

**Report of the
Reviewing Committee
of
Indian Institute of Technology Delhi**

**Ministry of Education & Social Welfare
Government of India**

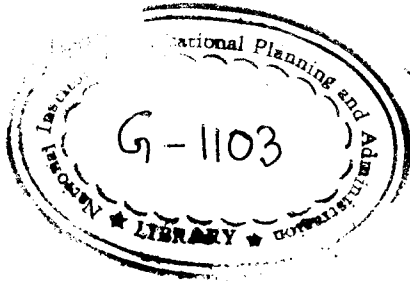
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**N 40, Panchshil Park,
New Delhi-17.**

16 September, 1972

From

**Dr. M.R. Chopra,
Former Vice-Chancellor,
Roorkee University
(Chairman, Reviewing Committee,
Indian Institute of Technology, Delhi)**

To

**The President of India,
New Delhi.**

Dear President,

I have the honour to forward herewith the Report of the Reviewing Committee appointed in terms of Government of India Resolution No. F-5-11/68-T.6, dated the 31st March, 1970, to review the work and progress of the Indian Institute of Technology, Delhi, since its inception.

Yours faithfully,

**(M.R. CHOPRA)
Chairman**

**APPOINTMENT OF THE COMMITTEE, ITS TERMS OF REFERENCE
AND WORKING**

1. We, the members of the Reviewing Committee of the Indian Institute of Technology, Delhi, have the honour to submit our report.

2. The Committee was appointed by the President of India in his capacity as the Visitor of the Institute and in exercise of the power vested in him under sub-section (2) of section 9 of the Institutes of Technology Act, 1961 (59 of 1961).

3. The Committee consisted of:

- | | |
|---|-----------------|
| 1. Dr. M.R. Chopra,
Vice-Chancellor,
Roorkee University,
Roorkee. | Chairman |
| 2. Shri A.K. Ghose,
Vice-Chairman,
Central Water and Power Commission,
New Delhi. | Member |
| 3. Dr. P.S. Gill,
Director,
Central Scientific Instruments Organisation,
Chandigarh. | Member |
| 4. Dr. A.K. Kamal,
Professor of Elect. Communication Engineering,
Roorkee University,
Roorkee. | Member |

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|--|-----------|
| 5. Shri N. Balasundaram,
Managing Director,
Eastern Electronics Ltd.,
Faridabad. | Member |
| 6. Shri D.V. Narasimham,
Deputy Educational Adviser (T),
Ministry of Education and Youth Services,
New Delhi. | Secretary |

4. The terms of reference to the Committee were :

- (a) to review the present progress of the Institute of Technology in the fulfilment of its broad objective as a centre of advanced studies and research in science, engineering and technology ;
- (b) to examine how far the Institute has interacted with other technical institutes with particular reference to courses of study, programmes of research and faculty development ;
- (c) to assess the over-all impact of the Institute on the training of high grade engineers for the technological development of the country ;
- (d) to recommend the lines along which the Institute should be further developed for advanced studies and research, taking into account the developments that have taken place or are projected at the other Institutes of Technology and the Indian Institute of Science, Bangalore ; and
- (e) to report on any other aspect or aspects that are relevant to the over-all functioning of the Institute.

5. The Committee held its first meeting on 25th July, 1970 and decided on the plan of work. The Committee in all held 24 meetings to complete the review and finalise the report and recommendations. During the course of our review, we visited all the departments, the laboratories, the library, the students' hostels and recreational facilities and had detailed discussions with the concerned staff members. We had discussions with the Chairman, Board of Governors, the Senate, the Director and the Professors and Heads of Departments. We also invited suggestions for improvements in the work of the Institute from all categories of staff. We received a number of representations in response to our invitation and we had discussions with representatives of other teaching staff, supporting staff and administrative staff.

6. The authorities of the Institute supplied the Committee with the following documents :

- (i) IIT Delhi Act and Statutes.
- (ii) Revised Development Plan of the Institute (1966).

- (iii) **IV Five-year Plan of the Institute.**
- (iv) **Reports of the Departments.**
- (v) **Report of the Director.**
- (vi) **Revised Estimates 1971-72 and Budget Estimates 1972-73.**
- (vii) **Copies of Annual Reports.**
- (viii) **Prospectus 1970-71.**
- (ix) **Post-graduate Programmes 1970-71.**

7. We wish to express our grateful thanks to the Director, other authorities and members of the staff of the Institute for the kindness and courtesy shown to us and for the opportunity afforded to become acquainted with the various aspects of the work of the Institute and to all those who have taken much trouble to help us to acquire information which has been of service to us in our work.

8. We are greatly indebted to the Secretary of the Committee, Shri D. V. Narasimham, Deputy Educational Adviser (Tech.) to the Government of India, Ministry of Education and Social Welfare, for his able assistance in various ways especially in the preparation of the report. We record with great pleasure our high appreciation of the manner in which he carried out his duties and assisted in our relations with all concerned.

M.R. CHOPRA
Chairman

A.K. GHOSE
Member

P.S. GILL
Member

A.K. KAMAL
Member

N. BALASUNDARAM
Member

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CHAPTER—I

HISTORICAL BACKGROUND AND PRESENT STATE OF DEVELOPMENT

Historical Background

1.01 In pursuance of the recommendations made by the Sarkar Committee in 1945, the Government of India established four higher technological institutes to meet the large demand of technical personnel for post-war industrial development in the country. The institutes are located at Kharagpur, Bombay, Kanpur and Madras and were established in the years 1950, 1958, 1960 and 1959, respectively.

1.02 These institutes were modelled on the Massachusetts Institute of Technology in the United States of America and have been established with the objective of providing facilities on an extensive scale for advanced work and research in various branches of engineering and technology and training students in specialised fields for which facilities did not exist in the country. The Institutes are also expected to improve the tone of engineering and technological education in the country as well as to meet the special needs of industry which could not be achieved in the normal way.

1.03 The Institutes undertake training at first degree level in certain branches of engineering and technology to meet the needs of well-trained personnel. It was envisaged that the desirable proportion of under-graduate to post-graduate students would be 2 : 1 and that each of the institutes would ultimately have a total student population of around 3,000.

1.04 In order to enable them to function effectively they have been established as fully autonomous institutes and were declared institutes of national importance under the Institutes of Technology Act of 1961.

1.05 The Indian Institute of Technology, Delhi has its origin in the College of Engineering and Technology, Delhi. In 1958, proposals were first made to establish in collaboration with the Government of the United Kingdom and British industries, a College of Engineering and Technology at New Delhi.

1.06 A Trust called the Delhi Engineering College Trust was established in London for the purpose. As part of the programme of collaboration, the London Trust in the first instance agreed to give assistance amounting to £ 250,000, secondment of 10 British Professors and two Workshop Supervisors and provision for 10 training places for Indian faculty every year in U.K. universities.

1.07 Soon after, a 250-acre plot was acquired at Hauz Khas and the College of Engineering and Technology, Delhi was established in 1961 and registered under the Societies Registration Act of 1960 with its administration vesting in an autonomous Board of Governors.

1.08 The College was affiliated to the University of Delhi and students were admitted to under-graduate courses in Civil, Chemical, Electrical, Mechanical Engineering and Textile Technology for the B.Sc. Engineering Degree of the University of Delhi. The original proposals envisaged a student enrolment of 1,350 at the under-graduate level and 150 at the post-graduate level.

1.09 Shortly after the College started functioning, it was felt, both in India as well as in the U.K. that the scope of collaboration may be enlarged and that the status of the Delhi College of Engineering should be raised to the level of other institutes of technology in the country. Accordingly in 1963, the Government of India moved an amendment to the Institutes of Technology Act raising the status of the College of Engineering and Technology, Delhi and renaming it as Indian Institute of Technology, Delhi.

1.10 The Institute was thus empowered to formulate its own academic programmes and confer its own degrees. Simultaneously, the U.K. aid was also revised from £ 250,000 to 650,000 for equipment, secondment of 15 British Professors, 4 technicians and 10 places for higher training in the U.K., every year for the Indian faculty.

1.11 An intimate contact between the Imperial College of Science and Technology, London and the Indian Institute of Technology, Delhi, was also established for the development of the programme of collaboration between the two Institutes in the future. This collaboration was initially agreed to for a period of three years from the end of 1967 and as a result of further discussions in October 1970, it was agreed to extend the collaboration for another three years on the expiry of the term of the previous agreement, i.e., from December 1970.

1.12 After examining the needs of the various departments of the Institute, the Government of the U.K. also agreed to increase its assistance for equipment by an additional amount of £ one million. The general plan of operation for this assistance is now under discussion.

Original Development Plan

1.13 The original proposals of the Delhi College of Engineering envisaged a student enrolment of 1,350 at under-graduate level and 150 at the post-graduate level. At the time of commencement, however, the post-graduate enrolment was sought to be increased to 300 in 1962 and the first development plan was drawn accordingly, involving a non-recurring expenditure of Rs. 663.5 lakhs and annual recurring expenditure of Rs. 75.03 lakhs.

1.14 The plan provided for residential accommodation for all academic staff and the students and accommodation to cover 25% of the supporting staff.

1.15 In 1963 at the time of changing the status of the Delhi College of Engineering to that of Indian Institute of Technology, the Government of India approved a non-recurring expenditure of Rs. 565.00 lakhs (excluding the cost of equipment to be received from the U.K.) and an ultimate recurring grant of the order of Rs. 65 lakhs per annum subject to detailed scrutiny of final plans.

1.16 This approval was for a student enrolment of 1,250 for under-graduate courses and 300 for post-graduate and research courses.

The Revised Development Plan

1.17 In 1966, the Institute formulated a Revised Development Plan involving a non-recurring expenditure of Rs. 788 lakhs as against Rs. 663.5 lakhs in the original estimates of 1962.

1.18 According to the Institute this was necessary because the post-graduate enrolment was raised again from 300 to 400 and also the final purchase price of the land and building costs were higher than those initially provided for. The increase in non-recurring estimates was also necessitated to provide for change in scope of post-graduate courses at the Institute, as outlined by the Council of IITs, at its 5th meeting in 1965, where it was suggested that the post-graduate in-take should be progressively increased so that the ratio of post-graduate to under-graduate students could be increased from 1 : 3 to 1 : 2, and also the Institute should develop facilities for post-graduate and research in applied sciences and technology.

1.19 A break-up of the revised non-recurring estimate of Rs. 788 lakhs is given in Annexure I.

Present State of Development

1.20 The revised development plan of 1966, the stage of its implementation by 31st March, 1969 and the carry over of the development into the 4th plan period are discussed in the following paragraphs.

Teaching Staff

1.21 The development plan provided for a total teaching staff of 216 consisting of 10 Senior Professors, 24 Professors, 80 Assistant Professors and 102 Lecturers. In addition, the Institute, during the 4th Plan, provided for additional 24 teaching posts (7 Assistant Professors and 17 Lecturers) for specialised services such as supervised practical training, Workshops, Computer Centre and Instrument Design Development Centre.

1.22 The break-up of the teaching staff between the various departments and specialised services as provided for in the revised development plan, the Institute's Fourth Plan, the

staff actually in position and the difference of Fourth Plan posts with staff in position may be seen in Annexure II.

1.23 The staff provided for in the revised development plan is on the basis of 16 to 18 hours of load per staff member per week. It also works out to staff to student ratio at 1 : 5 for post-graduate student body and 1 : 10 for under-graduate student body (1,350 UG + 400 PG).

1.24 The total student body of the Institute in 1971-72, excluding part-time research students, is 1,827. For a teaching staff of 230 actually in position, the staff to student ratio works out to 1 : 8.

Supporting Staff

1.25 The supporting staff provided for in 1966 development plan, that in position on 1.1.72, sanctioned staff in the Fourth Plan and difference between sanctioned Fourth Plan staff and staff in position is as follows :

	Development Plan 1966	Staff in position as on 1.1.72	Sanctioned staff in 4th Plan	Difference between sanctioned 4th Plan staff and staff in position
A—Dept. Office staff	58	62	68	(—) 6
B—Technical staff	232	218	290	(—) 72
C—Drawing Office staff	20	18	24	(—) 6
D—Class IV staff	105	95	129	(—) 34

1.26 Administrative, Ministerial, Technical and Operative staff as provided for in the development plan, that in position on 1.1.72 and sanctioned posts under the 4th Plan with difference of staff sanctioned vis-a-vis staff in position is shown below :

	Development Plan	In position as on 1.1.72	Sanctioned posts under the 4th Plan	Difference in staff sanctioned for 4th Plan vis-a-vis staff in position
A—Officers	26	28	31	(—) 3
B—Ministerial technical staff	306	403	473	(—) 70
C—Class IV staff	379	313	376	(—) 63

1.27 The number of Deans shown under the development plan is only 3 (but there are six posts in the 4th Plan provision). There is, however, no extra cost involved because

3 more senior faculty members have been associated with the management of the Institute. It may also be observed that under the 4th Plan, the post of one Public Relations Officer, one Assistant Registrar and one Superintendent, Student Affairs, have been provided in addition to the posts provided in the development plan.

1.28 Regarding the Ministerial, Technical and Operative Staff, the main increase is in relation to Operative Staff in the hostel (10), maintenance of buildings (25) and some increase in the Ministerial Staff (29). There is also an increase of 63 in Class IV posts.

1.29 The increase in Operative Staff in the hostel is aimed at maintaining peace on the campus by efficient organisation of the student facilities and extra-curricular activities for which the development plan provision was inadequate. The buildings of the Institute having all come up, their maintenance has assumed a substantial importance for which it was necessary to employ regular labour force of workers and supervisors which hitherto was on a temporary basis on the works side.

Land and Development

1.30 The Institute purchased 325 acres of land and developed approximately 250 acres which is at present in use. For this an amount of Rs. 67.96 lakhs was spent. Out of a provision of Rs. 125.78 lakhs for land acquisition, site development and general services, up to March 1969, the Institute incurred an expenditure of Rs. 100.10 lakhs carrying over the balance of Rs. 25.68 lakhs along with additional requirements for new works of Rs. 9.21 lakhs, i.e., a total of Rs. 34.29 lakhs as 4th Plan requirement.

1.31 The additional requirements are (a) Rs. 2.50 lakhs for providing a boundary wall right around the periphery of the Institute in place of the originally proposed boundary wall and fencing, (b) a sum of Rs. 5.71 lakhs for a second 500 kVA sub-station with an independent source of supply to increase the reliability of the power-supply of the Institute, and (c) an amount of Rs. 1 lakh for a reservoir and boosting station near the residential area for improving the present unsatisfactory water-supply position to the staff quarters.

Building

Academic and other Non-residential

1.32 The development plan has a provision of Rs. 699.81 lakhs for the academic building complex consisting of Science and Engineering Departments (717,846 sq. ft. plinth), Workshops (42,455 sq. ft. plinth), Administration and Central Services Building (68,481 sq. ft. plinth), and an Assembly Hall (34,000 sq. ft. plinth) with a small provision for temporary structures and air-conditioning of limited areas in the building. Against this, up to March 1969, a sum of Rs. 143.76 lakhs was spent for building 6.31 lakh sq. ft. carrying over Rs. 23.15 lakhs to the 4th Plan.

1.33 The revised development plan did not provide for a separate Computer Centre Building as it was intended to house the computer in one of the laboratories in the Multi-

storey Block. When the computer arrived, this arrangement was found unsatisfactory and the Institute built a separate Computer Centre with the provision already existing for the Assembly Hall (construction of which is now abandoned).

1.34 In addition to the carry over, the Institute estimated an amount of Rs. 23.63 lakhs for additional works in the 4th Plan. These comprise :

(a) Air-conditioning of Computer Centre	Rs. 4.00 lakhs
(b) Construction of additional three-storeyed Lab. Block	Rs. 9.26 lakhs
(c) Instrument Design Development Centre Building	Rs. 7.70 lakhs
(d) Air-conditioning of I.D.D. Centre and Lecture Theatre	Rs. 2.67 lakhs
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	Rs. 23.63 lakhs
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Student Residential Buildings

1.35 The development plan provided Rs. 78.78 lakhs (including 1% contingency) for hostel accommodation for 1,750 students. Against this, the Institute built accommodation for 1,815 students including accommodation for 40 girl students, 23 married research scholars and 50 foreign students at a cost of Rs. 81 lakhs, the excess from the provision being met from savings under other heads.

1.36 The Institute estimates the student enrolment to go up by 2,000 (1,300 undergraduate, 625 post-graduate, 50 foreign students and some CSIR scholars and research workers against other schemes). Additional hostel accommodation for 200 students is, therefore, suggested by the Institute at a cost of Rs. 15.84 lakhs.

Student Recreational Buildings

1.37 The development plan provided Rs. 18.57 lakhs for student recreational buildings and amenities (gymnasium, stadium, squash-racket courts, cricket pavilion, swimming pool, open air theatre, etc.). Those were provided by March 1969 at a cost of Rs. 14.86 lakhs, the excess expenditure being met from contingencies and other savings.

1.38 Gymnasium Hall is also utilised for other activities including lectures and film shows which made it necessary to provide sound proofing to it at an extra cost of Rs. 50,000 for which additional funds are to be provided in the 4th Plan.

Accommodation for Staff

1.39 The Institute is required to provide accommodation on the campus for all academic staff and for 50% of the supporting staff. The development plan provided for 949 units of staff quarters at a cost of Rs. 146.6 lakhs. The Institute, by March 1969, built 680 units at a cost of Rs. 116.49 lakhs. The carry over of Rs. 12.67 lakhs is adequate to build the remaining number of staff units.

1.40 The academic staff sanction has, however, increased to 276 in the 4th Plan and the Institute needs additional 35 units at a cost of Rs. 14.4 lakhs.

1.41 Although there has been an increase in supporting staff as well, no additional units for them are proposed by the Institute since in its view such staff members can easily find accommodation in the new sufficiently developed vicinity of the Institute.

Miscellaneous Buildings

1.42 These include sick bay and dispensary, school, guest house, club office and shopping centre, post office, accommodation for hostel bearers (200 units) for which a provision of Rs. 16.41 lakhs was made in the development plan. An expenditure of Rs. 6.07 lakhs was incurred on these items till March 1969. With the carry over of Rs. 10.34 lakhs to the 4th Plan, the rest of the work was completed.

1.43 The school which originally was to be only up to the VIII class, has now been made a higher secondary school under the Central Schools Organisation for which an additional amount of Rs. 5 lakhs is required in the 4th Plan.

Equipment, Books and Furniture

1.44 The development plan provided Rs. 147.96 lakhs for equipment, books and furniture, against which an expenditure of Rs. 115.93 lakhs was incurred up to March 1969, with a carry over of Rs. 32.03 lakhs into the 4th Plan. At the under-graduate level, equipment for laboratories, library books and furniture have been adequately provided.

1.45 On account of the increased activity at the post-graduate level, the Institute estimates a minimum expenditure of Rs. 114.42 lakhs in the 4th Plan. Thus, in addition to the carry over of Rs. 32.03 lakhs, an additional sum of Rs. 82.39 lakhs is needed during the 4th Plan period.

Imported Equipment

1.46 Of the £ 650,000 worth of equipment agreed to be provided by the U.K. Government, the Institute by March 1969, received equipment costing £ 535,000. The balance of £ 115,000 is a carry over to the 4th Plan.

1.47 A provision of Rs. 25.91 lakhs was made in the 4th Plan only for this carry over. It is, however, necessary that the entire value of the equipment has to be set off against Plan provision. The ceiling of equipment from U.K. has now been enhanced to £ 900,000 and already the value of equipment received up to date is £ 716,925. The Institute has proposed a revised 4th Plan provision of Rs. 125.91 lakhs for the set off of U.K. equipment comprising the carry over of Rs. 25.91 lakhs and an anticipated delivery of equipment worth Rs. 100 lakhs in the remaining years of the 4th Plan.

1.48 The Institute initially formulated a 4th Five-year Plan for an expenditure of Rs. 307 lakhs which has been revised to Rs. 506 lakhs on account of the various factors

discussed above. This increased provision will absorb the set off for the whole enhanced value of U.K. equipment delivered in the 4th Plan period and also provide the necessary infra-structure for research and post-graduate activity at the Institute.

1.49 A summary of Plan proposals initially formulated and revised, may be seen in Annexure III.

Recurring Expenditure

1.50 When it was decided to convert the Delhi College of Engineering to an Institute of Technology, it was estimated that the ultimate recurring expenditure would be of the order of Rs. 65 lakhs per year. This has reached Rs. 95.50 lakhs in 1968-69, Rs. 106.5 lakhs in 1969-70, and Rs. 124.68 lakhs in 1970-71.

1.51 The detailed break-up of recurring expenditure, actuals for 1970-71, sanctioned and revised estimates for 1971-72 and budget estimates for 1972-73, may be seen in Annexure IV.

The total recurring expenditure for 1970-71 was Rs. 124.68 lakhs made up of :

(i) Staff remuneration	Rs. 78.13 lakhs
(ii) Operational and other expenses	Rs. 37.53 lakhs
(iii) Estate maintenance	Rs. 9.02 lakhs
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	Rs. 124.68 lakhs
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1.52 Of the total amount of Rs. 78.13 lakhs on staff remuneration, Rs. 28.33 lakhs is on academic staff up to Associate Lecturers and Rs. 14.16 lakhs on supporting and other staff. The rest of the amount Rs. 34.64 lakhs is spent on staff for general administration, upkeep and maintenance of the Institute and the campus.

1.53 Of the total amount of Rs. 37.53 lakhs spent on operational costs and other expenses, Rs. 8 lakhs is on academic departments including library and Rs. 12.86 lakhs is on students' scholarships and amenities.

Courses of Study, Admissions and Out-turn

1.54 The Institute has been offering under-graduate courses in five disciplines—Civil, Chemical, Electrical and Mechanical Engineering and Textile Technology since 1961 and has reached a total student enrolment of 1,300.

1.55 The revised development plan of the Institute provides for an enrolment of 400 students to post-graduate courses and research. The Institute has now a proposal to establish under-graduate courses in applied sciences (M.Sc.) of five years' duration, keeping the total under-graduate enrolment at the existing figure of 1,300. This is to be achieved by reducing annual admission to the engineering disciplines—each of them admitting 45 students per year and in addition 15 foreign students to all 5 disciplines

along with 20 students per year to M.Sc. Applied Science courses ($5 \times 45 + 15 + 20 = 260$ per year or $260 \times 5 = 1,300$ total enrolment).

1.56 The student enrolment to post-graduate courses and research has now been fixed at 625. The Institute has already established 18 M.Tech. post-graduate courses and 4 one-year post-graduate diploma courses in different branches of Engineering and Science. There are also 3 two-year M.Sc. courses in physical sciences. There is a proposal to establish a two-year M.Tech. course in Industrial Management and Behavioural Sciences in the Humanities and Social Sciences Department and 2 one-year post-graduate courses in Systems Engineering and Operational Research during the 4th Plan period.

1.57 Annexure V shows the post-graduate courses already established and those provided for in the 4th Five-year Plan. The current enrolment is 425 students in post-graduate courses and 107 for research.

1.58 So far 6 batches of students have graduated from the Institute. The various degrees and the number of candidates who were awarded these degrees is shown below:

	64-65	65-66	66-67	67-68	68-69	69-70	70-71	Total
B.Tech.	—	111	202	218	193	251	247	1,222
M.Sc.	—	12	14	21	22	18	33	120
M.Tech.	4	7	18	32	49	78	101	289
Post-graduate and Post-M.Sc. Diploma	10	11	10	17	21	16	14	99
Ph.D.	—	1	5	16	12	30	20	84
Total	14	142	249	304	297	393	415	1,814

1.59 The placement position of B.Tech. graduates for the 4 years from 1965-66 to 1969-70 is as follows:

	Mech. Engg.	Elect. Engg.	Civil Engg.	Chem. Engg.	Text. Tech.
No. of Graduates	250	245	187	213	88
No. absorbed in industry	138	127	93	137	68
No. in higher studies/practical training:					
(a) in India	27	33	30	22	6
(b) abroad	72	58	32	34	13
Position not known	13	27	32	20	1

1.60 It will be seen from the above that of a total of 983 B.Tech. trained at the Institute in the 4 years 209 or 22% have gone abroad. The highest percentage is in Electrical Engineering and Mechanical Engineering—between 26% and 30% and the lowest in Textile Technology—12%. Of the graduates absorbed in industry, those in Textile Technology show the highest percentage about 78%.

CHAPTER—II

OBJECTS, CHARACTER AND DIRECTION

Objects

2.01 The Institutes of Technology were set up outside the university system under a separate Act of Parliament with the object of creating centres of excellence where education and training of applied scientists and technologists could be undertaken at internationally accepted standards.

2.02 These Institutes are required to fulfil the obvious need for building up cadres of teachers, research workers, development engineers and managers for industry for building a firm base of technical know-how for our economy and providing facilities and congenial environment for our young scientists to think of future technologies relevant to our economic and socio-political system.

2.03 The Indian Institutes of Technology Act empowers the Institute to provide for instruction and research in such branches of engineering and technology, science and arts as the Institute may think fit and for the advancement of learning and dissemination of knowledge in such branches.

2.04 We hold the view that the Indian Institute of Technology in achieving the above objectives should complement the excellence of engineering and technological education and developments in other institutions rather than engaging themselves in similar lines of work as of those institutions. This clearly lays emphasis on post-graduate courses, research activities and industrial consultancy.

2.05 We are pleased to note that the Council of Indian Institutes of Technology in 1965 came to the conclusion that while the normal university system should provide for under-graduate training in technology, the Institutes of Technology should concentrate on developing facilities for post-graduate and research work in applied sciences and technology at the highest level. The need for maintaining a small intake of students at the under-

graduate level was recognised and it was suggested that the ratio of post-graduate to under-graduate students should increase from the existing value of 1 : 3 to 1 : 2.

2.06 The Indian Institute of Technology, Delhi, has already taken steps to achieve this ratio. The number of full-time students in post-graduate and under-graduate courses in 1971-72 is 667 and 1,160, respectively. In addition, there are 65 part-time research students in the Institute in 1971-72.

2.07 We should, however, like to see this ratio of post-graduate students to under-graduate students being further increased to 1 : 1 in the course of the next 2 plans, i.e., 5th and 6th Plan periods while the total student body in the Institute may remain at about 2,000. This means that there should be a total enrolment of 1,000 students in the post-graduate courses and research activities by the end of the 6th Plan period.

2.08 We are aware that there are several difficulties in achieving this high student enrolment in the post-graduate courses particularly in the Departments of Engineering and Technology while the position regarding enrolment to the Departments of Science and Humanities may be comparatively easier. This is so because many bright engineering graduates after a long institutional course would like to go for employment readily available to them on reasonably attractive terms. The acquisition of post-graduate qualifications in the present set-up of the country generally does not add any additional emoluments at any rate in the beginning of their career. There is also the attraction for a number of these graduates to go to foreign countries either for employment or for post-graduate studies.

2.09 An analysis of the total post-graduate enrolment at the Institute in the year 1971-72 reveals the following : The total enrolment is 712, made up of 422 post-graduate students and 290 research scholars.

2.10 Of the 422 students in post-graduate courses 410 are regular Institute students and 12 others. In the 410 regular students there are 151 in the Departments of Mathematics, Physics and Chemistry whereas the six Departments of Engineering and Technology claim only 259 students.

2.11 Of the 290 research scholars only 106 are on full-time basis, the balance 184 being part-time from CSIR and other organisations. Of the full-time research scholars 41 are in the three Departments of Mathematics, Physics and Chemistry and 65 in the six Departments of Engineering and Technology. The distribution of 184 part-time research scholars is 108 in the Departments of Mathematics, Physics and Chemistry and 76 in the Engineering departments.

2.12 Thus taking only the full-time students in the post-graduate courses and research activities there are as many as 192 students in the three Departments of Mathematics, Physics and Chemistry while the six Engineering and Technology departments can account for only 315 students.

2.13 Again including the part-time research students also, there are as many as 300 students in the Departments of Mathematics, Physics and Chemistry and only 391 in all the Engineering departments. This clearly shows the imbalance in the emphasis, running contrary to the avowed character and objectives in the establishment of the Institute of Technology.

2.14 From the above analysis it is clear that it is not enough to establish a ratio of post-graduate to under-graduate students of 1 : 1 in the Institute which could be achieved by admitting disproportionately large numbers to the Departments of Science and Humanities.

2.15 We would, therefore, further desire that there should also be an attempt in maintaining a ratio of post-graduate enrolment in the Departments of Science and Humanities to those in the Departments of Engineering and Technology. We would suggest that the 1,000 proposed post-graduate enrolments should be distributed as 275 in the Departments of Science, 25 in the Department of Humanities and 700 in the Departments of Engineering and Technology.

2.16 A suggested detailed distribution of 1,000 places for post-graduate courses and research activities is shown in Annexure VI. This, we believe, can ensure the proper direction and avowed character of the Institute as a centre of excellence in engineering and technology.

2.17 We have earlier pointed out that sufficient number of engineering graduates are not attracted to post-graduate courses or research work. Even those that are admitted are not generally the best. Adequate measures have to be adopted particularly at the governmental level to correct this.

2.18 In the first place, sufficient inducement should be provided by offering better emoluments and promotional prospects to post-graduate students in engineering and technology.

2.19 Their pursuing these courses should not be an additional burden on their parents and, therefore, all post-graduate students should be given scholarships and those in research courses taking longer periods should be given scholarships of higher value.

2.20 As a matter of policy, technical departments of Central and State Governments and Public Sector organisations, should have regular programmes of sending their selected engineers for post-graduate courses in their own specialised areas. This will surely raise the technical competence of the concerned departments and encourage them to improve and modernise their outlook and performance. We are pleased that of late the Defence Ministry has been taking some active interest in this direction but other Ministries and organisations could also make similar efforts.

2.21 Finally, we would suggest that Indian students should not be allowed to go abroad for more M.Tech. courses as most of these facilities are now available in India and they should be fully utilised. In our view this will not only save some avoidable foreign

exchange expenditure but also retain brighter Engineering graduates in the country and make them available for various development programmes. It was earlier pointed out that in 4 years from 1965-66 to 1969-70, 20% of Delhi IIT graduates had gone abroad. This has reached 26% and 30% in the Departments of Electrical and Mechanical Engineering.

2.22 We have come across the criticism that the Institute has more or less the same attitude and outlook as that of traditional universities and that it has yet to distinguish itself as a centre of excellence in the field of Engineering and Technology. The first part of the criticism may have something to do with the present role of the Departments of Science and Humanities in the Institute. The second part of the criticism may be considered a little premature since it is only recently that the Institute has been established fully and just reached a stage for further development at the post-graduate and research level.

Engineering Education for National Requirements

2.23 Engineering education is very expensive and requires excellence in terms of qualified personnel and equipment. A basic understanding of science and humanities is very important in engineering studies. But a proper perspective has to be maintained in the role of these departments vis-a-vis the main departments of engineering and technology in an Institute of Technology if we have to achieve good results with the limited resources available in a developing country like ours. This situation may undergo a change when the country as a whole develops.

2.24 An engineer or a technologist has to assume management responsibilities on graduation. It is, therefore, important that he should have training in social sciences, economics and business administration. An understanding of management responsibilities could be an important asset for the engineer. Thus the role of social studies, economics, business administration, effective communication and expression and related courses is important in an engineering curricula. But what this role should be, needs to be determined carefully for a particular institute and a particular country.

2.25 In deciding on a system of engineering education, the specific needs of the country should be analysed as it is impossible to transfer the whole realities of education and industry from one country to another. Advanced countries have engineering institutions at many levels and with many different orientations, all of which refer to the spectrum of industrial requirements within their countries. Copying existing traditional educational systems from these countries will result in the transfer of only one part of the spectrum and inevitable distortion of the engineering product, and the engineer is likely to become a misfit.

2.26 Addition of much greater scientific content in engineering activity and implementation of scientific advancement in industry together with an increase in industrial capability and diversification, have made the American institutions introduce variations and experiments in curriculum design. The increased requirements of industry have also

produced a trend for a greater emphasis on post-graduate education. In countries more concerned with initial stages of development, industry needs graduate engineers to assume practical responsibilities immediately on completion of their education. This requires the curriculum organisation to have a fair degree of specialisation and a high degree of practical orientation.

Role of the Departments of Science and Humanities

2.27 We have noted with some concern that the interests of the Departments of Science and Humanities in the Institute tend to be very general and varied. The subjects chosen for research in these departments are not very much different from those in universities. It is the development of these departments on these lines that is attracting the criticism that the Institutes are functioning like traditional universities and are not fulfilling the specific purpose for which they have been established at a huge cost.

2.28 The Departments of Physics, Chemistry and Mathematics have to provide basic training in these subjects to various engineering disciplines. The Departments, however, began to undertake in different stages of their development, graduate programmes of their own as the facilities were made available. In doing so, the growth of these departments took the natural course of the university departments and emphasis was laid on the special interests of the staff. For instance a large number of the academic staff of the Department of Chemistry have specialised in one branch (organic chemistry) and in the Department of Physics nearly half the staff has specialised in Solid State Physics neglecting other equally important areas of these two subjects. The Department of Physics has gone into several other areas of pure theoretical studies chosen rather inappropriate in a technological institute.

2.29 In support of the present direction of the departments of science in pursuing pure scientific work, the example of U.S. institutes is cited. This is not entirely comparable to the Indian situation. In many U.S. institutes, the science departments provide strong theoretical under-graduate courses in applied areas only. Only in a few institutions substantial work on the pure side also is done. But one has to remember that the U.S. institutions have vast financial resources and employ considerable number of senior staff members who can undertake such programmes in addition to the requirements of applied sciences in support of the technological departments.

2.30 In view of what has been stated above, we feel that it is now necessary to clearly define the role of the science departments in the Institute.

2.31 Our present limited resources can be made best use of, if these departments concentrate on providing strong under-graduate courses in these basic subjects and applied areas only. Research activities in the Departments of Science and Humanities should be in applied areas and should have a close relevance to the economic development of the country

and they should take the form of a collaborative effort with the Departments of Technology.

2.32 This calls for close inter-departmental understanding and programmes. Individual staff members of these departments may have special interests and competence in research activities of a purely academic nature. We have no objection to such members of staff engaging themselves in advancing the frontiers of knowledge, but the bulk of the work in the departments should be concerned with research activity in applications of science/applied sciences and in areas that have a close relevance to the economic development of the country. As a rough guide, we would suggest that 75% of the research activity in these departments should be in applied sciences and areas of relevance to the economic development and 25% for work on frontiers of knowledge by competent individual staff members.

Co-operation and Relation with other Institutions

2.33 The Institutes of Technology have an important role in vitalising technical education in other institutions. They should provide leadership to other technical institutions in the country in the same manner as universities do to other colleges in their respective areas of jurisdiction.

2.34 In this context special mention must be made of the highly desirable need for the IITs to establish very close relations with the Regional Engineering Colleges in their respective regions.

2.35 These colleges have been established as joint ventures by Central and State Governments with massive financial support from the Central Government. All these colleges have good facilities and some of them have already come up as premier institutions in their respective States. They have also built close links with industry in their vicinity particularly those that are being assisted under U.H.D.P. project and have established useful post-graduate and first degree courses in collaboration with industry.

2.36 The Regional Engineering Colleges could, therefore, be further developed as strong second line institutions to the IITs. Very close and intimate academic links between an IIT and the Regional Engineering Colleges of the region can thus ensure live contact with industry in the region, and the institutions developing post-graduate and research programmes, to meet the real needs of industry.

2.37 It would also be possible for the IITs with their vast resources to concentrate more and more on post-graduate and research programmes with the Regional Engineering Colleges providing first degree training of high standard. Post-graduate courses and research programmes emerging out of areas of excellence in the Regional Engineering Colleges should be in a position to draw on the experience and highly sophisticated equipment available at the IITs in addition to an interaction of high quality staff at these institutions.

2.38 In our discussions with the Director, he was in complete agreement with the view that IITs have a special role in vitalising technical education in other institutions. How-

ever, he pointed out that so far the Institute has been establishing its own bonafides and it is only just now that it is in a position to render this sort of assistance to other institutions.

2.39 The contribution made by the Institute in this regard can be judged by the number of post-graduate students of the Institute who take up teaching positions at other institutions and also by the assistance rendered by the staff of IIT Delhi to such institutions.

2.40 The Institute, we understand, has in view academic staff exchange programmes under bilateral and multi-lateral arrangements which will go a long way in the improvement of faculty. We fully support these programmes and recommend that governmental action both at the Centre and the States should be taken to resolve several procedural and financial problems that will come up in the implementation of these programmes. We would, however, like to emphasise that one or two members of the teaching staff giving occasional lectures at other institutions will not be of much help. The staff members should be deputed for preferably a full academic year or at least one semester.

2.41 Our discussions with members of the teaching staff gave us the feeling that while they are anxious in an interchange of teaching positions with institutes abroad the same or even sufficient enthusiasm is not evident for interchange of staff with institutions within the country. We feel that much greater attention should be paid to this important aspect of interaction with other technical institutions in the country which would lead to the betterment of technical education and improvement of standards within the country.

Utilisation of the Capabilities of the Institute

2.42 Several programmes of economic development and industrial establishment are being undertaken in the country through the successive five-year plans. There will be a number of important problems that need attention in the execution of these programmes.

2.43 An important role can be played by the Institutes of Technology and the Indian Institute of Science in making a co-operative and concentrated effort for the solution of some of these important problems. We, therefore, suggest that the Heads of Departments of these Institutes should meet at least once a year and that they should visit one another's laboratories to make plans for undertaking this type of work effectively.

2.44 We have a feeling that several Ministries and Technical Departments in the Government of India are not fully aware of the capabilities and potential of the Institutes of Technology. They should recognise these capabilities and in seeking solutions of their problems they should first explore the expertise available in these institutions before they decide to take assistance from outside and foreign agencies.

2.45 Often members of the teaching staff of the Institute are sent to foreign countries for special experience. In doing so necessary attention does not seem to have been given

to a very valuable field of experience existing in this country itself in design, research and construction organisations under the Central and State Governments. Many of the project sites could also provide such experience and live problems, on which work may be carried out at the Institute considerably improving an understanding of the local problems. A fund of data could be collected on the existing dams which would be useful in future designs. For instance, the foundation behaviour of Bhakra Dam could be studied by collecting data from instruments which are already incorporated in the construction of the dam. We believe that so far no measurements of this nature have been taken by any Institute for analysis and checking.

We, therefore, suggest that the Institute should prepare a separate programme for the exchange of teachers of the Institute and experts engaged on design, research and construction projects within the country.

2.46 The projects selected by the Institute should be of interest and need for the country. Priorities should be given for national problems. The research topics and projects selected by the Institute should be oriented to technological work and the Institute should be satisfied about the proper topics for research and their relevance to the development of technology and thereby to the economy of the country. The teaching staff of the Institute, particularly senior members, should be fully aware of most if not all the important projects planned and being executed by the various Ministries and Departments of the Government and the problems encountered in their execution.

2.47 The Institute should react well with industry and for this purpose should publicise its capabilities and maintain excellent contacts with industry on an institutional basis and not an individual basis. We suggest the establishment of a unit in the institute for the promotion of liaison with industry. The right type of person should be appointed as the head of this unit which may be attached to any department or work under the Director. Necessary financial support for this work should be provided.

Orientation and Choice of Subjects for Research

2.48 On this subject we would like to endorse the following observations made by the Reviewing Committee of the Indian Institute of Science, Bangalore in 1955, headed by the late Dr. J.C. Ghosh :

“The character of subjects chosen for research has an important bearing on the work of the departments. Particularly at the present stage of Indian development, a wise choice in this matter is of great importance. The need is to build up a well-trained body of technical personnel, well grounded in methods of research, and confident in their ability to solve concrete problems. In order to serve this end, it is desirable that the research activities undertaken should, if brought to a successful conclusion, represent a substantial contribution to the subject. But we would attach particular importance to the work being well done and brought to a successful conclusion. In research, success cannot be guaranteed, but we

would prefer to see problems of such a character chosen for investigation that, given the available resources in men and materials, there is a high probability of a successful outcome. Young men benefit by overcoming difficulties and bringing work to a successful conclusion, and a sure way of undermining the morale of any organisation is to make it attempt problems beyond its capacity. We, therefore, suggest as a general principle for consideration but to which there may be exceptions—(a) a limitation of the investigations of a department to a few well-considered themes; (b) organisation of groups of researchers for the attack on these problems, who work in collaboration and who are thoroughly familiar with the basic experimental resources of the subject, and technically equipped to enlarge them, if necessary. We may emphasise that we regard it as particularly important in India, at the present time, that research students in all departments should be provided with ample opportunities to get practical experience in all the mechanical arts employed in the work. It would be difficult to over-estimate the importance of students making things themselves.”

2.49 We have earlier commented on the disproportionately large number of post-graduate and research students in the science departments as compared to the departments of engineering and technology. In the research programmes of the science departments the staff members have been taking too many research scholars for guidance. In the Department of Physics alone there are as many as 100 research scholars in February 1972 and in the Department of Chemistry this number is 46. In our view it will not be possible for any member of the teaching staff to take on more than 3 or 4 research scholars for guidance if he is to do justice to his normal teaching duties and also give effective guidance to the scholars under him. We suggest that the Institute takes suitable steps in making research guidance and participation in teaching duties by staff member more realistic and effective.

2.50 The research activities that have been undertaken in the Institute in the different departments are either need-based or activity-based. Some of these projects have an inter-disciplinary interaction. Discussions with the staff members of the various departments gave us the impression that while in principle, good understanding and liaison between the various departments of the Institute, very essential in tackling problems involving inter-disciplinary co-operation are generally accepted, a lot more could be done to make this co-operation much more effective.

2.51 Research work in the departments should normally be discipline-oriented unless a big project requiring the concentrated effort of several departments has to be taken up. Inter-disciplinary programmes are very difficult to work and have not proved successful even in U.S. institutions with their vast resources in men and materials. Such programmes should be undertaken at the Institute only when all facilities are available. As a rule, no new staff should be provided for such work. The programmes should be linked up with the relevant ministries/departments of governments and industry who will be the users and beneficiary organisations for such projects.

2.52 A perusal of the subject titles of research papers given in the annual reports for the last three years particularly in the Departments of Science and Humanities would convey the impression that more serious problems connected with the economic and industrial situation in the country could have been chosen for investigation.

2.53 In these Departments of Science and Humanities it is necessary to choose well-defined areas of research in which they should excel. The research programmes of the staff and doctoral candidates should be oriented towards finding solutions to industrial problems or to utilise advanced technologies with a view to exploiting natural resources of the country. The country needs applied scientists and to this end the Institute's contributions will go a long way in overcoming many problems which require specialised training. A high quality of research on live industrial problems should be aimed at and repetitive type of work should be scrupulously avoided.

Relations with Industry

2.54 In order to fulfil the Institute's important role to contribute to the development of industry in India it is a matter of utmost importance to improve the understanding between engineers and scientists in industrial establishments/technical departments of government on the one hand and those in the Institute on the other. With a proper integration in this respect the common resources of knowledge and experience can be used by both, avoiding wastage of much valuable time and money through a lack of co-ordination.

2.55 In addition to the Institute's own efforts in establishing these relations, we feel that a central organisation in which the Institutes of Technology, the research laboratories and technical departments of Government are represented would be very helpful in identifying over-all problems for investigation and competence existing in these institutions enabling a suitable allocation of work avoiding unnecessary duplication and wasteful pursuits of research activities.

2.56 It is important to realise that connections between industry and institutions do not arrive automatically but have to be worked for and heads of departments should take pains to promote close relations with industry wherever it appears appropriate. A two-way traffic between the teachers from the Institute to industry on the one hand and experts and research staff from the industries to the Institute on the other, should be established. Experts from industry may also be appointed as visiting professors and requested to deliver a course of lectures in the field of their specialisation and experience.

2.57 An important step towards improvement in the understanding between the industry and the institutions would be that a head of the department ensures that a part of the effort and research in his department is devoted to a subject with a clear bearing on problems facing industry. Such work should be discussed from time to time with representatives of the industry from where the problems have been lifted for investigation. Another step in this direction would be that a number of symposia and residential courses are held in the Institute on carefully chosen topics.

2.58 We are glad to see evidence of some effort in this direction at the Institute and would like to see greater and more fruitful efforts on these lines. In our view, one of the principal duties of the Director is to be well-acquainted with all the main lines of scientific and technical development in the country in order that he may serve as a close and effective link between the Institute on the one hand and government departments and industry on the other.

Consultancy Work by Staff Members

2.59 Sponsored research projects from industry, CSIR and other similar organisations and consultation work undertaken by departments, provide excellent opportunities for the staff members to improve their professional competence and value as teachers. We support the idea that work of this kind should be carried out by the departments, but we feel that care should be taken to ensure that the normal activities of the Institute are not unduly disturbed thereby.

2.60 The Director has reported that in the last three years, consultation of some staff members and departments has brought more volume of work than has been possible to cope with the available staff. We suggest that no proposal for sponsored research or consultancy work should be accepted without the concurrence of the Director and the Director should report acceptances to the Governing Body of the Institute. The foremost consideration in building up consultancy work should be quality which alone can improve the competence of the staff members and hence the quality of training to students.

2.61 One has to be careful in assessing the relative performance of the departments in developing consultation work. Although the departments may all be equally competent to undertake such work, some of them have the advantage of established industries in their vicinity. All the Departments except that of Humanities have been able to build some consultancy work. The Department of Chemical Engineering, in spite of the fact that established chemical industries do not exist round about Delhi, has been able to build satisfactory arrangements with such industries far remote from Delhi. We believe that the Department of Humanities is trying to establish consultation work in the field of Management and we hope it will be able to do some useful work in this field. The Departments of Civil Engineering, Applied Mechanics, Chemical Engineering and Electrical Engineering have all done well in the field of consultancy work and sponsored projects.

2.62 A list giving the present status of sponsored programmes, industrial collaboration and consultation work in different departments may be seen in Annexure VII.

2.63 One of the principal handicaps for the enlargement of quality consultancy work which needs remedial measures urgently, is the lack of a satisfactory procedure for the distribution of the revenues derived from consultancy work to the various elements that contribute to its execution. The entire income from the Institute's consultancy work goes into the general revenues of the Institute and leaves no incentive to the department that does the work. The equipment of the department undertaking this work undergoes depreciation and there is no compensation provided for this.

2.64 We, therefore, suggest that there should be a proper costing of consultancy work and that fees are charged on the basis of sound estimates. Revenues realised should be set apart for (a) depreciation, (b) consumables, (c) honorarium to participating members, and (d) contribution to a Research Fund for providing special amenities, equipment, etc.

2.65 We further suggest that 50% of the revenues so realised should go to the proposed Research Fund. Incidentally, contributions made by a department to the Research Fund would be a measure of its performance in this field.

Courses and Admissions

2.66 The Institute admits students to the under-graduate courses on the basis of a combined entrance examination to all the Institutes of Technology in the country. The entrance examination is conducted in the subjects of Mathematics, Physics, Chemistry (Physical Science and Engineering Drawing may be taken in place of separate papers in Physics and Chemistry) and English and each candidate should obtain a minimum number of qualifying marks in each subject. The merit list for admission is prepared on the basis of total marks obtained in all the subjects after qualifying in each.

2.67 This method of determining merit for admissions, lays an unnecessary emphasis on proficiency in the English language and often gives an edge to students from public schools and metropolitan schools although their proficiency in Mathematics and Science may be comparatively lower than those who might have passed the qualifying examination with a medium other than English. We do believe that a minimum proficiency in the English language is necessary for students to follow the courses at the Institute. Nevertheless higher proficiency in this language than necessary should not compensate for lower merit in the more important subjects of Mathematics and Sciences.

2.68 We, therefore, suggest that English should be treated only as a qualifying subject and merit should be determined only on the basis of performance in Mathematics, Physics and Chemistry.

2.69 The Institute is currently offering under-graduate courses in Civil, Mechanical, Electrical, Chemical Engineering and Textile Technology with a total annual admission of 260. The Institute has now finalised a scheme of revised courses for under-graduate studies in an attempt to modernise its curricula and courses and develop them on an entirely new approach to engineering education at the under-graduate level to suit the requirements of modern developments in technology and needs of industry. The courses incorporate graphic science in the first year (in place of the traditional subject of Engineering Drawing), Design Engineering in the second year, Systems Engineering in the third year and Experimental Analysis in the 4th year.

2.70 A copy of the scheme may be seen in Annexure VIII.

2.71 The project concept is kept right from the beginning, the students being required to complete projects first under the guidance of the staff and later on quite independently.

An important approach made by the Institute in respect of student projects is that the same thing is not done year after year, but new concrete items of relevance to industrial needs are taken up as projects.

2.72 We hope that these changes will bring forth the right type of engineering graduates for employment in modernising Indian industry. We agree with the concept in which these courses have been framed, viz., that the practical sense to be useful to industry comes not so much out of a long drill as from the right type of education and training which enables the graduates interpret in a live way and synthesise engineering situations.

2.73 The Institute has now a proposal to introduce from the next academic session (1972-73), a five-year integrated course in Applied Science leading to the award of M.Sc. in Applied Sciences. The total annual admissions will remain the same, but students in the third year will have an option to take either the Engineering disciplines or the Applied Science disciplines. Twenty places out of a total of 260 are to be set apart for Applied Science courses.

2.74 The Institute has advanced the following arguments for the introduction of the integrated course in Applied Sciences. The students in the 3rd year of the course will have better maturity and will be better motivated. Therefore, their performance will be better if they make a choice of their discipline at this stage. Career prospects influence choice of discipline. Flexibility in this choice between Applied Sciences and Technology up to a certain stage will better meet the student preferences and employment opportunities—the entire system would be in a position to react to these preferences making suitable adjustments possible.

2.75 We gather the impression that the aim of introducing these courses is principally to attract the top-merit students to the Institute of Technology who are currently taking to science courses in universities mainly on account of temporary unsatisfactory employment position for engineering graduates.

2.76 We have earlier expressed the view that the main activity of the Institute should be in the field of post-graduate education and research with emphasis on Engineering, Technology and Applied Sciences. Accordingly, we have suggested that the under-graduate student body, even in Engineering disciplines should be reduced.

2.77 It may be mentioned that the Indian Institute of Science at Bangalore, a centre of excellence primarily in the field of science, has decided not to admit any students for the Master of Science course and concentrate only at the research level. Since the Indian Institute of Technology, Delhi is primarily established to become a centre of excellence in Engineering and Technology, we do not agree with the proposal of the Institute to start the under-graduate courses in Applied Sciences.

2.78 Any development in the area of Applied Sciences at the IITs should only be at the post-M.Sc. level admitting Masters in Science qualified from regular university

institutions. Regular courses in pure or Applied Sciences up to M.Sc. level should be left to university colleges and departments.

2.79 In the light of the above considerations, we hold the view that in the Departments of Mathematics and Sciences, there should neither be under-graduate nor M.Sc. courses. The programmes in these departments should either lead to Ph.D. awards or concerned with post-doctoral work. They may, however, conduct pre-Ph.D. courses of one year's duration and at the end of such courses, students who are not suitable for research work should drop out. The pre-Ph.D. courses should be in highly specialised fields of particular interest to the departments and which later on should provide scope for doctoral work for the award of Ph.D.

2.80 We are aware of the difficulty of the departments giving up all of a sudden the Master's degree courses they have been conducting for some time. We, therefore, suggest that the M.Sc. courses should be progressively wound up and merged into the pre-Ph.D. and doctoral programmes.

Post-graduate Courses

2.81 Post-graduate courses already established and those provided for in the 4th Five-year Plan are shown in Annexure V. The courses offered lead to the award of M.Tech., M.Sc. and Post-graduate Diploma. Their distribution in the Departments of Engineering, Sciences and Humanities and annual in-take in each of these categories is as follows :

Courses	Departments of Engineering		Departments of Science		Department of Humanities	
	Courses	Annual in-take	Courses	Annual in-take	Courses	Annual in-take
M.Tech.	15	150	—	—	—	—
	+2 (proposed)				1 (proposed)	
M.Sc.	—	—	3	40	—	—
Post-graduate Diploma	—	—	1 (proposed)		—	—

2.82 The Institute in its earlier years of post-graduate instruction had a number of post-graduate diploma courses. In the course of the last 5-6 years, most of these diploma courses have been gradually converted to the degree level. There is also a tendency to argue in favour of the post-graduate degree courses of one year's duration instead of two years' duration as at present.

2.83 In addition to the post-graduate degree and diploma courses, several refresher and specialised short-term courses both for industry and teaching institutions have been organised. The Institute is also participating in the Quality Improvement Programme of the

Ministry of Education under which faculty members from various other institutions are being trained for the higher degrees of M.Tech. or Ph.D. in engineering and science subjects.

2.84 The scope and diversity of these other courses may be seen from the list of "Summer Schools, Seminars, and Short-term Courses" given in Annexure IX.

2.85 In organising the summer institutes and other special courses right round the year we wish that the Institute takes sufficient care to see that the staff members are not continuously strained and that they get reasonable vacation for rest and recreation.

2.86 We have already laid stress that post-graduate courses at the Institute offered in the Departments of Engineering, or Humanities and Sciences, should serve primarily the requirements of industry, technical departments of the Government and be of relevance to the economic development and social changes in the country. The support given to the post-graduate courses by industry either by way of deputing their employees or allowing their senior staff members to assist in teaching, or project guidance, should be taken as a measure of the success of the courses offered. Advanced technological courses are particularly relevant to research, development, technical and design staff of industry. Conscious attempt should be made to remove the existing feeling in organisations of industry that the courses offered are too academic and are not sufficiently oriented to industrial applications and practice. Post-graduate courses established after a proper diagnosis of the needs of industry and with the assistance of staff from research centres and from industry have the greatest chance of success because they will be able to draw on active research programmes.

2.87 Industry often complains that projects undertaken under the courses are of an academic nature and are not dealt with in a full industrial context. There is, in our view, ample scope for instituting well-supported post-graduate design courses of two years' duration in close co-operation with industry to train engineers to deal with the manufacturing and design problems encountered in practice.

2.88 Industry generally requires a person trained in a broad-based first degree course in the field of engineering, but it also needs a specialist. It would, therefore, be appropriate that the first degree course should be of a general type and should be followed by a post-graduate course for adding the required specialisation. The under-graduate courses of the Institute of Technology should follow this principle in establishing modern courses for the setting up of standards in engineering education and to act as good feeders for the post-graduate courses.

2.89 Electives and specialisation provided either at the under-graduate or post-graduate level should be carefully chosen and limited. Establishment of new programmes in highly specialised areas like Aeronautics, Material Science, Automation, Nuclear Science, etc., should follow a very careful assessment of requirements. We suggest that courses at the Institute of Technology should be started only after they have been screened and approved by a Specialist Committee with representatives of the Institutes of Technology, the Council of Scientific and Industrial Research and the Post-graduate Committee of the A.I.C.T.E.

so that unnecessary duplication is avoided and effective utilization of available resources is made.

2.90 With the rapid modernisation of industry in the country and the rate of technological change growing fast, a great need has arisen for periodic refresher courses. The demand in this respect will be for short full-time or part-time courses with specialists chosen from industry and research establishments participating in the teaching of these courses. The Institute, we are glad to see, has initiated such courses and should continue its efforts in organising more and more courses of this nature.

2.91 We are somewhat disappointed to see that the quality of admissions to the post-graduate courses, particularly in the Departments of Engineering, is not as high as one would wish for. The under-graduate courses of the Institute are particularly meant for providing the right type of material for the post-graduate courses and also setting up standards in the country. Yet graduates from Institutes of Technology form the smallest part of admissions to the post-graduate courses. We have already discussed the difficulties in attracting Engineering graduates of high merit for the post-graduate courses and suggested certain measures. If the under-graduate courses at the Institute of Technology are model courses and of high standard, every effort should be made to attract as many of these graduates to the post-graduate courses at the Institute in order to make such courses more effective and yield the results expected out of high investments and facilities provided at the Institute.

2.92 The Institute has argued that one of the reasons for graduates of merit not keen on joining the post-graduate courses is that they have to spend two long years whereas by going abroad they could accomplish this in just a year's time. The Institute has further argued that the duration of the post-graduate courses should be reduced to one year on account of this. We, however, do not support this view.

2.93 The post-graduate degree courses should have a uniform duration of two years and those of diploma courses specially organised to meet the needs of industry, should have a duration of one year. Other short-term specialised courses for specific needs of industry may be organised as refresher courses of varying duration according to needs.

CHAPTER—III

OPERATION AND GOVERNANCE

Authorities under the Act

3.01 The Indian Institute of Technology (IIT), Delhi Act is centrally administered by the IIT Council, a body constituted by the Government over which the Union Minister of Education presides. The Act defines the following as the authorities of the Institute :

- (a) The Board of Governors ;
- (b) the Senate ;
- (c) the Finance Committee ; and
- (d) the Works Committee.

The Board of Governors

3.02 The over-all administrative control of the Institute is vested in the Board of Governors with 14 members constituted as follows :

- (a) The Chairman—to be nominated by the Visitor ;
- (b) the Director ex-officio ;
- (c) one person to be nominated by the Government of each of the States comprising the zone ;
- (d) four persons to be nominated by the Council ; and
- (e) two Professors of the Institute to be nominated by the Senate.

3.03 The nominees of the State Governments are required to be from amongst persons who in the opinion of that Government are technologists or industrialists of repute. The nominees of the Council will be from amongst persons having knowledge or practical experience in respect of education—engineering or science. The Registrar of the Institute acts as Secretary of the Board.

The Finance Committee

3.04 This Committee scrutinises the annual budget prepared by the Director and recommends it to the Board. It also deals with all financial questions effecting the Institute and meets at least once a year. The Chairman of the Board is *ex-officio* Chairman of the Finance Committee. Other members are two persons nominated by the Central Government and two persons nominated by the Board and the Director.

The Buildings and Works Committee

3.05 This Committee is responsible to the Board for construction of all major works. It approves all estimates of costs and is responsible for making technical scrutiny and also enlistment of suitable contractors and acceptance of tenders. It has the power to settle rates not covered by tender and settle claims and disputes with contractors. It consists of not less than five and not more than seven members as may be appointed by the Board.

The Senate

3.06 The academic control of the Institute is through the Senate. This body is responsible for the maintenance of standards of instruction, education and examinations in the Institute. It has the following constitution :

- (a) The Director, *ex-officio*, who shall be the Chairman of the Senate ;
- (b) the Deputy Director, *ex-officio* ;
- (c) the professors appointed or recognised as such by the Institute for the purpose of imparting instruction in the Institute ;
- (d) three persons, not being employees of the Institute to be nominated by the Chairman in consultation with the Director, from among educationists of repute, one each from the fields of Science, Engineering and Humanities ;
- (e) Heads of the Departments other than Professors ;
- (f) the Librarian of the Institute ;
- (g) one Warden by rotation in order of seniority in service as Warden. for a period of one year ;
- (h) Workshop Superintendent of the Institute ; and
- (i) not more than six other members of the staff for their special knowledge appointed by the Chairman after consultation with the Director for such period as may be specified by the Chairman.

3.07 The Institute has added to it three members of the Alumni Association by invitation with a view to getting a meaningful feedback on the utility of the courses so that necessary changes and updating of the instructional methods and courses could be adopted.

3.08 The Senate meets four times a year. But there is a Standing Committee of the Senate which meets once every month. This consists of Heads of Departments and Senior Professors under the chairmanship of the Director.

The Institute has also introduced 8 other sub-committees, each having faculty representation spreading into the academic community of the Institute as follows :

- (a) Departmental Committees ;
- (b) Examinations Committee ;
- (c) Board of Post-graduate Studies and Research ;
- (d) Admissions and Scholarships Committee ;
- (e) Students Affairs Council ;
- (f) Library Committee ;
- (g) Computer Centre Committee ; and
- (h) Instrument Design Development Centre Committee.

3.09 The Standing Committee of the Senate acts as its executive. It considers the recommendations of the 8 sub-committees and co-ordinates their activities. The Institute claims that this method maximises the effectiveness of the system and contributes to the success of the academic programmes.

3.10 In our discussions with the different staff members a general feeling was evident that most of the decisions are taken by the Standing Committee on the recommendations of the concerned sub-committees of the Senate in the name of urgency, and thereafter the matter is reported to the Senate when it meets, only for formal confirmation.

3.11 This procedure has also the defect of denying an opportunity to the members of the Senate to participate in full discussion and come to an agreed solution. Thus the Standing Committee has come to enjoy powers which are not provided by the statutes. This practice can make it possible that the important statutory body—the Senate can be by-passed by taking decisions through the Standing Committee.

3.12 We do not see any special merit in having this Standing Committee and strongly recommend that it should be the Senate which itself should take the final decisions and not merely confirm the decisions of an intermediary Standing Committee. If there be any urgent situation, the Director himself should take the decision and report it to the Senate when it meets next. More frequent meetings of the Senate should be held if necessary—say every 6 weeks. It will be a very healthy practice if Senate members participate directly in the Senate meetings on all academic issues and appropriate decisions arrived at after meaningful discussions. If there be any need for a more detailed study of any particular topic, the Senate itself may set up an *ad hoc* sub-committee and this committee should submit its report to the Senate, for consideration and decision.

3.13 The term of office of the Members of the Senate other than those by ex-officio position, is according to the current practice, one year. In our view this is too short a period. Before members get used to its method of working, their term comes to a close and they can make no effective contribution to the work of the Senate. Further we also do not find any authority in the statutes to limit the term of nominated members to one year.

3.14 The manner in which the Standing Committee can function and the limit of the term of office of the nominated members to one year, in our view nullifies the effect and purpose of the Senate in as much as the opportunity for individual members to fully express themselves and contribute effectively on all important academic issues is severely limited.

3.15 We, therefore, suggest that the tenure of nominated members should be made three academic years and in no case less than two years. We also suggest the abolition of the Standing Committee of the Senate.

3.16 The various sub-committees of the Senate introduced by the Senate are expected to perform the following functions :

(i) *The Departmental Committees* presided over by the respective heads are to ensure implementation of the decisions taken by the Standing Committee and also to provide a feedback to it of the reaction of the staff. These Committees are expected to provide the forum for discussion by the total faculty of academic problems on which the Senate has to take decisions.

(ii) *The Examinations Committee* headed by the Dean of Examinations, conducts all the under-graduate examinations and is responsible for the examination policy, conduct of examinations and the declaration of results. This Committee is also fed by the Departmental Committees where the assessment of the students' sessional and written papers is made and discussed.

(iii) *The Board of Post-graduate Studies and Research* presided over by the Dean of Post-graduate Studies, is responsible for all post-graduate activities. It looks after the conduct of examinations and declaration of results concerning post-graduate degrees.

(iv) *The Admissions and Scholarships Committee* decides the admission policy and award of scholarships to the student community. It is responsible for the conduct of joint entrance examination and admission of students to the under-graduate courses.

(v) *The Students Affairs Council*. This works under the chairmanship of a Dean who is directly responsible to the Senate. The Council has an Executive Committee and four other Committees working for it. These are the Inter-House Working Committee, the Sports Committee, the Recreation and Creative Activities (R.C.A.) Committee, and the Student Publications Committee. In addition, each of the hostels has a House Working Committee which manages the affairs of the hostel including messing and discipline with the Warden as its Chairman. A senior professor is the House Master for each hostel and acts as a guide to the students and the administration. These various Committees through their executive take complete charge of students' affairs and provide a feedback to the Senate on students' reactions and responses.

(vi) The other three Committees, viz., the Library Committee, the Computer Centre Committee and the Instrument Design Development Centre Committee are advisory in nature and report their affairs to the Director, the Chairman of the Senate.

3.17 In addition, there is an Administrative Committee under the chairmanship of a Dean who is a senior professor of the Institute. This Committee comprises the Registrar and the Deputy Registrars with representation from the teaching faculty and is meant to maintain liaison between administration and members of the teaching faculty.

3.18 To assist the Senate in its responsibility of academic administration through the various sub-committees, Deans are appointed from amongst professors by rotation. There is no monetary remuneration attached to these posts. At present there are 6 Deans, one for each of the following functions :

1. Under-graduate Courses ;
2. Under-graduate Studies in Science ;
3. Post-graduate Studies and Research ;
4. Examinations ;
5. Administration ; and
6. Students.

3.19 The Deans are assisted by their own Committees in their duties. The Director expressed the view that this arrangement of having 6 Deans to look after the various aspects of academic administration is a far more satisfactory arrangement than having one Deputy Director because the Deputy Director, who will have to be taken from amongst the academic staff, will not have any time left for his academic work. In addition, this practice, according to him, brings more academic people into administration and gives them experience without sacrificing their academic duties.

3.20 We have carefully examined the duties attached to these 6 posts of Deans. In our view, the Deans-in-charge of the first four functions can cope with the work without sacrificing their normal academic duties in their respective departments.

3.21 The Dean of Students who presides over the Students Affairs Council, the apex body of all student committees and organisation on the campus, has a difficult task and has to devote almost his full time to these duties. This Council looks after the staff-student committees, the hostel organisation, extra-curricular activities, tutorial schemes and student counselling scheme.

3.22 The staff-student committees discuss curricula, examinations and other academic matters and provide guidelines in modifying and changing academic programmes. In the hostel organisation each hostel has a House Working Committee dealing with the affairs of mess, common room and discipline. There is an Inter-House Working Committee consisting of representatives of the various House Working Committees which deals with problems common to all hostels and plans programmes on inter-hostel basis. The R.C.A. Committee co-ordinates the various extra-curricular programmes planned and implemented by the students. In this are included the Games and Sports Committee and the Student Publications Committee.

3.23 The Dean of Students has also to supervise the Tutorial and the Student Counselling Schemes. The Personal Tutorial Scheme is hostel-based. In the first two years of the course each student is assigned to a faculty member with the objective of strengthening bonds of personal relationship between the students and the staff. The Scheme also provides for frequent opportunities for contact between parents and staff which goes a long way in achieving educational influence on the whole community. The Student Counselling Scheme is department-based. Each student from the third year onwards till he leaves the Institute, has a personal counsel to discuss with him his academic problems, vocational goal, specialisation, research methodology etc.

3.24 The Dean of Administration, a senior member of the Institute, is the Chairman of the Administration Committee which comprises the Registrar and Deputy Registrars etc. with representation from the teaching faculty. The functions of the Registrar's office, viz., establishment, academic, examinations and conference, budget and accounts, audit, stores purchase and training and placement, all come under the purview of the Administration Committee. We also find that the present senior professor who is the Dean of Administration, is devoting practically whole of his time to this work and thus his valuable direction to the Department is also lost.

3.25 From what has been stated above in regard to the duties attached to the posts of Dean of Students and the Dean of Administration and the present position in the Institute, we make the following suggestions :

(i) The Institute should have a full-time post of Dean of Students of the level of a senior professor who may alternatively be designated Deputy Director, Students' Affairs. This should be a post in addition to the sanctioned strength of the Institute at present. This post may be filled in rotation by one of the senior professors for a period of two years at a time. This will ensure the staff member keeping his academic touch.

(ii) We see no justification whatsoever why a senior professor should be wasted on administrative duties which should be discharged by the Director with the help of the Registrar and his office. The senior professor who is now working full time as Dean of Administration, should be released to the academic work of his department.

Academic Problems

Headships of the Departments

3.26 The current practice in the Institute is that one of the professors in a department acts as the Head of the Department by rotation. The term of each professor as Head of the Department is two years. The usefulness or the purpose of this arrangement is not very clear to us.

3.27 We believe that this practice is followed in some foreign institutions particularly the U.S.A. According to our information, even in the United States, in many cases, the system has not worked well. The only reason we could see in support of rotation of the headship of a

department is that the academic interests of all the professors in the department are taken care of in turn by rotation. However, too frequent rotation of the Head of Department can seriously interfere with the continuity of outlook and interest in the work of the department.

3.28 Whether a Head of the Department is appointed by seniority or by rotation, the important consideration should be that the work of the departments goes on conveniently and smoothly. Good management should be the only criterion which should determine whether the Head should be by rotation or by seniority. It is, however, necessary that each professor in a department should be made financially independent of others. If this safeguard is provided, it really does not matter whether the Head is by rotation or not.

Use of Expensive Equipment

3.29 There is a noticeable tendency for departments to acquire some expensive items of equipment separately. There is also the possibility that in such cases optimum utilization of the items of equipment is not made. We recommend that expensive items of equipment should not be duplicated in departments.

3.30 A procedure should be evolved whereby a particular item of expensive equipment located in any one department could be utilised by the other departments of the Institute. An alternative procedure for this would be to locate in a central place all items of expensive equipment for common use and providing all the departments equal access to their use. This arrangement will also simplify the maintenance of such equipment and procuring spares often with foreign exchange, to keep them in working order.

Teaching Costs

3.31 We have observed that the Institute is conducting a number of post-graduate courses and also special electives in the under-graduate courses for too few number of students in each course. The academic staff that has to be provided to take care of these courses will, however, have to be employed at the full required strength which has an effect in increasing the cost of teaching per student. We, therefore, suggest that no post-graduate course should be offered for a group of students less than 6 and that no elective at the under-graduate level should be offered for a group of students less than 10 nos.

3.32 We have also noticed that some of the departments conduct separate courses in the same subject particularly at the M.Tech. level for each M.Tech. course. For instance, the Department of Mathematics conducts 40 separate courses in Mathematics for various M.Tech. programmes. Even when special requirements for the various M.Tech. programmes have to be catered for, in our view, these 40 courses could be considerably reduced. Teaching a large number of courses needs a large academic staff which has the effect of increasing the cost of training.

3.33 The main reason for offering such large number of separate courses is said to be the difficulty in arranging for time-tables. We do not agree with this because the actual number

of lecture hours for M.Tech. courses is small and also the teaching can be spread over the whole day. We, therefore, suggest that courses in subjects common for many departments should be organised and offered on unit basis. This can make it possible to effect considerable savings on teaching staff.

Teaching Load of Staff Members

3.34 The staff members in their various representations to the Reviewing Committee complained that the present average teaching load of 18 hours a week per staff member is high, if the various other academic duties such as participation in research activities, guidance to students, preparation of new courses which the teachers have to perform, are all taken into account.

3.35 An average student to staff ratio of 12 : 1 for under-graduate courses and 6 : 1 for post-graduate courses with an average of 30 contact hours per week, and an average teaching load of around 16 hours per week per staff member is, we believe, obtained in most well-established institutions all over the world. In the case of IIT Delhi, with the existing staff in the year 1970-71, the average teaching load has only been 15-16 hours per week and this would be further reduced if the vacant positions are filled up. We, therefore, see no justification for a further reduction in the teaching load of staff members which will only increase the already high cost of teaching. The teaching load on staff members should be in accordance with standards laid down by the A.I.C.T.E.

3.36 The staff members also complained that the teaching load on some of them is high and this is because that some heads of the departments do not share any part of the teaching load. In addition, some other senior staff members either do not teach at all or take a very little teaching load. We have also observed that in calculating the teaching load, the time spent in guiding research scholars is also included. This, however, is not the correct practice.

3.37 While we believe that the teaching load on staff members need not be uniform for all members of the staff, we hold the view that every member of the staff should participate in teaching to some extent. We also believe that it will be a very healthy practice if senior members of the staff have teaching contact with junior classes for at least a few periods in a week. We further believe that the senior staff members should participate not only in lectures, but also in laboratory work, design and project work.

3.38 We would like to emphasise our view that all aspects of teaching and training at the Institute, namely, lecture work, laboratory work, guidance of design project and research work are all equally important. Senior staff members should, therefore, share all aspects of teaching work at all levels. The Heads of the Departments will, no doubt, use their discretion in allotting different types of work to the other staff members according to their practical interests, abilities and requirements of the Institute.

Career Interests and Advancement of Academic Staff

3.39 There was a feeling amongst some of the staff members that dedicated teaching is not adequately recognised in the matter of promotions to senior positions. It was pointed

out to us that far too much credit is being given for published papers and devoted teaching of a staff member is often not adequately recognised.

3.40 We have already emphasised our view that all aspects of academic work in the Institute are equally important. The faculty in any department should be well balanced by including members who are good in research and guidance of research activities and also members who are good in teaching and guiding design and project work. Engineering education, only when oriented by those who are involved in engineering practices, can hope to produce competent professional engineers. There should, therefore, be a constant search for appointment to staff positions from among those who have real life experience in engineering and technology. A staff member should be allowed quality consultation work to improve his professional capabilities, such consultation, of course, not unduly interfering with his institutional work. Whether making first appointments or promotions, too much emphasis on published work alone will not serve the purpose, particularly when such publications are not in accredited professional journals of high national and international repute. It may, however, be observed that promotion by itself has a very limited scope as a reward for good work.

3.41 Several staff members complained that there are too many designations of teaching posts at present. When a teacher reaches the end of his particular scale, he gets stuck up and tries to leave the Institute. This happens even in the case of professors. One of the main reasons for this is that some of the first appointments are made with a high starting salary in the scale attached to the post and the incumbent very soon reaches the maximum. We see some merit in having running scale for teachers provided indiscriminate higher start is not admissible so that a person appointed in the scale can hope to progress in his scale over the years avoiding unnecessary frustration.

3.42 We considered the question whether teaching staff should be appointed on a five-year renewable contract or the appointment should be made on a permanent basis. Appointments on a contract basis do not provide security and stability amongst staff members. Also, we hesitate to recommend this procedure having regard to the present conditions of management in the country.

3.43 We, however, feel that the period of one year fixed for probation as at present is rather inadequate to completely judge a person. This period should be raised to two years when it is possible to make a reliable judgement of the person employed. After satisfactory completion of this period, the staff member may be given a running scale with some efficiency bars. There should, however, be provision for continuous assessment of individual teaching staff members by annual reports. Continually bad work and inadequate performance of any individual member should be brought before a Committee of Assessment if discontinuation of his service is considered necessary in the interest of the Institute. No single individual shall, however, be allowed to decide on such action.

3.44 Occasions may arise when the development of a department may not be according to the objectives of the Institute as laid down from time to time. This situation often results from the thinking of some staff members at variance with these objectives.

3.45 We, therefore, suggest that a suitable machinery be devised to review the work of the individual departments when considered necessary by the Board.

3.46 Some of the staff members expressed their concern that the Director of the Institute has a very big discretion in the implementation of rules and regulations. This has sometimes led to unjust results although rules as such exist. As an instance, it was pointed out that funds allotted for conferences and meetings are not equitably distributed, with the result that some staff members could enjoy the benefits repeatedly, while others could get no benefit at all. Another grievance of the staff was that rules for Sabbatical leave have not yet been made.

3.47 With a view to avoiding such minor irritations amongst the staff members, we recommend that rules wherever necessary as in the case of Sabbatical leave should be formulated soon and adequate steps taken for just implementation of existing rules on other subjects.

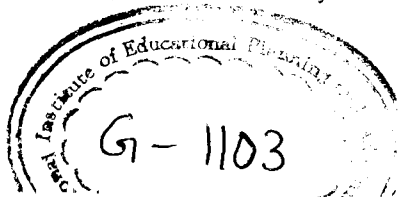
3.48 There have been instances in Institutes of Technology and higher learning that appointments to senior staff positions are made without providing adequate facilities by way of laboratory space, equipment and supporting staff. This has led to such senior staff members not being able to pursue their academic work with consequent frustration and deterioration of the academic atmosphere in the Institute. We would strongly recommend that such situations should be scrupulously avoided and senior staff members should be employed only after necessary facilities have been arranged for.

General Problems

3.49 Experienced and competent technical persons are required to handle certain specialised jobs in instruments repair, construction etc. at the Institute. The highest post at present available at the Institute for such work is that of a Senior Technical Assistant. The salary scale attached to this post is poor and cannot command the services of a sufficiently competent person for the work. We, therefore, recommend that this post should have a salary scale at least comparable to that of a Lecturer. We should, however, caution against filling this post by a person only on the basis of academic qualifications. What is required is, in addition to minimum technical qualification, a thorough practical experience and competence in handling work of this nature.

3.50 Almost all the departments have complained that the present system of purchases centrally is unsatisfactory. It is leading to difficulties and handicaps for the departments and their work is often interrupted for want of material or equipment. Instances of delays as much as three months have been pointed out in the procurement of materials for the work of the departments.

3.51 We have discussed the present Central Purchasing Organisation and whether decentralisation would really help improve matters. Our view is that a Central Purchasing System has both its merits and drawbacks. If the system could be worked on proper



lines, the advantages of centralised purchases may outweigh the disadvantages. The answer seems to be the retention of the Central Purchasing System but to build up a Departmental Store for each department. For this, it may be necessary to provide an initial block grant for the departments over a period. This along with raising the purchasing powers of the Departmental Heads to Rs. 2,000 in place of the existing limit of Rs. 500 for current needs would in our view be an adequate solution to this problem.

3.52 There is also a general complaint that substantial part of the Institute budget is being spent on maintenance and upkeep of the Institute rather than on the academic departments. The substance of this may be verified from the break-up of recurring expenditure for 1970-71. Out of a staff remuneration of Rs. 78.13 lakhs, Rs. 27.33 lakhs is spent on academic staff, Rs. 16.16 lakhs on supporting staff and as much as Rs. 34.64 lakhs is spent on other administrative staff, upkeep and maintenance etc. Again out of an operational expenditure of Rs. 37.73 lakhs in this year, only Rs. 8 lakhs is spent on academic departments, Rs. 12.86 lakhs on scholarships and amenities and the rest on maintenance and upkeep. In a large Institute of this type, there will be a tendency for the growth of non-teaching staff and other maintenance and upkeep expenditure. This needs careful watching and control.

3.53 An analysis of expenditure on staff in ordinary engineering institutions shows that teaching staff accounts for 60 per cent, administrative staff for 25 per cent and supporting technical staff accounts for the balance of 15 per cent. In this analysis, Class IV staff is included in the group of administrative staff.

3.54 In an Institute of this type, we do not expect the same distribution of expenditure on different categories of staff. Nevertheless, the actual expenditure in 1971 of 50 per cent of the total cost of staff on administration and Class IV staff, needs a thorough looking into. We suggest appropriate measures should be taken for reducing this cost. As a positive measure in this direction, we suggest a total embargo on any further recruitment of administrative and Class IV staff against vacancies until the results of this examination are available and final decision taken by the Governing Body of the Institute.

3.55 The Institute is now only copying procedures and methods adopted in Government departments. These procedures may not be conducive either to efficiency or to economy in an academic institution. The Institute needs a system whereby it should be capable of properly using its autonomy and developing administrative procedures and method with a view to achieving better efficiency. Government procedures involve considerable paper work and consume time which will be detrimental to the progress of academic projects at the Institute. We endorse a suggestion of the Director that Management Consultants should make a study of the type of administrative set-up and machinery suitable for this Institution.

Student Welfare

3.56 Special attention and priority need be given for three important aspects of student welfare measures. These are sports activities, messing arrangements and guidance and employment. We do not advocate immediate provision of an auditorium and other expensive amenities. These may come in gradually.

3.57 Adequate facilities for sports, swimming pool and a place of collection for all the students is necessary. These facilities have already been provided on the Institute campus.

3.58 There are excellent facilities for sports at the Institute, but the students' participation is not quite satisfactory. Some of the reasons for this poor response could be the attitude of the students towards sports, alleged heavy work-load in the Institute, attitude of staff and location of the Institute in a big city where the student population may find other attractions and occupations to occupy their spare time. Also a large number of students coming from the city, would like to visit their homes in spare time. Appropriate steps may be taken to improve student participation in sports which might include, grading in every year and in final assessment and joint campus activities for staff and students.

3.59 In recent times, food position has considerably deteriorated all over the country. Unwholesome and impure food supplied to students in some institutions has affected their health and welfare. We, therefore, strongly recommend that the Institute management should give serious attention to this problem to avoid such a situation in this Institute.

3.60 We recommend that the cost of food to the students in the hostels should be kept within reasonable limits and necessary measures in the form of subsidy should be taken to make this possible. We are aware that the mess costs are already subsidised to some extent, and suggest increase in possible subsidies. We would, however, sound a note of caution that the strength of the Institute's Class IV staff should not be further increased by taking on to its mess employees. Mess employees should be the concern of the student messes and their own management.

3.61 We suggest the establishment of a Students' Guidance and Appointment Board in the Institute. This may be placed under the Dean of Students who will be dealing with all problems in the Institute concerning the students.

3.62 Elsewhere we have recommended a Unit in the organisation for liaison with industry. This Unit and the Appointments Board will have a number of common contacts and interests. It may, therefore, be worthwhile to examine the alternative of the feasibility of having a common organisation for appointments and industrial liaison.

CHAPTER—IV

REVIEW OF THE WORK OF DEPARTMENTS AND SPECIAL CENTRES

DEPARTMENTS

Department of Humanities and Social Sciences

4.001 The sanctioned staff consists of teaching — Professors 2, Assistant Professors 10, Lecturers 8, Associate Lecturer 1, and non-academic supporting staff 4. The Department has an accommodation of 7,450 sq. ft. of carpet area. It has acquired up to March 1971, equipment worth Rs. 25,150. The expenditure for the year 1970-71 incurred by the Department is Rs. 2.63 lakhs. Practically the entire amount is on staff salaries.

4.002 So far the main work of the Department is teaching the under-graduate courses to the Engineering departments, in languages, literature, social sciences including management. The Department has also been rendering some service in offering courses on specialised topics for M.Tech. programmes in the Departments of Mechanical Engineering and Applied Mechanics.

4.003 There is no well-defined programme of research in the Department although individual members have interested themselves in certain topics, but the results of such efforts are still inconclusive. These areas of individual interest are (1) Technology, Productivity and Social Changes, (2) Education Economy and Society, (3) Urban Growth in the Northern Region, (4) Economics including Planning Research, and (5) Organisational Behaviour including Managerial Decision-making.

4.004 The proposed developments by the Department are—Introduction of three M.Tech. degree courses in Management, Social Science and Behavioural Sciences, with annual admission of 10 students to each. The Department has also proposed to strengthen their existing research activities and in addition take up new programmes of research in :

1. Social Change and Modernisation.
2. Problems of Managerial Decision-making and Organisational Behaviour.

3. Economics (including Planning Research).
4. Urban Growth in the Northern Region.

4.005 The Department further proposes to undertake post-doctoral research programmes in social sciences including applied and linguistics and also to strengthen the consultancy competence by solving managerial problems of Indian industries.

4.006 An Engineer or a Technologist should have an understanding of management responsibilities and with this view, we have stressed the need for training him in social studies, economics, business administration and effective communication and expression and some related courses. The role of the Department of Humanities and Social Sciences in the Institute should precisely be this at the under-graduate level and it should concentrate on equipping the students adequately in these fields. We do not support any specialised post-graduate courses by the Department of Humanities, particularly in the field of management or social sciences. There are other specialised institutions in the country to cater to the needs of both social sciences and management and proliferation of these courses in an Institute of Technology is, in our view, totally out of context.

4.007 Industrial Engineering and Industrial Management is a specialised field appropriate for an Institute of Technology and this Department can usefully collaborate with the Department of Mechanical Engineering in organising suitable courses in this field. The main responsibility should, however, be that of the Department of Mechanical Engineering, in organising suitable courses in this field, the Department of Humanities only providing the support courses within its competence. We do not support addition of specialised staff in this Department since such staff will not have adequate work-load and its cost can be prohibitive. Even the existing staff does not have enough teaching and work-load. High level staff in specialised fields exists at the Jawaharlal Nehru University only next door and the Department of Humanities should establish close contacts with them and involve them fruitfully in their programmes.

4.008 Till recently 10 per cent of the total contact time of the students over the 5 years was set apart for subjects in the field of Humanities and Social Sciences. With the revised under-graduate programme the contact hours have been reduced and in consequence the share of the Department of Humanities has also been reduced to 9 per cent of the total time. The staff members of the Department of Humanities even initially did not have enough work-load. This position becomes worse with the reduction in the contact hours in the field of Humanities and Social Sciences. In recent years larger number of students are being admitted to the Institute with language requirements lower than the minimum. The spare capacity of the staff should, therefore, be fully utilised in extra time to make up particularly the language deficiencies in the students.

4.009 We have also observed that in the initial period, larger staff was recruited in the field of languages, but the needs of the Department in other areas should now be catered for and an appropriate balance obtained for the Department to provide effective support to the courses at the Institute of Technology. This should be done by earmarking future recruitment to existing vacant positions and those that may arise in future for the special fields until a proper balance is achieved. As already mentioned earlier, high level specialised staff of Jawaharlal Nehru University may be involved in the Institute's programmes to the extent possible.

4.010 Both in the interest of development of subject fields in their specialised areas and individual academic advancement of the staff members, their spare time should be utilised in research activities of relevance to the objectives and purposes of the Department and its services to the Institute of Technology. For this Department we recommend an ultimate allotment of 15 doctoral and 5 post-doctoral fellowships for research programme.

Department of Mathematics

4.011 The Department started functioning from 1961 at the under-graduate level. A post-graduate diploma course in Numerical Analysis and Automatic Computing was added in 1967 and a post-graduate course of M.Sc. in Mathematics was added in 1969. The sanctioned staff consists of teaching—Professors 3, Assistant Professors 13, Lecturers 9, Associate Lecturers 3, and supporting staff 8.

4.012 The accommodation allotted to the Department is 25,945 sq. ft. (carpet area). Up to March 1971, the Department acquired indigenous equipment of the value of Rs. 6.43 lakhs and foreign equipment of U.K. origin valued at £ 1,19,666. For the year 1970-71, expenditure on salaries of staff was Rs. 3.30 lakhs and working expenses Rs. 3,000.

4.013 The Department is at present teaching under-graduate courses to the Engineering Departments and conducting a post-graduate degree course of M.Sc. in Mathematics admitting 15 students annually and post-graduate diploma course in Numerical Analysis and Automatic Computing admitting 10 students annually. The Department also gives support to 25 post-graduate courses in various engineering departments. The Department has facilities for research and doctoral work in Applied Mathematics, Pure Mathematics, Numerical Analysis/Pure Science, Statistics/Operational Research. There are at present 35 students enrolled for research work against a sanctioned research fellowship strength of 25. So far 7 students for M.Sc., 26 for Post-graduate Diploma and 36 for the Ph.D. have been trained by the Department. Up to 1971, 31 students of the Department obtained Ph.D. awards.

4.014 A list of the subject titles on which Ph.D. awards were made for the students of this Department may be seen in Annexure X.

4.015 The Department has undertaken limited consultancy work assisting two industrial organisations.

4.016 The proposals made by the Department for further development are as follows :

1. The Department has proposed that the M.Sc. Maths. course be discontinued and in its place introduce the 5-year integrated course in Applied Mathematics.
2. Conversion of the P.G. Diploma Course in Numerical Analysis and Computing to an M.Tech. course in Computer Science.
3. Introduction of Post-M.Sc. Diploma Courses in :
 - (i) Mathematical Methods with an annual intake of 10 students ; and
 - (ii) Applied Statistics with an annual intake of 10 students.

4.017 In addition to the existing research programmes, it is proposed to create an advanced centre in Numerical Analysis both for advanced studies and research in Numerical Analysis and Computer Science.

4.018 We have earlier recommended that the Institute should not conduct any under-graduate courses other than in branches of engineering and technology. We do not, therefore, support the proposal for the 5-year integrated under-graduate course in Applied Mathematics.

4.019 We have, in defining the role of science departments emphasised that these departments should ultimately have only research activities and doctoral programmes in special and applied fields. They may, however, conduct one-year post-Ph.D. courses in special fields. Until this reorientation is achieved, we suggest that the present M.Sc. in Mathematics may continue with annual admission of 10 students.

4.020 We also support the proposed conversion of one-year post-graduate diploma course in Numerical Analysis and Automatic Computing to a two-year M.Tech. course in Numerical Analysis and Computing. Numerical Analysis and Computing may alternatively be offered as pre-Ph.D. courses and successful candidates from these courses allowed to take regular doctoral programmes.

4.021 Regarding the proposal for post-M.Sc. diploma courses, one in Mathematical Methods and the other in Applied Statistics, our views are as follows : The course in Applied Statistics will ultimately be useful at the Institute, but at present, adequate facilities to offer this course, do not exist. Instead, there is a good case for a course in Operational Research which would be able to have a good interaction with the course in Industrial Engineering in the Department of Mechanical Engineering and the course in Control and System Theory in the Department of Electrical Engineering. We, therefore, support that

the new post-M.Sc. diploma courses to be offered should be one in **Mathematical Methods** with an intake of 10 students per year and the other in **Operational Research** with an annual intake of 10 students. These should ultimately be pre-Ph.D. courses to fit into the proposed general structure of science departments' activities.

4.022 We envisage that the Department would ultimately have a student body of 90 all at post-graduate level—20 in course work, 25 in pre-Ph.D., 30 in doctoral programmes and 15 in post-doctoral work. This allows for a drop out of 10 students after the pre-Ph.D. course.

Department of Physics

4.023 The Department started functioning from 1961 at the under-graduate level. In 1964, the post-graduate degree course of **Masters of Science** and post-M.Sc. diploma course in **Applied Optics** were added. In 1965, a post-M.Sc. diploma course in **Solid State Physics** was started. In 1966, M.Tech. courses in **Applied Optics** and **Solid State Physics** were also introduced. The Department has so far trained 69 M.Sc.s, 34 M.Tech.s, 41 post-M.Sc. diploma holders and 30 Ph.D.s.

4.024 The sanctioned staff consists of teaching—Professors 4, Assistant Professors 18, Lecturers 8, Associate Lecturer 1, and other staff 25. The Department has 25,270 sq. ft. (carpet area) of accommodation. Up to March 1971, the Department acquired indigenous equipment worth Rs. 12.65 lakhs and foreign equipment of U.K. origin valued at £ 63,896.

4.025 For the year 1970-71, the actual recurring expenditure was Rs. 6.45 lakhs, made up of—expenditure on salaries of staff Rs. 5.10 lakhs and working expenses Rs. 1.35 lakhs.

4.026 The Department is at present teaching under-graduate courses to the engineering departments and conducting post-graduate courses of M.Sc. in **Physics** admitting 15 students annually and two-year M.Tech. courses in **Applied Optics** and **Solid State Physics** with annual admission of 12 students to each course. The Department is also conducting one-year post-M.Sc. diploma courses in **Applied Optics** and **Solid State Physics**.

4.027 The research interests of the Department are in the areas of **Applied Optics**, **Solid State Physics**, **Radio Physics** and **Physics of Ionised Media** and **Mossbauer Spectrometric Investigation of Solids**. At present 73 students are enrolled in the Department for Ph.D. and the subjects of registration for Ph.D. are **Optics**, **Solid State** and **Theoretical Physics**. In the field of **Optics** and **Solid State** where 40 per cent of the students are enrolled, the doctoral work is mostly experimental. The balance of 60 per cent registration for the Ph.D. is in **Theoretical Physics**.

4.028 Up to 1971, 30 students of the Department obtained the Ph.D. awards. A list of the subject titles on which the Ph.D. awards were made for this Department may be seen in Annexure X.

4.029 The proposals made by the Department for further development are as follows :

- (i) A 5-year integrated course in Physics at the under-graduate level with 10 annual admissions in place of the existing M.Sc. course.
- (ii) A pre-Ph.D. course of one year's duration and consolidation of the existing M.Tech., post-M.Sc. diploma courses in Applied Optics and Solid State Physics.

4.030 In the field of research, the Department desires to strengthen the existing research programmes in the areas of Micro wave, Plasma Diagnostics, Laser and Infrared Optics, Physics, and Technology of Thin Films, Material Sciences and Integrated Circuits.

4.031 In accordance with our recommendations for the role of science departments in an Institute of Technology, we do not support the Department conducting any under-graduate or M.Sc. course in Physics. We also do not support the continuation of the present post-M.Sc. diploma course of one year's duration.

4.032 The Department should ultimately conduct only doctoral and post-doctoral research courses and programmes in special and applied fields. It may also offer one-year pre-Ph.D. courses in specialised areas of Physics and successful candidates in these courses may be allowed to take up doctoral programmes. Until the Department is able to achieve this suggested reorientation, it may continue the present M.Sc. course with annual admission of 10 students.

4.033 The Department has been doing work in Applied Optics and Solid State Physics and these subjects could be offered as specialisations in M.Sc. which, in our view, will meet the aims of the Institute, particularly when the Department is offering Ph.D. training where the scholars will necessarily be working on specialised topics. The M.Sc. course thus offered by the Institute, would also have a distinct character from the normal M.Sc. course in Physics offered by universities.

4.034 We fully support the plan of the department to offer the one-year pre-Ph.D. course with a qualifying test on its conclusion. This will ensure that only those scholars who have basic fundamental knowledge of Physics and show special inclination for research work will remain to pursue their Ph.D. programmes.

4.035 The programme of the Department in Solid State Physics, Quantum Optics, Infrared Optics and Thin Films Technology, should be encouraged and proper facilities provided. The Department's interest in these fields of study should be well-defined.

4.036 The Institute proposed that a post-graduate course in Material Science should be offered through the Department of Applied Mechanics. We do not support any post-graduate course in this field because it basically needs a Department of Metallurgy and very large inputs. Such a course, we understand, is in the process of development already at the IIT Kharagpur. However, the Department of Physics has already some nucleus of

research facilities in this area and therefore we support an inter-disciplinary research activity in Material Science at this Institute with its base located in the Department of Physics.

4.037 Regarding the interest of the Department in Radio and Plasma Physics and Integrated Circuits, we do not support independent activities in these areas in the Department of Physics and also in the Department of Electrical Engineering. There should be close collaboration between these two departments to avoid unnecessary duplication of effort.

4.038 We have already commented elsewhere that it will be difficult for a senior staff member to take care of more than 4 candidates for guidance in doctoral work. This number of research scholars assigned to some staff members is much larger and we recommend that in the interests of quality work, the number of intake to Ph.D. should be suitably reduced.

4.039 In support of the activities recommended above for the Department, a sum of at least Rs. 15 lakhs for additional equipment may be provided. This amount can be found from out of equipment allocation of Rs. 114.42 lakhs for all departments in IV Plan and Rs. 7.5 lakhs for this Department in V Plan period suggested by us. There is no need to increase the staff.

4.040 We envisage that the Department would ultimately have a student body of 110 all at the post-graduate level — 20 in course work, 30 in pre-Ph.D., 40 in doctoral and 20 in post-doctoral programmes. This allows for a drop out of 10 candidates after the pre-Ph.D. course.

Department of Chemistry

4.041 The Department started functioning from August 1961 at the under-graduate level and post-graduate courses were added in July 1964. The sanctioned staff consists of teaching — Professors 3, Assistant Professors 10, Lecturers 11, and supporting staff 38. The Department has an accommodation of 19,520 sq. ft. (carpet area). Up to March 1971, the Department has acquired indigenous equipment valued at Rs. 4.49 lakhs and foreign equipment of U.K. origin valued at £ 32,836. For the year 1970-71, expenditure on salaries of staff was Rs. 3.96 lakhs and working and other expenses Rs. 1.45 lakhs.

4.042 The Department is at present teaching under-graduate courses to the Engineering departments and conducting post-graduate courses of M.Sc. Chemistry and M.Tech. in Modern Methods of Chemical Analysis with annual admission of 15 and 10 students, respectively. The Department has facilities for research and doctoral work in the broad fields of Bio-chemistry, Inorganic Chemistry and Analytical Chemistry, Organic Chemistry and Physical and Surface Chemistry. There are at present 25 students enrolled for

research work. So far 50 students for M.Sc. Chemistry and 5 for Ph.D. have been trained by the Department.

4.043 Up to 1971, four students of the Department obtained the Ph.D. awards. A list of the subject titles on which Ph.D. awards were made for the students of this Department may be seen in Annexure X.

4.044 The Department has a very well-organised Glass Blowing Workshop where scientific apparatus is fabricated for the departments of the Institute. The service is made available to outside organisations as well on special requests. The proposals made by the Department are :

1. Abolition of the existing M.Sc. course in Chemistry and in its place introduction of a 5-year integrated under-graduate course in Chemistry.
2. Introduction of M.Sc. course in Bio-chemistry with annual admissions of 10 students and a post-M.Sc. diploma in Bio-chemistry with an annual intake of 10 students.
3. Enlargement of the scope of existing areas of research in the department.
4. Establishment of the following new services :
 - (i) An analytical laboratory for total analysis of industrial raw materials ;
 - (ii) creation of a catalyst development cell ; and
 - (iii) development of an explosives laboratory.

4.045 We have earlier outlined the role of science departments in the Institute of Technology. In accordance with this, we do not support the department conducting any under-graduate course in Chemistry. The Department should give strong supporting courses at the under-graduate level for students of engineering and technology and at the post-graduate level should offer only doctoral and post-doctoral programmes in special and applied areas of Chemistry. It may also offer one-year pre-Ph.D. courses in such areas so that successful candidates in the pre-Ph.D. courses may be allowed to take the doctoral work.

4.046 Until the Department is able to reorient itself on these lines, only the present M.Sc. course in Chemistry and the Ph.D. programme may be offered. Any degree of specialisation necessary should be introduced in the 2nd year of the M.Sc. course in Chemistry which would give a distinct character from Master's degree awarded by universities in general. The Ph.D. programme will, however, be on highly specialised topics.

4.047 We suggest that the specialisation in the M.Tech. course should be suitably integrated with the M.Sc. and the Ph.D. courses.

4.048 While we support all the current research activities of the Department including Bio-chemistry, we do not recommend the starting of any post-graduate course in

Bio-chemistry at this stage. The prime consideration at this stage should be all round development in the major areas of Chemistry.

4.049 The majority of academic staff in this Department has specialised in one area and other equally important areas are somewhat neglected. We, therefore, suggest that in future recruitment of staff, great care should be taken to properly balance specialised staff in all four major disciplines of Physical, Organic, Inorganic, and Bio-chemistry.

4.050 In a teaching and training institution, as a matter of policy, no laboratory to cater exclusively for the industry, need be established. It should come only on the initiative of the industry and be fully supported by it. We, therefore, do not support the development of Analytical Laboratory at the Institute for industry's needs although the Department has argued that if such a facility is created, the Laboratory will become self-supporting.

4.051 The Department should concentrate its research efforts towards promoting industrial research and train scientists for that purpose. The Department has a strong case for some additional space.

4.052 We envisage that the Department would ultimately have student body of 80 all at the post-graduate level—20 in courses, 20 in pre-Ph.D., 30 in doctoral and 10 in post-doctoral programmes. This also allows for a drop out of 5 candidates after the pre-Ph.D. course.

Department of Applied Mechanics

4.053 The Department started functioning from October 1962 at the under-graduate level and post-graduate courses were added in July 1967. The sanctioned staff consists of teaching—Professors 4, Assistant Professors 8, Lecturers 8, Associate Lecturers 2, and supporting staff 29.

4.054 The Department has 24,000 sq. ft. carpet area of accommodation for its laboratories and departmental workshop, 9,000 sq. ft. carpet area for class-rooms, staff rooms etc. Up to March 1971, the Department has acquired indigenous equipment estimated at Rs. 5.36 lakhs and equipment of foreign origin (U.K.) estimated at £ 2^l,325.

4.055 For the year 1970-71, the actual recurring expenditure of the Department was Rs. 4.16 lakhs made up of approximately Rs. 3.5 lakhs on staff salaries and Rs. 0.66 lakh for consumables and minor equipment etc. In addition, a sum of Rs. 1 lakh is also available to the Department outside the Institute budget for special projects sponsored by CSIR and consultancy/other research projects.

4.056 At the under-graduate level, the Department is at present providing instruction in four subjects for students of all disciplines. These courses are in Fluid Mechanics, Solid Mechanics, Material Science, Mechanics, Design Engineering and Experimental Methods and Analysis.

4.057 The Department is currently offering two 2-year M.Tech. post-graduate courses in Design Engineering and Applied Mechanics with an annual intake of 10 students to each. The research activities of the Department are in the areas of Fluid Mechanics, Solid Mechanics and Material Science. The sanctioned strength of research scholars for the Department is 16, but currently there are 20 students enrolled for research work.

4.058 Of the students trained by the Department so far, 22 obtained the M.Tech. and 2 Ph.D. awards. The subject titles for the Ph.D. awards are :

- (i) Mechanics of Chip Formation in Two Dimensional Cuttings; and
- (ii) An Experimental and Theoretical Investigation of Turbulation Separated, Reattached and Redeveloped Flows with Transferred Rectangular Cavities.

4.059 The Department has undertaken consultancy and industrial collaboration work with a number of public and private sector organisations including the CSIR and the Ministry of Defence.

4.060 The proposals made by the Department are : The introduction of three 2-year M.Tech. P.G. courses in Engineering Materials, Aerodynamics and Propulsion, and Bio-engineering with annual admission of 10, 10 and 15, respectively. Under research activities, the Department has proposed consolidation of the present areas of work and in addition to undertake research programmes in the phased transformation and mechanical properties of materials.

4.061 In the former Delhi College of Engineering and Technology there was a separate Department of Applied Mechanics in which subject areas of common interest to the engineering departments (Civil, Mechanical and Electrical) were located under one charge. The idea was that this department should effectively organise courses, instruction and service in these subjects of common interest. Even after the College became the Indian Institute of Technology, the Department continued its separate existence.

4.062 The scope of activities of this department do not seem to have been well defined. It now claims to take up the work of planning and instruction of engineering science courses as its major role. This has also encouraged the department to have an expansive outlook and take on to itself normal functions of other departments.

4.063 Recently, the contact hours for under-graduate classes have been cut down to 28 in a week. The Department of Applied Mechanics controlling some of the basic subjects has severely reduced and modified their content to suit the minimum requirements of a number of departments. This has put serious limitations on the requirements of the other departments, e.g., the treatment of the subject of strength of materials has affected students of Civil Engineering. Again, there was a criticism that so far no effort was made by the Department to formulate a suitable course in the subject of fluid machinery which was entrusted to it. We are unable to understand how this Department is the appropriate

place to develop courses in subjects such as Aircraft Propulsion, Material Science and Bio-engineering.

4.064 We understand that amongst the IITs, the one at Madras is the only institute with a separate Department of Applied Mechanics. But in that case the field of work allotted to it is specific. It offers certain courses both at under-graduate and post-graduate levels which are of inter-disciplinary character. Its special area is in the field of Elasticity, Fluid Mechanics and Machine Dynamics. It offers a post-graduate M.Tech. course in Engineering Mechanics.

4.065 We are not very clear whether a separate Department of Applied Mechanics has a specific role to play in an Institute of Technology. In our view, the subjects currently allotted to this Department in IIT Delhi should have formed part of regular engineering departments wherein they are most appropriate. Even at this stage, we consider that such a redistribution of work and staff will be quite appropriate. We, however, have no intention to dislocate the existing arrangements in view of the fact that the Department has been functioning independently for quite some time. Nevertheless, we do not agree that the activities of this Department should be expanded to extend to all areas and disciplines of engineering as it has been trying to do.

4.066 We understand that a number of candidates have been sponsored from technical institutions under the Quality Improvement Programme for the M.Tech. course in Applied Mechanics, the first batch of students from which, has yet to pass out. This course may have some utility for sponsored teachers, but we doubt if it has any specific field of employment in the present conditions in the country. In our view, therefore, it is very unlikely that it can sustain for long. From the post-graduate course of M.Tech. in Engineering Design, three batches have passed out. We are informed that most of them have been employed in industry and the rest have gone to their departments from where they were sponsored. A well-organised course can serve a very useful purpose, but it cannot succeed unless it involves case studies and specific project activity. More principles of Design without actual and specific component and unit designs will not be much useful. We suggest that the Institute lifts live design work for actual production from various industrial establishments in the country maintaining close links with them.

4.067 We do not support the Department starting new course of M.Tech. in Material Science. But we do support research in fields for which there is now base in the Department of Physics. There is, therefore, no need to start the research activity in another department of the Institute. We also do not support the Department starting a post-graduate course in Aerodynamics and Propulsion. While the subject of Aerodynamics may have some relevance to the work of the Department, we do not consider it appropriate for this subject to be developed in the Institute without a basic course of Aeronautical Engineering. As for the subject of Aircraft Propulsion, its base should more appropriately be located in the Department of Mechanical Engineering if any.

4.068 While the demand for trained people in the field of Bio-engineering is gradually building up, the stage has not yet reached when there should be a special course in this field at the M.Tech. level. We, therefore, consider such a course at this stage as somewhat premature, but we support research in this field to be organised at the Institute on an inter-disciplinary basis. We feel that the Department of Electrical Engineering will be an appropriate place for a base of this inter-disciplinary research work.

4.069 We envisage an ultimate post-graduate enrolment for this Department of 59—40 in post-graduate courses, 15 in doctoral and 4 in post-doctoral research programmes.

Department of Civil Engineering

4.070 The Department started functioning from 1961 at the under-graduate level and post-graduate courses were added in 1964. The sanctioned staff consists of teaching—Professors 4, Assistant Professors 10, Lecturers 10, Associate Lecturers 2, and supporting staff 27.

4.071 The Department has an accommodation of 34,180 sq. ft. carpet area (61,588 sq. ft. plinth). Out of this, 23,000 sq. ft. carpet area is for laboratories and the rest is for staff rooms, class rooms etc.

4.072 Up to March 1971, the Department has acquired indigenous equipment of Rs. 4.46 lakhs and equipment of foreign origin (U.K.) valued at £ 67,750. For the year 1970-71, the expenditure on salaries of staff is Rs. 5.35 lakhs and working expenses on consumables and equipment etc. is Rs. 1.3 lakhs.

4.073 The Department is at present conducting under-graduate courses in Civil Engineering with an annual admission of 45 students. Also 3 post-graduate M.Tech. courses have been introduced in (1) Soil Mechanics and Foundation Engineering, (2) Structural Engineering, and (3) Water Resources, each with an annual admission of 10 students (total 30). The sanctioned strength of research scholars for the Department is 16, but there are currently 17 students enrolled for research work. The Department has facilities for research and doctoral work in the areas of Soil Mechanics, Concrete and Structural Engineering, Water Resources Engineering, Engineering Geology, Public Health Engineering and Highway Engineering.

4.074 Of the students trained by the Department so far, 234 obtained B.Tech., 49 M.Tech., 7 Post-graduate Diplomas and 2 Ph.D.s.

4.075 A list of subject titles on which Ph.D. awards were made for the students of this Department may be seen in Annexure X.

4.076 The Department has been undertaking consultancy and industrial collaboration from 1970-71 onwards and has earned Rs. 9,500 on routine consultancy and Rs. 86,800 on other types of consultancy.

4.077 The proposals made by the Department for further development are as follows : Two additional post-graduate M.Tech. courses — one in Engineering Geology and the other in Earth quake and Blast Resistant Structures each with an annual admission of 10 students and an increase in the number of research scholars by 4 making the total allotment for the Department 20 research scholars. In addition to the current activities, the Department has proposed the following research activities in the fields of Engineering Geology, Soil and Rock Mechanics, and Static and Dynamic Analysis of Structures through computers, utilising these specifically for dams, multi storeyed buildings, bridges, docks, material technology for developing experimental techniques for solution of involved problems.

4.078 The Department is strong in the field of structures and we support the proposed research activities in this area. We, however, do not recommend the proposal to support a post-graduate course in Earthquake and Blast Resistant Structures in view of the fact that there is already a strong school in this area at the Roorkee University and the efforts of the Institute will only be a duplication of these facilities.

4.079 Research activities of the Department in this field of Soil Mechanics are also good and the Department has been involved in consultancy work on Foundation problems. There is a good scope for interaction between these research activities in Structures and Soil Mechanics. While most of the institutes are engaged in the field of Soil Mechanics, the subject of Rock Mechanics is totally neglected by all. A course in Rock Mechanics will be very useful and can meet the needs of the country. We feel that this Institute with its background would be quite appropriate to develop such a course, may be through an initial experience of research in this area.

4.080 In our view the M.Tech. course in Water Resources currently offered by the Institute has also not much utility particularly when a similar course is being offered at the University of Roorkee. We recommend the winding up of this course after trying its utility for another session or two. We also do not recommend the proposed post-graduate course in Engineering Geology as several centres all over the country have already been developed in the field of Geology and Geophysics.

4.081 We envisage that ultimately the Department will have 105 students at the post-graduate level—80 in post-graduate degree courses, 20 in doctoral and 5 in post-doctoral programmes.

Department of Mechanical Engineering

4.082 The Department started functioning from 1962 at the under-graduate level and post-graduate courses were added in 1966. The sanctioned staff for the Department consists of teaching—Professors 5, Assistant Professors 14, Lecturers 13, Associate Lecturer 1, and non-academic staff 45. The Department has an accommodation of 30,245 sq. ft. carpet area (55,330 sq. ft. plinth).

4.083 Up to March 1971, the Department acquired indigenous equipment valued at Rs. 11.23 lakhs and foreign equipment of U.K. origin valued at £ 84,026.

4.084 For the year 1970-71, the total recurring expenditure was Rs. 6.5 lakhs made up of staff Rs. 5.1 lakhs and running expenses Rs. 1.4 lakhs. The Department has also a grant of Rs. 4.32 lakhs from sources other than the Institute budget. The Department is at present conducting under-graduate courses in Mechanical Engineering with an annual admission of 66 students and three post-graduate M.Tech. courses (1) : Production Engineering, (2) Thermal Engineering, and (3) Design and Production Machines, each with an annual admission of 10 students. The sanctioned number of research scholars for the Department is 14. There are currently 22 students and other staff members enrolled for research work. The Department has facilities for research and doctoral work in the fields of Thermal Engineering, Production and Industrial Engineering, and Engineering Design and Analysis.

4.085 So far the Department has trained 306 students for the B.Tech., 67 for the M.Tech. and 6 for the Ph.D.

4.086 A list of the subject titles on which the 6 Ph.D awards were made for the students of this Department may be seen in Annexure X.

4.087 The Department has undertaken consultancy work mainly in the field of I.C. Engines and earned a fee of Rs. 4.32 lakhs so far.

4.088 The proposals made by the Department for further development are as follows : Introduction of a post-graduate M.Tech. course in Industrial Design with an annual admission of 10 students, and an industry-oriented post-graduate diploma course of one year's duration for Refrigeration Engineering with an annual intake of 10 students. Under research activities, the proposals of the Department include work in Plastic Technology, Problems in Machine Tool Design, Industrial Engineering and Thermal Engineering.

4.089 The Institute is currently offering a combined course in Production and Industrial Engineering. Courses both in Production and Industrial Engineering are in good demand from various employing organisations and industries and each field is capable of being developed into a regular two-year post-graduate degree course. We, therefore, support the proposal of the Department to split up the existing course into two distinct M.Tech. courses—one in Production Engineering and the other in Industrial Engineering, each with an annual admission of 10 students.

4.090 Earlier we recommended that a post-graduate diploma course in Operational Research should be conducted by the Department of Mathematics in association with the Departments of Mechanical Engineering and Electrical Engineering. A separate course in Industrial Engineering in this Department can promote the growth of Operational Research as an inter-disciplinary activity.

4.091 The Department should consolidate the other existing courses.

4.092 We are not inclined to support the proposal of the Institute for a post-graduate diploma course in Refrigeration Engineering for the time being. Instead, the Department should strengthen its research activities in this area and also in Airconditioning. At a later stage, perhaps in the course of next 4-5 years, it may be appropriate to introduce a full-fledged Master's degree course in Refrigeration and Airconditioning. We fully support the proposal of the Department for research activities in the fields of Industrial and Production Engineering and to increase their activities in the field of I.C. Engines under Thermal Engineering.

4.093 We recommend that the ultimate post-graduate student enrolment in this Department should be 133—100 in M.Tech. courses, 25 in Ph.D. and 8 in post-doctoral programmes.

Department of Electrical Engineering

4.094 The Department started functioning from 1959 at the under-graduate level and post-graduate courses were added in 1963. The sanctioned staff consists of teaching—Professors 5, Assistant Professors 13, Lecturers 11, Associate Lecturers 2, and other non-academic and supporting staff 41. The Department has an accommodation of approximately 36,000 sq. ft. carpet area (61,361 sq. ft. plinth).

4.095 Up to March 1972, the Department has acquired indigenous equipment of the value of Rs. 13.34 lakhs and foreign equipment of U.K. origin valued at £ 93,784. For the year 1970-71, the recurring expenditure for the Department was Rs. 7.24 lakhs comprising staff salaries approximately Rs. 5.74 lakhs and consumables and working expenses Rs. 1.5 lakhs. The Department is at present conducting under-graduate courses in Electrical Engineering with an annual admission of 45 students and 4 post-graduate M.Tech. courses in (1) Electronics/Communication, (2) Control Engineering, (3) Power Apparatus and Systems, and (4) Radar Technology with annual admission of 10 students each to the first three courses and 5 to the last one. The sanctioned number of research scholars to the Department is 16. There are at present 22 full-time students and 5 faculty members as part-time students enrolled for research work in the department. The Department has facilities for research and doctoral work in areas of Control Systems, Electronics and Communication, Power Systems and Networks.

4.096 So far the Department has trained 302 students for the B.Tech., 86 students for the M.Tech., one for the post-graduate diploma and 7 for the Ph.D.

4.097 A list of subject titles on which Ph.D. awards were made for the students of this Department may be seen in Annexure X.

4.098 The Department provides facilities for routine services for industry and public organisations in repairing, servicing and calibration of electrical and electronic instruments. With the well-equipped laboratories, the faculty of the Department has a wide range of interests in the areas of Electronics, Communications, Control Machines and Power

Systems. The Department has the expertise in these fields and has provided consultancy services to public and private organisations. The Department has also established research collaboration both formal and informal with Government departments and private sector organisations.

4.099 The proposals made by the Department for further development are as follows : Two new M.Tech. post-graduate courses—one in Computer Science and Technology and the other in Instrumentation and Automation, each with an annual admission of 10 students, an increase in the number of research scholars by 4, making the total allotment to the Department 20. In the field of research, the Department has proposed that the subjects currently being pursued should be expanded and in addition to create a nucleus for research in the areas of Space Communication Digital Techniques, Integrated Circuit Technology and Micro Miniaturisation, Power Electronics, Electro Propulsion Techniques and Socio-economic Systems and Propagation in Arid Zones.

4.100 We recommend that the four post-graduate courses already being run by the Department should be consolidated. It has been proposed by the Institute that to support the programme in Radar Technology, financed by the Ministry of Defence, research should be initiated in the areas of Control Systems and Power Electronics. We are of the view that financial support for this also should come from the Ministry of Defence. Expertise in the areas of Electronics and Communication Engineering available in the Department supplies the support for the course in Radar Technology.

4.101 Production of computers indigenously has assumed great importance in recent times. Already manufacturing units in both private and public sectors are engaged in this activity. Thus a need has already arisen for training in the hardware aspect of computers. We, therefore, support in principle the proposal of the Department for an M.Tech. course in Computer Technology. Enough expertise by research work in this field should first be built before such a course is introduced.

4.102 We do not, however, support the introduction of a new course in Instrumentation and Automation. This is a very wide field needing lot of financial inputs. An advanced school in Instrumentation and Automation is being developed under a special project at a huge cost at the Indian Institute of Science, Bangalore. We, therefore, suggest that the IIT Delhi need not duplicate this effort. In our view it would serve the purpose quite well if the present course in Control Engineering is revised to include certain aspects of Instrumentation and Automation.

4.103 We recommend that the ultimate post-graduate enrolment in this Department should be 135—100 in M.Tech. courses, 25 in doctoral and 10 in post-doctoral programmes.

Department of Chemical Engineering

4.104 The Department started functioning from the middle of 1960 admitting the first batch of students to the under-graduate courses in July 1961. The programme of post-

graduate courses was started in the Department in 1968-69. The sanctioned staff consists of teaching—Professors 4, Assistant Professors 7, Lecturers 10, and supporting staff 28.

4.105 The Department has 27,347 sq. ft. of carpet area (56,999 sq. ft. plinth).

4.106 Up to March 1971, the Department has acquired indigenous equipment valued at Rs. 6.24 lakhs and equipment of foreign origin (U.K.) valued at £ 78,556. For the year 1970-71, the total actual recurring expenditure for the Department was Rs. 3.93 lakhs made up of approximately Rs. 3.3 lakhs on staff and the balance on working expenses (consumables, minor equipment etc.).

4.107 The Department is at present conducting an under-graduate course in Chemical Engineering with an annual admission of 45 students; and three post-graduate courses (1) Reaction Engineering (Petro-chemicals), (2) Bio-chemical Engineering, and (3) Process Plant Design, each with an annual intake of 6 students. The sanctioned strength of research scholars for the Department is 14, while the actual number of students currently enrolled for research work is 7. The Department has facilities for research and doctoral work in the areas of Bio-chemical Engineering, Process Dynamics and Control and Reaction Engineering (Petro-chemicals.).

4.108 Of the students trained by the Department so far, 279 obtained B.Tech., 6 M.Tech. and 3 Ph.D.

4.109 A list of subject titles on which the Ph.D. awards were made for the students of this Department up to 1971, may be seen in Annexure X. The Department has been undertaking consultancy work of a limited nature.

4.110. The proposals made by the Department for further development are as follows : Consolidation of the existing 3 post-graduate courses and developing them into organised schools and in addition starting two new post-graduate courses in Polymer Engineering and Process Dynamics and Control each with an annual intake of 10 students.

4.111 The Department contemplates long-term advanced research programmes as follows : In the field of Bio-chemicals : Enzyme science and Technology ; Dynamics of Microbiological Growth and Product Bio-Synthesis; Mass Transfer in Macorobial Systems and Scale up; Computer Application in Fermenter Design; Mathematical Modelling of Industrial Fermentation; Separation and Recovery of Microbial Proteins from their Cell Walls; and Food Processing and Engineering. In the field of Polymer Engineering : In the areas of Kinetics and Thermodynamics, Scale up Operations, Process Dynamics and Material Science.

4.112 There have been certain handicaps in a substantive development of the Department of Chemical Engineering. The physical existence of this Department in its present environment is only 5 years. The profession of Chemical Engineering is the youngest in the country and has suffered earlier from extreme shortage of senior and competent faculty.

The preoccupation of the Department in the past years has mainly been the establishment and consolidation of a sound under-graduate programme in Chemical Engineering. The first post-graduate course could only be started in 1968. In spite of these limitations, some useful work has been done in all the three areas of Process Dynamics and Control, Reaction Engineering and Bio-chemical Engineering. It is hoped that further developments would take place in these activities which would justify additional support. The strength of the Department lies in the area of Bio-chemical Engineering and Reaction Engineering. The post-graduate courses in these areas are based on faculty interest and needs of the country. We recommend a consolidation of all these three courses and increase in the intake to each to 10 students per year instead of the existing level of 6.

4.113 Judging from the present faculty position or research activity in the Department, we feel that it is somewhat premature to think of a new post-graduate course either in Polymer Engineering or Process Dynamics and Control.

4.114 We recommend for this Department an ultimate post-graduate student enrolment of 80—60 in M.Tech. courses, 15 in doctoral and 5 in post-doctoral programmes.

Department of Textile Technology

4.115 The Department started functioning from July 1964 at the under-graduate level and post-graduate courses were added in 1967 and 1970. The sanctioned staff consists of teaching—Professors 3, Assistant Professors 7, Lecturers 5, Associate Lecturers 2 and supporting staff 30.

4.116 The Department has 33,200 sq. ft. carpet area (55,333 sq. ft. plinth) for accommodating its laboratories and workshops, 3,120 sq. ft. for class-rooms, 2,240 sq. ft. for staff rooms and 7,436 sq. ft. for library, committee room and other amenities.

4.117 Up to March 1971, the Department has acquired equipment of indigenous origin valued at Rs. 9.5 lakhs and equipment of foreign (U.K.) origin valued at £ 6,160.

4.118 The actual recurring expenditure for the Department in 1970-71 was Rs. 4.19 lakhs made up of Rs. 3.85 lakhs on staff salaries and Rs. 0.34 lakh on working expenses (consumables, minor equipment etc.).

4.119 The Department is at present conducting the under-graduate course in Textile Technology with an annual admission of 45 students. The under-graduate course has three specialisations—Textile Technology, Textile Engineering and Textile Chemistry. The Department is also conducting two M.Tech. post-graduate courses of two years' duration—Textile Engineering, and Fibre Science and Technology each with an annual intake of 10 students. The Department has facilities for research and doctoral work in the areas of Fibre Science, Textile Chemistry and Textile Engineering. The sanctioned strength of

research scholars for the Department is 10 but currently there are only 5 students enrolled for research work.

4.120 Of the students trained by the Department so far, 112 obtained the B.Tech., 23 M.Tech. and one Ph.D. The Ph.D. award was made for the work of distribution and movement of fibres on a Revolving Flat Card.

4.121 From 1970-71, the Department is engaged in consultancy and industrial collaboration. One of the important items of this work is studies on cost at each stage of textile products in various mills in collaboration with the Bureau of Costs and Price. These studies would form the basis for fixing standards. The Department has also rendered advice on technical problems referred to them by certain textile mills in the Northern Region.

4.122 The proposals made by the Department for further development are as follows : A new M.Tech. post-graduate course of two years' duration in Textile Machine Design with an annual admission of 10 students and an increase in the number of research scholarships to 20 from the existing level of 10. The Department has proposed the intensification in the research activities in the three specific areas—Textile Engineering, particularly in the field of Fibre Assemblies, Fibre Science and Chemical Processing in the field of Cloth Finishing. There is also a proposal to set up an Industrial Co-operative Research Centre to be financially supported by the participating industrial concerns. The Centre would undertake research programmes pertaining to industrial problems.

4.123 The under-graduate course at this Institute is slightly different from similar courses elsewhere in as much as courses in Fibre Science and other modern areas are also introduced which has helped in better employment of the graduates.

4.124 We welcome the proposal of the Department for the introduction of two more electives at the 5th year level of the under-graduate course in Management, and Textile Design and Colour, but this should be done only after stabilising the present three electives at the under-graduate level and competent faculty is available both in the department and in the Department of Humanities which deals with the subject of Management. Of the two post-graduate courses, the one in Fibre Science and Technology was started only recently and it is necessary that this should be properly stabilised before any further courses at the post-graduate level are contemplated.

4.125 The Department is working on structural properties of natural and man-made fibres and the chemical aspects of dyeing and polymers as well as textile processing. In the last couple of years, the Department has established very close liaison with textile industry of the country. We were told that industry has agreed with the department to set up a Co-operative Centre for research involving both fundamental and applied aspects of textile and man-made fibres.

4.126 No specific estimates of cost for this Centre and the relative contributions by industry and the Institute have been presented to us. Nevertheless, we feel that this is a

very encouraging and satisfactory development and we support the proposal on the understanding that a substantial part of financial commitment will be met by industry and only ancillary support is required from the Institute.

4.127 ATIRA (Ahmedabad Textile Industries Research Association) and SASMIRA (Silk and Art Silk Mills Industries Research Association) are two organisations which work in the field of textile technology, but they do not cover all aspects of development in this field. It is also felt that these research institutions are not adequate to cope with the entire needs of the country. Moreover, the existing institutions have only specific problems of purely industrial research. No Institute is at present engaged in research and development of structure of fibre assemblies nor in textile machine design.

4.128 While the proposed Centre will have the advantage of the impact of the other departments of the Institute in a fundamental approach to problems, the turn-over of students with newer ideas and approaches will be a further advantage. We, therefore, conclude that there is a case for the establishment of an institute of this type and we welcome the proposal to set up a Co-operative Centre involving both fundamental and applied aspects of textile and man-made fibres. We would, however, emphasise that the financial commitment of the Institute should not go beyond ancillary support to the project and that bulk of the finance for the Centre would come from the main user—the textile industry of the region.

4.129 We envisage for this Department an ultimate total post-graduate student enrolment of 53—40 in M.Tech. courses, 10 in doctoral and 3 in post-doctoral programmes.

SPECIAL CENTRES

Centre of Radar Studies and Research

4.130 Self-reliance in the field of Radar Science and Technology is vital for defence needs of the country. The Ministry of Defence accordingly decided to set up a dynamic organisation for which service officers have to be given specialised training both in M.Tech. and block courses of 3 months duration.

4.131 The Institutes of Technology, the Indian Institute of Science and the University of Roorkee have been selected by the Defence Ministry to organise these courses. The institutes are to specialise in separate branches of Radar Technology such as Signal Processing and Fast Aerial Systems, Microwave, Computer Processing of Signals and Control and Guidance. This Institute is to specialise in Signal Processing and Fast Aerial Systems. We also appreciate the point that there may be some unavoidable overlapping in areas of specialisation.

4.132 The Defence Ministry would be supporting these programmes for a period of five years for which they would make a grant of Rs. 55.87 lakhs for recurring expenditure and

Rs. 35 lakhs for equipment. The Institute is required to provide the necessary building for the purpose at a cost of Rs. 38.64 lakhs. The Institute has proposed that an additional sum of Rs. 8 lakhs for equipment and Rs. 0.75 lakh for buildings would be needed to develop auxiliary areas of research and development around Radar studies. This is a very desirable and welcome feature in the outlook of the Ministry in trying to make use of existing facilities and capabilities at the Institute of Technology. This is also a vital area for civilian training as in the case of cyclone forecasting. We, therefore, whole-heartedly support the programme to be initiated at the Institute.

4.133 The amount provided for equipment by the Ministry of Defence may prove to be inadequate in view of the expensive items required for a satisfactory programme of development and research in this area. We, however, hope that the Ministry of Defence will be prepared to support such of these centres which show promise with adequate financial support at a later stage. For the time being we would like the institution to get a start and watch how this programme builds up and develops.

4.134 While we feel that the Ministry of Defence could as well have provided the amount of Rs. 38.4 lakhs required for building also, this amount may be granted to the Institute by the Ministry of Education if the Ministry of Defence cannot do so. The funds needed for developing the auxiliary areas of research and development should come out of the Institute's own resources.

4.135 We recommend that the title of the post-graduate course should be M.Tech. in Electronics with emphasis and specialisation in Radar Technology instead of M.Tech. course in Radar Technology as proposed by the Institute.

Computer Centre

4.136 The Centre has an I.C.L. 1909 paper tape computer system costing approximately £ 1,20,000 (Rs. 24 lakhs) installed in August 1967. The Centre provides computational facilities and gives advice in designing and executing proper computer strategy for solving research problems in all departments of the Institute.

4.137 The Centre has the following teaching activities :

(a) *Courses for the Institute*

- (i) A course in Programming in Numerical Methods for fourth year undergraduate students ;
- (ii) four courses — Programming Simulation and Related Computer Methods, Analogue and Digital Computers, Programming Language, and Numerical Analysis for M.Tech. students ; and
- (iii) two short-term courses for students, research scholars and staff—Fortran Four

Programming—a six-week course each semester ; and **Systems Programming** of six weeks' duration.

(b) *Courses for Outsiders*

These are given on request and so far two such courses have been organised, one for the officers of the CWPC in December 1968 and another for the post-graduate students of the School of Planning and Architecture in March 1970. The Centre has also so far offered two advertised short-term evening courses in October-November 1970 on Fortran Four Programming, charging a fee of Rs. 250 per candidate. Fifty students were admitted in each batch.

4.138 The computer is at present working only for 6-8 hours in a day because of limitations of memory and attachments. Most of the working time is utilised only for the Institute and assistance to outsiders has not been possible on account of these limitations. From out of the new one million pounds British assistance, funds to the tune of £ 57,000 have been allocated for a 16 K Ferrite Core Memory, and disk and magnetic tape system imparting multi-programming capabilities to the computer.

4.139 The Centre and the Director acknowledge that the system is fairly satisfactory for the present needs. They, however, propose to instal a new third-generation computer system (ICL 1904 preferably with 64 K memory) costing at least £ 5,00,000 or Rs. 1 crore, mainly on the ground that the present system is likely to become out of date in the course of next three years or so. This would also involve a total of Rs. 20 lakhs non-recurring expenditure over the next five years, Rs. 6.5 lakhs equipment from indigenous sources and Rs. 3.6 lakhs worth of building. We do not see any justification in this huge outlay, particularly when the present system has not been used much and also when the capability of the system can be increased to take additional work by the provision of extra memory and other peripherals. Moreover, only next door a big sized computer system is being established at the Jawaharlal Nehru University. We, therefore, support only a further expenditure on the existing system of about £ 50,000 or Rs. 10,00,000 for a second line printer and card recorder to improve the utility of the system and it can serve the needs of the institution and other local needs as well quite adequately for some.

4.140 The Centre has proposed the introduction of an integrated educational programme leading to M.Tech. in computer science. This course will admit B.Tech. in any branch of engineering or M.Sc. in any branch of science. The students will undergo basic courses which form their foundation for computer science and specialised courses pertaining to the basic courses they are trained there.

4.141 We do not agree with the proposal that the Computer Centre should also organise regular post-graduate teaching programmes like the departments. It should only function as a Central Servicing Unit. The courses in Computer Science or Technology should be the concern of the appropriate departments—courses concerning software should be the

responsibility of the Department of Mathematics and courses concerning hardware should be the responsibility of the Department of Electrical Engineering. We had separately recommended M.Tech. course in Numerical Analysis and Computing for the Department of Mathematics and M.Tech. course in Computer Technology for the Department of Electrical Engineering.

4.142 We also support the proposal for the establishment of a computer laboratory in which students can learn the fundamentals both from software and hardware angle. For this purpose a sum of about £ 15,000 or Rs. 3 lakhs may be allocated. The Computer Centre has a sanctioned staff of 15 for the 4th Plan period while the actual number in position is only 8. We do not recommend any further addition to the staff of the Centre. An additional sum of Rs. 5 lakhs as operational cost may, however, be provided for a five-year period.

Instrument Design Development Centre

4.143 The objectives in the setting up of this Centre are stated to be (1) to repair, service and calibrate certain types of Institute equipment and instruments, (2) to design and develop prototypes of instruments and scientific equipment developed by the departments of the Institute, (3) to produce the design sheets and prototype units of instruments on request by Government and private agencies, and (4) to undertake evaluation studies of instruments and scientific equipment developed in the country.

4.144 The Institute has about Rs. two crores worth of sophisticated equipment and instruments. The Centre thus has a very useful role in assisting the departments in keeping expensive items and equipment in working condition. We, however, understand that full use is not made by the departments to avail of this facility. Often damaged equipment is sought to be set right by importing duplicates or spare parts without an attempt at rectifying them using internal resources. This was possible so long as British assistance was available. Once this resource will have dried up, the departments have no alternative but to condemn the equipment unless the Centre can help them in effecting the necessary repairs and putting equipment in working condition.

4.145 The objectives (2) and (3) can only be met with partial success as experience throughout the world shows that industry does not accept laboratory prototypes for manufacture. From the very early stages, industry has to be associated with the design and development of instruments. We question whether an IIT should engage in this sort of work.

4.146 There is, however, an important role for the Centre to play in the development of instruments and apparatus produced by the students and staff in their project and research work in the various departments. The Centre can render assistance to the departments in the proper design and construction of equipment for intensive educational purposes if it maintains close liaison with the departments. The Centre can fulfil another important function, namely, the training of skilled technicians for maintenance and fabrication of

instruments for the institute laboratories and instrument industries. Such trained technicians are in great demand.

4.147 The objective (4) of evaluation studies is, in our view, much too ambitious. Industry will have to pay for such evaluation and at the present stage of development of instruments industry in the country, this is not feasible. Any evaluation without active co-operation of manufacturers and users with the Centre will be of no use. It also requires a variety of instrument scientists of different categories on the staff of the Centre which is prohibitive in cost.

4.148 The Director has proposed an expenditure of Rs. 20 lakhs non-recurring and Rs. 17.5 lakhs recurring over five years for further development of the Centre for the fulfilment of the objectives mentioned at the outset. As we have already pointed out, the Institute's Instrument Centre is not the right place to fulfil all the objectives stated both from the point of view of providing expertise at various levels in the diverse fields of instruments production and the prohibitive cost such a scheme demands.

4.149 The Centre should restrict itself to the chief task of maintaining equipment and instruments of the Institute in order to assisting the students and the staff members of the departments in building apparatus and instruments for project works and research and train instrument repair technicians needed by the educational institutions. The Centre can, with its existing facilities further develop such of the useful equipment and instruments produced in the departments and supply them to various educational institutions needing them.

4.150 Even for this limited objective, it may be necessary to augment the skilled staff of the Centre and we believe that such staff is available partly in the Centre and partly in the departments. The Centre should be allowed a free choice of collecting the skilled staff necessary for running it thoroughly. We do not recommend any addition to the existing facilities of the Centre either by way of equipment or by way of building.

Centre for Enterprises and Management

4.151 The Institute made a proposal for the establishment of a Centre for Enterprises and Management to provide a two-year post-graduate course. At present the Institute is conducting two short-term courses each of three months' duration supported by the Ministry of Industrial Development. These courses have come into being in an attempt to divert engineering graduates from job-seeking to self-employment in small industry.

4.152 Some amount of training in entrepreneurship and management may, no doubt do good to those who wish to do something on their own, but we are not quite sure whether this calls for a separate academic discipline with a post-graduate award of M.Tech. We also do not understand why an academic award is necessary for a person going for self-employment when there are no such statutory restrictions. The clamour for degrees in this

country is normally associated with job-seeking. When our aim is precisely to divert people from job-seeking, the idea of providing them with a degree course seems to be somewhat anomalous.

4.153 In our view, a well-planned course for those interested graduates in engineering for a period of one year should be adequate to deal with the needs of those looking for avenues of self-employment. We go a step further and suggest that the Institute may do something more than merely organise a course in entrepreneurship. Intimate contact should be developed with big industrial establishments like the Heavy Electricals, Bhopal, who may be needing a large number of small components which they buy from outside. Assistance should be organised for graduates going for self-employment in the development and production of these components. For this purpose the services of an industrial estate will also be extremely useful.

4.154 A provision of Rs. 10 lakhs for recurring expenditure and Rs. 2.51 lakhs for additional buildings would meet the requirements of this course. These amounts can be found from the annual financial provision we are making for the Institute.

4.155 We do not at all support any course in pure management for this purpose.

Other Centres

4.156 The Director in his report to the Reviewing Committee made proposals for the following nine Research and Development Units :

1. Computer Centre ;
2. Instrument Design Development Centre ;
3. School of Radar Research ;
4. Centre for Enterprises and Management ;
5. Co-operative Research Centre for Textile Technology ;
6. Educational Research Technology ;
7. Quality Improvement Programmes ;
8. Curriculum Development Cells ; and
9. Bio-medical Engineering Unit.

We have already discussed the first four centres. We have also discussed the Co-operative Research Centre for Textile Technology under the Department of Textile Technology. In support of our proposal, we recommend an amount of Rs. 2.5 lakhs for equipment and Rs. 5 lakhs for recurring expenditure in five years.

4.157 In our review of the Department of Applied Mechanics we discussed the proposal of the Department for two research units ; one in Material Science and the other in Bio-medical Engineering. We agreed to these two units, but we did not agree to their location in the Department of Applied Mechanics. We suggested that the Material Science Unit should have its base in the Department of Physics where already a nucleus in this area

exists and that the Bio-medical Engineering Unit should have its base in the Department of Electrical Engineering which is more appropriate for it. We recommended that for these two units a non-recurring expenditure of Rs. 22 lakhs and a recurring expenditure of Rs. 10 lakhs over 5 years may be provided.

Our views on the remaining proposals are as under

Centre for Educational Research and Technology

4.158 In 1965, the Government of India introduced the programme of Technical Teachers Training in selected centres to meet the shortage of teachers in technical institutions. This was a three-year programme including two years for the M.Tech. and one year for pedagogical training. Such a centre was also functioning in the IIT Delhi. The shortage of lecturers has now been overcome. Also difficulties are encountered in finding employment for teacher trainees from fresh graduates. The programme has now been replaced by the Quality Improvement Programme (Q.I.P.). In this only serving teachers sponsored by their respective institutions are taken for M.Tech. programmes in selected centres.

4.159 The proposal of the Director is to convert the former Teachers Training Centre to a Centre for Educational Research and Technology having an Educational Research Cell and a Unit for Educational Technology. The Educational Research Cell will make new educational experiments to improve the educational process. The Educational Technology Unit will develop audio-visual and close circuit television services for improving the quality of education. The estimate of cost for this Centre is Rs. 15 lakhs non-recurring and Rs. 10 lakhs recurring in 5 years.

4.160 We have now established in the country 4 Regional Technical Teachers Training Institutes and the National Council for Educational Research and Technology. All these institutions are already engaged in work similar to the one proposed by the Director for the Centre of Educational Research and Technology. We do not, therefore, see any justification for another Unit in the Institute at such a cost. We recommend that the former Technical Teachers Training Centre in the Institute may be closed down and the lone teacher in the Centre may be absorbed in the Department of Humanities with suitable allocation of duties.

Quality Improvement Programme

4.161 The Government selected the Institute as a Centre for Quality Improvement Programmes and Curriculum Development. Under the Quality Improvement Programmes, the Institute is required to provide facilities for serving college teachers for two-year M.Tech. courses, doctoral programmes and short-term in-service programmes. To support these programmes, the Director put up before the Reviewing Committee an estimate of Rs. 13 lakhs non-recurring expenditure for buildings and Rs. 35.75 lakhs recurring

expenditure over 5 years. The building is to provide accommodation for sponsored teachers and the recurring expenditure is to meet operational cost and payment to staff.

4.162 The need for the teachers to maintain two establishments while undergoing the courses has been taken note of and it has been provided in the Quality Improvement Programme as an essential condition that the sponsoring institutions should pay the teachers their salaries and allowances. They will in addition be paid the scholarships and fellowships appropriate for the programmes under the scheme. Government also pays the Institute a grant of Rs. 500 per student per year. We have made it clear earlier that the total post-graduate and research student body in the Institute should ultimately be 1,000 from all sources. Student accommodation, staff fellowships and consumable expenditure have been provided for this number. Sponsored teachers under the Quality Improvement Programme should also be counted in the approved post-graduate student body. We, therefore, see no justification for the Institute to put up additional demands to implement this programme. It will, however, be noted that we have already provided some extra accommodation in post-graduate hostels for some contingencies.

4.163 The Institute's estimate for the curriculum development cells is a non-recurring expenditure of Rs. 10 lakhs for buildings and Rs. 6 lakhs for recurring expenditure including operational costs and pay and allowances. We do not support these estimates. When a Curriculum Unit is allotted to an Institute under the Quality Improvement Programme, Government makes a certain financial provision and the Institute should be able to manage within that provision.

CHAPTER—V

FINANCIAL REVIEW AND RECOMMENDATIONS

5.01 The Institute submitted to the Committee the revised development plan formulated in 1966. We discussed in detail this plan and its implementation in the opening chapter. Therein we indicated the actual achievements by the beginning of the 4th Plan period, i.e., 1st of April, 1969 and the carry over to the 4th Plan period. The development proposals made by the Institute for the 4th Plan period were also indicated. The 4th Plan allocation made for the Institute, however, is less than the actual needs.

5.02 We generally support the proposals made by the Institute for the 4th Plan outlay comprising carry over of the part yet to be implemented after April 1969 for the development plan and the additional development requirements for the 4th Plan period itself. We presume the beginning of the actual implementation of the recommendations made by this Committee will commence with the 5th Five-year Plan beginning 1st of April, 1974 and may even go into the 6th Five-year Plan period.

5.03 We have attempted to indicate the financial requirements of the Institute during the 4th Plan period and the 5th Plan period. Owing to uncertainty of the provision of funds for the 4th Plan period, we cannot foresee how much of the proposed outlay would actually be made during this period. On account of this we take it that necessary additional developmental funds will be provided to the Institute in the 5th Plan period for that part of the 4th Plan outlay which it may not be possible to implement during the 4th Plan itself. In order to arrive at the developmental expenditure during the 5th Plan period on account of the recurring expenditure, we have taken that a ceiling of Rs. 150 lakhs per annum of recurring expenditure will have been reached by the end of the 4th Plan period. This amount is also taken as the non-plan expenditure for the 5th Plan period and only developmental expenditure in addition to this on recurring account has been assessed and included in the 5th Plan.

5.04 The deviations in our acceptance of the proposals made by the Institute for additional 4th Plan requirements as indicated in the opening chapter of this report are

discussed below :

(i) Under the head Academic and Non-residential Buildings the Institute proposed Rs. 23.63 lakhs whereas we have accepted only Rs. 19.96 lakhs. This is because we consider that the airconditioning of the Computer Centre and the airconditioning of the IDD Centre and Lecture Theatre need not be provided more than Rs. 2 lakhs and 1 lakh, respectively.

(ii) Under the head Student Residential Buildings, the Institute proposed an amount of Rs. 15.84 lakhs for 200 additional students. We, however, recommend that this number should be 250 and all provided as post-graduate hostel accommodation at a total cost of Rs. 20 lakhs. The total provision of Rs. 114.42 lakhs (i.e., Rs. 32.03 lakhs carry over from the development plan and Rs. 82.39 lakhs additional provision under the 4th Plan) under equipment, books and furniture is only for equipment to take care of the increased post-graduate activity as compared to that initially contemplated.

5.05 In our estimates for the requirements of the Institute for the 5th Plan period, we included an amount of Rs. 40 lakhs for the construction of additional staff quarters. Our recommendation for a total student body of 2,000 at the Institute (1,000 at under-graduate and 1,000 at post-graduate level) requires a total teaching staff complement of 300. With the provision made in the 4th Plan, 276 members of the teaching staff will have been provided with staff quarters. For the additional 24 members, approximately an amount of Rs. 15 lakhs is required. We also recommend a further provision of Rs. 25 lakhs for staff quarters so that 50 per cent of the permanent staff other than teaching staff also could be provided with staff quarters appropriate to their grades.

5.06 To support the further increase in post-graduate activity, both in the courses and in research programmes, proposed by us, we recommend a total provision of Rs. 110 lakhs mainly for equipment as indicated below :

Department	Amount for equipment (Rs in lakhs)
Applied Mechanics	8
Chemistry	4
Chemical Engineering	10
Civil Engineering	10
Electrical Engineering	15
Humanities and Social Sciences	—
Mathematics	1
Mechanical Engineering	15
Physics	7.5
Textile Technology	7.5

5.07 In addition to this, we also recommend a sum of Rs. 12 lakhs for necessary adjustments in some buildings and a sum of Rs. 20 lakhs to be provided as foreign exchange for components and spares required for various departments.

5.08 For the development of the specialised centres on the lines indicated by us, we suggest the financial provision during the 5th Plan period as follows :

Centre	Non-recurring		Recurring
	Equipment	Building	
	(Rupees in lakhs)		
Computer Centre	15.00	—	5.00
Instrument Design Development Centre	5.50	—	5.00
Co-operative Centre of Textile Technology	2.50	—	5.00
Bio-medical Engineering and Material Science	20.00	2.00	10.00
Total Non-recurring	45.00		25.00

5.09 The developmental recurring expenditure in the 5th Five-year Plan has been estimated at Rs. 170 lakhs. This includes : (1) a provision of Rs. 40 lakhs for a 5% growth on recurring expenditure of approximately Rs. 150 lakhs that will have been reached by the end of the 4th Five-year Plan, (2) a provision of Rs. 15 lakhs for salaries for additional 24 teaching staff members, (3) a provision of Rs. 90 lakhs for increased post-graduate activities, and (4) a provision of Rs. 25 lakhs for the development of specialised centres.

5.10 It will be observed that all the recurring expenditure has to be suitably phased since the ultimate activity at the post-graduate level envisaged by us will take time to build up and may not reach the level suggested by us even by the end of the 5th Plan period. We foresee that only in the earlier years of the 6th Plan period, it will be possible for the full financial impact of our recommendations being felt. Therefore, a suitable and judicious phasing of recurring expenditure is indicated.

5.11 We have earlier in this report made a reference to the £ 1 million U.K. assistance in addition to the £ 9,00,000 assistance already agreed to. The allocation of this assistance to the various departments made by the Institute is as follows :

Carry over from old lists	£ 1,50,000
Incidental and Operational expenses	£ 1,50,000
Reserve	£ 1,00,000
	£ 4,00,000

Department	Dept. allocation (£)	Dept. allocation including Central facilities (£)
Physics	30,000	70,000
Chemistry	40,000	80,000
Applied Mechanics	55,000	70,000
Textile Technology	65,000	80,000
Electrical Engineering	60,000	60,000
Mechanical Engineering	60,000	60,000
Chemical Engineering	60,000	60,000
Civil Engineering	60,000	60,000
I.D.D. Centre	40,000	40,000
Mathematics	2,000	2,000
Humanities and Social Sciences	2,000	2,000
Central Facility (Library/Audio-visual Aids)	15,000	15,000
Total	4,89,000	5,99,000 Approx. 6,00,000

5.12 We agree with this distribution. The provision of this equipment under U.K. assistance and the equipment to be procured locally with rupee funds recommended by us, will provide all the necessary facilities for the ultimate level of post-graduate and research activity at the Institute envisaged by us along with the development of Specialised Centres.

5.13 A summary of the financial estimates made by us for the 4th Plan and the 5th Plan periods of the Institute is given below :

Non-recurring	Requirements of 4th Plan			
	Particulars	Carry over from 1966 Development Plan	Additional needs of 4th Plan	Total
			(Rs. in lakhs)	
1.	Land and development	25.68	9.21	34.89
2.	Academic and non-residential buildings	23.15	19.96	43.11
3.	Students' residential buildings for 250 post- graduate students	—	20.00	20.00

4.	Students' recreational buildings	—	00.50	00.50
5.	Accommodation for staff	13.67	14.04	27.71
6.	Miscellaneous buildings	10.34	5.00	15.34
7.	Equipment, books and furniture	32.03	82.39	114.42
8.	Provision for offset of imported U.K. equipment	—	125.91	125.91
<i>Recurring</i>	(Developmental expenditure in the Plan period)			<u>131.59</u>
	Total IV Plan requirements			<u>513.47</u>

5.14 Estimates for the 5th Plan for implementing the recommendations of the Reviewing Committee.

<i>Non-recurring</i>		(Rs. in lakhs)
1.	Development of land 62 acres	19.00
2.	Construction of additional staff quarters	40.00
3.	Sick-Bay extension	1.25
4.	Shopping Centre	0.225
5.	Acquisition of land near Nala 2.2 acres	2.02
6.	Development of 2.2 acres of land (Item 5 above)	0.58
7.	Further development of departments	110.00
8.	Development of Specialised Centres	45.00
9.	Rupee provision for U.K. £1 million assistance	<u>180.00</u>
	Total V Plan (non-recurring)	<u>398. 2</u>
10.	Plan recurring expenditure (developmental) :	
(i)	Provision for 5% growth of expenditure reached by the end of 4th Plan	40.00
(ii)	Salaries for 24 additional teaching staff	15.00

(iii) Increased post-graduate activities	90.00
Recurring expenditure (Specialised Centres)	25.00
	<hr/>
Total 5th Plan developmental expenditure (recurring)	170.00
	<hr/>
Total V Plan requirements	568.2
	<hr/>

5.15 It will be seen that these estimates include rupee provision in full for setting off the value of equipment that will be received under the new £ 1 million of U.K. assistance. However, for the equipment received under the original £ 9,00,000 assistance, the rupee provision shown for setting off the U.K. equipment is only Rs. 125.91 lakhs against an actual value of approximately Rs. 180 lakhs.

5.16 For the Centre of Radar Science and Technology, we have agreed that there should be a building provision of approximately Rs. 40 lakhs as has been proposed by the Ministry of Defence. We have also suggested that it is only appropriate that the Ministry of Defence provides this amount also as in the case of equipment and running expenditure for this Centre. However, in case this amount is not forthcoming from the Ministry of Defence, it will be necessary to provide a sum of Rs. 40 lakhs for building in the Institute's 5th Plan estimates.

5.17 The total financial estimates for our recommendations are a sum of Rs. 513.47 lakhs in the IV Plan period and Rs. 568.2 lakhs in the V Plan period. These estimates are for developmental expenditure only. We take it that in the event of the funds recommended for IV Plan not being made available to the Institute, the short-fall will be provided as an addition to the funds recommended for V Plan period. Also this amount for V Plan period will be increased by Rs. 40 lakhs in case the Ministry of Defence cannot provide funds for buildings for the Centre of Radar Science and Technology.

CHAPTER—VI

PRINCIPAL RECOMMENDATIONS

CHAPTER II

1. The Institute should lay emphasis on post-graduate courses, research activities and industrial consultancy. 2.04
2. During the 5th and 6th Plan periods, the post-graduate and research student body should be raised to 1,000 out of the Institute's total enrolment of 2,000. 2.07
3. The post-graduate and research enrolment should be 700 in the Departments of Engineering and Technology, 275 in the Departments of Mathematics and Science and 25 in the Department of Humanities. 2.15
4. Adequate measures at the governmental level should be taken to attract good quality students to post-graduate courses in sufficient numbers. 2.17
5. It is necessary to clearly define the role of the Departments of Mathematics, Physics, Chemistry and Humanities at the Institute. They should concentrate on providing strong undergraduate courses in the respective basic subjects and applied areas only. At least 75% of their research activity should be in Applied Sciences and areas of relevance to the economic development of the country. 2.30, 2.31 and 2.32
6. The Institute has an important role in vitalising technical education in other institutions and should establish close and intimate links with Regional Engineering Colleges of the region. 2,33, 2.34, 2.35, 2.36 and 2.37

7. To promote academic staff exchange programmes between the Institute and other technical institutions, governmental action is necessary both at the Centre and in the States. 2.39, 2.40 and 2.41
8. Necessary steps should be taken for utilisation of the capabilities of the Institute. 2.42, 2.43, 2.44 and 2.47
9. A programme for the exchange of teachers of the Institute and experts engaged on design, research and construction projects within the country should be drawn up and implemented. 2.45
10. Number of research scholars under the guidance of any one staff member should not exceed 4. 2.49
11. Research programmes in the departments should be discipline-oriented. Inter-disciplinary projects should be undertaken only when all facilities are available. No new staff should be provided for such projects. 2.51
12. High quality research on live industrial problems should be aimed at and repetitive types of work should be avoided. 2.53
13. A central organisation of the Institutes of Technology, the Research Laboratories and Technical Departments of Government should identify competence and allot important problems for investigation to the institutes. 2.55
14. Connections between the industry and the Institute shall have to be worked for. 2.56, 2.57
15. Consultancy work of quality only should be encouraged and necessary measures taken for enlargement of quality consultancy work. 2.59, 2.60, 2.63, 2.64 and 2.65
16. In the test for admission to the Institute, English should be treated only as a qualifying subject. 2.66, 2.67 and 2.68

17. There should be neither under-graduate nor M.Sc. courses at the Institute in Mathematics, Physics and Chemistry. The Departments should only offer pre-Ph.D., doctoral and post-doctoral programmes. 2.76, 2.77
2.78, 2.79
and 2.80
18. Post-graduate courses at the Institute should be started only after they have been screened and approved by a Specialist Committee with representatives of the Institutes of Technology, the CSIR and the Post-graduate Committee of the A.I.C.T.E. 2.89

CHAPTER III

19. The Standing Committee of the Senate which is not statutory should be abolished. Nominated members of the Senate should have at least two years' tenure. 3.10, 3.11,
3.12, 3.13,
3.14 and
3.15
20. A new post should be created for a full time Dean of Students and senior professors should be posted for two-year terms by rotation. There is no justification for a senior professor working as Dean of Administration. This should be the responsibility of the Director and the Registrar. 3.25
21. Expensive items of equipment should be made available and accessible to all departments wherever they are located. 3.30
22. To reduce teaching costs, courses in subjects common for many departments should be organised and offered on unit basis. Teaching loads on staff members should be in accordance with standards laid down by the A.I.C.T.E. 3.33, 3.35
23. Every staff member should participate in teaching to some extent and senior staff member should participate not only in lectures but also in laboratory work, project and design work. 3.37
24. At the time of making first appointments or promotions, too much emphasis on published work alone is not desirable. 3.40
25. The probation period of a teaching staff member should be two years to enable a proper assessment of the individual. 3.43
26. Wherever necessary rules should be formulated and steps taken for proper implementation of all approved rules. 3.45

27. The salary scale for Senior Technical Assistant handling jobs in instruments repair and construction should at least be that of a Lecturer. 3.47
28. A block grant over a period should be made to build a departmental store in each department and the purchasing power of the departmental heads should be raised to Rs. 2,000. 3.49
29. No fresh appointments to administrative and Class IV staff should be made until the present high cost on this category of staff is thoroughly examined by the Governing Body of the Institute. 3.52
30. Management consultants should make a study to suggest a suitable administrative machinery for the Institute. 3.53
31. Appropriate measures should be taken to improve student participation in sports. 3.56
32. The Institute should establish a Unit for liaison with industry and a Student Guidance and Appointments Board. 3.59, 3.60
33. Weeding out of a staff member for continued bad work should be through a Committee of Assessment. 3.43

CHAPTER IV

Department of Humanities and Social Sciences

34. At the under-graduate level, this Department should equip students adequately in the fields of Social Studies, Economics, Business Administration and Effective Communication and Expression and related courses enabling them to understand management responsibilities. 4.006
35. The Department need not conduct any specialised courses at the post-graduate level particularly in the field of Management or Social Sciences. 4.006
36. The Department should establish close contacts with the Jawaharlal Nehru University and involve high-level staff available there in specialised fields fruitfully in their own programmes. 4.007
37. The spare capacity of the staff of the Department should be fully utilised in extra time to make up particularly the language deficiencies in the students. 4.008

38. Future recruitment of the Department should aim at a balance of teaching staff in all areas of its concern. 4.009

Department of Mathematics

39. There should neither be an under-graduate nor an M.Sc. course in Mathematics at the Institute. 4.018, 4.019
40. A two-year M.Tech. course in Numerical Analysis and Computing may be introduced. Numerical Analysis and Computing may alternatively be offered as pre-Ph.D. courses. 4.020
41. Pre-Ph.D. courses may be offered in the fields of Mathematical Methods and Operational Research. 4.021

Department of Physics

42. There should neither be an under-graduate nor an M.Sc. course in Physics in the Department. 4.031
43. The Department should ultimately conduct only doctoral and post-doctoral programmes in special and applied fields. It may also offer one-year pre-Ph.D. courses in specialised areas of Physics leading to doctoral programmes later on. 4.032
44. The Department need not organise any post-graduate course in Materials Science but a base for inter-disciplinary research activity in Material Science may be located in this Department around the nucleus already existing. 4.036
45. Activities in the field of Radio and Plasma Physics and integrated circuits should not duplicate similar activities in the Department of Electrical Engineering. 4.037
46. Number of research scholars under the guidance of one teaching staff member should not exceed 4. 4.038

Department of Chemistry

47. There should neither be an under-graduate nor an M.Sc. course in Chemistry in this Department. It should confine its activities to doctoral and post-doctoral programmes. Pre-Ph.D. courses may be offered in specialised fields ultimately leading to doctoral programmes. 4.045

48. Care should be taken in future appointments to properly balance specialised staff in all four major disciplines of Physical, Organic, Inorganic and Bio-chemistry. 4.049
49. The Department need not develop an analytical laboratory for industry's needs. 4.050

Department of Applied Mechanics

50. The scope and activities of this Department should be well-defined so that they do not include normal functions of other departments. 4.062
51. The M.Tech. course in Engineering Design should involve case studies and specific project activity. 4.066
52. The Department need not start an M.Tech. course in Material Science nor a Research Group in this field. Post-graduate courses in Aerodynamics and Propulsion need not be started in this Department. 4.067

Department of Civil Engineering

53. The Department should develop a course in Rock Mechanics through an initial experience of research in this area. 4.079
54. Post-graduate courses in Earthquake and Blast Resistance Structures and Engineering Geology need not be organised by this Department. 4.078, 4.080

Department of Mechanical Engineering

55. The existing M.Tech. course in Production and Industrial Engineering may be split up and offered as two distinct M.Tech. courses—one in Production Engineering and the other in Industrial Engineering. 4.089
56. The Department should strengthen its research activities in Refrigeration and Airconditioning and ultimately develop a post-graduate course in this field. 4.092

Department of Electrical Engineering

57. Sufficient expertise should be built through research programmes in Computer Technology and a post-graduate course in hardware aspects of computer may be introduced. 4.101

58. The present course in Control Engineering should be revised to include certain aspects of Instrumentation and Automation and there is no need for a new post-graduate course in Instrumentation and Automation. 4.102

Department of Chemical Engineering

59. Post-graduate courses in Polymer Engineering or Process Dynamics and Control will be premature at the Institute. 4.113

Department of Textile Technology

60. Electives in Management and Textile Design at the undergraduate level should be introduced only after competent faculty is available. 4.124

61. A Co-operative Centre for Research involving fundamental and applied aspects of textile and man-made fibres may be set up, but financial commitments of the Institute should not go beyond ancillary support—bulk of the finance for the Centre should come from textile industry of the region. 4.128

Centre of Radar Studies and Research

62. Funds for the building of the Centre amounting to Rs. 38.4 lakhs should be provided if the Ministry of Defence cannot do so. 4.134

Computer Centre

63. There is no need for the present to instal a third generation computer system. 4.139

64. The Centre should function only as a central servicing unit and post-graduate courses in Numerical Analysis and Computation and Computer Technology (Hardware) should be the concern of the Departments of Mathematics and Electrical Engineering, respectively. 4.141

Instrument Design Development Centre

65. The Centre should restrict itself to the task of maintaining the instruments of the Institute and building apparatus and instruments for project work and research. It should also train repair technicians for educational institutions, 4.146

Centre for Enterprises and Management

66. There should be no M.Tech. post-graduate course in Entrepreneurship and Management at the Institute. 4.152

Centre for Educational Research and Technology

67. There is no need to organise a new Centre in this field at the Institute. The Technical Teachers Training Centre at the Institute should be closed down. 4.160

Quality Improvement Programmes

68. No separate provision of building, consumable expenditure or other items is necessary for implementing this programme. The M.Tech. and doctoral fellows taken in this programme should be within the total approved post-graduate and research student body. 4.162

Curriculum Development Cell

69. When a Curriculum Development Unit is allotted to the Institute, required financial support is also made available. No separate provision is, therefore, necessary for this work. 4.103

To—Financial implications of the recommendations (Chapter IV).

ANNEXURE--I

Revised Development Plan 1966

Non-recurring Estimates

Item No.	Description	Item cost Rs.	Cost for section Rs.	Total group cost Rs.
3. Land Acquisition, Site Development and Central Services				
3.1	Purchase of Land	62,51,740		
3.2	Site Development	19,46,365		
3.3	Main Services	38,15,411		
3.4	Miscellaneous Items	5,64,000		
	Total for Land etc.		1,25,77,516	1,25,77,516
4. Buildings				
<i>A. Teaching and other Non-residential Buildings</i>				
4.1	Academic Buildings (717,846 sq. ft. plinth)	1,42,93,309		
4.2	Administration and Central Service Buildings (68,401 sq. ft. plinth)	15,01,179		
4.3	Temporary Structures and Alterations	1,31,610		
4.4	Airconditioning of certain Buildings and Rooms	6,00,000		
4.5	Contingency—1%	1,65,261		
	Total for Teaching and other Buildings		1,66,91,359	

B. Student Residential Buildings and Amenities

4.6	Student Hostels and Furniture (1,750 students)	78,00,300	
4.7	Student Recreation Buildings and Amenities	13,56,600	
4.8	Contingency—1%	91,569	
	Total for Student Residential Buildings etc.		92,48,469

C. Staff Residential Buildings and Amenities

4.9	Staff Accommodation (914 units)	1,24,54,900	
4.10	Accommodation for N.C.C. staff (35 units)	4,32,100	
4.11	Miscellaneous Buildings	16,24 800	
4.12	Contingency—1%	1,45,118	
	Total for Staff Residential Buildings etc.		1,46,56,918
4.13	Consultants and Supervisory Staff	20,10,461	
	Total for Buildings		4,26,07,207

5. Equipment, Books and Furniture

5.1	Teaching Equipment (U.K. and Indian)	1,82,73,240	
5.2	General Equipment	16,42,100	
5.3	Library Books	10,00,000	
5.4	Furniture	26,50,812	
	Total for Equipment Books, Furniture	2,35,66,152	2,35,66,152
5.5	N.C.C. Equipment	30,000	30,000
	Total for Equipment etc.		2,35,96,152
	Final Total of Capital Estimates		7,87,80,875

ANNEXURE—II

Break-up of Teaching Staff between Departments and Special Centres

S.No.	Department	Staff provided in Development Plan					Staff total in position	IV Plan	
		SP	P	AP	L	Total		Staff sanctioned	Diff. with staff in position
1.	Electrical	1	3	10	12	26	24	30	—6
2.	Mechanical	1	3	9	11	24	27	32	—5
3.	Civil	1	3	9	10	23	23	23	—
4.	Chemical	1	3	7	9	20	18	20	—2
5.	Textile Technology	1	2	4	6½	13½	12	16	—4
6.	Applied Mechanics	1	3	9	11	24	20	26	—6
7.	Physics	1	2	10	11	24	26	28	—2
8.	Chemistry	1	2	8	11	22	23	26	—3
9.	Mathematics	1	2	9	11½	23½	26	29	—3
10.	Humanities	1	1	5	8	15	16	16	—
Total 1-10 above		10	24	80	101½	215½	215	246	—31
11.	Computer Centre	—	—	1	1	2	8	15	—7
12.	Allowance for Training and Super- vision	—	—	5	4	9	5	5	—
13.	Workshop	—	—	1	1½	2½	2	3	—1
14.	I.D.D. Centre	—	—	—	—	—	4	7	—3
14(a)	U.K. Training	—	—	—	10	10	—	—	—
Total 11-14(a) above		—	—	7	16½	23½	19	30	—11
Grand Total		10	24	87	118	239	234	276	—42

ANNEXURE—III

Initial and Revised IV Plan Proposals

Student Population	1969-70	1970-71	1971-72	1972-73	1973-74	Total
Post-graduate	300	400	450	450	450	
Research	125	150	175	175	175	
Total	425	550	625	625	625	
<i>A. Recurring</i> (Rs. in lakhs)	12.00	15.63	13.88	43.00	47.08	131.59
	12.00	15.63	33.05	35.05	35.86	131.59
<i>B. Non-recurring</i> (Rs. in lakhs)						
Major works	28.19	25.16	20.00	40.00	31.06	134.41
	28.19	25.16	17.84	—	—	71.19
Equipment, Books and Furniture	16.81	20.42	20.00	30.00	27.19	114.42
	16.81	20.42	20.00	13.18	8.00	78.31
U.K. Equipment	15.91	20.21	30.00	30.00	29.79	125.91
	15.91	10.00	—	—	—	25.91
Total (Rs. in lakhs)	72.91	81.42	83.88	143.00	135.12	506.33
	72.91	71.21	70.89	48.18	43.86	307.00

Note— (i) The figures above the line represent the distribution of the Revised Plan requirements.

(ii) The figures below the line represent the distribution given in the Plan sent to Government earlier.

ANNEXURE—IV

Recurring Expenditure

(Figures in Rs. Lakhs)

Head of Account	Actuals for 1970-71	Sanctioned Estimates 1971-72	Revised Estimates 1971-72	Budget Estimates 1972-73
Recurring				
<i>Salaries of Staff</i>				
Pay of Officers				
(i) Academic	22.86	—	27.02	30.53
(ii) Administrative and Non-teaching	2.05	—	2.31	2.39
	24.91	25.40	29.33	32.92
Pay of Establishment				
Supporting Staff for Academic Departments	7.60	—	9.72	11.70
Administrative and Non-teaching	9.31	—	9.22	10.36
	16.91	17.08	7.73	22.06
Allowances and Honoraria	27.18	27.52	30.75	34.38
Total	69.00	70.00	79.02	88.86
C.P.F./Pen. Contr./ Leave Salary Contri- bution	5.84	6.00	5.50	5.50
Institute Contribution to Pen. Fund	2.54	1.35	2.29	2.40

Conveyance Advance	0.73	0.73	0.73	0.95
Festival Advance	0.02	0.02	0.02	0.05
	9.13	8.10	8.54	8.90
Total Staff Remuneration	78.13	78.10	87.56	97.76
<i>Operational Cost + Other Miscellaneous Expenses</i>				
Academic Deptt. including Library Students, Scholarships and Amenities	8.00	7.00	10.13	13.46
Other Educational Expenses	12.86	15.00	16.65	19.28
Office Expenses	1.63	1.30	1.57	2.34
Medical Expenses	3.80	3.18	4.17	4.38
Estate Maintenance and Minor works	0.93	0.95	1.09	1.42
Water, Power, Fuel and Lubricants	5.02	5.00	10.68	12.01
Other Expenditure	+4.00	+4.46		
Contingencies and Convocation	5.80	5.00	5.50	5.50
Property Tax and Building Rent of Bombay Office	1.66	1.37	1.74	2.20
N.C.C. Running Expenditure	0.18	0.20	0.20	0.20
Primary-cum-Nursery School	2.03	2.00	2.08	2.08
I.D.D. Centre	0.11	0.10	0.10	0.15
	0.53	0.50	0.50	0.60
	—	4.00	4.50	7.00
	46.55	45.60 +4.46	58.91	70.62
Total Recurring	124.68	128.16	146.47	168.38

ANNEXURE—V

Post-graduate Courses—Established and Proposed

		Already Established	Provision for in the IV 5-year Plan
I. Electrical Engineering			
M.Tech.	1. Radar Engineering	X	
	2. Control Engg./ Instrumentation	X	
	3. Electronics/ Electrical Commn.	X	
	4. Power Apparatus and Systems	X	
II. Mechanical Engineering			
M.Tech.	1. Production and Industrial Engg.	X	
	2. Thermal Engg.	X	
	3. Design of Produc- tion Machines	X	
	4. Sandwich Course on Machine Tool Design and Production		X
III. Civil Engineering			
M.Tech.	1. Soil Mechanics and Production Engg.	X	
	2. Structural Engg.	X	
	3. Water Resources System	X	

IV. Chemical Engineering

M.Tech. 1. Chemical Engg.

V. Applied Mechanics

M.Tech. 1. Design Engg. X

2. Applied Mechanics X

P.G. Diploma 1. Systems Engg. X

VI. Textile Technology

M.Tech. 1. Textile Engg. X

2. Fibre Science and
Tech. X**VII. Physics**

M.Tech. 1. Applied Optics X

2. Solid State Physics X

Post-M.Sc. 1. Solid State Physics X

Diploma 2. Applied Optics X

M.Sc. 1. Physics X

VIII. ChemistryM.Tech. 1. Modern Methods in
Chemical Analysis X

M.Sc. 1. Chemistry X

IX. Mathematics

M.Sc. 1. Mathematics X

P.G. Diploma 1. Numerical Analysis
and Automatic
Computing X

Diploma 1. Operational Research X

X. Humanities

M. Tech. 1. Behavioural Science X

P.G. Diploma 1. Technical Education X

***Since suspended**

ANNEXURE—VI

**Suggested Distribution of 1,000 Student Body in Post-graduate Courses
and Research Activity**

Departments	Course work	Pre-Ph.D.	Research	Post-doctoral
Humanities	—	—	15	5
Mathematics	20	25	30	15
Physics	20	30	40	20
Chemistry	20	20	30	10
	60	75	115	50
<i>Engineering Departments</i>				
Civil	80	—	20	5
Mechanical	100	—	25	8
Electrical	100	—	25	10
Chemical	60	—	15	5
Textile Technology	40	—	10	3
Applied Mechanics	40	—	15	4
Bio-engg. and Material Science	—	—	20	10
Director's discretion for I.D.D. and Computer Centres	—	—	20	5
	500	—	150	50

Note—1. The above distribution leaves 80 places for course work in the engineering departments. These provisions can be utilised for special one-year post-graduate courses of special interest and requirement of industry. These courses need not be repetitive courses every year but may be designed and organised according to needs from year to year. These provisions may also be utilised for the introduction of new M.Tech. courses of two years' duration if so desired.

2. **The proposed Centres for research in Material Science and Bio-engineering should be Centres of inter-departmental research activity and should be administered by the Director. In Material Science research programme, the Departments of Physics and Chemistry and Engineering may participate. In research programme for Bio-engineering, the Departments of Chemistry, Electrical Engineering and Chemical Engineering will be interested.**

ANNEXURE—VII(a)

Departments' Earnings through Consultancy Work

Department	1970-71		1971-72 (till Dec. 1971)	
	Total No. of Projects	Total amount of Consultancy Rs.	Total No. of Projects	Total amount of Consultancy Rs.
Applied Mechanics	5	50,750.00	6	14,83,300.00
Chemical Engineering	3	8,450.00	5	27,300.00
Civil Engineering	35	75,491.49	34	70,637.35
Electrical Engineering	2	5,980.00	2	500.00
Mechanical Engineering	3	8,300.00	4	2,125.00
Textile Technology	1	100.00	1	10,500.00
Physics	—	—	—	—
Chemistry	1	800.00	2	6,500.00
Mathematics	1	(fee not charged)	—	—
Computer Centre	—	—	2	1,200.00
I.D.D. Centre	1	1,750.00	2	9,050.00
Workshop	—	—	—	—
Humanities & Social Sciences	—	—	—	—
Total	52	1,51,621.49	58	16,17,112.35

ANNEXURE VII(b)

Consultancy Projects

S. No.	<i>Title of Project</i>
1.	Improvement of Monoblock Pumping Sets Test.
2.	Fabrication of High Altitude Simulation.
3.	System Planning for Krishna Project.
4.	Designing of a Chain Testing Machine.
5.	Calibration Carboratter Jet.
6.	Model Analysis of Pressure Pumps.
7.	Know-how of Compressed Yeast Plant.
8.	Research Project, Aniline from Nitro Benzene.
9.	Possibility of Increase of P205 Contents in a Rock Sample from 21% to 25%.
10.	Synthesis of Ferrochroma Lignosulphonate.
11.	Extension of Lab. Facilities.
12.	Design of Multistoreyed Buildings at Curzon Road.
13.	Tests on Soil.
14.	Determination of Physical Properties of Rocks.
15.	Designing of Concrete Mix.
16.	Suitability of Rock Samples.
17.	Soil Bearing Capacity Test.
18.	Foundation Design Microwave Tower.
19.	Designing of Concrete Mix.
20.	Suitability of Tube-well Water.
21.	Designing Concrete Mix.
22.	Designing of Concrete Mix.
23.	Soil Bearing Test.
24.	Soil Bearing Test.
25.	Designing of Concrete Mix.
26.	Designing of Concrete Mix.
27.	Designing of Mixes.
28.	Carrying Non-destructive Tests.

29. Checking of Structural Design of Existing Ground Floor Roof of Office Building at Kelvinator of India Ltd.
 30. Tests on Building of Jai Drinks Ltd.
 31. Computer Analysis of the Multi storeyed Building.
 32. Testing of Soil and its Bearing Capacity Najafgarh Drain.
 33. Construction of Soil Stabilised Road.
 34. Construction of Outer Ring Road to Najafgarh Road including Bridge.
 35. Preliminary Investigation of Geo-thermal Power Generation/Manikaran.
 36. Testing of Soil Bearing Capacity.
 37. Foundation Design for Over-head Tank.
 38. Measuring of the Amplitude of Vibration as per ISI 2505-1968.
 39. Giri Bata Tunnel Project.
 40. Petrographic Analysis of River Seliment Samples.
 41. Advice on Construction Materials.
 42. Engg. Properties of Rock Samples.
 43. Testing of Cycle Frame.
 44. Testing of Stone Aggregate.
 45. Mixing of Design.
 46. Computer Studies, Beas Dam Organisation.
 47. Calibration of an Induction Motor.
 48. Checking of the Design of Gears of Saraswathi Sugar Mills.
 49. Advice on Designing and Fabrication of a Zone Refiner.
 50. Development 6-YDA Air Cooled Engine.
 51. Testing of Spintex.
 52. Technical Evaluation of Textile Mills.
 53. Manufacture of Xanthates.
 54. Setting up of a Chemical Plant of Indian Strip and Steels Ltd.
 55. Advice regarding System Forecasting.
 56. Know-how of the Photo-elastic Bench.
 57. Setting up of a Computer Centre.
 58. Testing of Electric Performance.
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ANNEXURE VII(c)

CSIR and other Schemes

<i>S. No.</i>	<i>Topic</i>	<i>Department</i>	<i>Year</i>
1.	Thermal Conductivity of Metals at High Temperatures	Physics	1968
2.	Development of Semiconductor Materials	Physics	1968
3.	To grow Large Crystals of Alkali Halides etc.	Physics	1968
4.	Development of Industrial Gauges for Thickness, Density and Moisture Measurement	Physics	1968
5.	Studies on the Collector Action in the Flotation of Sulphide Minerals	Chemistry	1968
6.	Development of Sulphide Phosphorus and Photo-conductors	Physics	1969
7.	Growth of II-VI Single Crystals and Optical Raman Laser and Infrared Studies of Crystals	Physics	1969
8.	Study of Crystals Imperfections in Hexagonal Materials with a special emphasis in Vapour-grown Crystals etc.	Physics	1969
9.	Flow Characteristics to Elastic Boundaries	Applied Mechanics	1969
10.	Study of Jute Flows in Moving Streams	Applied Mechanics	1969
11.	Investigation on the Photo-electric Effects Semiconductor Junction Devices	Physics	1969
12.	Chemistry of Metal Azides	Chemistry	1969
13.	Study of Lattice Dynamics of Metals and Semiconductors	Physics	1969
14.	Structure and Properties of Liquid Crystals	Chemistry	1969
15.	Commulative Damage in Fatigue	Applied Mechanics	1969-70
16.	Investigation of the Circuit Aspect of Tunnel Diodes and its Application in the Field of Electronics	Physics	1970

17.	Load Distribution in Torsionably Stiff Inter-connected Show Bridge Girdus	Civil	1970
18.	Transport of Neutrons in Crystals	Physics	1970
19.	Studies on the Colorination of Rock Phosphate and Sulphization without using Sulphuric Acid	Chemistry	1970
20.	Swirling Flows	Applied Mechanics	1970
21.	Oxidative Dehydrogenation of Olefines by Metal Oxide Catalyso	Chemistry	1971
22.	Engineers Entrepreneurial Programme	Applied Mechanics	1971

ANNEXURE VII

Revised Courses of Under-graduate Studies

	<i>L</i>	<i>T</i>	<i>P</i>
I Semester			
Language I	2	2	0
Graphic Science	2	0	4
Mathematics I	4	2	0
Chemistry I	3	2	3
Physics I	2	1	3
	<hr/>	<hr/>	<hr/>
	13	7	10
II Semester			
Language II	3	2	0
Graphic Communication	2	0	4
Mathematics II	3	3	0
Physics II	2	1	3
Chemistry II	2	2	3
	<hr/>	<hr/>	<hr/>
	12	8	10
III Semester			
Dept. Introduction	3	0	2
Manufacturing Processes	2	0	4
Mathematics III	3	3	0
Physics III	3	1	3
Mechanics I	3	2	0
	<hr/>	<hr/>	<hr/>
	14	6	9
IV Semester			
Social Frames	3	2	0
Chemistry III/Design Engg.	2	1	3
Experimental Method	2	0	4

Electrical Science	3	2	0
Mechanics II	3	1	2
	<hr/>	<hr/>	<hr/>
	13	6	9
	<hr/>	<hr/>	<hr/>

V Semester

Computation	2	2	0
Elect. Engg.	2	1	3
Physics IV	2	1	0
System Engg./Design Engg./Chem. IV	2	1	3
Thermal Sc. (Dept.)	2	1	2
Special Maths./Dept. Science	2	2	0
	<hr/>	<hr/>	<hr/>
	12	8	8
	<hr/>	<hr/>	<hr/>

VI Semester

Social Science I	2	1	0
Dept. Science/Bio-Sc./Systems Engg.	2	1	3
Materials Science (Dept.)	2	1	2
Dept.	3	1	3
Dept.	3	1	3
	<hr/>	<hr/>	<hr/>
	12	5	11
	<hr/>	<hr/>	<hr/>

VII Semester

Social Science II	2	1	1
Sp. Maths./Dept. Sc.	3	1	0
Dept. (3 courses)			19 hours

VIII Semester

Outside Elective	2	1	0
Dept. (4/5 courses)			21-25 hours

IX Semester

Management	2	1	0
Dept. (4/5 courses)			24 hours

X Semester

Dept. including project			27 hours
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ANNEXURE IX

Summer Schools, Seminars and Short-term Courses

Applied Mechanics	<ol style="list-style-type: none"> 1. Advance Summer School on Design Engg. 1970 2. Refresher Course in Structural Mechanics for Design Engineers of CPWD Oct. 1970 to Jan. 1971 3. Advance Summer School in Engg. Analysis 1971 4. Seminars on : <ol style="list-style-type: none"> (a) Design organised by IDDC Feb. 1970 (b) Boundary Layer Theory May 1970 (c) Lack of Interest amongst Students for Practical Training May 1970 (d) An Educational System—Design Approach March 1970
Chemical Engineering	<p>Seminar and discussion at the 22nd session of the Indian Institute of Chemical Engineers Dec. 1969</p>
Civil Engineering	<ol style="list-style-type: none"> 1. Seminar on Sociological and Economic Problems in the field of Housing in collaboration with NBO Dec. 1967 2. <i>Refresher Courses organised</i> <ol style="list-style-type: none"> a. Symposium on "Economic Design of Multistoreyed Buildings" in collaboration with NBO 1967 3. Sequential Summer School in Civil Engg. 1969, 1970 and 1971

	4. Advance Summer School in Soil Mechs.	1967
Textile Technology	1. Advance Summer School in Text. Tech.	1969
	2. Advance Summer School for research workers in the field of Textile organised by Department in collaboration with the Delhi Branch Textile Orgn. (India) contributing papers on technological research.	1968, 1969, 1970 and 1971
Electrical Engineering	1. Sequential Summer School in Elect. Engg.	1967, 1968 and 1969
	2. Advance Summer School in Modern Control Theory	1971
Mechanical Engineering	1. Advance Summer School in Industrial Engg.	1970
	2. Sequential Summer School in Mech. Engg.	1971
Mathematics	1. Advance Summer School in Numerical Analysis	1969, 1970 and 1971
	2. Summer School for National Science Talent Search Scholars (by U.G./P.G. level)	1970 and 1971
	3. Summer School for Secondary Scholar Teachers in Modern Mathematics	1970
	4. Advance Level Winter Workshop in Fluid Mechanics	1970
	5. Symposium in Algebra and Topology	1971
	6. Departmental Book Project in Maths. for Engineering Students	—
Physics	1. Indo-French Conference on Semiconductor Physics	1969
	2. Indo-French Seminar on Optical Behaviour of Materials	1971

**Humanities & Social
Sciences**

3. International Conference on Non-metallic Crystals 1969
 4. Conference on Plasma Physics 1970
 5. Summer School for National Science Talent Search Scholars at UG/PG level 1969, 1970 and 1971
- All-India Sociological Conference 1969

ANNEXURE—X

Subject Titles of Ph.D. Research Awards in the Departments

Department	Title of the Thesis	Year of Award
Humanities and Social Sciences	Nil	
Mathematics (31 awards)	1. Some Plane, Torsion and Dynamics Problems of Elasticity.	1968
	2. Flow and Heat Transfer Problems in Hydro-magnetics.	1968
	3. Axisymmetric Flow and Heat Transfer in Hydrodynamics and Magnetohydrodynamics.	1968
	4. Pulsating and Boundary Layer Flow with and without Heat Transfer.	1968
	5. Unsteady Flow and Heat Transfer in Viscous Incompressible Fluids.	1968
	6. Some Theoretical Problems of Gas Dynamics and Magnetogasdynamics.	1968
	7. Second Order Effects in Boundary Layer Problems.	1968
	8. Some Flow Problems in Fluid Dynamics and Magnetofluid Dynamics.	1968
	9. Some Problems in Hydromagnetic and Hydrodynamics.	1968
	10. Flow and Heat Transfer of Bingham Material.	1968
	11. Some Problems in Statistical Theory of Turbulence.	1968
	12. Estimation of Errors of Numerical Integration for Analytic Functions.	1968
	13. Hydromagnetic Oscillatory Boundary Layer and Entrance Region Flow.	1968

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|-----|---|------|
| 14. | Numerical Solution of Differential Equations. | 1968 |
| 15. | Numerical Solution of Ordinary Differential Equation. | 1969 |
| 16. | Some Problems on Flow and Heat Transfer of Thermo-Viscous Fluids. | 1969 |
| 17. | Error Estimates of Certain Quadrature and Cubature Formulas. | 1970 |
| 18. | On Some Elasticity Problems of Finite Member subjected to Functional Loads. | 1970 |
| 19. | Higher Order Methods for the Solution of Ordinary Differential Equations. | 1970 |
| 20. | Some Problems on Statistical Theory of Turbulence. | 1970 |
| 21. | Some Aspects of Hydromagnetic Flows : Slander Channels ; Boundary Layer Growth. | 1970 |
| 22. | Effects of Slip, Suction, Rotation and Magnetic Field on Flow and Heat Transfer Problems. | 1970 |
| 23. | Waves and Flows in Radiation Magnetogasdynamics. | 1970 |
| 24. | On Certain Hypergeometric Functions and Polynomials of one and more Variables. | 1970 |
| 25. | Some Singular Perturbation Problems of the Fluid Mechanics of Permeable Media. | 1970 |
| 26. | General Theory of Discontinuities in Non-equilibrium Gas Dynamics. | 1970 |
| 27. | A Generalised One Dimensional Random Walk—Associated Convolution Identities and Inverse Series Relations. | 1970 |
| 28. | Single Step Methods for Initial Value Problems in Differential Equations. | 1970 |
| 29. | Flow Problems in Plastico-Viscous Fluids. | 1970 |
| 30. | Some Problems in Hydromagnetics and Hydrodynamics. | 1971 |
| 31. | Numerical Methods in Digital Real-Time Simulation | 1971 |
| 1. | Interaction of Electromagnetic Waves with Plasma. | 1966 |

Physics
(30 awards)

2. Study of Some of the Thermal Properties of Caesium Halides in Harmonic and Quasi-harmonic Approximation with a Supplement on the Low Temperature Study of Specific Heat of Alpha Iron. 1968
3. Investigations in Atmospheric and Instrumental Optics. 1968
4. X-ray Investigations of Lattice Defects on Certain F.C.C. and B.C.C. Metals and Hexagonal Gold-Cadmium Alloys. 1968
5. Colour Centres in Alkali Halide doped with Cadmium and Zinc. 1968
6. Conductivities and Emissivities of Metals at High Temperatures. 1969
7. Harmonic Generation and Other Transport Phenomena in Semi conductors. 1969
8. Physics of Colloidal Plasmas and Magneto-hydrodynamics Power Generation. 1969
9. Electromagnetic Wave Propagation in Plasmas. 1969
10. Investigations on Flux and Spectrum of Cosmic Radiation and Electromagnetic Phenomena. 1969
11. A Study of Thermalisation of Neutron in Various Moderators. 1969
12. Demodulation and Cross Modulation of Electromagnetic Waves in Plasmas. 1969
13. ESR, Optical and Electrical Studies of Some Ionic Crystals. 1970
14. Interaction of Electromagnetic Waves with Plasmas and Semi conductors. 1970
15. Non-linear Interaction of Electromagnetic Waves with Gaseous and Semiconductor Plasmas. 1970
16. Investigations in Theoretical Optics and Ellipsometry. 1970
17. A Study of the Decays of Heavy Hypernuclei. 1970
18. Non-central Interactions in Non-cubic Metal. 1970

	19.	Studies of Electret Effect in Plastic Materials.	1970
	20.	Diffusion of Impurities in Semiconductors.	1970
	21.	Hot Carrier Transport in Semiconductors.	1970
	22.	Wave Interaction and Hot Electron Effects in Semiconductors and Plasmas.	1970
	23.	High Field Transport and Tunnelling Phenomena in Semiconductors and Metals.	1970
	24.	Interaction of Electromagnetic Waves with Gaseous and Solid State Plasmas.	1971
	25.	Lattice Dynamics of Metals and Solidified Noble Gases.	1971
	26.	Optical, ESR and Electrical Studies of Pure and Pd, Mn, Rh and U-doped Alkali Halide Crystals.	1971
	27.	A Study of Neutron Wave and Pulsed-Neutron Problems in Multiplying and Non-multiplying Assemblies.	1971
	28.	Some Aspects of Silicon Solar Cells in Terrestrial Environment.	1971
	29.	Optical, Magnetic and Transport Properties of Some Impurity Doped Alkali Halide Crystals.	1971
	30.	Theory Design and Some Application of Tunnel Diode Triggers.	1971
Chemistry (4 awards)	1.	Thermodynamics of Adsorption and Solution.	1968
	2.	A Study of the Surface Properties of Chromium Oxide obtained by Ammonium Dichromate Decomposition.	1970
	3.	Studies on Synergistic Effects in Ion-exchange and Solvent Extraction.	1971
	4.	Studies on the Collector Action in the Flotation of Sulphide Minerals.	1971
Applied Mechanics (2 awards)	1.	Mechanics of Chip Formation in Two-dimensional Cutting.	1970
	2.	An Experimental and Theoretical Investigation of Turbulent Separated, Reattached and Redeveloped Flows with Transverse Rectangular Cavities.	1970



Civil Engineering (2 awards)	1. Shear Strength of Sand.	1969
	2. Creep Strength of Saturated Clays.	1971
Mechanical Engineering (6 awards)	1. Power Savings and Low Temperatures in Refrigerating Machines using Mixed Refrigeration	1968
	2. Wave Propagation in Non-linear Continuous Media.	1696
	3. Heat Transfer and Pressure Drop Characteristics of Refrigerant Condensing inside a Horizontal Tube.	1970
	4. An Experimental and Theoretical Investigation of Turbulent, Separated Reattached and Re-developed Flows with Transverse Rectangular Cavities.	1971
	5. Effects of Ethanol Blending on the Performance and Exhaust Emission of Spark Ignition Engines.	1971
	6. Vibration Analysis of Multi-layered Beams with Constrained Viscoelastic Layers.	1971
Electrical Engineering (7 awards)	1. Application of Tunnel Diodes to Power System Protection.	1968
	2. Planar Antennas with Linearly Polarised Aperture Fields.	1970
	3. A Functional Analysis Approach to the Optimal Control of Systems with Distributed Parameters.	1970
	4. A Format Vocodex for Vowel Sounds.	1971
	5. On Optimal Control of Stochastic Dynamical Systems.	1971
	6. Design of Multivariable Systems.	1971
	7. Studies of Signal Theory.	1971
Chemical Engineering (3 awards)	1. Mass Transfer from Falling Drops.	1969
	2. Investigations in the field of Separation of Cyclohexane from Ankleshwar Crude.	1971
	3. Studies in Industrial Crystallization.	1971
Textile Technology (1 award)	1. Movement and Distribution of Fibres on the Revolving Flat Card.	1970

