No. 1

BASIC DESIGN STUDY REPORT
ON
THE PROJECT FOR PROVIDING THE EQUIPMENT
FOR
THE GOVERNMENT COLLEGE OF ENGINEERING,
PUNE
IN
INDIA

SEPTEMBER 1991

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

In response to a request from the Government of India, the Government of Japan decided to conduct a basic design study on the Project for Providing the equipment for the Government College of Engineering, Pune and entrusted the study to the Japan International Cooperation Agency (JICA).

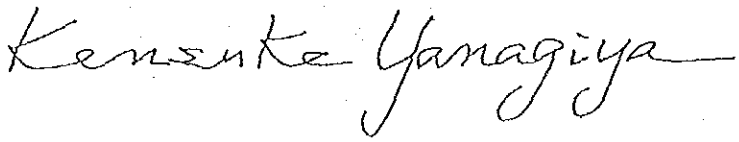
JICA sent to India a study team headed by Prof. Ariyama, Professor of the University of Electro-Communications, from April 4 to April 24, 1991.

The team held discussions with the officials concerned of the Government of India, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to India in order to discuss a draft report and the present report was prepared.

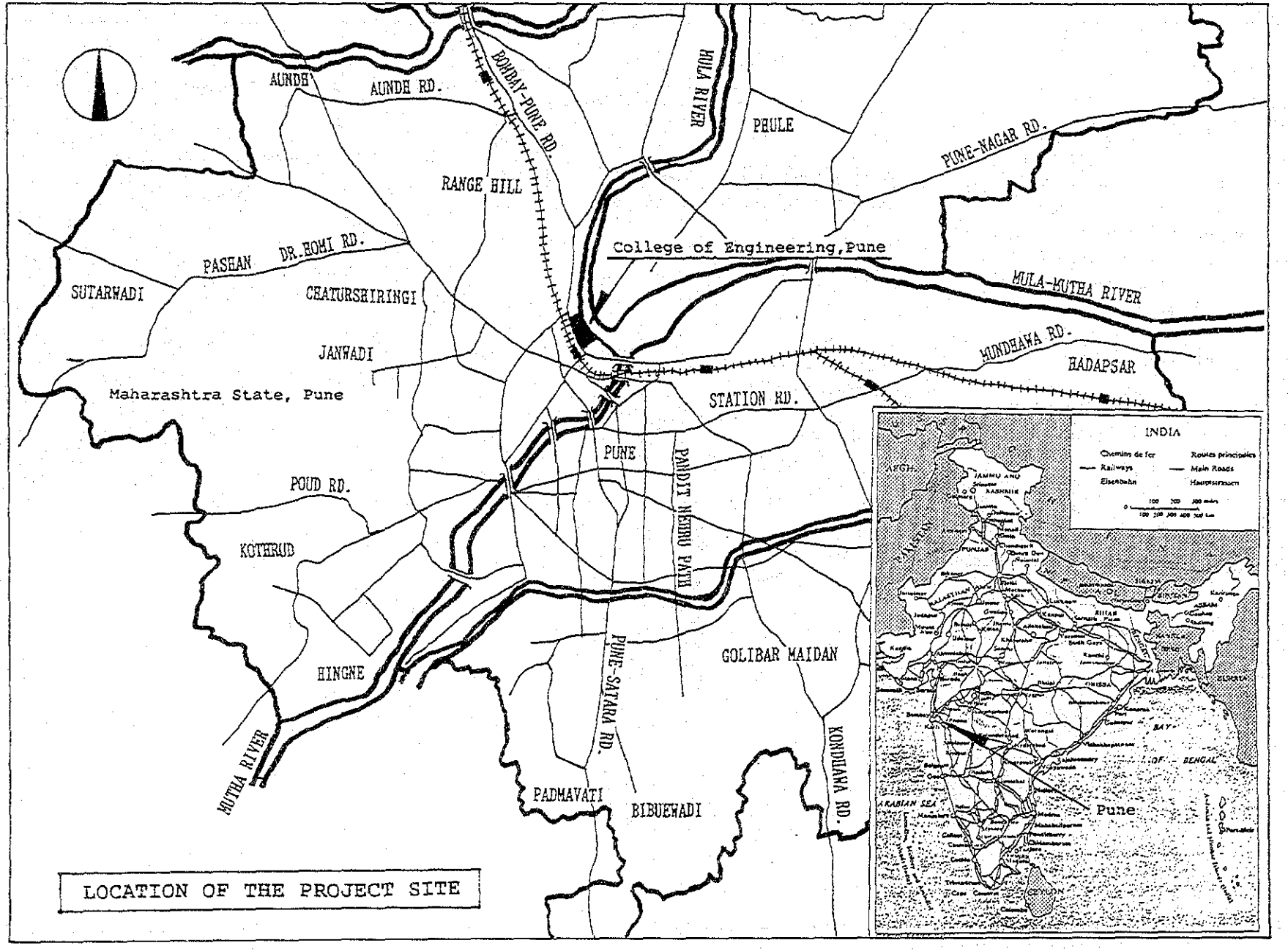
I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of India for their close cooperation extended to the teams.

September 1991

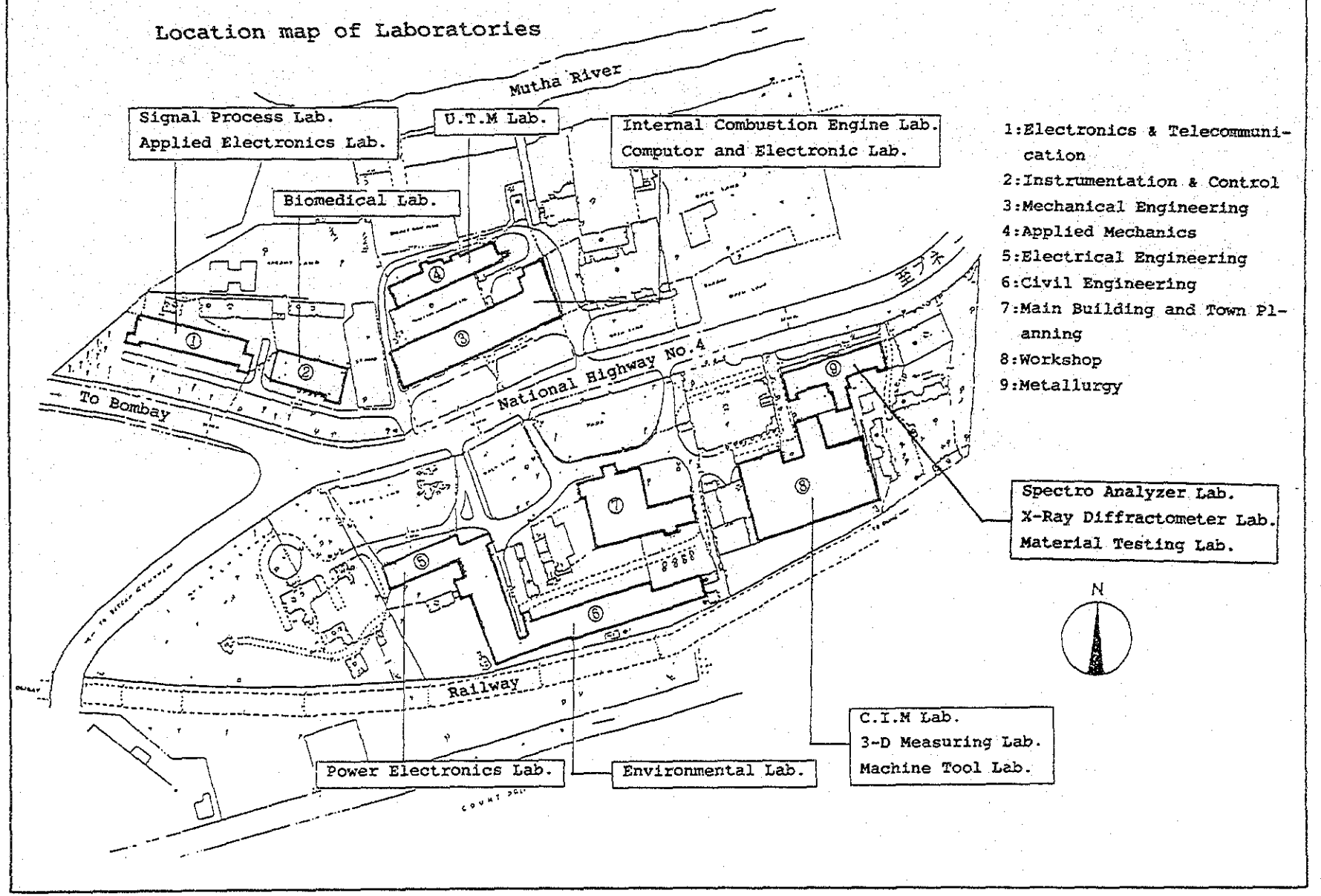


Kensuke Yanagiya
President
Japan International Cooperation Agency



LOCATION OF THE PROJECT SITE

Location map of Laboratories



SUMMARY

SUMMARY

The Ministry of Human Resources Development (the name was changed in 1986 from the Ministry of Education) which is responsible for education in India has been making efforts to expand education since 1951. In the technical education sector which is under the jurisdiction of the Bureau of Technical Education of the Ministry of Human Resource Development, the number of total enrolled students was 200 thousand in 1951/52, of which 25 thousand were students of technical colleges. However, in 1989/90 the number of total students was 4 million, of which 207,200 were technical colleges. The increase in number is remarkable.

However, the technical education sector which includes technical colleges, polytechnics and vocational training schools is criticized of its insufficient contribution to technical education and R & D through supply of qualified engineer/researcher and dissemination of technical information and expertise developed by the College, to bridge technology gaps existing between India and advanced countries where the production technology has progressed rapidly applying high technology and is on a far higher level than that of India, and to the national and regional development.

In these circumstances, the Bureau of Technical Education instituted in 1987/88 the Schemes of Thrust Areas of Technical Education Achievements comprising Strengthening of Facilities in Crucial Areas of Technology where Weakness exists, Creation of Infrastructure in Areas of Emerging Technologies and Programmes of New and /or Improved Technologies and Offering New Courses in Specialized Fields, within the framework of the National Policy on Education approved in 1986/87. The College of Engineering, Pune is the oldest engineering college in India and has about 2,350 students and 130 teaching staff members. The number of departments is 15. It has provided industry and the governments with a lot of excellent engineers since its foundation in 1854. However, its activities are weak in the field of advanced technology against the needs to the engineering institution in the State of Maharashtra which is the most industrialized state in India and produces about 30% of the GNP of India. Against the above background, the Indian Government requested the Japanese Government for a Grant-In-Aid to provide educational and research equipment to the College of Engineering, Pune.

Upon this request the Japanese Government decided to conduct a basic design study and the Japan International Cooperation Agency dispatched a basic design study mission on grant-in-aid to India from April 4th to 24th, 1991.

The departments for which the Indian Government has requested assistance from Japan are six of the 15 departments; Department of Electronics and Telecommunication, Department of Metallurgy, Department of Electrical Engineering, Department of Instrumentation, Department of civil Engineering and Department of Mechanical Engineering.

The modernization plan of the College intends to improve technical education, to produce engineers in advanced technology fields who can contribute to the development of economy and society of India, to promote research in advanced technology fields and further to make the College self-reliant during the period of Eighth Five Year Plan. It consists of the following plans.

(1) Improvement of Curriculum

The present curricula of the 6 departments will be revised in line with the programme to strengthen the technical education sector. Especially, experimental subjects will be expanded.

(2) Establishment of New Master Courses

To respond to the needs in high technology areas, master courses will be established in computer technology, material science and biomedical engineering during Phase I, and in electronics, CIM and energy management during Phase II.

(3) Establishment of Research Centers

In order to strengthen the contribution of the technical education sector to the social and economic development of India, especially to the local industries in Maharashtra State, three research centers will be set up in the fields which are among Critical Areas of Technology for Removal of Weakness by Strengthening Infrastructure Facilities and the College is strong in.

(i) Telematics Center

To develop an information system of the whole College and expand digital communication and network services through modernizing the existing communication engineering laboratory.

(ii) Material Science Center

Research into materials is a main concern of all the departments. The Center will do research into new materials such as compound semiconductors, ferrites, ceramics, superconductor, composite materials, materials for microelectronics and optical devices etc.

(iii) Prototype design and Development Center

This Center is to conduct R & D into the utilization of locally available resources and to provide more extended technical services to support local industries.

At present, the College is promoting a preparatory work for 1) Reform of curriculum 2) Establishment of new course for master degree as a first phase program for the above renovation program of the College, and requested the Japanese Grant Aid for the provision of equipment needed to the above programs.

The College also has completed the modifications and preparation work of buildings and facilities necessary to install the equipment and allocated the budget for expansion of teaching staff and technical assistants.

In addition to the above first phase programs, establishment of three centers is planned and has been promoted in the condition of the provision of equipment by the Japanese Grant Aid.

In the light of the above situation, equipment necessary for experiments of students in undergraduate and master courses and for research is provided as shown in the summary table.

The capital requirement for Indian constructions work is estimated to be approximately Rs. 434 million including construction of new buildings, modification of the facilities, partitioning, rearrangement of electricity, water and telephone, foundation for the equipment, and purchase of equipment and furniture, etc. As to a term of works, three months for tender and contract conclusion, and nine months for manufacturing, transport and installation of equipment, thus a total of twelve months will be required.

The implementing agency of this project is the College of Engineering, Pune. The Directorate of Technical Education of the Maharashtra State Government is in charge of the formulation of policies, evaluation and maintenance management of the project as the upper government organ of the College. The Directorate General of Technical Education, the Ministry of Human Resources Development, India supervises the above two organizations and coordinates the Ministry of Finance, the Ministry of Industry, the Ministry of Commerce in the implementation of the project.

Summary Table Outline of Target Department and Major Equipment to be Provided

No.	Target Department	Floor Area (m^2)	Objectives and Contents of Upgrading Plan	Major Equipment Proposed
1.	Electronics and Telecommunication	1797	This department is a priority department in the Project. Laboratory practice and research activity on a telecommunication method, microwave, and optical fiber shall be strengthened together with expansion of curriculum in the field of telecommunication engineering.	Field Strength meter, Standard Dipole Antenna Set, Electronic Counter, Radio Communication Analyser, Microwave Sources, Spectrum Analyzer, Network Analyzer, Scalar Network Analyzer, Logic Analyzer, EMI Test System, Waveform Synthesizer, Video Signal Processing Equipment
2.	Metallurgy	1822	Activities of laboratory practice in the undergraduate course are at the reasonable level of the requirement, target field of upgrading shall be placed in the research activity of post graduate students. Especially material testing and analytical activity shall be strengthened and overall research and development capability shall be enlarged.	Fatigue Testing Machine, Hisomet Microscope, Microhardness Tester Vacuum Emission Spectrometer, Auto Sonobard Ultrasonic Hardness Tester, X-Ray Stress Analyzer, Induction Remelting Unit, Carbon Sulfur Analyzer
3.	Electrical Engineering	2215	All most necessary laboratory equipment for undergraduate course is equipped excluding high voltage, low cost automation, etc. These research equipment shall be provided for laboratory practice and research and development etc.	Self Education Robotic Trainer, Multichannel Voltage & Current Source, Digital Power Meter, Digital Memory, Fast Transient Digitizer, HDVC Transmission Line Simulator
4.	Instrumentation and Control	1017	Main objectives of upgrading includes development of industrial automation and instrumentation technology which are urgently needed in the industrial sector and strengthing of biomedical research activities such as application technology of various sensor which has been developed in this department.	Arbitrary Waveform Generator, Analyzing Recorder, Data Acquisition System with Processing Unit, Ultrasonic Analyser with Accessories, FFT Analyzer
5.	Civil Engineering	3642	This is the oldest department and activities of basic laboratory practice reaches at completeness. Therefore main upgrading plan shall be placed in provision of laboratory equipment for air pollution and testing function for structural engineering in the structural engineering department.	Computer Controlled UTM System, Electronic Digital Theodolite, Electronic Distance Meter, Gas Monitor for CO_2, H_2S, SO_2 Portable
6.	Mechanical Engineering	120	Machine design by CAD/CAM, and machining and workshop engineering shall be enlarged and strengthened.	Fully Automatic Compressor Testing System, 3-D Coordinate Measuring Machine, Universal Gear Tester

What is expected as effect of this project are as follows.

Directly;

- More engineers of better quality who meet acquirements of the society and economy will be supplied to Maharashtra State, especially to the region around Bombay and Pune. The number of graduates will be about 500 every year.

- At present, equipment for student experiments, research equipment, books, periodicals,technical reports etc. are in severe shortage. The project will make a significant contribution to improve in research by about 100 teachers of the College of Engineering, Pune and consequently to the upgrading of quality of technical education through the expansion of equipment.

- Provision of equipment through this project will help increase in number and upgrade the quality of analysis and testing services, diagnosis services and joint research with industries which the College is doing at present and will contribute to raising technical level of the College itself and of the local industries.

Indirectly,

- The improvement of equipment at the College of Engineering, Pune will help expand the community education activities of the College and increase its role as an information center for the local industries. These activities will contribute to the promotion of industry in Maharashtra State and to the social and economic development of the region.

  Judging from these effects, it is considered that this project will make a significant contribution to upgrading of the quality of technical education in Maharashtra State and is well worth offering a Grant-In-Aid of the Japanese Government.

CONTENTS

APPENDIXES

Abbreviation

<Abbreviation>

AICTE	:	The All Indian Council for Technical Education
CSIR	:	Council of Scientific and Industrial Research
CCIE	:	Chief Controller of Import and Export
DGTD	:	Directorate General of Technical Development
ICAR	:	Indian Council of Agricultural Research
IIT, Bombay	:	Indian Institute of Technology, Bombay
IIMs	:	Indian Institutes of Management
ICSSR	:	Indian Council of Social Science Research
ICMR	:	Indian Council of Medical Research
NPE	:	National Policy on Education, 1986
NCERT	:	The National Council of Educational Research and Training, 1975
NIEPA	:	The National Institute of Educational Planning and Administration
POA	:	Programme of Action
UGC	:	University Grants Commission

CHAPTER 1

CHAPTER 1 INTRODUCTION

Bureau of Technical Education under the Ministry of Human Resources Development, the Government of India has been executing reform of curricula for engineering education, modernization of facilities and equipment of laboratory practice, establishment of new undergraduate and master courses and research centers in the fields of advanced technology to meet the needs of the whole country and the regions around technical institutions, since 1987/88 in the implementation of the National Policy on Education, recognizing the weakness in science and industrial technology, especially in advanced technology in view of international levels.

Under these circumstances, Government of India has requested the Government of Japan to provide educational and research equipment for the undergraduate and master courses of the Government College of Engineering, Pune in the State of Maharashtra which is deemed as a center of Industrial development in India to contribute to the need of technical support for the industrial sector.

In response to the request of the Government of India, the Government of Japan decided to conduct a basic design study and entrusted the study to Japan International Cooperation Agency. Japan International Cooperation Agency sent to India the basic design study team headed by prof. Masataka Ariyama of Department of Computer Science and Information Mathematics, the University of Electro-Communications for 21 days from 4th April to 24th April 1991.

The Team discussed with the officials concerned in India of the requests from India and made surveys on the existing equipment, sites, buildings and facilities.

The major points confirmed by both parties in the course of discussions are summarized in minute of Discussions (Appendix 3).

This report summarizes the results of the Basic Design Study on the Project for Providing Equipment for the Government College of Engineering, Pune.

CHAPTER 2

CHAPTER 2 BACKGROUND OF THE PLAN

2.1 Present Situation of Engineering Education in India

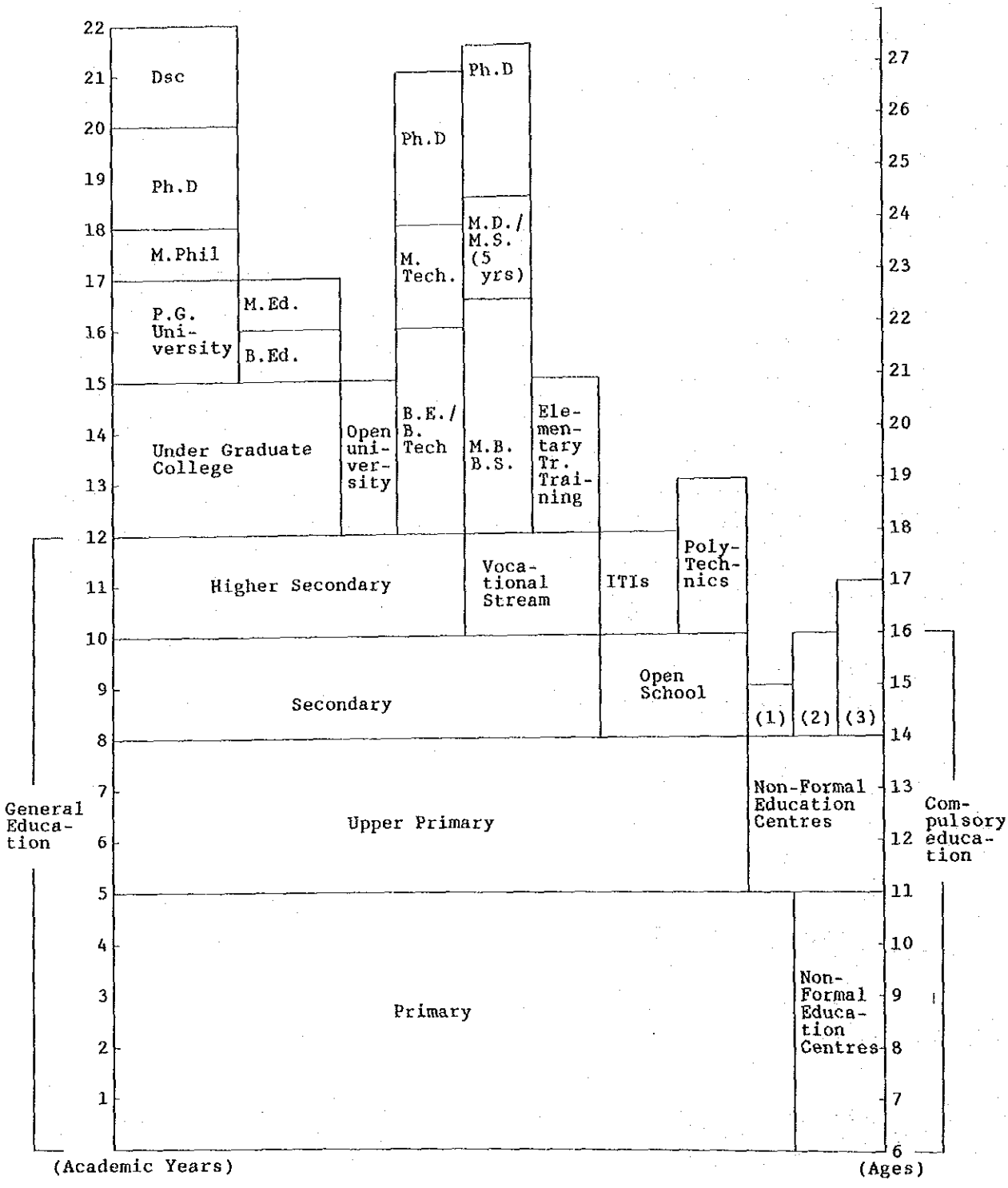
2.1.1 Outline of the Engineering Education

The education in India had been within the jurisdiction of a State Government until 1976 and the education systems had been different from state to state. In 1976 the education was placed under the joint jurisdiction of the Central Government and State Governments. The Education Commission (1964-66) which was set up at the Ministry of Education recommended that the Government of India should issue a statement on the National Policy on Education. In 1968 the Government of India issued the Resolution on the National Policy on Education which suggested the unification of education systems throughout the country and the adoption of the 10 + 2 + 3 system consisting of 10 years of primary and secondary education, 2 years of higher secondary education and 3 years of undergraduate higher education as shown in Fig. 2-1. This 10 + 2 + 3 system has been adopted by most of the States and Union Territories of the country.

The Commission regards the formal education as one of the processes of a life- long education and suggests the construction of an education system which integrates three education forms, namely full-time, part-time and self learning and is linked closely with jobs. At present plans in line with this policy are carried forward.

In the higher education sector, there are 179 university level institutions as of 1989 (Refer to Fig. 2.1). Of these, 131 are universities and deemed universities. There are 48 professional universities. Of these, 26 provide education in agricultural and veterinary sciences, 14 in engineering and technology, 7 in medical sciences and 1 in law. Furthermore there are ten institutes of National Importance. Of these, the five Indian Institutes of Technology (Bombay, Delhi, Kanpur, Kharagpur and Madras) provide education in science and technology at high level, one provide education in statistics, three in medical sciences and one in Hindi language.

Fig. 2-1 Structure of the Education System (1986)



Note: (1), (2), (3) shows vocational Institute and Industrial Training Institute

There are 6040 colleges. Of these, 1272 colleges provide education in professional disciplines such as engineering, agriculture, medicine and architecture. Others provide education in arts, physical sciences, social sciences and commerce. These institutions enroll 3.58 million students including postgraduate and employ 234 thousand teachers.

The academic year usually begins in June/July and ends in March/April. The admission requirements are that the student must have completed 12 year of schooling. The academic council of a university determines admission requirements in accordance with the guidelines common to the country. Selection is made on the basis of entrance examination score and previous scholastic records. Usually the degree course takes three years to complete. In engineering and architecture it is a 4-5 year degree course. In medicine it is a four and a half year degree course followed by one year of internship. In agriculture it is a 3-4 year degree course. The master's degree courses take usually 2 years and PhD programme is research study for 3 years. The competition for admission into postgraduate courses is less than that into undergraduate courses.

The largest number of universities belong to the affiliating and teaching type, in which university departments impart instruction at the postgraduate level and undertake research. These universities have a large number of degree colleges affiliated to them giving undergraduate education and oversee the academic standards of the affiliated colleges. The second type is universities which do not have the affiliated colleges and provide undergraduate and postgraduate teaching as well as research. There are also some universities which are a mixture of the two types. Of the 179 university level institutions, 10 are Central Government universities and others are State universities. Many affiliated colleges are private. Education is provided still in most cases in English although use of Indian languages are growing. Beginning with the establishment of the School of Correspondence Courses and Continuing Education at the University of Delhi in 1962, an increasing number of universities have introduced open university courses. In 1980s Indira Gandhi National Open University started.

Central universities receive funds from the University Grants Commission (UGC) as development grant and maintenance grant. Institutions of national importance, like the Indian Institutes of Technology receive their grants directly from the Ministry of Education. State universities are funded by the State Governments in the form of block/maintenance grant as well as development grant. State universities also receive development grants from the UGC. Government and private colleges receive funds from government in the form of grants-in-aid for maintenance and development purposes. The system of grants-in-aid is mainly based on a flat percentage increase on the previous year's budget, and does not take into account the changing academic and research needs of the institution or the changes in prices of supplies and increase in student enrollment.

As shown in Table 2-1, colleges are rapidly growing in the country.

Table 2-1 Growth of Colleges in India

Unit: Numbers

Category	Item	1950-51	1960-61	1984-85	1986-87	1987-88
Eng. & Tech colleges	Numbers	33	81	587*	968*	1044*
	Enrollment	13268	47838	292303*	380963*	434168*
Eng. & Tech schools	Numbers	109	283	2285	3386	3720
	Enrollment	21148	86302	182223	308279	314104
Medical colleges	Numbers	28	60	116	125	125
	Enrollment	2675	5874	11817	13287	14166
Dental colleges	Numbers	4	11	25	36	40
	Enrollment	18	333	881	1461	1715

Source: CSO, Basic Statistics Relating to Indian Economy, 1989

* Excludes statistics of post matric institutions, and includes diploma course.

Table 2-2 shows similar statistics in Maharashtra State in which The College of Engineering, Pune is.

Table 2-2 Numbers of Institutes of Technical Education and Numbers of Students in the State of Maharashtra

Unit: Numbers

Technical Institutions	Index	Private	Aided	National	Total
Engineering College	Number of College	54	13	5	72
	Standard Intake	11,415	1,655	1,180	14,250
	Enrollment	26,453	5,247	4,852	36,552
Poly technics*	Number of College	98	11	27	136
	Standard Intake	18,900	1,700	3,810	24,410
	Enrollment	28,448	6,235	10,201	44,884
Industrial Tra ining Institute	Number of College	78	102	180	360
	Standard Intake	7,032	34,704	41,736	83,472
	Enrollment	5,236	33,441	38,677	77,354
Vocational Training School*	Number of College	183	163	49	395
	Standard Intake	8,625	8,102	1,624	18,351
	Enrollment	--	--	--	-
Technical Institute	Number of College	206	58	111	375
	Standard Intake	11,805	6,720	13,670	32,195
	Enrollment	--	--	--	67,347

Source: Education and Employment Department, Technical Education of the State of Maharashtra (1988)

Note *: Includes only technical engineering departments.

2.1.2 Issues in Engineering Education Sector

Technical education institutions such as engineering colleges, polytechnics, technical training schools, vocational training schools, engineering schools are rapidly increasing in number as mentioned in the previous section. However, the following problems are pointed out in the Ministry of Human Resource Development, Bureau of Technical Education , UGC etc.

(1) Strengthening of Important Technology Areas

The Indian Government considers that India lags behind advanced countries in the high technology areas such as computer applications, electronics, new materials, biotechnology, and is taking measures to strengthen and expand engineering education at undergraduate and master course levels in these fields. For this it is necessary to solve the problems involving lack of education and research facilities; obsolescence of equipment for education, experiments and research, lack of equipment of the latest types, insufficient number of teachers, and the quality of teachers.

The Ministry of Human Resource Development and its Bureau of Technical Education launched 872 projects in Emerging Technology Areas, Areas of Weakness and New Programmes since the Seventh Five Year Plan and the funds disbursed to these projects amount to about 108 Million Rupee. However, there are too many organizations to be supported by these projects and the result has not yet answered the expectations.

(2) Economic and Social Needs

One of the characteristic features of the Indian economy is that it is self supporting in most economic sectors. The five major items of export commodities in 1988/1989 are handicrafts (Rs 51,940 million), machinery and transport equipment (Rs 23,220 million), chemicals (Rs 15,340 million), leather and leather products (Rs 14,900 million), and cotton fabrics (Rs 11,310 million). The five major items of import commodities are machinery and transport equipment (Rs 53,160 million), mineral fuels, lubricants and related materials (Rs 43,740 million), chemicals (Rs 19,400 million), iron & steel (Rs 19,370 million) and non-ferrous metals(Rs 7,860 million). In manufacturing, still parts requiring precision in machinery and electric appliances depend on imports, and especially electronics, measurement and control instruments, robotics etc. are considered to lag behind. The level of graduates is low in view of the requirements from industries and the improvement of curricula and practice in engineering education institutions is considered to be necessary.

(3) Facilities and Equipment

As mentioned before, Central universities and institutes of technology which are under the Ministry of Human Resource Development receive comparatively ample funds and have good education and research facilities and equipment through bilateral assistances from abroad. Colleges including the College of Engineering, Pune, have basic experimental equipment. However, most pieces of the equipment are obsolete and their repair costs a lot. Since they are of obsolete types, their uses are very limited and the sizes are rather big. Because of their big sizes, the fuel and light expenses become high. Thus large part of the research budget is wasted.

There is a standard list of facilities and equipment necessary for practice in engineering colleges. However, it is not revised often enough to meet the needs of technical education. It is requested to implement without delay the expansion programme of research facilities which is now being prepared by the technical education sector of the Ministry of Human Resource Development.

(4) Maintenance

The running cost for technical education is appropriated 10,000 Rupee per annum per undergraduate student and 15,000 per master course student. The appropriations for facilities and equipment excluding buildings are 10,000 and 15,000 Rupee per annum per undergraduate student and per master course student respectively. The appropriation for facilities and equipment which is also used to purchase parts of equipment and consumables is not enough. Meanwhile, product available in India is not permitted to import. Importing product/material shall be applied to and approved by the Directorate General of Technical Development under the Ministry of Industry. However, in case of the educational institutions, a Pass Book Scheme has been introduced from 1988. It authorizes for the head of the Institute to import technical equipment under the condition of its essentiality and "not manufactured in India", to the maximum upper limits allowed annually for equipment. It excludes any single equipment or accessory whose CIF value exceeds Rs. 5 lakhs. The Bureau of Technical Education in the Department of Education is responsible for issuing pass books. But the procedures are complicated as exemplified in the import permission procedure of the Directorate General of Technical Development.

2.2 Outline of Engineering Education Development Program

2.2.1 The Government Policies for Technical Education in the Eighth Five Year Plan

India entered Eighth Five Year Plan (1990/91-1995/96) in April 1991. Seventh Five Year Plan (1985/86-1990/91) which was finished in March 1991 has achieved the unprecedented economic growth owing to the contribution from the manufacturing sector and the service sector as in the case of Sixth Five Year Plan. The average yearly economic growth rate during Seventh Five Year Plan is estimated 5.3 %. The details of Eighth Five Year Plan has not yet published. However, an overall GDP growth rate of 5.5 % per annum is planned to be maintained during Eighth Five Year Plan according to the Approach to Eighth Five Year Plan discussed in the National Development Council on 18-19 June 1990.

The National Policy on Education approved at the Parliament in 1986 after discussions on the Resolution on the National Policy on Education adopted in 1968 contains 156 paragraphs and includes all important ideas to reform education in India. Important parts concerning higher education are extracted as follows.

(1) To make education to link to national and regional development and to national unity and integration.

(2) It is important that an technical education system matches the national needs and it is necessary to provide a core curriculum to give adequate scope for accommodating local and regional needs.

(3) To provide a national minimum standard of achievement for the different stages and levels from primary to the tertiary, including professional education.

(4) There is the much needed thrust on vocational education under the New Education Policy.

(5) The new system of education proposed planned linkage with real job opportunities and the world of work.

(6) It is necessary to refrain employing agencies from prescribing the degrees as essential qualification for a job. Work ability and performance should be given preference to degrees.

2.2.2 Policy of Technical Education Sector

The policy of technical education sector to which the College of Engineering , Pune belongs is as follows.

(1) The All India Council For Technical Education (AICTE)

The All India Council for Technical Education (AICTE), which was set up in 1945 as a national expert body to advise the Central and the State Governments on the development of technical education, has been vested with statutory powers with effect from March 29, 1988 to ensure:

- proper planning and coordinated development of technical education system throughout the country;
- promotion of qualitative improvement of technical education in relation to planned quantitative growth;
- regulation of the system and proper maintenance of norms and standards.

(2) Modernization and Removal of Obsolescence

To remove obsolete educational facilities at all levels, to ensure modernization and to enhance their functional efficiency. This includes:

1) Removal of obsolescence in machinery and equipment in the laboratories and workshop;

2) Addition of new equipment relevant to the curricular needs as a sequel to the fast developments taking place in technology;

3) Provision of computers for training and retraining of faculty and supporting staff.

(3) Thrust Areas in Technical Education

In view of the present situation of the technical education sector, the Government has launched the scheme on Thrust Areas of Technical Education which comprises the following.

1) Strengthening of Facilities in Crucial Areas of Technology where Weakness exists.

The identified areas of technology where weakness exists are as follows.

* Computer Science/Technology
* Electronics
* Instrumentation
* Material Science/Technology
* Maintenance Technology
* Product Development/Design
* Bio-Conversion
* Ergonomics
* Printing Technology
* Management Science & Entrepreneurship

The Government is taking measures to strengthen these areas in technological institutions through (i) augmentation of physical facilities such as laboratory equipment, space, faculty and supporting staff, (ii) diversification of courses, and (iii) preparation of base for post-graduate programmes.

2) Creation of Infrastructure in Areas of Emerging Technologies

The scope and dimensions of the scheme instituted on an experimental basis during the Sixth Plan period were enlarged. The objectives of the scheme are:

- To develop infrastructure in terms of modern laboratories in identified areas of emerging technologies.

- To develop a strong base for advanced level work by identifying programmes and courses.

- To provide facilities and support for R & D activities in frontier areas of technology on an national basis so that technology gaps with reference to advanced countries are eventually bridged.

- Development of manpower

- Facilities for training the faculty

- Development of linkages with other institutions including R&D establishments and user agencies.

- Dissemination of information in the areas of expertise developed by the supported institutions.

The 16 areas identified for support under this scheme are shown in Table 2-3.

Table 2-3 Emerging Technologies Identified for Creation of Infrastructure

Energy Science	Optical Communication & Fiber Optics
Transportation Engineering	Laser Technology
Microelectronics	Informatics
Remote Sensing	Telematics
Atmospheric Science	Educational Technology
Reliability Engineering	CAD/CAM
Environmental Engineering	Microprocessors
Water Resources Management	Robotics and Artificial Intelligence

(4) Programmes of New and/or Improved Technologies and Offering New Courses in Specialized Fields

This scheme was instituted during 1987-88 as part of the

National Policy on Education. The scheme was formulated keeping in view the changing industrial scene and the pace of technology development the world over. Several new/improved areas of technology have been identified where programmes/courses will be supported under the scheme. Some areas are shown in Table 2-4.

Table 2-4 New/Improved and Specialized Fields of Technology

1. Energy Engineering
1) Energy storage techniques 2) Nuclear engineering 3) Extra high voltage D.C. transmission 4) Fuel efficient I.C. engines 5) Solar energy based heating and cooling systems 6) Wind energy system 7) Sea-bed mining 8) Magneto-hydrodynamics, Plasma engineering
2. Computer Technologies
1) Automation & robotics 2) Computer applications in communication system 3) Computer integrated manufacturing 4) Computerized industries and process control 5) Computer applications in office automation 6) Expert systems, Space engineering
3. Electronics and Telecommunication
1) Satellite communication system 2) Digital communication engineering 3) Photonics (Opto-electronics) 4) Molecular electronics 5) Super conductors 6) Engineering application of lasers
4. Ergonomics
1) Bio-engineering (bio-mechanics, bio-electronics) 2) Bio-chemical engineering 3) Genetic engineering
5. Military Technology
1) Rocket & missile technology
6. Environment Technology
1) Water resources development 2) Recycling & waste utilization
7. Industrial Technology
1) Membrane technology 2) Cryogenetic engineering 3) Food preservation technology

8. Materials Engineering
1) Packaging technology 2) Petro-chemicals 3) Composite materials 4) Low cost housing/building materials
9. Resource Development Technology
1) Ocean engineering 2) Remote sensing & applications 3) Frontiers of fisheries technology 4) Ocean engineering, Off-shore structures
10. Transportation Technology
1) Magnetic levitation techniques in high speed transportation
11. Others
1) Urban development planning 2) Appropriate technology for rural development 3) Management education for small scale/unorganized sectors 4) Tribology

The support for the thrust areas of technical education during Seventh Plan period is shown in Table 2-5.

Table 2-5 Summary of Project Supported During Seventh Plan Period

Thrust Area	Project supported	Amount disbursed (Rs. lakhs)
1. Emerging Technology	458	5733.51
2. Areas of Weakness	347	3930.00
3. New Programmes	67	1122.15
Total	862	10785.66

2.3 Outlines of the College of Engineering, Pune

2.3.1 General

The predecessor of the College of Engineering, Pune was established in 1854 by the British-Indian Government in the southeastern part of Bhawani Peth in Pune as a training school to produce young Indian civil and architectural engineers. It is one of the oldest schools in the country. It moved to the present campus along the Highway No. 4 in 1865. In 1911 it became the College of Engineering, Pune. A cooperative scheme with Bombay University started in 1912 and with Pune University in 1949 in order to raise the academic level of the College. At the initiation it had only the department of civil engineering. In the course of these developments, other departments such as electronics & telecommunications, mechanical engineering etc. were set up. In 1965 the department of instrumentation engineering was set up and the master's courses were opened.

The present campus is situated between River Muta and the railway in the northern part of Pune. The highway No.4 runs through the center of the campus dividing it into two parts. The area is of 15 ha. and there are 11 major buildings. The campus is flat and surrounded with many trees. There are other two sites for the future expansion of the College; one across Muta River and the other adjacent to the present campus. The major buildings are the main building, the electronics & telecommunications department building, the electrical engineering department building, the instrumentation department building, the library(45,000 books and 200 journals) etc.. The total area of the buildings is more than 23,000 square meters. In the neighborhood of the campus there is a dormitory of 275 rooms accommodating 655 male students and 18 female students.

2.3.2 Organization and Outlines of each Department

The College is a State college and under the jurisdiction of the Bureau of Engineering Education of Maharashtra State. There are two divisions under the principal; education division and administration division. The education division consists of departments which have

undergraduate as well as master courses such as electronics & telecommunications, metallurgy etc.; a department which has only the master's course (the department of urban engineering); departments which are chaired by a professor or associate professor; and departments which have only lecturers. These organizations are shown in Fig. 2-2 and Table 2-6. The number of students, teaching staff by academic status and academic degrees are shown in Table 2-7.

The College of Engineering, Pune is affiliated to Pune University since the latter was established in 1949. [1)]

In the period of 136 years of its existence and through 77 years of its university affiliation, it must have sent out at least 15000 graduate professionals. Their main position is as follows.

· Machinery/Manufacturing	27%
· Electrical Power	17%
· Electronics and Computer	13%
· Steel, nonferrous and Construction Materials	11%
· Construction and Engg.	7%
· Higher Education	13%

1) Affiliated colleges

There are several types of universities. The first type is universities which conduct undergraduate and postgraduate teaching as well as research. The second type is universities which have large number of degree colleges affiliated to them giving undergraduate education, in some cases also giving postgraduate teaching and research, and oversee the academic standards of the affiliated colleges. The College of Engineering, Pune is one of the affiliated colleges of Pune University.

Fig 2-2 Organization Chart of the College of Engineering, Pune

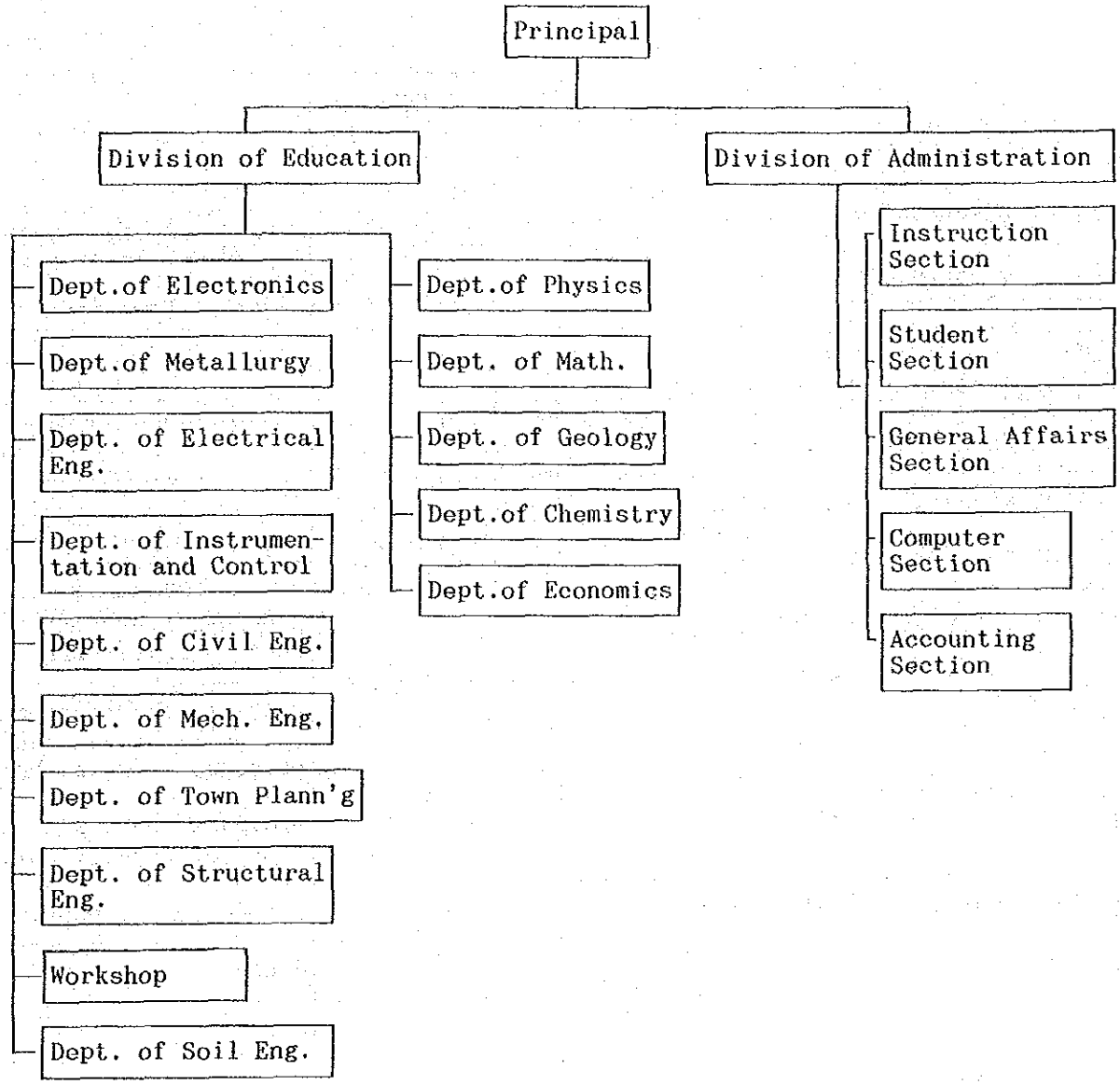


Table 2-6 List of Departments and Engineering Courses

	Under-graduate course	Master course	
Dept. of Electronics & Telecommunication	o	o	
Dept. of Metallurgy	o	o	
Dept. of Electrical Engineering	o	o	
Dept. of Instrumentation and Control	o	o	
Dept. of Civil Engineering	o	o	
Dept. of Mechanical Engineering	o	o	
Dept. of Town Planning		o	only master course
Dept. of Structural Engineering			provides course to Dept. of Civil Eng.
Workshop			provides courses common to the first year and to Dept. of Mech. Eng.
Dept. of Soil Engineering			provides courses to Dept. of Struct. Eng.
Dept. of Geological Engineering			common to all Dept.
Dept. of Physics			ditto
Dept. of Mathematics			ditto
Dept. of Chemistry			ditto
Dept. of Economics			ditto

Table 2-7 Standard Intake

		Students		Enrolled Students				Teaching Staff						Teaching Staff Total	Floor Area of of major Build-ings
								Post			Degree				
		BE	ME	1st Yr.	2bd Yr.	3rd Yr.	4th Yr.	Prof	Assoc. Prof.	Lec-turer	PhD	MS	BA		
Dept. of Electronics & Telecommunication	Dept. of Electronics & Telecommunication	60	24		70	74	69	3	4	9	1	7	8	16	4,304
Dept. of Metallurgy	Dept. of Metallurgy	60	12		68	63	77	2	4	3	3	3	3	9	2,215
Dept. of Electrical Eng.	Dept. of Electrical	60	12		76	70	70	4	5	18	2	18	7	27	1,009
Dept. of Instrumen-tation & Control	Dept. of Instrumen-tation	30	-	479	40	36	38	1	1	4	-	3	3	6	1,000
Dept. of Civil Eng.	Dept. of Civil Eng.	120	44		133	138	136	1	4	10	3	8	2	13	3,119
	Dept. of Town Plann'g							1	1	1	-	3	-	3	300
	Dept. of Struct. Eng.							4	2	7	3	8	2	13	1,017
Dept. of Mech. Eng.	Dept. of Mech. Eng. Workshop	120	12		151	152	134	4 1	7 -	9 3	3 1	9 1	8 2	20	1,000
Others		-	-	-	-	-	-	2	3	11	3	10	3	32	7,376
Sub-total		450	104	479	519	533	524	23	31	75	19	70	40		
Total							2,237						129		

(1) Department of Electronics & Telecommunications

This department is a priority department in the expansion project. It provides education in electronics, telecommunications, informatics, controls and computers as well as conducts research into these fields. There are computers made in India, but in other fields mainly theory is taught using obsolete equipment (e.g. vacuum tubes). It plans to provide education in the latest technology by introducing new equipment.

(2) Department of Metallurgy

The curriculum is similar to the one in international level. The study in the master's course is mainly on materials including plastics.

(3) Department of Electrical Engineering

This department is the oldest one in the field of electricity and provides education in generation, transmission and distribution. It is now giving courses in new technologies such as high voltage D.C. transmission, power electronics, low cost automation etc. However, they are limited to theoretical education since available equipment is obsolete. Equipment assembled by the teaching staff themselves are used (e.g. robot manipulator).

(4) Department of Instrumentation

This department was branched off from the Department of Electronics & Telecommunications. Emphasis is placed on education and research into instrumentation and measurement and control of plants etc. The demand for this field is rapidly increasing. Research and development on biomedical electronics instruments are active and included in priority allocations. Especially support to the development of sensors is strongly requested.

(5) Department of Civil Engineering

This is the oldest department and has the largest number of students. It covers civil engineering, architecture, town planning, structural engineering, hydraulics,geology, environmental engineering and traffic engineering. The Department of Structural Engineering and the Department of Soil Engineering comprise part of the Department of Civil Engineering.

(6) Department of Mechanical Engineering

Equipment for internal combustion, fluid experiments and material experiments is very old. But students in the master course are active in research. A journal for publishing research by students exists for more than 20 years. The workshop is part of the department and doing research into precision measurement, machine tools, machining and robots.

2.3.3 Maintenance Cost

The budget to cover the running cost is provided by the Maharashtra State Government. The amount and its breakdown is shown in Table 2-8. The maintenance cost of the buildings is provided by the Public Works Ministry of the State and is not included in the yearly budget of the College. The costs of extending and renovating buildings, the purchasing costs of equipment and books and the costs of establishing a new research institute etc. of the four state Colleges of Engineering are estimated to be 424 million Rupee in the Eighth Five Year Plan. The purchasing costs of equipment and books of the four State Colleges of Engineering are shown in Table 2-9 for the past 6 years.

Table 2-8 The Budget of the College of Engineering, Pune

unit: million Rupee

Item \ Year	1989	1990	1991
1. Salary & wages	18.8	19.6	27.5
2. Administrative (including water, electricity)	1.2	1.8	1.8
3. Subcontract	0.45	0.6	0.6
4. Tax	0.4	0.4	0.4
5. Equipment & materials	0.9	1.1	1.2
6. Facilities(including books)	6.0	8.8	17.3
7. Publications	0.35	0.45	0.45
8. Moving	0.07	0.08	0.09
Total	28.17	31.03	49.34

Note: The maintenance costs of buildings are not included.

Table 2-9 The Budget for Purchasing Equipment and Books of four State College of Engineering in Maharashtra

unit: million Rupee

year	85	86	87	88	89	90
Total Budget	20	20	23.5	34	36.4	42

Source: Directorate General of Technical Education, the State of Maharashtra

2.4 Background and Contents of the Request

2.4.1 Background of the Request

India has placed great importance on education since it started the First Five Year Plan after the independence in 1947. As the result, education institutions and students remarkably have increased in all educational sectors and the educational level has been raised.

As mentioned in the previous section, since the adoption of two basic national education policies , the Resolution on National Policy of Education in 1968 and the National Policy on Education in 1986, the education policies and systems have been critically appraised and evaluated and the results have been incorporated in the successive Five Year Plans. The technical education sector is expected to contribute more to the national economic development, especially to local and regional development, and to bridge technology gaps with reference to advanced countries in crucial areas of industrial technologies. These points are more stressed in Eighth Five Year Plan started in April 1991.

In these circumstances, the Bureau of Technical Education of the Ministry of Human Resource Development instituted in 1987/1988 schemes of Thrust Areas of Technical Education Achievements comprising 1) Strengthening of Facilities in Crucial Areas of Technology where Weakness exists, 2) Creation of Infrastructure in Areas of Emerging Technologies, and 3) Programmes of New and/or Improved Technologies and Offering New Courses in Specialized Fields, in Colleges of Engineering which are expected to play a major role in the technical education sector of national technological development programmes.

However, the funds allocated to implement the programmes mentioned in the previous section are still not enough. Equipment and facilities are not enough to expand and strengthen engineering education which can produce engineers who have mastered advanced production technology and can contribute to the promotion of the local industries.

For these reasons mentioned above, the Directorate General of Technical Education of the Ministry of Human Resource Development requested a Grant-in-Aid of the Japanese Government for the improvement of educational and research equipment at the College of Engineering, Pune in which the quality of the teaching staff and students is high. This College is in Pune and is the oldest educational institution in Maharashtra State which produces about 30 % of the GNP of India.

2.4.2 Contents of the Request

(1) Objective

The Indian Government started the Schemes of Thrust Areas of Technical Education Achievements in 1987/1988 to upgrade the quality of its technical education and the College of Engineering, Pune is included in this programme since 1990. The Modernization Programme of the College of Engineering , Pune consists of the improvement of equipment for teaching and research; renovation, expansion and new construction of buildings; establishment of new undergraduate as well as master courses; establishment of research centers; and increase of faculty and support staff . It is expected to be completed during the Eighth Five Year Plan. After the completion the College is expected to become one of the Deemed Universities which are still a few in number.

(2) Implementing Agency

The implementing agency is the College of Engineering, Pune which is in Pune, Maharashtra. The upper level supervisory organs are Bureau of Technical Education, Maharashtra State and the Directorate General of Technical Education, Ministry of Human Resource Development. These two organs are to supervise the operation and maintenance of the programme.

(3) Plan

The outline of the plan is shown in Fig. 2-3. It is planned to improve the technical education, train engineers in high technology fields who can contribute to the development of economy and society of India after graduation, improve research capabilities in high technology areas and to become a deemed university.

1) Improvement of Curricula

Curricula of undergraduate courses in 6 departments will be revised. Especially experimental units will be increased in accordance with improvement programmes in the technical education sector in India.

2) Establishment of New Master Courses

The following courses will be established to respond to the needs in high technology areas.

Phase 1: biomedical engineering, computer technology, material engineering

Phase 2: energy management, electronics, CIM

3) Establishment of Research Centers

In order to establish a system which can contribute to the development of economy and society in India, especially the local industries in Maharashtra State, the following three centers are planned to be set up. These three fields are among the Crucial Areas of Technology for Removal of Weakness by Strengthening Infrastructure Facilities and the ones in which the College is strong.

Figure 2-3 Outline of Modernization Plan of Government Engineering College of PUNE

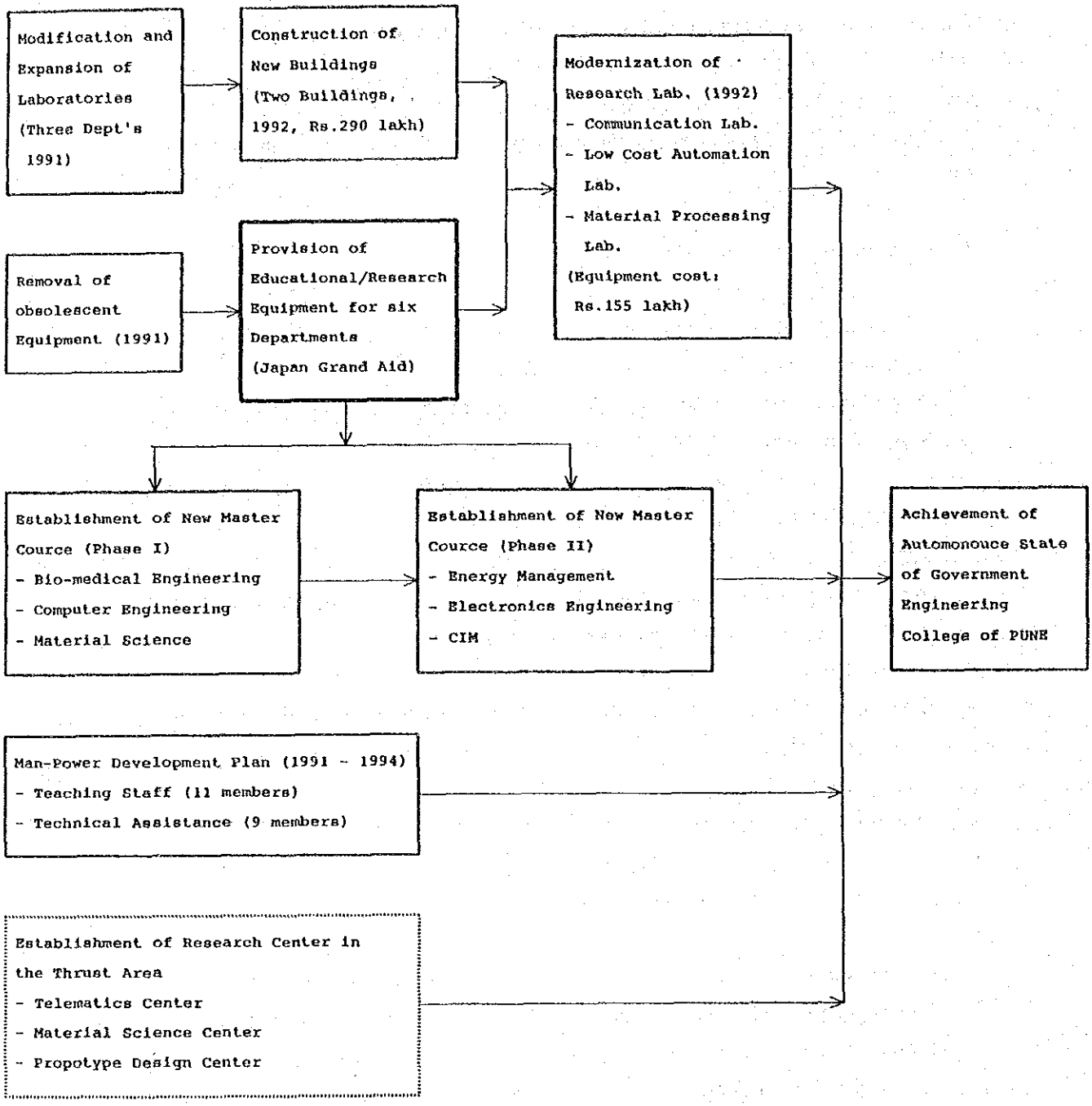


Table 2-10 Teaching Staff Development Plan (1991 - 1995)

	1991/92	1992/93	1993/94	1994/95
1. Teaching Staff for Master Course				
-1. Professor	1	2	-	
-2. Asst. Professor	1	3	2	
-3. Lecturer	2	-	-	
Grand Total	4	5	2	
2. Teaching Staff for Degree Course				
-1. Professor	1	1	-	-
-2. Asst. Professsor	1	1	1	1
-3. Lecturer	2	2	2	2
Grand Total	4	4	3	3
3. Assistant Expansion				
-1. Programmer	-	1	1	-
-2. Foreman	1	-	-	-
-3. Tech. Asst.	-	-	1	1
-4. Electrician	-	1	-	-
-5. Clerk Typist	1	-	1	-
-6. Jr. Clerk	3	1	2	1
Grand Total	5	3	5	2

(i) Telematics Center

This center is to develop an information system of the College and expand digital communication and digital network services through modernizing the present communication engineering laboratory.

(ii) Material Science Center

This center is to conduct R & D on the new and specialty material in the field of microelectronics, optical devices, compound semiconductors, ferrites, ceramics, superconducting materials, composite materials etc..

(iii) Prototype Design and Development Center

This center is to conduct R & D into the utilization of locally available resources and provide technical services to expand supporting services to local industries.

The budget for the increase of faculty and support staff; for the renovation, expansion and construction of laboratories and class rooms; and for the purchase of part of equipment for teaching and research is provided by the budget of the Central Government and the Maharashtra State Government. Major part of addition of new equipment is to be provided by a Grant-in-Aid of the Japanese Government.

(4) Requested Equipment

The requested equipment includes equipment for experiments by the undergraduate students in the Department of Electronics & Telecommunications, the Department of Metallurgy, the Department of Electrical Engineering, the Department of Instrumentation and Control, the Department of Civil Engineering (including the Department of Town Planning and the Department of Structural Engineering), and the Department of Mechanical Engineering (including the Workshop), and equipment for research by the

students in master courses. The requested equipment also includes the one which will be used in the three planned research centers.

The details of the requested equipment from the above six departments are as follows:

1) Department of Electronics & Telecommunications

Mainly for student experiments and for research in communication engineering.

- Measurement instrument of field strength (measuring receiver, field strength meter, various types of antenna etc.)
- Equipment for research into communication methods (modulation analyzer, FM linear detector, radio communication analyzer etc.)
- Equipment for research into microwaves (frequency counter, microwave power meter, standing wave measurement apparatus etc.)
- Equipment for communication engineering analysis (spectrum analyzer, network analyzer, scalar network analyzer etc.)
- Equipment for optical communication (optical fiber communication test set)
- Equipment for computer related communication (interface monitor, logic analyzer, protocol analyzer etc.)
- Equipment for analysis and synthesis of signal waves (waveform synthesizer, digital oscilloscope, analyzing recorder etc.)
- Equipment for image signal processing (video signal processing equipment etc.)
- Equipment for measuring electromagnetic interference (electromagnetic interference test apparatus etc.)

2) Department of Metallurgy

Mainly for research equipment in the master course.

- Equipment for material testing (fatigue testing machine, universal testing machine, ultrasonic hardness tester etc.)
- Equipment for metallography and crystal structure analysis (X-ray diffractometer, X-ray stress analyzer, thermal analysis apparatus etc.)
- Equipment for metal element analysis (vacuum emission spectrometer, X-ray emission spectrometer, carbon-sulfur analyzer etc.)
- Equipment for material processing (vacuum high frequency induction electric furnace etc.)
- Equipment for metal smelting and casting (ultrasonic flaw detector etc.)

3) Department of Electrical Engineering and Control

Mainly for laboratory practice and research equipment by undergraduate and master course's students

- Equipment for high voltage technology (power line multi-transducer, high voltage impulse generator, High voltage D.C. transmission simulator etc.)
- Equipment for power electronics (digital electrometer, digital oscilloscope, C and tan delta measuring bridge etc.)
- Equipment for low cost automation (self learning robot trainer, analog oscilloscope, digital memory etc.)

4) Department of Instrumentation and Control

Mainly for laboratory practice and research equippmente by undergraduate and master course students

- Equipment for industrial instrumentation (single loop programmable controller, smart field communicator etc.)
- Equipment for biomedical engineering (arbitrary waveform generator, portable digital calibrator, electro myographic unit with accessories etc.)

5) Department of Civil Engineering

Mainly for research experimental equipment by undergraduate and master course students in the Department including the Town Planning and the Structural Engineering Departments

- Equipment for measurement of air pollution (gas chromatograph, UV absorption spectrometer, portable gas monitor etc.)
- Equipment for Town Planning (traffic volume counter, slide projector with sound systems etc.)
- Equipment for structural experiments (computer controlled universal material testing machine)

6) Department of Mechanical Engineering

Mainly for experimental equipment by undergraduate and master course students and for assisting industry

- Equipment for CAD (X-Y plotter, computer data logger, portable FFT analyzer, etc.)
- Equipment for machining (3-dimensional coordinate measuring machine, twin spindle CNC chucker, auto loader & robot etc.)
- Equipment for control experiments (vibration tester, pneumatic transducer theory apparatus, servo controlled equipment etc.)

CHAPTER 3

CHAPTER 3 OUTLINE OF THE PROJECT

3.1 Objective

The Indian Government has allocated a relatively big proportion of the national budget to the education sector recognizing the importance of human resources development to the economic development of the country. Consequently the number of public educational institutions has rapidly increased.

However, many subjects and experimental practice which are given at most engineering colleges except a few have no more matched with the recent technological progress in industry. The deterioration of the facilities and lack of equipment for engineering experiments in advanced technological fields are also preventing engineering colleges from providing proper engineering education.

The College of Engineering, Pune, is one of the oldest engineering colleges in the country and is situated in the area where industries are developing rapidly and the needs for advanced technical education are high. Bombay is also in this area. In these circumstances, the modernization of this College has become an emergency issue.

This project aims at upgrading the quality of the engineering education at the College of Engineering, Pune and strengthening its role in leading the development of industries.

3.2 Review of the Request

3.2.1 Necessity and Verification of the Project

This project will be one of the major components in the modernization plan of the College of Engineering, Pune which is part of the Schemes of Thrust Areas of Technical Education Achievements in Seventh five Year Plan based on "the Resolution on the National Policy on Education".

The modernization plan of the College of Engineering, Pune is intended, as mentioned in section 2.4.2, to modernize its laboratories by removing outdated equipment, renovating and expanding the laboratories, introducing new equipment for experiments and practice by students and for research by master course strudents and teaching staff, thus to upgrade the quality of technical education and to strengthen the research activities in advanced thechnology fields, and to contribute to the economy and society through providing Pune area with high quality engineers as well as with dissemination of the R & D expertises.

As shown in Table 3-1, this project will;

(1) directly benefit about 130 teachers and about 2300 students in the six target departments of the College of Engineering, Pune and provide the area of Maharashtra State around bombay and Pune with about 450 graduates (bachelors) and about 150 masters

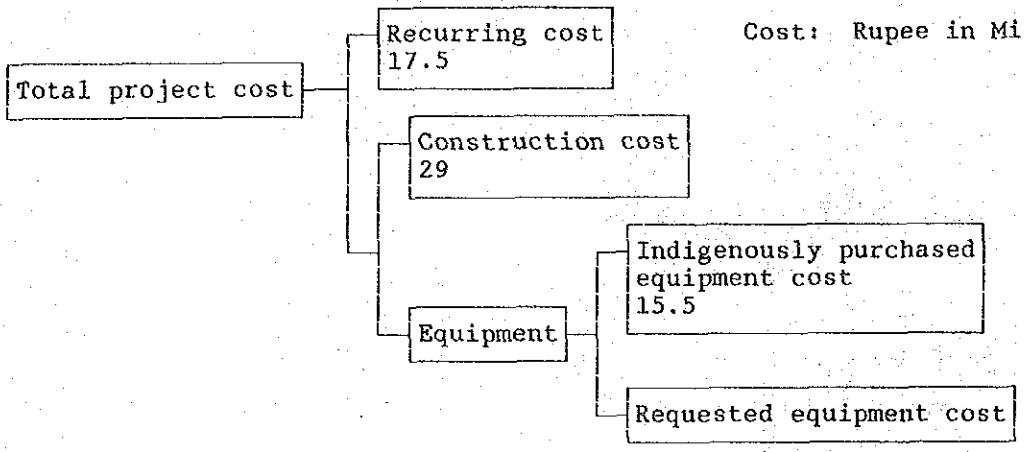
(2) contribute indirectly to the promotion of industries in the region since most of the graduates of the College will get jobs in private and public sectors in Maharashtra State.

Table 3.1 Necessity and Verification of the Project

Necessity of the Project	Content of the Project	Effect and Verification
1. Improvement of equipment for teaching, experiments and practice	The existing equipment is mostly old and obsolete (for instance, some were purchased forty years ago) and its functions are limited and not suited for modern technology education. The Project will improve and expand equipment for experiments and practice replacing old one with new one	Provision of the new equipment will improve the quality of the existing theoretical education and practice training, and make the sandwich course (3-6 months in-service training in factories of public and private sectors) more effective. Consequently the graduates will be able to proceed to the advanced courses or industries without experiencing particular difficulties (the number of the target undergraduate students is about 2250 and that of the master course students is about 100).
2. Improvement of equipment for testing and research	There are not many varieties of equipment for testing and research at the College and their performance is very poor. The present situation discourages the teachers and students from doing research and can not meet the needs of the economy and society. The Project will provide equipment to conduct the present and planned research.	Provision of the new equipment will significantly help the undergraduate in practice for thesis, activate research activities of the master course students and teachers and contribute to improve morale of the teachers and students (about 2250 of students and 130 of teachers). The results of research will become more useful and attractive to the Pune area and help promote joint research with industries and contribute to the economy and society in the region.
3. Provision of equipment for research in advanced technology fields	R & D in the high technology fields is among the most important components in the technical education development programme of the Directorate General of Technical Education, the Ministry of Human Resource Development. In line with this programme, equipment to be used for research in high technology fields will be provided to the Dept. of Electronics & Telocommunication, Dept. of Metallurgy, and Dept. of Electrical Engineering	Computer control, mechatronics and new materials are widely utilized in industries in India. In the circumstances, the establishment of research facilities in these fields of technology at the College will upgrade the quality of research at the College as well as help promote joint research with industries in the region and improve technical services to industries such as technical diagnostics, and is expected to make a significant contribution to the small and medium sized industries in the region.
4. Increase of teaching and technical staff	At present there are about 2250 of students and 130 of teachers in the College. About 25 teaching staff (professors 5, assistant professors 10 and lecturers 10) will be added with the extension of educational and research activities due to the expansion of the equipment and the opening of new courses.	New equipment will be used effectively by the present teaching staff. The College is planning to open new courses in the undergraduate and master courses and to set up new research centers; Telematics Center, Material Science Center, and Prototype Design and Development Center. The teachers will be increased for these new facilities. Equipment to Equipment to be provided by this project will be also used effectively by these new courses and research centers.

3.2.2 Review of Implementation and Operation Plan

The Plan is to be implemented under the scheme of upgrading plan of the Government College of Engineering, Pune. Total project cost is estimated as below.



Cost: Rupee in Million

The project cost includes expansion and modernization of laboratories, establishment of research centers, establishment of new courses for computer engineering, material science etc. In consideration of quantity and function of equipment to be provided to the College, small amount of increase for electricity and material shall be considered. Meanwhile, total budget for expenditure including utility and maintenance cost was 3 Million Rupee, in 1992, therefore there is no influence on the operation due to the additional running of equipment. Total numbers of teaching staff of the College is 129, consisting of 19 members of doctorate (15%), 70 members of master (54%) and 40 members of Bachelor (31%).

In addition to these teaching staff, all most all technical assistants is bachelor grade, there is no problems to utilize these equipment from Japan grant aid.

3.2.3 Relation to the National Plan

The modernization plan of the College of Engineering, Pune is in line with the Schemes of Thrust Areas of Technical Education Achievements of the Ministry of Human Resource Development mentioned in Chapter 2 and is to be carried out in the crucial areas identi-

fied in the Schemes. The interrelation between the said crucial areas and the target departments of the College is as follows.

(1) Crucial Areas of Technology Identified for removal of Weakness by Strengthening Infrastructure Facilities/Diversification of Courses

No.	Crucial Area	Related department in the College
1.	Computer Science/Technology	Dept. of Electronics & Telecommunication
2.	Electronics	Dept. of Electronics & Telecommunication
3.	Instrumentation	Dept. of Instrumentation and Control
4.	Material Science/Technology	Dept. of Metallurgy
5.	Maintenance Engineering	Workshop
6.	Product Development/Design	
7.	Bio-Conversion	Dept. of Instrumentation and Control
8.	Ergonomics	Dept. of Instrumentation and Control
9.	Management Science & Entrepreneurship	all target Departments

(2) Emerging Technologies Identified for Creation of Infrastructure

No.	Emerging Technology	Related depatment in the College
1.	Laser Technology	Dept. of Electronics & Telecommunication
2.	Informatics	Dept. of Electronics & Telecommunication
3.	Telematics	Dept. of Electronics & Telecommunication
4.	Educational Technology	all target Departments
5.	Computer Aided Design/ Computer Aided Manufacturing	Dept. of Electronics & Telecommunication

6.	Microprocessors	Dept. of Electronics & Telecommunication
7.	Robotics and Artificial Intelligence	Dept. of Mech. Eng., Dept. of Electronics & Tele communication, Dept. of Electrical Eng.
8.	Energy Science	Dept. of Mech. Eng.
9.	Transportation Engineering	Dept. of Civil Eng.
10.	Micro-electronics	Dept. of Electronics & Telecommunication
11.	Remote Sensing	Dept. of Electronics & Telecommunication
12.	Atmospheric Science	Dept. of Electronics & Telecommunication
13.	Reliability Engineering	Dept. of Electronics & telecommunication Dept. of Electrical Engineering Dept. of Mechanical Engineering
14.	Environmental Engineering	Dept. of Civil Eng.
15.	Water Resource Management	Dept. of Civil Eng.
16.	Optical Communication & Fibre Optics	Dept. of Electronics & Telecommunication

(3) Programmes of New/Improved and Specialised Fields of Technology

1) Energy Storage Techniques
2) Bio-Engineering (Bio-Mechanics, Bio-Elecronics)
3) Automation & Robotics
4) Digital Communication Engineering
5) Satellite Communication System
6) Computer Integrated Manufacturing (CIM)
7) Computerised industrial & Process Control
8) Nuclear Engineering
9) Magneto-Hydrodynamics & Plasma Engineering
10) Rocket & Missile Technology
11) Remote Sensing & Applications
12) Water Resource Development
13) Membrane Technology (e.g Desalination of Sea Water)
14) Bio-Chemical Engineering
15) Genetic Engineering
16) Recycling & Waste Utilisation
17) Urban Development Planning
18) Engineering Applications of Lasers
19) Engineering Applications of Ultrasonics
20) Packaging Technology
21) Appropriate Technology for Rural Applications
22) Petro-Chemicals
23) Tribology
24) Photonics (Opto-electronics)
25) Molecular Electronics
26) Cryogenic Engineering
27) Extra High Voltage D.C. Transmission
28) Composite Materials
29) Materials & Technology of Low Cost Housing
30) Fuel Efficient I.C. Engines
31) Solar Energy based Heating and Cooling Systems
32) Automated Microhydel System
33) Wind Energy System
34) Computer Applications in Office Automation
35) Expert Systems & Space Engineering
36) Superconductors & Cermets

37) Magnetic Levitation Techniques in
High Speed Transportation
38) Ocean Engineering, Off-shore Structures
39) Sea-bed Mining
40) Frontiers of Fisheries Technology (Marine Fisheries)
41) Food Preservation Technology
42) Management Education for
43) Small Scale/Unorganised Sectors

3.2.4 Review of Requested Equipment

As mentioned in Section 3.2.3, the national plans intend the improvement and expansion of technical education and R & D in advanced technology areas. However, the present College is not yet ready to undertake research in these areas. The equipment is obsolete and not efficient, its quantity is not enough and the types and kinds are limited. There is no equipment for engineering research in advanced technology. The first step is to improve its facilities and manpower in order to function as a core technical educational and research institution in the advanced technology in Maharashtra State. The equipment is requested for realizing these purposes of the College and selected based on the following considerations.

1) For experiments by undergraduate students

- to replace obsolete one
- to augment functions which have been lacked
- one which is necessary to start new subjects

2) For research

- equipment which makes it possible to challenge research which has not been undertaken so far due to lack of equipment
- equipment which makes it possible to launch new themes

3) For support to industries

- equipment to provide standards with more precision
- equipment which makes it possible to support development of new products

The evaluation of individual departments are as follows.

(1) Department of Electronics & Telecommunications

1) Background

The department is the first priority in the project. In advanced countries the progress of electronics is remarkable and application of electronics constitutes basic almost all engineering fields. As a result application of electronics has a characteristic feature to each discipline. This has resulted in branching of an electronics department into departments of communications, electronic engineering, computer & control engineering, image processing engineering, electromagnetic environment engineering etc. The development of these various branches of electronics engineering is indispensable to the development of industries in India and is given a priority in university education and research. In India, a department of electronics has not yet branched off and so this department must cover wide ranges of electronics.

2) The Present Situation of Facilities

In the undergraduate courses, basic education in experimental subjects are provided. Although the equipment available is old, for example a vacuum tube type of thirty years ago such as klystron oscillator, it serves for understanding of principles and theories since it anyway generates electromagnetic waves. However, these old type instruments are no more produced by the manufactures and it is difficult to obtain parts. Some old type instruments are not suitable for education of recent technology, for instance, waves from a klys-

tron are phase-unstable and not suitable for PCM communication. There is no equipment for recent technology like optical communication. Only the theory is taught.

There were a number of support services for industry in the past (more than 20 cases). These support services were successful to the extent that could be attained at the technology level at that time, but could not meet further requirements. the College intends to upgrade the services to those made possible by present technology. The industries request upgrading these services. If the College succeeds in upgrading its support services, more demands will arise. There are many requests from industries for calibrations. But the College lacks enough equipment to be used as standard for calibration. In the field of electronics too it is necessary to have equipment to be used as standard for calibration.

3) Expansion Plan

This department deals with many subjects which are dealt with by different departments in advanced countries. There are specialized courses corresponding to subject fields. It is planned to strengthen all specialized courses.

Course	
Communication Engineering	electromagnetic waves, especially, microwaves, modulation, demodulation, etc.
Control Engineering	power electronics, control theory, microcomputer control system
Image Processing Engineering	TV engineering, digital image processing (theory), waveform processing

Computer Technology	personal computer(PC-XT), computer system, CAD,CAM etc.
Electronics Engineering	circuits, circuit network, electronic devices, elective: signal wave analysis, optical communication, electromagnetic environment

The improvement of laboratories, and the establishment of new centers and new courses are listed as follows. These plans are natural development of the College and the full use of the requested equipment will have substantial effects on improvement of education and research at the College.

Expansion Programme

Phase I
* Improvement of Communication Laboratory
* Establishment of Telematics Center
* Establishment of Computer Technology Course
  (undergraduate and master courses)

Phase II
* Establishment of Electronics Engineering Course
  (master course)

4) Operation and Maintenance

The running cost of electronics devices is in general low and is considered to be electricity charges only. The electricity charge is only 3-4 Rupee for ten hours use. The cost of consumables such as floppy disks, papers and ink is also negligible. At present, repair is done by themselves.

However, repair of high quality equipment as requested must rely on outside factories through sales agents. Usually MTBF of electronic devices is more than 20,000 hours and the repair cost is not so high.

5) Contribution to the Region

As mentioned in a paragraph on support to industries, 1) contribution to more difficult development projects will be made possible, and 2) calibration services will be realized using more precise standard.

Table 3.2 Present activities of Dept. of Electronics and Tele-communication

	Contents	Main Equipments
Curriculum	Microwave Engineering Study of basic microwave engineering	- Electronic Counter - VSWR Meter - Microwave Power Meter - Microwave Sources - Microwave components
	Power Electronics Study of basic electronics for motor and actuator control	- Waveform Synthesizer
	Television Engineering Study of TV signal and theory of TV set	- Video Signal Processing Equipment
	Computer Engineering Study of software with personal computer	- Interface Monitor - Logic Analyzer - Protocol Analyzer
	Optical Fiber Communication Study of basic optical fiber communication	- Optical Fiber Communication Test Set Up
Research	Microwave Oven Research and development of high powermicrowave for agricultural and industrial applications	- Electronic Counter - Microwave Power Meter - Microwave Sources EMI Test System
	Astronomical Measurement Observation of ionosphere and electromagnetic energy	- Measuring Receiver and Field Strength Meter - Antenna - Spectrum Analyzer - EMI Test System
	Electromagnetic Interference Minimization Techniques Countermeasurement of electromagnetic interference from electronic equipment	- EMI Test System
	Electronic Scanning Antenna System Study of high frequency engineering	- Radio Communication - Microwave Power Meter - EMI Test System - Waveform Synthesizer
	Modulation and Coding Scheme Study of modulation and coding for high resolution TV	- Video Signal Processing
	Voice Synthesis Study of making artificial voice with synthesizing audio signal	- Waveform Synthesizer
	Video Signal Processing Study of processing techniques with digitizing	- Video Signal Processing Equipment - Spectrum Analyzer

	Contents	Main Equipments
Collaboration	FM Transceiver System	- Measuring Receiver - Field Strength Meter - Antenna - Modulation Meter - Radio Communication Analyzer, etc.
	Digital Data Communication	- Logic Analyzer - Interface Monitor - Protocol Analyzer
	Recording of Cassettes	- Video Signal Processing Equipment
	Auto Field Strength Measurement	- Spectrum Analyzer - Network Analyzer - Power Meter - VSWR Meter - EMI Test System
	Wire Antenna System	- Spectrum Analyzer - Network Analyzer - Power Meter - VSWR Meter - EMI Test System
	Telemetry System	- Spectrum Analyzer - Network Analyzer - EMI Test System
	Microwave Source Using Klystron Tube	- Field Strength Meter - EMI Test System
	U.H.F. Transmitter	- Radio Communication Analyzer
	U.H.F. Transmitter	- Radio Communication Analyzer - EMI Test System
	Low Noise Front End Amplifier	- Spectrum Analyzer - Network Analyzer - Microwave Sources - Power Meter - EMI Test System
	Microwave Band-Pass Filter	- Spectrum Analyzer - Network Analyzer - Microwave Sources - Power Meter - EMI Test System
	Microwave Directional Coupler	- Spectrum Analyzer - Network Analyzer - Microwave Sources - Power Meter - EMI Test System
	Microwave Power Amplifier	- Network Analyzer - Microwave Sources - VSWR Meter - Power Meter
	Microwave Up-Down Converter	- Network Analyzer - Microwave Sources - VSWR Meter - Power Meter - EMI Test System
	Microwave High Power Reeliation System	- Spectrum Analyzer - Network Analyzer - Microwave Components - EMI Test System
	He-Ne Gas Laser System	- Optical Fibre Communication Test Set Up
	Slotted Waveguide Antenna	- Spectrum Analyzer - Microwave Power Meter - Microwave Sources - Network Analyzer
	Microwave Tracking Antenna with Auto-Measuring System	- Spectrum Analyzer - Microwave Power Meter - Microwave Sources - Network Analyzer
	Selftuning P.I.D. Controller	- Logic Analyzer - Digital Oscilloscope
	Micro Processor Based Cable-Harness Tester	- Logic Analyzer - Digital Oscilloscope
	80286 Based Simultaneous Control of Six-Axis Robotic Manipulator	- Logic Analyzer - Digital Oscilloscope

(2) Department of Metallurgy

The requested equipment is for undergraduate student experiments which are practice subjects in the curriculum, for study of master course's student, and for testing contracted by industries and cooperative research with industries. The experimental themes of undergraduate students, research themes of teachers and master course students and support services for industries are summarized in Table 3.3 in relation to the major requested equipment.

This department is preparing the establishment of a new course in material science which is a crucial area of technology in the modernization plan of the College. It is also playing a leading role in the establishment of the Material Science Center. It is necessary to replace obsolete equipment with the latest type and to add equipment for testing and research in the research fields and the student experiment subjects mentioned above. It is appropriate to provide various material testing machines, X ray qualitative and quantitative analyzers , vacuum induction type electric furnaces, heat treatment testers etc. in view that this department is active in R & D of heat resisting steel, special steel like hard alloyed steel and composite materials, and is preparing the establishment of new courses and the Material Science Center. The maintenance of equipment is the responsibility of teachers in charge and a few support staff members. The management and technical care regarding maintenance is in good order. The maintenance of requested equipment will be done in the same way. Technical ability of maintenance is enough. The electricity consumption is estimated about 1,400 KWh per month and there is no problem with the running cost. The contents of the requested equipment are summarized as follows.

Table 3.3 Present activities of Dept. of Metallurgy

	Contents	Main Equipments
Curriculum	Material Test Mechanical test of metal and plastic	- Computer Controlled UTM - Fatigue Testing Machine
	Metallography, Crystal structure analyzing test, metallic element analyzing test Experiment of metal with microscope, analysis of crystalline-granular texture and qualitative analysis, quantitative analysis	- X-ray Diffractmeter - Thermogravimetric Analyzer - Vacuum Emission Spectrometer - X-ray Microanalyzer for SEM
	Raw Material Treatment Practice of pretreatment for smelting	- Particle Size Analyzer - Induction Remelting Unit
	Metal Smelting, Molding Heat Treatment .Experiment of smelting for steel, alloy, nonferrous metals .Experiment of heat treatment	- Carbon Sulphur Analyzer - Portable Ultrasonic Flaw Detector - Auto Sonobard Ultrasonic Hardness Tester - Microhardness Tester
	Practice of advanced computer engineering Analysis with computer of experimental data	- Digital Oscilioscope - Computer Controlled UTM
Research	Study of functional metal material	- Vacuum Emission Spectrometer - X-ray Stress Analyzer
	Material strength under repeating load Study of hard metal, refractory special steel, special magnet alloy	- X-ray Microanalyzer for SEM - Carbon Sulphur Analyzer
	Cold rolling plate Study of metal surface texture, smoothness, frow	- Digital Oscilloscope - Computer Controlled UTM
Collaboration	Consigning test Quality test(strength, hardness, etc.) of metal rubber, plastic, etc.	- Strograph - Taber Type Abrasion Tester

(3) Department of Electrical Engineering

The main concern of the department is generation, transmission, distribution and transformation of electric power. The basic equipment is generators, motors, transmission lines etc. Electric power supply is one of the most important components of infrastructure. Electric power engineering includes software such as a power supply scheme. The power supply in India is not yet enough and still unstable. There are many power failures. In order to avoid excess load, measures are taken to ensure even consumption by allotting holidays on different days to different industries. Power supply technology is one of the most important technology. In this field, high voltage (above 500 kV) D.C. transmission is also drawing attention.

The recent progress of semiconductor technology is changing electric power engineering, as seen in D.C. transmission. (semiconductors are more efficient for rectifying action.) Actuators of a pulse motor (It is a motor which is driven by digital signals, also known as a slap motor.), an inverter (a device for converting D.C. into A.C.) etc. are also used commonly in industries. The technology for converting electricity into mechanical power or energy using electronics devices including control is called power electronics. India lags behind in this field because human labor is cheaper. However, power control requiring high precision and efficiency is not manually handled. The future development of this field is highly desirable.

Low cost automation (LCA) is considered a step before the present robots. This is an automation system which utilizes human power where it is advantageously available and utilizes electricity where it works better than human handling and tries to gain maximum cost-effectiveness. In India there are still many machines which use air pressure or oil pressure for control, but the processing facilities which use electric energy will be needed more. The development of LCA technology is highly desirable. Electrical engineering is requested to be developed as providing a basis to society and industry.

Education in undergraduate courses is centered on introductory electrical engineering and such basic experiments as A.C.-D.C. conversion using converters and inverters, characteristics of motors, actuators etc. For these experiments which are aimed at acquiring basic technique, ammeters, voltmeters, and/or oscilloscopes suffice. Even though meters and measurement instruments are obsolete and cumbersome to handle, they do for learning the principles. However, these now obsolete instruments were precision instruments in the old days and so inadvertent overloading causes easily damages and teachers must repair them. New equipment will enable students to touch on part of the latest technology and to acquire better knowledge and ability to apply it to the present situation.

Themes utilizing semiconductors dominate research reflecting the recent progress of semiconductor technology. High Voltage D.C. transmission was proposed and used in some part in the end of the 19th century when power transmission began. However, it did not developed as expected because the technology of A.C.-D.C. conversion was immature at that time. Recently the conversion efficiency has remarkably increased owing to semiconductor's applications and the HVDC transmission has begun to draw attention again. This department too has taken up several research themes in this field. So far expected results have not yet been attained since the available equipment is only oscilloscopes and some others. Addition of digital memories, recorders etc. will advance the analysis and design to a greater extent. Beside these, progress is expected in electronics and LCA.

There is no indication of expectations from industries for technical support services. It may be that the department has met the needs of the industry by producing engineers in the operations and maintenance of power plants and substations. The demand for technical support services in LCA such as providing cheap robot systems using microcomputers will increase. So far the department has succeeded in the production of a robot with only two joints. Further progress is expected. The demand for testing services is big and helping the local industries to a

great extent. The service charges are the ones approved by the State Government.

The equipment requested by the department is mainly for improving the undergraduate courses. It also includes more specialized equipment for three master courses in the department: Electrical Engineering, Power Electronics and Control Engineering (LCA). Furthermore some equipment for illumination engineering is also requested.

Expansion of the LCA Laboratory is under plan. This is a timely plan for the coming robot age. The equipment for LCA and part of the equipment for power electronics will be placed in the LCA Laboratory.

The equipment to be used in electrical engineering and power electronics has bigger rated capacity than that of electronics devices. However, the electricity charges do not amount to much since the operation time is short. The electricity charges paid for measurement instruments are in general not expensive. The cost of consumables like recording paper, ink etc. is negligible.

At present the repair of equipment is done by the support staff under the instruction of the faculty staff. Part of the requested equipment is complicated and can not be repaired by the College staff. The repair of this kind of equipment must be requested to the manufacturer or the sales agents. The budget to cover these costs is allotted. In fact, the MTBF of these high quality measurement instruments is long (more than 20,000 hours) and the expenses will not run up.

The testing services will be upgraded by the introduction of new equipment. The chances of cooperation with industries in the development of new products and new research will be increased by the introduction of new equipment. Especially automation of manufacturing processes in the region is expected to be developed with the expansion of LCA laboratory.

As mentioned above, the equipment requested by the Department of Electrical Engineering is for the experiments in high voltage technology, in power electronics, low cost automation and illumination technology. The department is equipped with basic experimental equipment to some extent. Therefore, the priority is placed on the expansion of equipment for power electronics and low cost automation for research and for support to industries, especially for the technical diagnosis of medium and small sized industries. In particular, self-learning robots and digital memories to be used in automation experiments and R & D, and simulators of electric power generation, transmission and distribution for student experiments will be provided.

Table 3.4 Present activities of Dept. of Electrical Enginnering

	Contents	Main Equipments
Curriculum	Electrical Engineering Study of electric power transmission, transformation	- Power Line Multitransducer - Multichannel Voltage & Current Source, etc.
	Power Electronics Study of semiconductor for motor actuator	- Analyzing Recorder with Colour Plotter - Digital Multimeter - Digital Electrometer, etc.
	Control Engineering Study of robotics	- Self Education Robotic Trainer - Digital Oscilloscope
Research	High Voltage Direct Current Power Engineering Study of problems concerning to DC/AC transformation	- Simulator - Power Line Multitransducer - Multichannel Voltage & Current Source - Digital Power Meter - Isolated Probe System
	Power Electronics Study of condenser, transformer, cable etc. for motor	- Analyzing Recorder - Digital Multimeter
	Low Cost Automation Study of robot and its control	- Self Education Robotic Trainer
Collaboration	.Testing and calibration services .Testing services for illumination equipment .Development of high voltage generation for power supply to X-ray tubes	- Power Line Multitransducer - Analyzing Recorder with Colour Plotter - Self Education Robotic Trainer - Portable Photometer

(4) Department of Instrumentation and Control

1) Background

This is the first department branched away from the Department of Electronics and Telecommunications. The recent progress of electronics is remarkable and measurement of almost all physical quantities is made electrically. Most of industrial machines and manufacturing process are equipped with measurement instruments which measure quantities of state electrically , process the information gained electronically and control the process electrically. This department deals with technology of electrical and electronical instrumentation. The students of the department take the same basic subjects except telecommunications as the students of the Department of Electronics & Telecommunications. The technology which is taught in this department will be used more widely as industrial machines and manufacturing process are improved and renovated. Another characteristic feature of this Department is research into biomedical electronics which is conducted by young professors (PhDs) who produced excellent achievements in the Indian Institutes of Technology (Technical Colleges of the highest level in India) in cooperation with local university hospitals. Biomedical electronics deals with electrical measurement of information sent from the heart, muscles etc. of a living body and observes various functions of a living body. Its progress is expected together with the progress of medical treatment.

2) Equipment in Relation with Education, Research and Technical Services

Education of undergraduate students is almost common to that of the Department of Electronics & Telecommunications. So the equipment of that Department is also used by this Department. Equipment proper to this Department is a single closed loop programmable controller and smart field communicators.

It has several research themes because the master course started this year. The major research activities are on instrumentation in biomedical electronics and a digital measurement system using microcomputers. The former concerns passive measurement of bio-information (electrical signals) sent by a human body. The objects of measurement are the heart, chest, muscles etc. The key issue is the development of sensors which requires standard instruments and calibrators. Requested equipment is mainly in this category. There are also active ways to obtain bio-information (a measurement instrument sends signals to a living body and measures the reflection of the signals). Technique using ultrasonics is an example.

The technical support service is planning to provide industries with a Distributed digital controller. Even small and medium businesses will be able to control easily their production process by measuring quantities of state (temperature, pressure, rotational frequency, quantity of flow, acceleration etc.) in the process using this instrument.

Measurement of quantities of a living body has been made in most cases utilizing mechanical means (for example, a clinical thermometer utilizes thermal expansion of mercury). However, electrical means are in more use recently because the accuracy is higher and the handling is easier. The cooperative programme with medical institutions intends to advance these applications. For this programme, equipment Group 1 is requested for the development of sensors and the necessary calibration instruments.

3) Improvement Plan

The undergraduate course will be improved through the improvement of the Department of Electronics & Telecommunications since basic equipment for education is common to both departments and can be shared by both. Equipment proper to this Department is digital instruments for measurement and control using personal computers which are to be used in

industrial instrumentation; and equipment for biomedical electronics. These pieces of equipment constitute nuclei to strengthen this young department. The master course was just opened this year and is expected to start full-scale research soon.

4) Operation and Maintenance

The expenses necessary for operating measurement instruments are only electricity charges. They are negligible. The ex penses for recording paper, pens, ink, floppy disks are also little and negligible. Some repair jobs are able to be done in the laboratory. Some complicated repair must be done by the manufacturers or sales agents. Provision of the budget for outside repair is necessary. But the MTBF of the equipment is in general long (more than 20,000 hours) and the repair costs do not run up.

5) Contribution to the Region

Provision of standard instruments to the local small and medium businesses will be received favorably. The cooperative programme with medical institutions is one of the most expected contribution from the College of Engineering, Pune.

Table 3.5 Present activities of Dept. of Instrumentation and Control

	Contents	Main Equipments
Curriculum	Transducer and Signal Improvement Study of transducer for sensor related to temperature, humidity, displacement, pressure, flowrate, etc.	- Analyzing Recorder - Data Acquisition System with Processing Unit - Digital Manometer - Digital Portable Calibrator - Ultrasonic Analyzer with Accessories - Elector Myographic Unit - Analyzer
	Control System Components Study of PID control, hydraulic and pneumatic technique	- Analyzer - Arbitrary Waveform Generator - Single Loop Programmable Controller - Smart Transmitter and Smart Field Communicator
	Electronic Instrumentation Study of character of electronic parts, analysis of signal wave with oscilloscope, analyzer, etc.	- Arbitrary Waveform Generator - Analyzing Recorder - Data Acquisition System with Processing Unit - Digital Manometer - Analyzer, etc.
Research	Reflected Ultrasound Study of reflected ultrasound for characterizing the media	- Ultrasonic Analyzer with Accessories - Analyzer - Analyzing Recorder, etc.
	Physiological Parameters Study of electric signal from heart, breast, muscles, etc.	- Electrical Engineering Set for Biomedical
	Distributed Digital Controller Study of production controller with IBM-PC	- Data Acquisition System with Processing Unit
	Microcontroller Based Instrumentation System Study of digital network between instrumentation and control	- Single Loop Programmable Controller - Smart Transmitter and Smart Field Communicator - Analyzer
Collaboration	Distributed Digital Controller Development of personal computer with add-on card and software	- Single Loop Programmable Controller - Analyzing Recorder - Data Acquisition System with Processing Unit - Analyzer, etc.
	Collaboration with Medical Institution Development of various instruments, systems for medical application	- Arbitrary Waveform Generator - Analyzing Recorder - Data Acquisition System with Processing Unit - Digital Manometer - Ultrasonic Analyzer with Accessories - Elector Myographic Unit - Analyzer - Digital Portable Calibrator

(5) Department of Civil Engineering

The weight of civil engineering is relatively low in the national projects which place stress on R & D of electronics, electricity and energy. The influence of automobile exhaust gas and industrial wastes on the environment has caused public concerns not only in Bombay or Pune but also in the whole country. The environmental pollution includes air pollution, noises, water pollution, soil contamination etc. Demand on the College of Engineering, Pune for solving these problems is strong from society. However, the College does not have equipment for R & D on the environmental pollution except for a gas collector to measure air pollution. It does not have any equipment to measure traffic volume and noises.

High technology areas are identified as priority areas to be strengthened in national plans. But the application of high technology lags behind in civil engineering. The existing equipment for surveying, drafting and urban planning is all obsolete analog type equipment. These instruments serve for teaching students principles of the subject, but are not useful for research. However, a digital drafter using computers, software for surveying and urban planning, a photoplotter etc. are considered to be too high level equipment in view of the present level of the faculty staff and the contents of education of the College. Concrete experiments, soil experiments etc. which are not included in priority areas can be conducted with the existing equipment.

The requested equipment is categorized by laboratories in the following table.

The relation between experiments and equipment is shown in the following table.

Table 3.6 Present activities of Dept. of Civil Engineering

	Contents	Main Equipments
Curriculum	Surveying Study of surveying totally with advanced digital equipment	- Soft-Ware for Land use and Transportation for Town Planning - Automatic Level - Distance Meter - Theodolite - Interprotoscope - Digital Planimeter - Digital Curvimeter with Microcomputer - Photoplotter 30' x 40'
	Environmental Engineering Analysis of air pollution gas	- Gas chromatograph - Gas Monitor for CO, H2O, SO2 Portable - UV Spectrophotometer - Particle Size Analyzer - Total Organic Carbon Analyzer - Sound Level Meter - Vehicular and Traffic Speed Analyzer with Video Speed Meter - 35mm Pentax Camera with Close-up and Telephoto Lenses, Filter, etc. Completer Kit - Simultaneous Slide Project and Sound System
	Drafting Study of advanced drafting machine	- Digitizing Drafting Machine - Plotter
	Material Testing	- Computer Controlled UTM System
Research	Surveying project for alignment of ring railway	- Distance Meter - Theodolite - Automatic Level - Digital Curvimeter with Micro-computer - Interprotoscope - Digital Planimeter
	Monitoring emission of various exhaust gases by traffic and industries	- Gas Monitor for CO, H2O, SO2, Portable - Gas Chromatograph - Total Organic Carbon Analyzer - Particle Size Analyzer - UV Spectrophotometer
Collaboration	Survey for irrigation projects percolation tanks, canal and dam alignment for Government	- Distance Meter - Theodolite - Digital Curvimeter with Micro-computer - Automatic Level - Digital Planimeter - Interprotoscope
	Monitoring of pollution due to traffic	- Gas Chromatograph - Gas Monitor for CO, H2O, SO2 Portable - UV Spectrophotometer - Particle Size Analyzer - Total Organic Carbon Analyzer - Sound Level Meter - Vehicular and Traffic Speed Analyzer with Video Sound Meter - 35mm Pentax Camera with Closeup and Telephoto Lenses Filter, etc. Completer Kit - Simultaneous Slide Projector and Sound System
	Development of new material with local industries	- Computer Controlled UTM System
	Study of new transportation system and land use	- Analyzer for Town Planning - Simultaneous Slide Projector and Sound System

(6) Department of Mechanical Engineering

1) Department of Mechanical Engineering

The requested equipment is basic equipment for undergraduate student experiments related to practice subjects in the curriculum and equipment for research by students in the master course and above. Equipment to be used for testing and cooperative research with industry is also included.

The experiment subjects, research themes and technical services to industry are summarized as follows:

- Measuring practice
- Production engineering
- Technology & Manufacturing Processes
- Machine Tool practice
- Tool design
- Welding practice
- Cutting method
- Tool material and jig design
- Efficient utilization of composite materials for tool
- Improving machining accuracy of CNC
- Press tool design, Software for CAD/CAM

Most pieces of the existing equipment are basic and obsolete, and must be replaced with new ones. The department is preparing, in cooperation with the Workshop, a new course in automation and mechatronics which are identified as important

areas in national technology promotion plans.

In these circumstances, it is requested to provide automatic control experiment apparatuses and equipment for CAD/CAM in order to modernize the Department and improve its education and research.

The operation and maintenance of new equipment will be done by the faculty and support staff in the same way as present. The quantity and quality of the staff is enough to do this new job. The electricity consumption is estimated to be about 540 kWh per month and it is not necessary to take special measures to cover additional costs.

The contents of the requested equipment are summarized in the following table.

Table 3.7 Present activities of Dept. of Mechanical Engineering

	Contents	Main Equipments
Curriculum	Fluid Mechanics Study of fluid mechanics, pump, compressor	- Flow Rate Control - Pneumatic Transducer Theory Apparatus
	Internal-combustion, automobile engineering Study of fuel injection pumps	- Fuel Injection Pump Tester
	Theory of mechanics and mechanism	- Servo Controlled Equipment - X-Y Plotter
	CAD Machine design and drawing	- Computing Data Logger
	Mechanical Measurement and control Study of distortion, vibration, friction	- Anemosystem
	Refrigeration and air conditioning Study of compression, solidification, expansion, evaporation	- Repeated Tension & Bending Fatigue Testing Machine - Digital Thermo Hygrometer
	Analysis and Synthesis of Mechanism Study of mechatronics	- Oil Hydraulic Servo Mechanism Experiments - Liquid Level Control Model Plant
	Heat Transfer Study of heat condition	- Anemosystem - Computing Data Logger
Research	Study of Tribology	- Vibration Meter
	Study of Journal Bearing	- Journal Bearing Demonstration Apparatus
Collaboration	Consigning Test Engine test, pump performance test, meter-calibration	- Sound Lead with Octave Band Analyzer - Vibration Meter

2) Workshop

The requested equipment is basic equipment for undergraduate student experiments related to practice subjects in the curriculum and equipment for research by students in the master course and above. Equipment to be used for testing and cooperative research with industry is also included.

The experiment subjects, research themes and technical services to industry are summarized as follows

At present the Workshop places emphasis on experimental research into machining. More than half of the themes listed above are on cutting and machine tools. Numerically controlled lathes and milling machines are available, although they are not of high quality. They are not yet compupterized. The level of CAD/CAM is low.

In the modernization plan of the College,the workshop is in charge of the establishment of a new course in automation/mechatronics which are identified as important areas in national technology promotion plan. It has further a future plan of setting up a MC machining center equipped with CNC machining tools to upgrade R & D on CAD/CAM and further CAE and robots, and intends to do research into a FMC, FMS, CIM computerized production systems.

In view of these plans, the requested equipment such as CNC 3-dimensional coordinate measuring machines, CNC multispindle lathes and various digital type measurement instruments etc. is indispensable to improve education and research in the future. It is desirable to provide these instruments urgently. The maintenance of equipment is the responsibility of the teachers in charge and a few support staff members. The management and technical care regarding maintenance is in good order. The maintenance of requested equipment will be done in the same way. Technical ability of maintenance is enough. The electricity consumption is estimated about 2,000 KWh per month and there is no problem with the running cost.

The contents of the requested equipment are summarized as follows.

Table 3.8 Present activities of Workshop

	Contents	Main Equipments
Curriculum	Measurement Practice of measuring with tools and equipment for machine parts	- Roundness Measuring Machine - Electronic Bore Gauge with Data Processor
	Production Engineering Study of production management and quality control	- 3-D Coordinate Measuring Machine - Electronic Height Gauge with Data Processor
	Production Process Study of CAM production system with machining centre and CNC	- 3-D Coordinate Measuring Machine - Roundness Measuring Machine
	Machine Tool Study of NC machine tools	- Twin Spindle CNC Chucker - Auto Loader & Robot
	Tool Design Design of cutting tools bite holder, drilling tools, chuck for milling machine	- Electronic Digital Micrometer - 3-D Coordinate Measuring Machine
	Welding Study of arc welding	- Electronic Depth Gauge with Data Processor - Electron Height Gauge with Data Processor
	Cutting Method Study of cutting speed, sending speed, cutting oil, cutting tools, etc.	- Screw Thread Measuring Machine - Twin Spindle CNC Chucker
Research	Study of tool material and jig design	- Twin Spindle CNC Chucker - Screw Thread Measuring Machine
	Study of efficient utilization of composite materials for tool structure	- 3-D Coordinate Measuring Machine - Twin Spindle CNC Chucker
	Study and analysis of CNC for improving machinery accuracy	- 3-D Coordinate Measuring Machine - Twin Spindle CNC Chucker
	Study of CAD/CAM for press tools	- 3-D Coordinate Measuring Machine - Twin Spindle CNC Chucker
Collaboration	Consigning test	- Dual Channel Frequency - Waveform Analyzer

1. Department of Electronics and Telecommunication

A. Equipment for Field Strength Meter

(1.11)	Measuring Receiverx	x
(1.12)	Field Strength Meter	o
(1.13)	Dipole Antenna	x
(1.14)	Log Periodic Antenna	x
(1.15)	Loop Antenna	x
(1.16)	Standard Dipole Antenna	o

B. Equipment for Communication Methods

(1.18)	Logic Analyzer	o
(1.19)	FM Linear Detector	x
(1.20)	Radio Communication Analyzer	o

C. Equipment for Microwave

(1.17)	Eelctronic Counter	o
(1.21)	Microwave Power Meter	o
(1.22)	VSWR Meter	x
(1.23)	Microwave Sources	o
(1.24)	Microwave Components	x
(1.25)	Coaxial Components	x

D. Equipment for Electronic Analysis

(1.1)	Spectrum Analyzer	o
(1.5)	Network Analyzer	o
(1.3)	Scalar Network Analyzer	o

E. Equipment for Optical Fiber Communication

(1.9)	Optical Fiber Communi-cation Test Set Up	o

F. Equipment for Computer Engineering and Communication

(1.8)	Interface Monitor	x
(1.4)	Logic Analyzer	o
(1.2)	Protocol Analyzer	x

G. Equipment for Waveform Synthesizer

(1.10)	Waveform Synthesizer	o

H. Equipment for Video Signal Processing

(1.7)	Video Signal Processing Equipment	o

I. Equipment for EMI test System

(1.6)	EMI Test System	o

J. Others

	Electronics Parts and devices	o
	Standard Equipment	o

2. Department of Metallurgy

A. Equipment for Material Test

(2.2)	Fatigue Testing Machine	o
(2.4)	Microhardness Tester	o
(2.14)	Strograph	x
(2.15)	Tuber Type Abrasion Tester	x
(2.16)	Rubber Hardness Tester	x
(2.17)	Specimen Punching Machine	x
(2.18)	Automatic Torsion	x
(2.19)	Creep Tester	x
(2.20)	Brittle Point Temperature Tester	x
(2.21)	Thermal Stability Tester	x
(2.22)	Computer Controlled UTM	x

B. Equipment for Metallography, Crystal Structure Analyzing Test

(2.1)	X-ray Diffractometer	x
(2.8)	Thermogravimetric Analyzer	x

C. Equipment for Metallic Element Analyzing Test

(2.5)	Vacuum Emission Spectrometer	o
(2.6)	X-Ray Microanalyzer for SEM	x

D. Equipment for Metal Smelting and Molding

(2.3)	Hisomet Microscope	o
(2.11)	Particle Size Analyzer	x

E. Equipment for Metal Smelting and Molding

(2.10)	Carbon Sulphur Analyzer	o
(2.13)	Portable Ultrasonic Flaw Detector	x

F. Equipment for Heat Treatment

(2.7)	Auto Sonobard Ultrasonic Hardness Tester	o
(2.9)	X-Ray Stress Analyzer	o

G. Equipment for Functional Metal Material

(2.12)	Induction Remelting Unit	o

3. Department of Electrical Engineering

A. Equipment for High Voltage Engineering

(3.2)	Power Line Multitransducer	o
(3.3)	Multichannel Voltage & Current Source	o
(3.4)	Isolated Probe System	o
(3.5)	Digital Power Meter	o
(3.6)	Electronic Hybrid Meter	o
(3.20)	H.V. DC Voltmeter	o
(3.21)	H.V. AC/DC Voltmeter	o
(3.22)	H.V. DC Transmission Line	o
(3.23)	Power Line Carrier Communication System	x
(3.24)	Power Station Simulator	o
(3.25)	Substation Simulator	o

B. Equipment for Power Electronics

(3.7)	Analyzing Recorder with Color Plotter	o
(3.8)	Digital Multimeter	o
(3.13)	C and Tan Delta Measuring Bridge	x
(3.14)	Fast Transient Digitizer	o
(3.15)	High Resolution, High Accuracy DMM	o
(3.16)	Digital Electrometer	o
(3.17)	Powerscope	o
(3.26)	H.V. Impulse Generator	o

C. Equipment for Low Cost Automation

(3.1)	Self Education robotic Trainer	o
(3.9)	Digital Oscilloscope	o
(3.10)	Digital Indicating Controller	o
(3.11)	Analogue Oscilloscope	o
(3.12)	Digital Memory	o

D. Equipment for Illumination

(3.18)	Portable Photometer	o
(3.19)	Test Chamber for Illumination	x

E. Others

	Electrical parts and devices	o

4. Department of Instrumentation & Control

A. Equipment for Biomedical

(5.1)	Arbitrary Waveform Generator	o
(5.2)	Analyzing Recorder	o
(5.3)	Digital Portable Calibrator	o
(5.4)	Data Acquisition System with processing unit	o
(5.5)	Digital Manometer	o
(5.8)	Ultrasonic Analyzer with Accessories	o
(5.9)	Electro Myographic Unit	o
(5.11)	FFT Analyzer	o

B. Equipment for Instrumentation

(5.6)	Single Loop Programmable Controller	o
(5.7)	Smart Transmitter & Smart Field Communicator	o
(5.10)	Optical Spectrum Analyzer	x

C. Others

	Electronics Measurement parts and devices	o
	Sensors	o

5. Department of Civil Engineering

A. Equipment for Surveying

(7.3)	Electronic Digital Theodolite	o
(7.1)	Automatic Level	o
(7.2)	Electronic Distance Meter	o
(7.5)	Digital Curvimeter with Microcomputer	x
(7.6)	Interprotoscope	x
(7.13)	Digital Planimeter	o
(7.20)	Software for Landuse and Transportation for Town Planning	x
(7.21)	Photoplotter	x

B. Equipment for Environmental

(7.7)	Gas Chromatography	x
(7.8)	UV Spectrophotometer	x
(7.9)	Particle Size Analyzer	x
(7.10)	Total Organic Carbon Analyzer	x
(7.15)	Portable Gas Monitor	o
(7.17)	Vehicular and Traffic Speed Analyzer with Video Speed Meter	x
(7.14)	Sound Level Meter	o
(7.18)	Traffic Volume Counter	x

C. Equipment for Town Planning

(7.11)	Analyzer for Town Planning	x
(7.16)	35mm Camera with Accessory	x
(7.19)	Simultaneous Slide Projector and Sound System	x

D. Equipment for Drafting

(7.4)	Digitizing Drafting Machine	x
(7.12)	Plotter with 10 Colors	x

E. Equipment for Structural Analyzing

(6.1)	Computer Controlled UTM System	o

6. Department of Mechanical Engineering

A. Equipment for Fluid Mechanics

(8.4)	Precision Integrating Sound Level Meter with Impulse and Peak Response	x
(8.5)	Sound Level with Octuve Band Analyzer	x
(8.18)	Liquid Level Control Model Plant	x

B. Equipment for Internal Combustion Engine

(8.13)	Fuel Injection Pump Tester	x

C. Equipment for Theory of Mechanics & Mechanism

(8.12)	Critical Revolution Experimental Apparatus	x
(8.14)	Cam Analysis Experimental Apparatus	x
(8.23)	Repeated Tension & Bending Fatigue Testing Machine	x
(8.11)	Experimental Device	x

D. Equipment for CAD Machine Design and Drawing

(8.1)	X-Y Plotter	o
(8.2)	X-Y Plotter	x
(8.6)	X-Y Plotter	x

E. Equipment for Mechanical Measurement and Control

(8.7)	Computing Data Logger	o
(8.15)	Servo Controlled Equipment	x
(8.16)	Pneumatic Transducer Theory Apparatus	x
(8.17)	Oil Hydraulic Servo Mechanism Experiments	x
(8.19)	Flow Rate control	x

F. Equipment for Refrigeration and Air Conditioning

(8.3)	Digital Thermo Hygrometer	o
(8.8)	Anemosystem	x
(8.22)	Fully Automatic Compressor Testing System	o

(8.20)	Pressure Control	x
(8.21)	Temperature control Model Plant	x
(8.25)	Electric Turn Table	x
(8.27)	Related Adaptors for Electric Turn Table	x
(8.28)	Vibration Testing Machine Electric Pulsator System	x

G. Equipment for Tribology

(8.9)	Vibration Meter	x
(8.24)	Universal Wear Testing Machine	x
(8.26)	Portable FFT Analyzer	x

H. Equipment for Journal Bearing

(8.10)	Journal Bearing Demonstration Apparatus	

J. Equipment for Production Engineering

(4.6)	Auto Loader & Robot	x

L. Equipment for Tool Design

(4.9)	Screw Thread Measuring Machine	x
(4.5)	Universal Gear Tester	o
(4.7)	Non-Destructive Coating Thickness Measuring Unit	x

I. Equipment for Measurement

(4.4)	Roundness Measuring Machine	x
(4.8)	Electronic Height Gauge with Data Processor	x
(4.10)	Electronic Depth Gauge with Data Processor	x
(4.11)	Electronic Bore Gauge with Data Pricessir	x
(4.12)	Electronic Digital Micrometer	x

K. Equipment for Machine Tool

(4.1)	3-D Coordinate Measuring Machine	o
(4.2)	Twin Spindle CNC Checker	x

M. Equipment for Cutting Method

(4.3)	Dual Channel Frequency Waveform Analyzer	x

3.2.5 Necessity of Technical Cooperation

This project involves provision of equipment for student experiments and research related to advanced technology fields. As considered in Section 3.2.4, the equipment to be provided is not highly advanced one and can be operated without problem by the faculty and support staff of the College of Engineering, Pune without further training.

There is a high level university, the Indian Institute of Technology near this College and many companies in Pune have enough technical competence. Through cooperation with these institutions and setting up joint research groups within the College, it is presumed that effective and efficient use of the equipment is possible.

3.2.6 Basic Policy in Cooperation

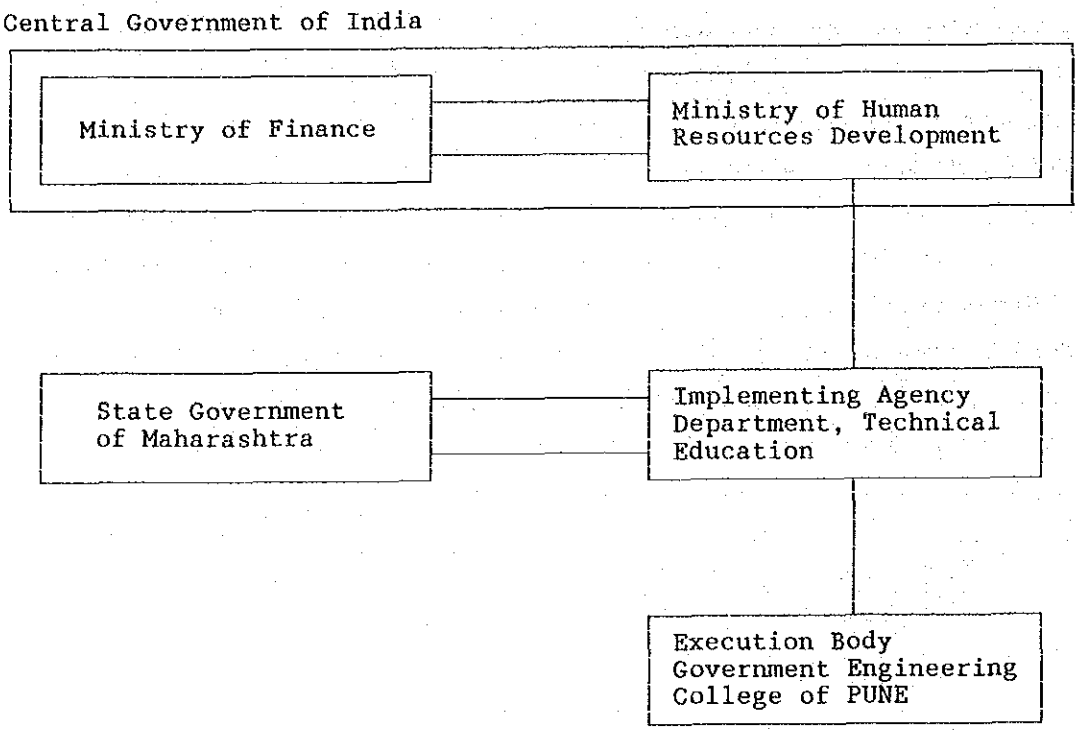
It is considered to be appropriate to implement this project by a Grant-In-Aid of the Japanese Government in view that the effects and feasibility of the project and the implementation capability of the recipient party have been confirmed, and the project is in line with the institution of the Grant-In-Aid of the Japanese Government. Consequently, assuming the implementation by a Grant-In-Aid of the Japanese Government, the project outline will be discussed in the following sections and a basic study design will be prepared. As mentioned in the discussion of the contents of the requested equipment, it is appropriate to modify the contents taking consideration of the present situation of the College.

3.3 Outline of the Project

3.3.1 Implementing Agency and Administration

The upper level organ of the College of Engineering, Pune which is the target of the project is the Directorate General of Technical Education of Maharashtra State. It was confirmed in the discussion with the Bureau of Technical Education in the Ministry of Human Resources Development of the Central Government that the Implementing Agency would be the Directorate General of Technical Education of Maharashtra State and the Execution Body would be the College of Engineering, Pune.

Fig 3.1 Implementing Agency and Execution Body of the Project



In the implementation of the project it is necessary to effect close liaison with the Directorate General of Technical Development (DGTD) which validates non-substitutability of imported goods by local products and gives import permission, the Ministry of Commerce which supervises Chief Controller of Import/Export(CCIE) who issues import license after import permission is granted, and the Ministry of Finance which is involved in A/P issue and services to be borne by India in the implementation of the project.

3.3.2 Plan of the Project

The project aims at expanding the equipment for experiments by the undergraduate and master course students of the College of Engineering, Pune and equipment necessary for the College to provide technical support services to industry.

Target departments: Department of Electronics & Telecommunications
Department of Metallurgy
Department of Electrical Engineering
Department of Instrumentation