barometer	20	A -	○	EN-13	
4-15	5-15	Barograph	20	A -	○	EN-14	
4-16	5-16	Anemometer	20	A -	○	EN-15	
4-17	5-17	Tractor	1	C -	×	-	Possible to use existing equipment
4-18	5-18	Electric Generator	1	B +	○	EN-16	
4-19	5-19	Binocular	10	A -	○	EN-17	
4-20	5-20	Microscope	10	A -	○	EN-18	
4-21	5-21	Video Camera	1	A -	×	-	Included in EN-7
4-22	5-22	Sleeping Bag	50	A -	○	EN-19	
4-23	5-23	Tent	20	A -	○	EN-20	
4-24	5-24	Cooking Stove	10	A -	○	EN-21	
4-25	5-25	Altimeters	40	A -	×	-	Included in EN-13
4-26	5-26	Overhead Projector	1	B -	○	EN-22	
4-27	5-27	Irrigation Pump	1	B +	○	EN-23	
4-28	5-28	Computer	1	B -	○	EN-24	
4-29	5-29	Electronic Typewriter	1	B -	○	EN-25	
4-30	5-30	Electronic Calculator	10	B -	○	EN-26	
4-31	5-31	Secondary School Equipment	1	A +	×	-	Not a primary department, so unnecessary
4-32	5-32	Fundamental Facilities	1	B +	○	EN-27	

6 Education Department

Ori.Code	New Code	Description	Req.Qty.	Priority	Decision	Final Code	Reference
3-1	6-1	Video Set	1	B +	○	ED-1	
3-2	6-2	Television Set	2	B +	×	-	Included in ED-1
3-3	6-3	Projector 16 mm	2	B -	○	ED-2	
3-4	6-4	Portable Screen	2	B +	○	ED-3	
3-5	6-5	Overhead Projector	2	B +	○	ED-4	
3-6	6-6	Cinema Scope Lens	1	B +	×	-	Included in ED-3
3-7	6-7	Slide Projector	1	A +	○	ED-5	
3-8	6-8	Trolley	1	A +	×	-	Included in ED-2
3-9	6-9	Computer	1	C -	○	ED-6	
3-10	6-10	Manual Type Writer	40	B +	○	ED-7	
3-11	6-11	Electronic Typewriter	1	B -	○	ED-8	
3-12	6-12	Video Cassette Dubbing Machine	1	B +	○	ED-9	
3-13	6-13	Radio Cassette	1	B -	○	ED-10	
3-14	6-14	Photocopier	1	C -	×	-	Sharing with Library Science Dept.
3-15	6-15	Stencil Duplicator	1	B +	○	ED-11	
3-16	6-16	Epidiascope	1	A +	○	ED-12	
3-17	6-17	Public Address System	2	B +	○	ED-13	
3-18	6-18	Video Editing Control Unit	1	B +	○	ED-14	
3-19	6-19	VHF Movie System	1	B +	×	-	Included in ED-1
3-20	6-20	Portable Electric Power Generator	1	C +	×	-	Sharing with Environmental Science Dept.
3-21	6-21	Paper Cutter	1	A +	○	ED-15	

7 Language Department

Ori.Code	New Code	Description	Req.Qty.	Priority	Decision	Final Code	Reference
8-1	7-1	LL Equipment for Teacher	1	A +	○	LL-1	
8-2	7-2	LL Equipment for Students	24	A +	×	-	Included in LL-1
8-3	7-3	Fundamental Facilities	1	B +	○	LL-2	

8 Library Science Department

Ori.Code	New Code	Description	Req.Qty.	Priority	Decision	Final Code	Reference
1-1.	8-1	Books	1	A +	○	LB-1	
1-2.	8-2	Photocopier	1	A +	○	LB-2	
1-3.	8-3	Wall Charts	1	A +	○	LB-3	
1-4.	8-4	Video Set	1	B +	×	-	Sharing with Education Dept.
1-5.	8-5	Electronic Typewriter	1	B +	○	LB-4	
1-6.	8-6	Headphones (Stereo)	1	B +	×	-	Sharing with Education Dept.
1-7.	8-7	Overhead Projector	1	A -	○	LB-5	
1-8.	8-8	Film Projector (35mm)	1	B +	×	-	Sharing with Education Dept.
1-9.	8-9	Display Screen	1	B +	×	-	Sharing with Education Dept.
1-10.	8-10	Slide Projector	1	B +	×	-	Sharing with Education Dept.
1-11.	8-11	Rotor Screen	1	B +	×	-	Sharing with Education Dept.

9 Administration

Ori.Code	New Code	Description	Req.Qty.	Priority	Decision	Final Code	Reference
2-1.	9-1	Electronic Typewriter	2	A -	○	MN-1	
2-2.	9-2	Stencil Duplicator	1	B +	○	MN-2	
2-3.	9-3	Stencil Cutter	2	B +	×	-	Included in MN-2
2-4.	9-4	Offset Machine	1	C -	×	-	Possible to repair existing equipment
2-5.	9-5	Transparency Machine	2	B +	×	-	Possible to use photocopier for this
2-6.	9-6	Collector Machine	1	B +	○	MN-3	
2-7.	9-7	Photocopier	3	A -	○	MN-4	
2-8.	9-8	Computer	1	A -	○	MN-5	
2-9.	9-9	Software for Computer	1	A -	×	-	Included in MN-5
2-10.	9-10	Vehicles	1	B -	○	MN-6	

Table 2-9 List of Equipment

1. Biology Department

Final Code	Description	Specification	Q'ty
BI-1	Microtome		
-1	Microtome (1)	Using to cut thin sections of specimens for microscopic examination, Hand microtome type, razor, razor blade with dispenser provided	2
-2	Microtome (2)	Using to cut thin sections of specimens for microscopic examination, Minot type, section thickness 1-25 μ	1
BI-2	Elelctric Centrifuges	Separation of liquids or solid particles from a liquid by centifugal force, max. speed : 4000 rpm, with stepless speed control	4
BI-3	Slide Projector	Circular slede tray type, Autofocus, Cable remote control, Cabinet, Tripod Screen, Interchangeable lenses, Circular slide trays included	2
BI-4	Slide Viewer	Handy type slide magnifier	2
BI-5	Autoclave	Sterilizing with pressurized steam, capacity : 20 litres Internal temperature : 120℃	2
BI-6	Hemocytometer	Thoma's type, using to count blood cells manually,	2
BI-7	Stereo Microscope		
-1	Stereo Microscope (1)	Magnification : 30, Adjustable planoconcave mirror in holder	1
-2	Stereo Microscope (2)	Magnification : 60, Adjustable planoconcave mirror in holder	1
BI-8	Incubator		
-1	Incubator (1)	Volume : 150 litres, Temperature range : ambient temp.+5～60℃	1
-2	Incubator (2)	Volume : 50 litres, Temperature range : ambient temp.+5～60℃	1
BI-9	Electronic Balance	Capacity : 3000g, readability 0.1g	5
BI-10	Stopwatch	Mechanical type, reading : 0.1 second, 60 seconds, 60 minutes	15
BI-11	Water Still		
-1	Water Still (1)	Boiler and glass condenser type, 3 litres/hour	1
-2	Water Still (2)	Boiler and glass consenser type, 6 liters/hour	1
BI-12	Water Bath	Temperature range : ambient～80 ℃, sensitivity : ±0.5 ℃	4
BI-13	Hotplate	Maximum plate temperature : 450℃	3
BI-14	Stethoscope	School level	2
BI-15	Microscope		
-1	Microscope (1)	Magnification : 40 to 600, Adjustable planoconcave mirror in holder	19
-2	Microscope (2)	Magnification : 40 to 1000, built-in illumination	1
BI-16	Magnetic Stirrer	Maximum stirring capacity : 3 litres	2
BI-17	pH Meter		
-1	pH Meter (1)	Glass electrode type	2
-2	pH Meter (2)	ISFET (Ion-Selective Field-Effect Transistor) type	2
BI-18	Bomb Calorimeter	Measuring of calorific values of non-homogeneous samples Base control box, ballistic bomb, firing wire, bomb filling tube, reducing valve, thermocouple, galvanometer, etc.	2
BI-19	Sand Bath	Rectangular type, temperature range : ambient to 100℃	3
BI-20	Sound Level Meter	Measurement range : A weight 40-120 dB, built-in calibrator	2
BI-21	Deioniser	Removal species from a solution by an ion-exchange reaction Capacity : 200 litres/a carridge in 400 ppm t.d.s	1
BI-22	Binocular	Magnification : 7, Objective lens : 50 mm	15
BI-23	Spring Balance	Capacity : 10, 80 N	8
BI-24	Refrigerator	Capacity : 150 litres, Temperature range : 4-10℃	2
BI-25	Overhead Projector	Portable type, halogen lamp, OHP Trolly, Tripod Screen Acetate Sheets, Water soluble ink pens included	1

BI-26	Drying Oven	Capacity : 70 litres, Temperature range : 40-250 ℃	2
BI-27	DNA Molecule Kit	500 (approx.) spheres, 250 (approx.) small spheres, 800 (approx.) rods	2
BI-28	RNA Protein Synthesis kit	Showing the structures, replication and mutation of the DNA molecule	1
BI-29	Models Showing Mitosis & Meiosis	Mitosis : 8 steps, Meiosis : 6 steps	1
BI-30	Spectrometer	Measuring transmitted energy with respective wavelengths of radiation, Collimator, Telescope : 170 mm (approx.)	1
BI-31	Magnifier	Pocket folding type, magnification : 10	15
BI-32	Electric Typewriter	Typing Speed : 15 cps, Print Element : Drop in Daisywheel Paper Capacity (max.) : 295mm, Main dictionary	1
BI-33	Camera	Film size : 35 mm, Zoom lens : 38-105 mm, tripod provided	1
BI-34	Secondary School Equipment	Petri dishes, Beakers, Measuring cylinders, Flasks, etc.	1
BI-35	Fundamental Facilities		
-1	Laboratory Table	Overall dimensions : 3000(L)x600(D)x800(H)mm, Sink, Taps, Gas cocks, Receptacles	22
-2	Chair for Laboratory Table	Wooden	66
-3	Exhaust Fan	Replacement of existing fan	5
-4	Waste Water Treatment apparatus	Objectives : asids, alkakies and heavy metal, capacity : 3 litres/cycle	1

2. Physics Department

Final Code	Description	Specification	Q'ty
PH-1	Stop Watch	Mechanical type, reading : 0.1 second, 60 seconds, 60 minutes	7
PH-2	Electronic Balance	Capacity : 310g, readability : 0.001g	2
PH-3	Micrometer	Range : 0-25 mm, Reading : 0.01 mm	6
PH-4	Vernier Caliper	Measuring range : 200 mm, Reading : 0.01 mm	7
PH-5	Oscilloscope	Dual trace type, probes provided	7
PH-6	Voltmeter	DC : 100 mV-1000 V, AC : 3 V-1000 V	7
PH-7	Ammeter	DC : 100 μA-10 A, AC : 10 mA-10 A	7
PH-8	Multimeter	DC,AC voltage ranges : 400 mV-1000 V DC,AC current ranges : 400 ΩA-10 A Resistance ranges : 400 - 400 MΩ	7
PH-9	Vernier Microscope	Scale : vertical 0-120 mm, horizontal 0-165 mm, Total magnification : x20, x40	7
PH-10	Power Supply	Voltage output : AC 0-12 V, DC 0-12 V	7
PH-11	High Voltage Power Supply	Output voltage : 0-10kV, continually	2
PH-12	Van de Graaff Generator	Hand-driven type, diameter of dome : 175 mm Diameter of discharge sphere : 75 mm	1
PH-13	Rheostats	Resistance : 55-1325 Ω, 4 types	7
PH-14	Capacitor	Capacity : 10nF-470nF, 11 types	12
PH-15	Transformer	demonstration type, number of turns : 4 types	7
PH-16	Signal Generator	Frequency range : 10Hz-1MHz in 6 ranges	7
PH-17	Amplifier	AC/DC amplifier, bandwidth : AC 7Hz-10kHz, DC DC-10kHz	7
PH-18	Joule Meter	For determination of the specific heat capacity of a liquid by the electrical method.	6
PH-19	Immersion Heater	To heat small amounts of liquid, rating W : 500	7
PH-20	Thermal Conductivity apparatus	Wood and metal cylinder, thermal conductivity of metals apparatus, Ingenhausz's apparatus	6
PH-21	Spring Balance	Capacity : 5, 10,20 N	12
PH-22	Thermo Couple apparatus	Thermocouple range : 0-200, 0-500℃	6
PH-23	Furnace	Temperature (max.) : 1600℃, capacity : 3 litres	1
PH-24	Spectrum Lamp apparatus	Fillings : 3 types, sockets, lamphouse provided	6
PH-25	Ultraviolet Lamp apparatus	Mercury lamp, lamphouse, socket, stand, safety spectacles, power supply provided	7
PH-26	Franck-Hertz Experiment appatatus	demonstration of the quantization of atomic energy level	2
PH-27	Logic Circuit Experiment apparatus	Basic electricity, Digital/logic circuit kits	7
PH-28	Demonstration Engine Model	a four-stroke cut off engine model	2
PH-29	Spectrometer	Measuring transmitted energy with respective wavelengths of radiation, Collimator, Telescope : 170 mm (approx.)	7
PH-30	Diffraction Gratings	Mounts size : 50x50 mm, 3 types	5
PH-31	Geissler Tube appatatus	Dual-electrode discharge tube, 6 types, holder, power supply provided	3
PH-32	Microwave Experiment apparatus	Experiments of refrection, standing wage, polarization, interference, diffraction, etc. by microwave	3
PH-33	Geiger-Muller Counter	Radioactive counter for α, β, γ radiation, portable type	7
PH-34	Electronic Calculator	Solar battery type, 10 digits, Scientific functions included	7
PH-35	Capacitance Merter	Capacitance : 4 nF-40 μF	7
PH-36	Secondary School Equipment	Battery, Convex mirror, Concave mirror, Magnets, Resistance, etc.	1
PH-37	Fundamental Facilities		
-1	Laboratory Table	Overall dimensions : 2400(L)x600(D)x800(H)mm, Receptacles	30
-2	Chair for Laboratory Table	Wooden	90
-3	Exhaust Fan	Replacement of existing fan	2

3. Chemistry Department

Final Code	Description	Specification	Q'ty
CH-1	Infra-red Spectrophotometer	Wavelength range : 4000-600cm^{-1}, printer provided	1
CH-2	UV/Visible Spectrophotometer	Wavelength range : 300-800 nm, printer provided	1
CH-3	Vacuum Pump	Ultimate Vacuum : 1x10^{-2}mmHg	2
CH-4	Electronic Balance		
-1	Electronic Balance (1)	Capacity : 400g, readability : 0.001g	1
-2	Electronic Balance (2)	Capacity : 200g, readability : 0.0001g	1
CH-5	Power Supply	DC : 0-12V, AC : 0-12V	6
CH-6	High Voltage Power supply	AC output voltage : 0-10kV	2
CH-7	Waterbath	Temperature range : ambient~80 ℃, sensitivity : ±0.5 ℃	3
CH-8	Water Still	Boiler and glass condenser type, 3 litres/hour	2
CH-9	Magnetic Stirrer	Maximum stirring capacity : 3 litre	7
CH-10	Centrifuge	Separation of liquids or solid particles from a liquid by centifugal force, max. speed : 4000 rpm, with stepless speed control	2
CH-11	Drying Oven	Capacity : 70 litres, Temperature range : 40-250 ℃	2
CH-12	Ice-maker	Output : 22 kg/day	1
CH-13	Heating Mantle	Flask capacity : 500 ml, with safety earth screen	7
CH-14	Hot Plate	Maximum plate temperature : 450℃	7
CH-15	Gas Chromatograph	Separating gas mixtures by passing through a long column containing a fixed absorbent phase, printer provided	1
CH-16	Abbe refractometer	Using to determine the refractive index of a liquid, Refractive Index : 1.3000-1.7000nD	1
CH-17	Bomb Calorimeter	Measuring of calorific values of non-homogeneous samples Base control box, ballistic bomb, firing wire, bomb filling tube, reducing valve, thermocouple, galvanometer, etc.	5
CH-18	pH Meter	Glass electrode type	6
CH-19	Polarimeter	Using to measure the rotation of saccharoid and amino acid	5
CH-20	Conductance Meter	Conductivity range : 0-199.9 μs Conductivity cells, temperature probe provided	6
CH-21	Potentiomenter	Measuring electromotive force or potential difference by comparing a part of the voltage	6
CH-22	Melting Point apparatus	Maximum temperature : 350 ℃, Cooling plug, Melting point tubes	5
CH-23	Thermometer	Mercury type, Spirit type, Digital type	7
CH-24	Joule Meter	For determination of the specific heat capacity of a liquid by the electrical method.	6
CH-25	Galvanometer	Measuring a small electric current by measuring the mechanical motion derived from electromagnetic or electrodynamic forces	4
CH-26	Regulated Power DC Supply	Power supply for electrolysis, chemical experiment	1
CH-27	Glass ware	Flasks, Beakers, Test tubes, Petri dishes, Measuring flasks, glass funnels, etc.	1
CH-28	Electronic Typewriter	Typing Speed : 15 cps, Print Element : Drop in Daisywheel Paper Capacity (max.) : 295mm, Main dictionary	1
CH-29	OHP	Portable type, halogen lamp, OHP Trolly, Tripod Screen Acetate Sheets, Water soluble ink pens included	1
CH-30	Computer		
-1	Computer	Processor : Pentium 166, Memory : 32 MB, Hard Disk : 1.6 GB Colour Monitor, Keyboard, Printer, CD-DOM Drive, UPS Computer Desk and Chair	1
-2	Software	MS-Windows 95, Spreadsheet Programm, Word processing Programm, Database Programm, DTP Programm	1
CH-31	Secondary School Equipment	Beakers, Flasks, Pipettes, Petri dishes, Thermometers, etc.	1

CH-32	Fundamental Facilities		
-1	Laboratory Table	Overall dimensions : 3000(L)x600(D)x800(H)mm, Sink, Taps, Gas cocks, Receptacles	28
-2	Chair for Laboratory Table	Wooden	84
-3	Funie Hood	Mobile type	4
-4	Waste Water Treatment apparatus	Objectives : asids, alkakies and heavy metal, capacity : 3 litres/cycle	1
-5	Chemical Proof Floor	Including biology and physics department	1

4. Mathematics Department

Final Code	Description	Specification	Q'ty
MA-1	Computer		
-1	Computer	Processor : Pentium 166, Memory : 32 MB, Hard Disk : 1.6 GB Colour Monitor, Keyboard, Printer, CD-DOM Drive, UPS Computer Desk and Chair	5
-2	Software	MS-Windows 95, Spreadsheet Programm, Word processing ProgrammProgramming Language, Database Programm, DTP	5
MA-2	Electronic Calculator	Solar battery type, 10 digits, Scientific functions included	33
MA-3	Electronic Typewriter	Typing Speed : 15 cps, Print Element : Drop in Daisywheel Paper Capacity (max.) : 295mm, Main dictionary	1
MA-4	Overhead Projector	Portable type, halogen lamp, OHP Trolly, Tripod Screen Acetate Sheets, Water soluble ink pens included	2
MA-5	File Cabinet	A4 size, 3 drawers	5
MA-6	Bookbinding Machine	Paper manual boring machine : multi holes, Ring fixture, Rings	1
MA-7	Mobil Writing Board	Board size : 900x1800 mm, with stand, rotary type	3
MA-8	Geometrical Set	Compass, Protractor, Set square, Rule for teacher	3

5. Environmental Science Department

Final Code	Description	Specification	Q'ty
EN-1	Water Test Kit	Objectives : pH, ammonia, nitrite, sulfate, phosphate, etc.	15
EN-2	Air Quality Test Kit	Objectives : Carbon monoxide, Carbon dioxide, Nitrogen oxides, etc.	15
EN-3	Sound Level Meter	Measurement range : A weight 40-120 dB, built-in calibrator	15
EN-4	pH Meter	ISFET (Ion-Selective Field-Effect Transistor) type	15
EN-5	Luxmeter	Measuring range : 0-50000 lux, accuracy : ±5%	15
EN-6	Dissolved Oxygen Meters	Range : 0-100% in water, 0-30% in air	15
EN-7	Video set	Video Camera (Q'ty=2), Video Recorder (Q'ty=2), Tripod, Battery Case, Headset, Carrying Case, Television (Q'ty=2)	1
EN-8	Slide Projector	Circular slede tray type, Autofocus, Cable remote control, Cabinet, Tripod Screen, Interchangeable lenses, Circular slide trays included	1
EN-9	Camera	Film size : 35 mm, Zoom lens : 38-105 mm, tripod provided	1
EN-10	Water Still	Boiler and glass consenser type, 6 liters/hour	1
EN-11	Thermometer	Mercury type, Spirit type	15
EN-12	Thermograph	Recording relative humidity and temperature on the same charts. Weekly and daily recording, spring clock movement	6
EN-13	Barometer	Aneroid Type, Range : 955 to 1070 hpa	15
EN-14	Barograph	Weekly recording, spring clock movement	3
EN-15	Anemometer	3 plastic cups, Scale : 0 to 35 m/s	15
EN-16	Electric Generator	4 Stroke Engine	1
EN-17	Binocular	Magnification : 7, Objective lens : 35 mm	10
EN-18	Microscope	Magnification : 40 to 600, Adjustable planoconcave mirror in holder	10
EN-19	Sleeping Bag	3 season type	50
EN-20	Tent	Use by 5-6 people	10
EN-21	Cooking Stove	Portable type	10
EN-22	Overhead Projector	Portable type, halogen lamp, OHP Trolly, Tripod Screen Acetate Sheets, Water soluble ink pens included	1
EN-23	Irrigation Pump	Head of fluid : 15 m, caliber : 40-50, centrifugal pump	1
EN-24			
-1	Computer	Processor : Pentium 166, Memory : 32 MB, Hard Disk : 1.6 GB Colour Monitor, Keyboard, Printer, CD-DOM Drive, UPS Computer Desk and Chair	1
-2	Software	MS-Windows 95, Spreadsheet Programm, Word processing Programm, Database Programm, DTP Programm	1
EN-25	Electronic Typewriter	Typing Speed : 15 cps, Print Element : Drop in Daisywheel Paper Capacity (max.) : 295mm, Main dictionary	1
EN-26	Electronic Calculator	Solar battery type, 10 digits, Scientific functions included	10
EN-27	Fundamental Facilities		
-1	Waste Water Treatment apparatus	Objectives : asids, alkakies and heavy metal, capacity : 3 litres/cycle	1

6. Education Department

Final Code	Description	Specification	Q'ty
ED-1	Video Set	Video Camera (Q'ty=2), Video Recorder (Q'ty=2), Tripod, Battery Case, Headset, Carrying Case, Television (Q'ty=2)	1
ED-2	Film Projector 16 mm	Reel Capacity = 600m, Halogen lamp, Built-in Speaker, Stand	1
ED-3	Portable Screen	Tripod Screen	2
ED-4	Overhead Projector	Portable type, halogen lamp, OHP Trolly, Tripod Screen Acetate Sheets, Water soluble ink pens included	2
ED-5	Slide Projector	Circular slede tray type, Autofocus, Cable remote control, Cabinet, Tripod Screen, Interchangeable lenses, Circular slide trays included	1
ED-6	Computer		
-1	Computer	Processor : Pentium 166, Memory : 32 MB, Hard Disk : 1.6 GB Colour Monitor, Keyboard, Printer, CD-DOM Drive, UPS Computer Desk and Chair	1
-2	Software	MS-Windows 95, Spreadsheet Programm, Word processing Programm, Database Programm, DTP Programm	1
ED-7	Manual Type Writer	Daisywheel type	41
ED-8	Electronic Typewriter	Typing Speed : 15 cps, Print Element : Drop in Daisywheel Paper Capacity (max.) : 295mm, Main dictionary	1
ED-9	Video Cassette Duplicator	2 in 1	1
ED-10	Radio Cassette	Compact Disk Player attached	1
ED-11	Stencil Duplicator	Printing Speed : 120 sheets/min. Printing Paper Size(max.) : A3, Automatic Stencil Feed and Cabinet included	1
ED-12	Epidiascope	Table Size (max.) : A4, Halogen lamp, Stand, Tripod Screen, Pointer, Spare lamp included	1
ED-13	Public Address System	Tripod Speaker (Q'ty=2), Microphone (Q't=2), Amplifier, Microphone stands, Electric Power Generator, Rack	1
ED-14	Video Editing Control Unit	Editing Controller, Editing Recorder, Monitor, Microphone, Rack	1
ED-15	Paper Cutter	Manual type, Paper width (max.) : 390mm, Paper thickness (max.) = 35mm, Stand included	1

7. Language Department

Final Code	Description	Specification	Q'ty
LL-1	LL Equipment	Teacher's Booth, Student's Booth (Q'ty=20), Headset (Q'ty=21) Chair (Q'ty=21), Cassette Duplicator, Cassette Tapes	1
LL-2	Fundamental Facilities		
-1	Sound Proof Floor	Systematic floor, flooring : carpet	1

8. Library Department

Final Code	Description	Specification	Q'ty
LB-1	Books	Professional books for each department	1
LB-2	Photocopier	Maximum Original Size : A3, Copy Ratio : Zoom Variable Pager Feed : 3 types, Cabinet included	1
LB-3	Wall Charts	Periodic Table, Atlas, Human Body, Polution, Earth, Safety	1
LB-4	Electronic Typewriter	Typing Speed : 15 cps, Print Element : Drop in Daisywheel Paper Capacity (max.) : 295mm, Main dictionary	1
LB-5	Overhead Projector	Portable type, halogen lamp, OHP Trolly, Tripod Screen Acetate Sheets, Water soluble ink pens included	1

9. Administration

Final Code	Description	Specification	Q'ty
MN-1	Electronic Typewriter	Typing Speed : 15 cps, Print Element : Drop in Daisywheel Paper Capacity (max.) : 295mm, Main dictionary	2
MN-2	Stencil Duplicator	Printing Speed : 120 sheets/min. Printing Paper Size(max.) : A3, Automatic Stencil Feed and Cabinet included	2
MN-3	Collector Machine	Electrical paper sorting machine, paper size : 3 types	1
MN-4	Photocopier	Maximum Original Size : A3, Copy Ratio : Zoom Variable Pager Feed : 3 types, Cabinet included	2
MN-5	Computer		
-1	Computer	Processor : Pentium 166, Memory : 32 MB, Hard Disk : 1.6 GB Colour Monitor, Keyboard, Printer, CD-DOM Drive, UPS Computer Desk and Chair	1
-2	Software	MS-Windows 95, Spreadsheet Programm, Word processing Programm, Database Programm, DTP Programm	1
MN-6	Vehicles	Body type : 5 door station wagon, 5 seats	2

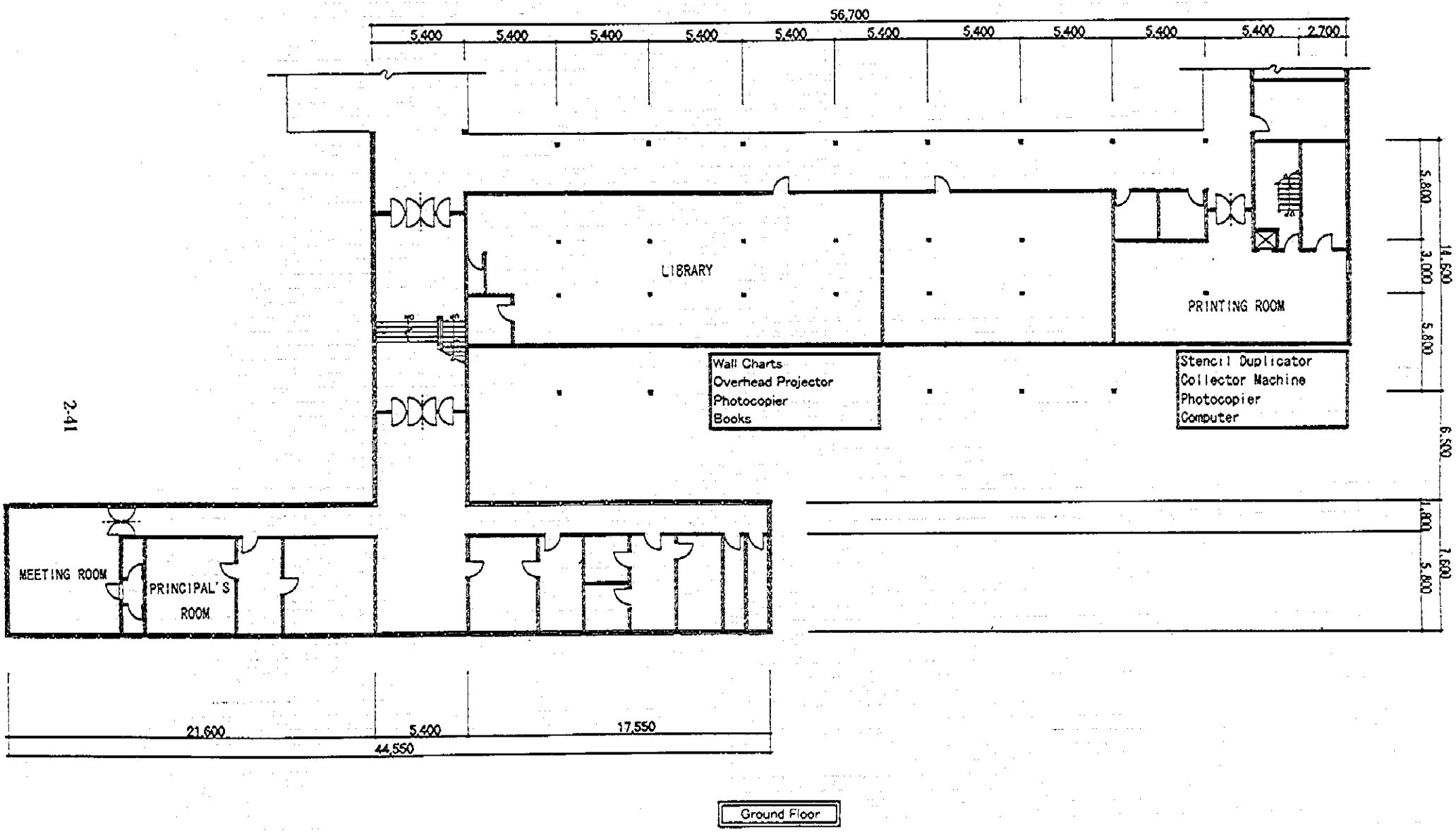
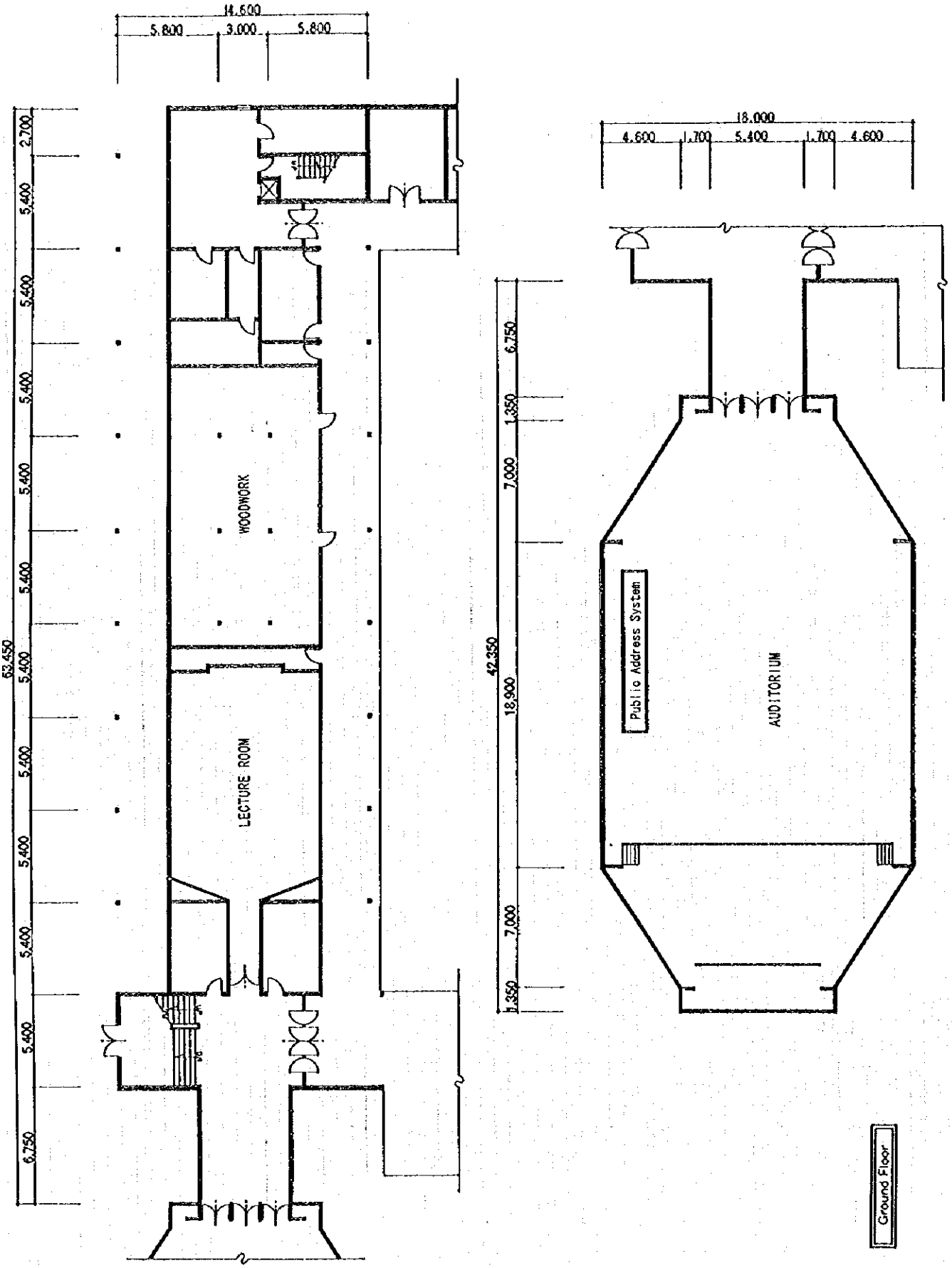


Figure 2-1 Layout Plan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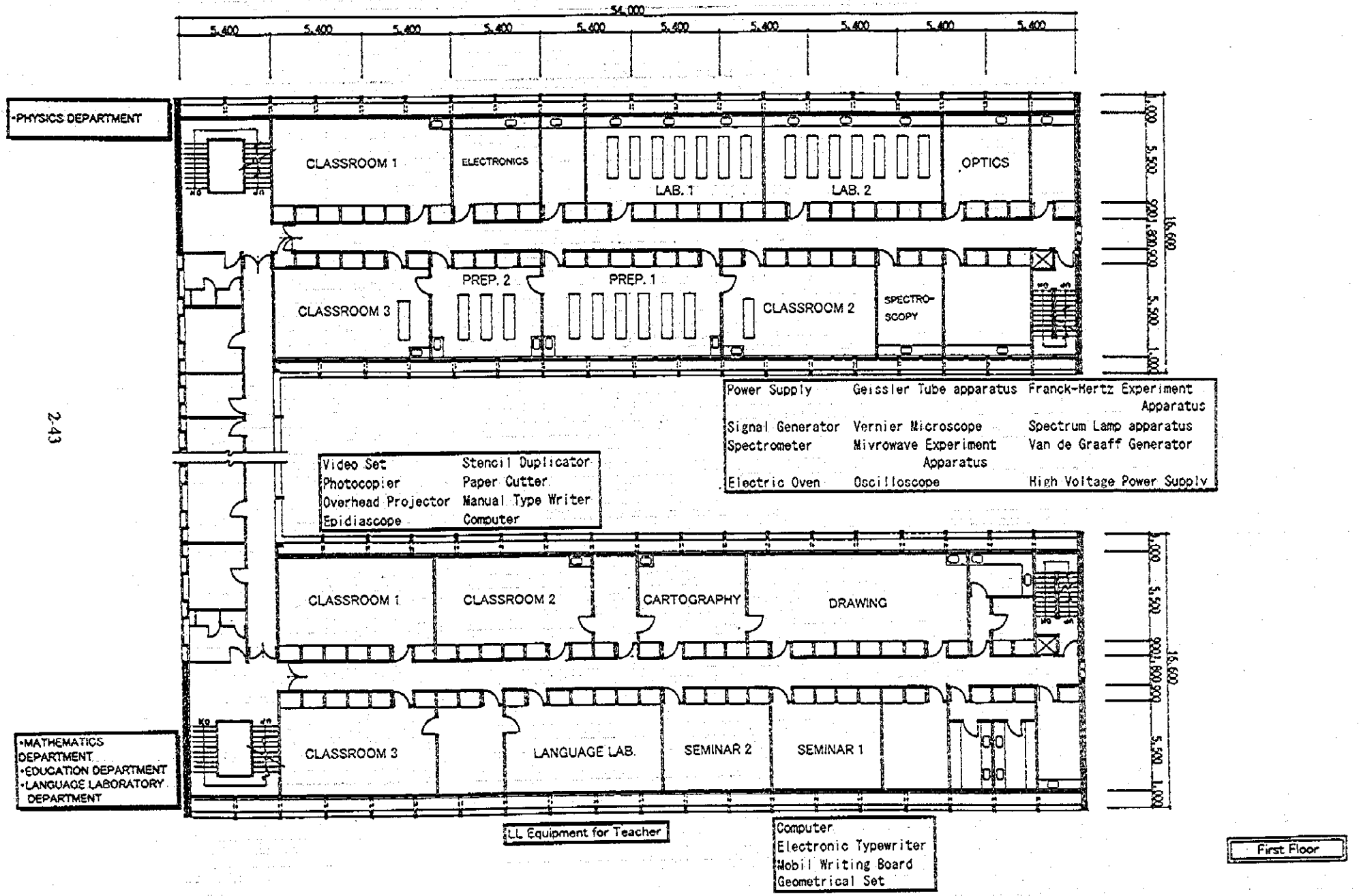
Public Address System
AUDITORIUM
Ground Floor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CLASSROOM 1
ELECTRONICS
LAB. 1
LAB. 2
OPTICS
CLASSROOM 3
PREP. 2
PREP. 1
CLASSROOM 2
SPECTRO-SCOPY
1,000
5,500
900
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900
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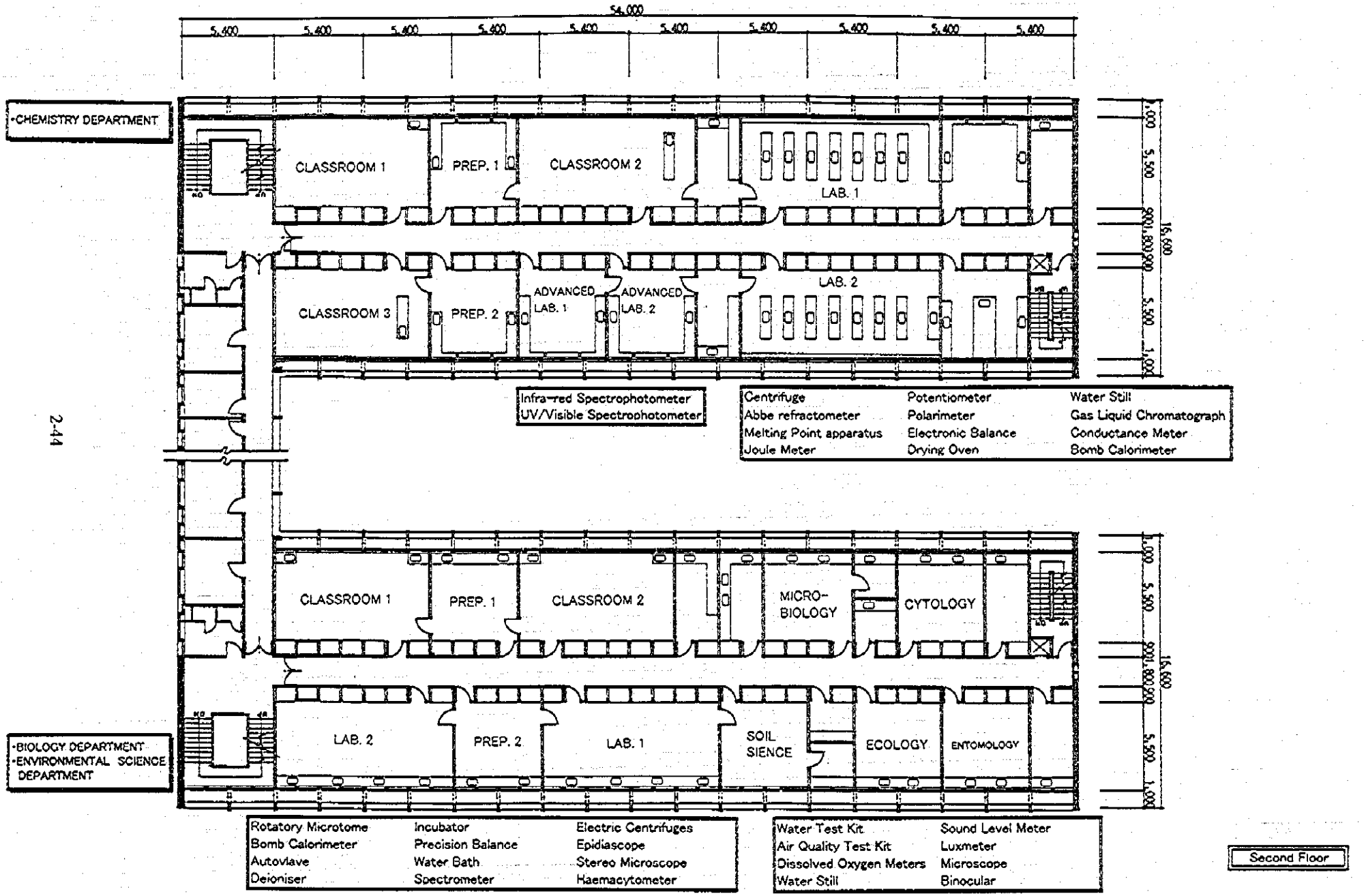
Power Supply
Geissler Tube apparatus
Franck-Hertz Experiment Apparatus
Signal Generator
Vernier Microscope
Spectrum Lamp apparatus
Spectrometer
Mivrowave Experiment Apparatus
Van de Graaff Generator
Electric Oven
Oscilloscope
High Voltage Power Supply
Video Set
Stencil Duplicator
Photocopier
Paper Cutter
Overhead Projector
Manual Type Writer
Epidiascope
Computer
CLASSROOM 1
CLASSROOM 2
CARTOGRAPHY
DRAWING
•MATHEMATICS DEPARTMENT
•EDUCATION DEPARTMENT
•LANGUAGE LABORATORY DEPARTMENT
CLASSROOM 3
LANGUAGE LAB.
SEMINAR 2
SEMINAR 1
LL Equipment for Teacher
Computer
Electronic Typewriter
Mobil Writing Board
Geometrical Set
First Floor


54,000
5,400
5,400
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•CHEMISTRY DEPARTMENT
CLASSROOM 1
PREP. 1
CLASSROOM 2
LAB. 1
CLASSROOM 3
PREP. 2
ADVANCED LAB. 1
ADVANCED LAB. 2
LAB. 2
1,000
5,500
1,800
1,800
5,500
1,000
16,600
Infra-red Spectrophotometer
UV/Visible Spectrophotometer
Centrifuge
Abbe refractometer
Melting Point apparatus
Joule Meter
Potentiometer
Polarimeter
Electronic Balance
Drying Oven
Water Still
Gas Liquid Chromatograph
Conductance Meter
Bomb Calorimeter
CLASSROOM 1
PREP. 1
CLASSROOM 2
MICRO-BIOLOGY
CYTOLOGY
LAB. 2
PREP. 2
LAB. 1
SOIL SIENCE
ECOLOGY
ENTOMOLOGY
•BIOLOGY DEPARTMENT
•ENVIRONMENTAL SCIENCE DEPARTMENT
Rotatory Microtome
Bomb Calorimeter
Autoclave
Deioniser
Incubator
Precision Balance
Water Bath
Spectrometer
Electric Centrifuges
Epidiascope
Stereo Microscope
Haemacytometer
Water Test Kit
Air Quality Test Kit
Dissolved Oxygen Meters
Water Still
Sound Level Meter
Luxmeter
Microscope
Binocular
Second Floor

Chapter 3 Implementation Plan

Chapter 3 Implementation Plan

3-1 Implementation Plan

3-1-1 Implementation Concept

This project uses grant aid from the Japanese government to improve the equipment at Kenya Science Teachers College (KSTC). KSTC, the body implementing this project, will make a contract with a Japanese consulting firm to have it act as its agent for the detailed design, the preparation of tender documents, the tender evaluation, and the management of the equipment installation work, etc. Additionally, KSTC will make contracts with Japanese supplier(s) of equipment, and supplier(s) will direct the supply of the equipment, its installation, and its operation and maintenance. During installation, the re-covering of the laboratory floors, the water supply and drainage system work and the electrical work for the laboratory tables, the repair of the fume chambers, and the placement of the equipment will be carried out by local workers under the direction of engineers. The engineers will perform tuning adjustments, test-runs, and direct maintenance. The implementation system for the plan is as shown in Figure 3-1.

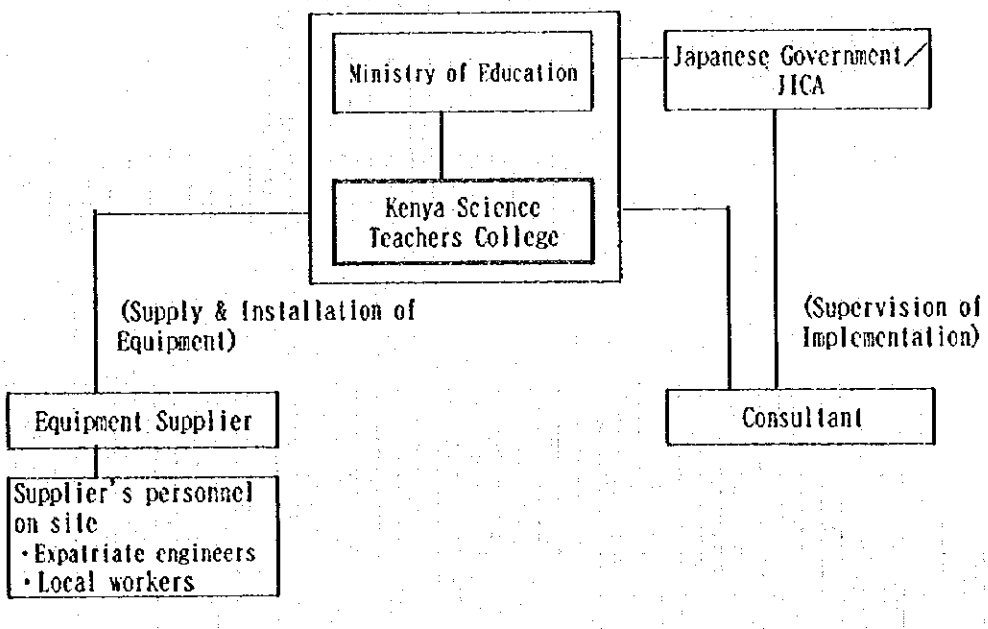

Figure 3-1 Project Implementation System

3-1-2 Implementation Conditions

(1) Transportation Plan

Equipment that is not procured locally will be procured from OECD countries and Japan, but due to the limited number of scheduled Kenyan marine transports, it is necessary to plan the entire process after confirming shipping schedules. Moreover, when transporting this equipment within Kenya, the distance from the port of Mombasa where the equipment is unloaded to the project site is approximately 500 kilometers. Not only is there an altitude difference of over 1500 meters, but there are a limited number of trucks for shipping the equipment, which will necessitate making arrangements well ahead of time.

(2) Installation Time-frame

The installation process will require approximately one month and equipment is being installed in all of the education buildings. Since KSTC conducts classes throughout the year, it will be necessary to coordinate the teaching periods with the work schedule.

3-1-3 Scope of Works

Once the grant is conferred, the breakdown of Japan's responsibility will be as follows:

1) Equipment procurement and the transportation, placement, and installation work that accompanies it.
2) The water supply and drainage work, the electrical work, and the repair work relating to re-covering the laboratory floors, installing laboratory tables, and repairing the fume chambers.
3) Directing the test-runs, adjustments, and maintenance of the equipment.
4) Consulting services relating to the detailed design, the preparation of tender documents, the tender evaluation, and the management of the equipment installation work.

3-1-4 Consultation Supervision

In accordance with the grant aid policy of the Japanese government and the consultant contract and also based upon the main points in the basic plan, the consultant will create an integrated project management team for the implementation plan and the administrative services, and must carry out this project without delays until all its services are completed. To ensure that the project proceeds smoothly, in the project supervision phase the consultant will approve equipment manufacturing plans, be present during the work-site inspection, and dispatch appropriate engineers to be present during the on-site installation work and during the inspection at the time of transference. Along with these duties, the consultant will ascertain whether the work that Kenya is responsible for in accepting the equipment is proceeding smoothly, and in cases where delays are seen, advise the Kenyan side on necessary solutions as is warranted. It is necessary for the consultant to oversee the implementation of the entire plan.

3-1-5 Procurement Plan

The selection of companies from which to procure the equipment will be decided after studying the ease of post-procurement maintenance and management, the customer service plan, the extent of a company's operations in Kenya, the quality, and the price. Because scientific experiment equipment, industrial products, etc., are either not manufactured in Kenya or if they are manufactured do not meet the specifications for this project, there will be no procurement of Kenyan products. However, for specific fields such as automobiles, printing presses, photocopiers, school scientific experiment-use apparatus (e.g., glassware), and computers, it is possible to procure within Kenya Japanese and European products that do meet the specifications and also have established customer service. Accordingly, these types of Japanese or third-party nation (which from the standpoint of engineering and quality would be products from OECD countries) equipment will be purchased locally. All other equipment will be imported whenever it is necessary, but it will be procured in Europe or in the United States. Taking into account the diffusion rate in the market and the procurement costs, not only Japanese-made equipment will be procured, but also products from third-party nations (which from the standpoint of engineering and quality would be products from OECD countries).

3-1-6 Implementation Schedule

In the case that this project is implemented through grant aid from Japan, it will proceed according to the following outline.

(1) Detailed Designs

Along with deciding on the detailed specifications for the improved equipment based upon the basic design study report, tender documents will be prepared, and approval will be obtained from the organizations concerned. Five months will be required for this process.

(2) Equipment Manufacturing and Installation

The contractor receiving the orders will prepare documents for obtaining approval and for production, will manufacture the equipment, load the equipment onto ships, and ship the equipment to Kenya. The contractor will execute all the local operations (unloading, domestic shipping, installation, etc.) up until the on-site test-runs are completed.

(3) Work Completion

When the equipment installation is completed, a test-run will be carried out with the Kenyan Ministry of Education, the consultant, and other concerned parties present. When it is determined that the equipment corresponds with its specifications, it will be presented to the Kenyan representative and that project will be complete. The Kenyan representative will then issue a completion certificate for the contractor. If all the project work goes smoothly, it is projected that it will take 6 months from the time an order contract is signed until it is completed.

The service implementation schedule diagram is shown in Figure 3-2.

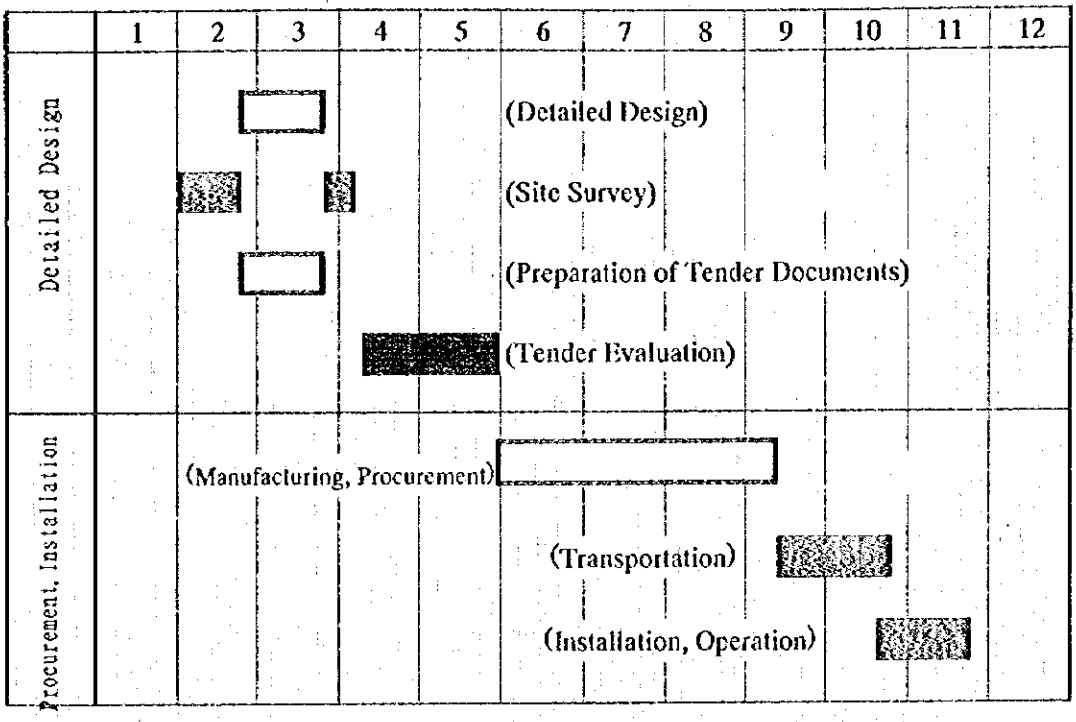

Figure 3-2 Implementation Schedule

3-1-7 Obligation of the Recipient Country

At the time the grant is conferred, the following actions will be requested from the Kenyan government:

1) Cover all banking arrangement fees to be paid to the foreign exchange bank authorized by the nation of Japan.
2) Securing warehouses and temporary equipment holding areas during the equipment installation period.
3) When equipment is imported, Kenya is responsible for permission authorization procedures pertaining to unloading and clearing customs.
4) Expediting the procedures for Japanese involved in business relating to this project when entering and leaving the country and during their stay in Kenya.
5) Practical and also effective application and management of the equipment procured by this grant aid.
6) All other expenses not included in the grant aid.
7) Providing all other personnel necessary for the operation and management of this project.

8) The building and facility work relating to equipment operation and to the installation work.
   - The basic construction and pit facility construction necessary for equipment installation.
   - The necessary electrical-related work for the equipment.
   - The necessary water supply and water drainage-related work for the equipment.
   - The necessary air-conditioning work for the equipment.
   - The necessary illumination and ventilation-related work for the equipment.
9) Procuring accessories and furnishings not included with the equipment.
10) Procuring chemicals and supplies.

3-2 Project Cost Estimation

The expenses to be covered by Kenya are not calculated in this project.

3-3 Operation and Maintenance Costs

Much of the equipment included in this project are equipment upgrades. For the additional equipment, equipment that uses electricity is only a small percentage, so power consumption will also be slight. Of the additional equipment, the photocopiers (3 photocopier will supplement the one existing photocopier) will be used the most frequently.

Photocopier evaluation

1) Power consumption: 1.35kW
2) Monthly usage time: for all 3 photocopiers a total of 1.4 hours (1000 copies; 5 seconds per copy)
3) Monthly maintenance contract costs (including drum and toner): for all 3 a total of 6,000Ksh
4) Accordingly, utility costs (electricity rates) will be 1.35kW x 1.4h x 4.25Ksh/kWh = 8Ksh per month, and the yearly cost will be 8Ksh x 12 months = 96Ksh. Because this is a yearly utility rate increase of only 0.003%, it is not significant (Table 3-1).
5) Moreover, because the maintenance contract costs will only increase the yearly repair and maintenance expenses by 1.4%, they can be adjusted for in the overall expenses.

Table 3-1 Recurring Expenses

(: Ksh)

Year	Personel Expenses	Boarding Equipment Stores	Tuition Equipment Stores	Repairs & Maintenance of Equipment	Electricity Water & Conservancy	Local Transportation & Travelling	Contingencies	Total
1991	4, 531, 000	4, 658, 230	3, 490, 984	3, 451, 000	2, 006, 000	1, 457, 789	1, 934, 512	21, 609, 515
(%)	21. 0%	21. 6%	16. 2%	16. 0%	9. 3%	6. 9%	9. 2%	100%
1992	5, 398, 668	4, 932, 693	3, 696, 336	3, 654, 000	2, 124, 000	1, 575, 306	2, 101, 248	23, 482, 251
(%)	23. 0%	21. 0%	15. 7%	15. 6%	9. 0%	6. 7%	8. 9%	100%
1993	5, 998, 520	5, 480, 270	4, 107, 040	4, 060, 000	2, 360, 000	1, 750, 340	2, 334, 720	26, 090, 890
(%)	23. 0%	21. 0%	15. 7%	15. 6%	9. 0%	6. 7%	8. 9%	100%
1994	6, 777, 538	5, 499, 300	4, 192, 670	4, 260, 000	2, 450, 000	1, 950, 360	2, 986, 612	28, 136, 480
(%)	24. 1%	19. 5%	14. 9%	15. 1%	8. 8%	6. 9%	10. 6%	100%
1995	9, 600, 000 #1	9, 161, 385 #2	4, 370, 817	4, 870, 000	2, 520, 000	2, 014, 404	6, 401, 281 #3	38, 937, 887
(%)	24. 7%	23. 5%	11. 2%	12. 5%	6. 5%	5. 2%	16. 4%	100%

Note #1: Expenses have risen because medical treatment and housing allowances have now been included.
Note #2: Expenses have risen due to widespread price increases in everyday goods.
Note #3: Communication costs (telephone, mail) are included, and adjustments in these usage fees have caused expenses to rise.

Not only are full-time repair and maintenance personnel assigned to the laboratory equipment in each department, engineers with science diplomas and electronic and electrical certification are also stationed in the building and repairs section to supervise repairs and maintenance. As a result, there are no problems relating to equipment repairs and maintenance after they are in place.