CENTRAL BUREAU OF EDUCATION INDIA

DEVELOPMENT
OF
HIGHER TECHNICAL INSTITUTIONS IN INDIA

(REPORT OF SARKER COMMITTEE)

MARCH 1948

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1951.

AN INTERIM REPORT OF THE COMMITTEE APPOINTED TO CONSIDER THE DEVELOPMENT OF HIGHER TECHNICAL INSTITUTIONS IN INDIA

To

Hon'ble Sirdar Sir JOGENDRA SINGH,

Member of the Viceroy's Executive Council,

Department of Education, Health and Agriculture,

New Delhi.

SIR,

In view of the certainty of an appreciable increase in the demand for higher specialists in Industry, a rapid expansion in the facilities of higher Technical Education is a pressing necessity. It is evident that apart from any other considerations, the calls of reconstruction in Europe and elsewhere, and the enormous industrial and Government undertakings contemplated in Europe and America to provide full employment, will make it difficult, if not impossible, to secure from abroad, the services of the right type of engineers, architects, technologists and planners, etc. to carry out India's post-war projects. The initiation of a programme of higher technical education and research in India should therefore be pushed forward with the utmost speed and determination.

Although the Committee have not as yet completed their labours, in view of the extreme urgency of the situation, they submit an interim report for your consideration and express the hope that the Committee's recommendations will be given effect to with the least possible delay.

DEVELOPMENT OF HIGHER TECHNICAL INSTITUTION OF INDIA

PART I

Interim Report of the Committee appointed by the Hon'ble Member of the Viceroy's Executive Council, Department of Education, Health and Agriculture, to consider the development of Higher Technical Institutions in India.

I—TERMS OF REFERENCE

1. With a view to ensuring an adequate supply of technical personnel which will be required for post-war industrial development in this country, to consider whether it is desirable to have (*a*) a central institution possibly on the lines of the Massachusetts Institute of Technology, with a number of subordinate institutions affiliated to it, or (*b*) several higher institutions on a regional basis, or (*c*) any other organisation.

2. In the light of the conclusions which may be arrived at in regard to item (1), to consider.

(*i*) the scope and size of the proposed institution or institutions ;

(*ii*) the situation of the institution or institutions ;

(*iii*) the control and management of the institution or institutions ;

(*iv*) the qualifications and conditions of service of the teachers to be employed therein and the best way of recruiting them ;

(*v*) the preparation of the necessary plan and specification for buildings and equipments ;

(*vi*) the cost involved and

(*vii*) other relevant questions relating to the establishment of such an institution/institutions and its/their future development.

II—LIST OF MEMBERS

Mr. N. R. SARKAR, ' Ranjani ' 237, Lower Circular Road, Calcutta (*Chairman*).

1. Dr. NAZIR AHMED, Office of the Indian Tariff Board, 1st Marine Street Kalbadevi, Bombay 2.

2. Dr. Sir S. S. BHATNAGAR, Director, Council of Scientific and Industrial Research, New Delhi.

3. Major General D. R. DUGUID, Director of Military Engineering, Master-General of Ordnance Branch, G. H. Q., New Delhi.

4. Mr. P. J. EDMUNDS, Chief Engineer, Posts and Telegraphs Department, New Delhi.

(Mr. N. F. FROME took Office after Mr. EDMUNDS' retirement).

5. Dr. Sir J. C. GHOSH, Director, Indian Institute of Science, Bangalore.

6. Mr. H. K. KIRPALANI, Industrial Adviser to the Government of India, Planning and Development Department, New Delhi.

7. Mr. W. W. LADDEN, C/o Messrs. Simpson & Co., Madras.

8. Mr. S. LALL, I.C.S., Additional Secretary, Labour Department, New Delhi.

9. Mr. G. L. MEHTA, 7, Wellesley Place, Calcutta.

10. Dr. A. H. PANDYA, 12, Raja Santosh Road, Alipore, Calcutta.

11. Dr. M. D. PAREKH, Delhi Cloth and General Mills, Ltd. Co., Delhi.

12. Mr. C. E. PRESTON, Principal, Osmania Technical College, Hyderabad (Dn.)

13. Mr. W. G. W. REID, Director, Mechanical Engineering, Railway Board, New Delhi.

14. Dr. Sir JOHN SARGENT, Educational Adviser to the Government of India, New Delhi.

15. Mr. A. D. SHROFF, Bombay House, Fort, Bombay.

16. Sardar Bahadur Sir SOBHA SINGH, 1-A, Queensway, New Delhi.

17. Mr. J. K. SRIVASTAVA, The New Victoria Mills, Kanpur.

18. Sir FREDERIC TYMMS, Director of Civil Aviation in India, Posts and Air Department, New Delhi.

19. Dr. K. VENKATRAMAN, Director, Department of Chemical Technology, University of Bombay, Bombay.

20. Mr. DHARMA VIRA, I.C.S., Deputy Secretary, Department of Industries and Supplies, New Delhi.

21. Mr. W. W. WOOD, Principal, Delhi Polytechnique, Delhi.

22. Brigadier R. D. T. WOOLFE, Controller General of Inspection, M. G. O. Branch, G.H.Q., New Delhi.

Dr. S. R. SEN GUPTA, Assistant Educational Adviser to the Government of India, New Delhi (*Secretary*).

III.—INTRODUCTION

3. The Committee are of opinion that the existing facilities for higher technical education in India are inadequate, both in quantity and quality, to satisfy India's post-war needs for high grade technologists. Although the Committee appreciate that under normal circumstances they might perhaps have undertaken, as an approach to their task, a survey, and examination of the existing facilities, they are of the opinion that the needs of the present situation are so apparent and urgent that a solution cannot be deferred pending such a survey which would necessarily take a considerable time.* The Committee, however, recognise the necessity of conducting such a survey before a final decision is reached as to the organisation and structure of Higher Technical Education in the country as a whole, and in particular, the relation of each new institution with those which already exist.

IV.—SUMMARY OF THE MAIN RECOMMENDATIONS

(*i*) Not less than four Higher Technical Institutions, one in the North, one in the East, one in the South and one in the West will be necessary to satisfy the post-war requirements.

(*ii*) The one in the East should be set up in or near Calcutta at an early date.

(*iii*) Establishment of the Western Institution which should be in or near Bombay should be taken in hand concurrently with the Eastern Institution or failing that as soon after as possible.

(*iv*) To satisfy the immediate needs for engineers generally and for those with specialised training in Hydraulics in particular, the engineering nucleus or the Northern Institution should be set up without delay.

(*v*) To ensure the proper planning of buildings, equipment and courses of study, the Principal and Heads of the Main Departments of these institutions should be appointed and the services of an architect with experience in the planning of technical institution secured at a sufficiently early stage.

*Please see a note of dissent from Dr. Nazir Ahmad—Part II.

V.—NUMBER OF HIGHER TECHNICAL INSTITUTIONS REQUIRED

5. The question to be settled is whether the anticipated requirements of post-war industrial development in higher technical personnel can be best met by,

(*a*) one Higher Central Technical Institution, possibly on the lines of the Massachusetts Institute of Technology with a number of secondary institutions affiliated to it, or

(*b*) several Higher Institutions of equal status on regional basis, or

(*c*) any other organisation.

After thorough discussion the Committee came to the conclusion that in view of the size of India, and the location of her industries, the provision of several higher technical institutions, on regional basis is the solution most likely to satisfy the post-war requirements. The Committee is of opinion that not less than four Higher Technical Institutions, one in the North, one in the East, one in the South and one in the West will be necessary. Such a distribution of Centres would conform with the geographical position of industrial areas as well as with location of the great majority of existing technical institutions and would be the most equitable and effective in the interest of India as a whole.

VI.—RELATION OF PROPOSED HIGHER TECHNICAL INSTITUTIONS TO SPECIALISED INSTITUTIONS AND TO TECHNOLOGICAL DEPARTMENTS OF UNIVERSITIES

6. The Committee realise that if the proposed higher technical institutions are to fulfill their intended functions efficiently they must be able to draw upon students with the appropriate training. This involves both the establishment of junior technical institutions in each region and an increase in the number of Technical High School. These matters will no doubt receive attention from the All India Council for Technical Education when this Committee's report is considered by them.

7. The Committee recognize the importance, in the interest of efficiency and economy, of co-ordinating the facilities to be provided in the proposed Higher Technical Institutions with those already available or likely to be provided in specialised Technical or Research Institutions and with the Technological (including applied science) Departments of the Universities. The Committee feel that the exact nature of this organisation can only be settled in consultation with the authorities concerned. However, they recommend, as a general principle, that while each Higher Technical Institution should provide instruction up to the graduate stage in all the main technical subjects likely to be of use to the region which it is designed to serve, it should leave post-graduate instruction in the subjects concerned to specialised institutions where such exist and are capable of satisfying the anticipated demands. Moreover, the Committee suggest that the extent of the provision to be made in each subject at the under-graduate stage should also be determined after careful consideration of the contribution which can be made by existing institutions (including Universities) in the region.

VII.—LOCATION OF THE INSTITUTIONS

8. It is considered to be of fundamental importance that a right relationship between the public, industry and education should be established and maintained. For this reason, the Committee feel that the proposed institutions should be located so as to be within easy reach of large industrial areas, even though climatic conditions may not altogether be favourable.

VIII.—ORDER OF ESTABLISHMENT OF THE PROPOSED HIGHER TECHNICAL INSTITUTIONS

9. In view of the time that must inevitably elapse before the products of these institutions are available for employment, the Committee would urge the establishment of all four institutions as speedily as possible. They recognise, however, that apart from the question of buildings, the difficulties of obtaining the requisite staff and equipment under existing circumstances may make it necessary to establish only one in the first instance and proceed with the others as soon as circumstances permit. They have carefully examined the question whether the first institution should be in the East or the West, and have come finally to the conclusion that if for the reasons given above it is necessary to proceed with one institution only then that in the East should have the priority. In view however of the important industrial developments in Bombay and neighbouring areas, they feel that the Western Institution should be taken in hand concurrently with the Eastern or failing that as soon after as possible.

10. The Committee further recommend that, to satisfy the immediate needs for engineers and particularly those with special training in Hydraulics the engineering nucleus of the Northern Institution should also be set up without delay (Please see paragraph 14).

IX.—CERTAIN OTHER PROPOSALS

11. Having reached the general conclusions, the main Committee appointed a sub-committee consisting of—

Dr. John Sargent (*Convener*),

Dr. Nazir Ahmad,

Dr. Sir S. S. Bhatnagar,

Dr. Sir J. C. Ghosh,

Mr. H. K. Kirpalani,

Dr. A. H. Pandya, and

Dr. K. Venkataraman

to explore subsidiary issues and prepare schemes in detail. Before proceeding to this task, the sub-committee felt it necessary to have regard to certain other proposals for projects for technical development which were brought to their attention.

12. Representations have been received both from the Military and Civil Authorities as to the urgent need for increasing the supply of trained engineers and in this connection it has been suggested that the establishment of a Central Engineering College is a matter of the utmost importance. It appears that the Central Public Works Department alone will require annually 40 to 50 Civil Engineers with specialised training in Hydraulics and that though Military Engineering requirements at the under-graduate stage will be met by the proposed Indian Military Academy, the Military Authorities will require about 20 post-graduate seats a year in Engineering and Technology.

13. Since a project such as the establishment of a Central Engineering College has an obvious bearing on the issues referred to this Committee, it was felt desirable to discuss the matter in detail with those directly interested. The following were accordingly invited to meet the Sub-Committee :

(*i*) Lt. General Sir Thomas Hutton, Secretary to the Planning and Development Department who has also called attention from the point of view of his Department to the shortage of high class engineers.

(*ii*) Mr. A. W. H. Dean, Chief Engineer, Central Public Works Department.

(*iii*) General Sir Clerence Bird, who, when Master General of Ordnance, first raised the question.

(*iv*) Lt. General K. M. Loch, Master General of Ordnance, General Headquarters accompanied by

(*v*) Major General D.R. Duguid, Director of Military Engineering, General Headquarters,

(*vi*) Major General H. M. Roome, Engineer-in-Chief, General Headquarters,

(*vii*) Brigadier R. D. T. Woolfe, Controller General of Inspection, General Headquarters.

14. As a restult of these discussions it was agreed that the requirements of the Central Public Works Department mentioned above might very well be met by the proposed Higher Technical Institutions provided it did not mean delay. Since however the establishment of an all-round fully developed Higher Technical Institution may involve some delay, it has been suggested that in order to meet these and other urgent needs, special provision for training of high grade engineers should be made as quickly as possible at some convenient Centre in the North of India, say near Kanpur. This should not be regarded as a separate college but should be absorbed in and become the engineering department of the proposed Northern Higher Technical Institution when established.

15. The questions were considered whether the time lag involved in turning out technical graduates from new Higher Technical Institutions would not retard the rapid growth of industries and whether the needs of industries could not, perhaps, be satisfied most effectively and expeditiously by institutions designed to cater for specific industries, and wherever practicable conducted in the main by them rather than by the omnibus institutions of the type under reference. A note submitted by Brigadier Woolfe in this connection is annexed in Part III. As a result of considerable discussion, the Committee came to the conclusion that the probable demands of industries for Higher Grade Technical personnel (Executives, research workers maintenance engineers and teachers) except in so far they will be supplied by the existing institutions mentioned in para. 6, would, of necessity, have to be met through the proposed Higher Technical Institutions, while the demands for lower grade technicians could be met by the Junior Technical Institutions of the less advanced type that would be linked to the Higher Technical Institutions.

16. The Committee is definitely of the opinion that the establishment of Higher Technical Institutions for undergraduate study (on modern lines and on a par with what obtains abroad) and for post-graduate study and research, facilities for which are almost non-existent in India, cannot be delayed.

17. A proposal from the Rampur State to the effect that Rampur might be considered as a possible location for one of the Higher Technical Institutions was considered. For the reasons stated in paragraph 8, the Committee regret that the claims of Rampur to be a suitable location for a Higher Technical Institution such

as they envisage cannot be regarded as comparable with those of a large industrial centre such as Kanpur. The Committee is, however, of opinion that the Technical Institutions proposed to be set up by the Rampur State should develop into a Polytechnique to be linked with the Northern Higher Technical Institution when established.

X.—SCOPE AND SIZE OF THE PROPOSED INSTITUTIONS

18. The Committee have devoted considerable attention to the nature and standard of instruction to be provided in the proposed institutions. It is felt that as a number of technical graduates far in excess of the output of the existing colleges would be required for post-war industrial and Governmental projects, it is necessary to provide under-graduate instruction in the main branches of Technology. Further in view of the fact that facilities for post-graduate study and research in Engineering and Technology are totally inadequate in this country, it is also necessary that these institutions should produce research workers and technical teachers.

19. The length of under-graduate courses at each Higher Technical Institution should be four years and the minimum standard for admission I. Sc. or the Higher Secondary Examination when the Intermediate course no longer exists. Selection for admission should be made purely on merit and no provincial quotas should be allotted, but some proportion of the seats should be reserved for the educationally backward classes so that in due course the general level of education throughout may be raised.* The standard for graduation should be not lower than that at a first class institution abroad for example B.Sc. (Tech.) of Manchester or B.S. of the Massachusetts Institute of Technology.

20. It is not possible to lay down any definite length for the post-graduate course. It may normally be of 1 or 2 years' duration though in the case of certain subjects and of students aspiring to higher degrees after research, it may be considerably longer.

21. The proportion of under-graduate to post-graduate students should be 2 : 1.

22. The subjects in which courses should be provided at each stage should be determined individually for each Higher Technical Institution in relation to ascertained needs and in the light of the considerations set out in paragraph 6. As an indication of what they have in mind the Committee have worked out in some detail the under-graduate basic courses which they think should be provided at the Eastern and the Western Higher Technical Institutions and the approximate number of students for which provision should be made in the Eastern Institution at the under-graduate stage. The results, which should be regarded as provisional, are set out below.

XI.—THE EASTERN OR CALCUTTA INSTITUTION

23. *Location.*—For reasons explained in paragraph 8 the Eastern Institution should be located as near Calcutta as possible, say within a radius of 20 miles, and preferably on the Hooghly.

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*NOTE.—This is only a tentative view not unanimously subscribed to by the members of the Committee and will receive further consideration.

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OSED INSTITUTIONS

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24. Scope and size.—

(*i*) *Basic Under-graduate Courses.*—The aproximate number of successful students to be turned out annually is shown in brackets against each subject :—

Aeronautical Engineering	(40)
Chemical Engineering	(60)
Civil and Sanitary Engineering	(40)
Electrical Engineering	(60)
Mechanical Engineering	(60)
Architecture (Building construction & Town Planning)	(60)
Metallurgy	(20)
Botany	(10)
Meteorology	(10)
Geology and Geophysics	(20)

*Industrial Administration, Industrial Hygiene and Economics.

*Humanities.

*Mathematics and Statistics.

*Chemistry.

*Physics.

(*ii*) Administration should take care of physical welfare of students and maintain industrial co-operation.

(*iii*) *Post-graduate Courses.*—The numbers in each subject cannot be fixed at this stage though the total number should be roughly half the under-graduate enrolment. It is not contemplated that Post-graduate students will be recruited exclusively from those who have graduated from the Higher Technical Institutions. Places should be available for suitably qualified graduates from other institutions both in the region and outside. Courses to be provided are :—

Fuel Engineering or Technology.

Pharmaceuticals and Fine Chemicals.

Regional Planning.

Paper Technology.

Glass and Ceramics (in co-operation with the proposed Glass and Ceramics Institute).

Plastics.

Paints and Pigments.

Hydraulic and River Research.

Transportation (including Railway Engineering).

Structural Engineering (including High Dams).

Design of Electrical Machinery.

Refrigeration and Air-conditioning.

Automobile Engineering.

Machine Tools.

Design of Machinery and Instruments.

Light Alloys.

Industrial Physics.

Electronics (including Radio Engineering).

* It is not proposed to provide instructions leading upto a special degree in the subject.

Economic Botany.

Geophysics, Geology, Mineralogy.

Meteorology.

Food Technology.

(Post-graduate training in Aeronautical Engineering to be given in the Indian Institute of Science, Bangalore and/or abroad.)

(*iv*) *Size of the Institution.*—With a four year course, the effective number of under-graduates ought to be 1916. To allow for wastage and future expansions plan should be drawn for an under-graduate student body of 2000 and for 1000 seat in post-graduate departments.

XII.—THE WESTERN OR BOMBAY INSTITUTION.

25. *Location.*—The institution should be located near Bombay.

26. *Scope.*—

(*i*) *Basic Under-graduate Courses.*—At the Bombay Institution the Basic courses to be provided are :—

Building Construction and Architecture.

Chemical Engineering.

Civil and Sanitary Engineering.

Electrical Engineering.

Geology and Geophysics.

Mechanical Engineering.

Textile Technology (including Designing).

Metallurgy.

Naval Architecture and Marine Engineering.

*Industrial Administration, Industrial Hygiene and Economics.

*Humanities.

*Mathematics and Statistics.

*Physics.

*Chemistry.

*Botany.

(*ii*) *Special Subjects.*—Special Subjects for post-graduate teaching and research at this institution should be :—

Regional Planning.

Pharmaceuticals and Fine Chemicals (in co-operation with Bombay University, if possible).

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* It is not proposed to provide instructions leading upto a special degree in the subject.

Cellulose Industries (in co-operation with Bombay University if possible).
Plastics, Paints and Pigment. (Do.)
Dye Chemistry. (Do.)
Food Technology. (Do.)
Transportation (including Railway Engineering).
Structural Engineering (including High Dams).
Design of Electrical Machinery.
Refrigeration and Air Conditioning.
Design of Machinery and Instruments.
Textile Manufacturing.
Textile Engineering.
Textile Chemistry (in co-operation with Bombay University, if possible).
Light Alloys.
Naval Architecture and Marine Engineering.
Economic Botany.
Hydraulic and River Research.

XIII.—ENGINEERING NUCLEUS OF THE NORTHERN INSTITUTION.

27. *Location.*—The Engineering Nucleus of the Northern Institution, if possible, should be located somewhere near Kanpur to cater for the requirements for engineers in particular of the Central Public Works Department for Civil Engineers with specialised knowledge in Hydraulics. The Master General of Ordnance has agreed to explore the possibility for finding a suitable building which may serve temporarily for this purpose.

28. *Scope.*—Instruction should be given in the following subjects :—

Civil and Sanitary Engineering ; Applied Mechanics* ; Hydraulics* ; Mechanical Engineering* ; Electrical Engineering* ; Geology* ; Industrial Administration ; Industrial Hygiene, and Economics * ; Humanities* ; Mathematics* ; Chemistry* and Physics* .

29. *Size.*—To ensure an annual output of about 50 civil engineers provision will have to be made for about 250 seats at this Nucleus.

XIV.—CONTROL AND MANAGEMENT OF THE INSTITUTIONS.

30. The management of each institution should be entrusted to a small governing body composed of persons with the requisite variety of qualifications and experience. Governing Bodies should be appointed by the Government in consultation with the All-India Council for Technical Education which has now been set up.

31. In order to enable these institutions to grant degrees and diplomas it may be necessary to establish these by statute as corporate bodies.

* It is not proposed to provide instructions leading upto special degree in a subject.

XV.—STAFF.

32. In fixing the number of teachers required the Committee took into account the fact that teachers would be expected to do only so much teaching work as would leave them sufficient leisure for research work, for which they should be given all reasonable facilities.

33. *Establishment.*—

(*a*) The strength of teaching staff (exclusive of laboratory assistants and demonstrators) to be provided should be fixed in the scale of 1 teacher per 10 students for basic courses and 1 teacher per 5 students for instruction in special subjects.

(*b*) At least two Professors would be required in each large (or major) department.

(*c*) If necessary, the Principal (or Director or President) and some Heads of Departments may have to be appointed with special personal pay.

(*d*) One of the Heads of Department should act as Vice-Principal in addition to his normal duties.

34. *Scale of Pay.*—

(*a*) The Committee strongly recommend that salaries should be sufficiently attractive to attract and keep capable men in spite of the inevitable competition from industry.

(*b*) The following scales of pay are recommended :—

	Rs.
For Principal	3000 P.M.
For Head of Deptt. including Deptt. in charge of organising practical training	1,500 to 2,000 P.M.
Professor	1,000 to 1,500 P.M.
Registrar	Do.
Assistant Professor	600–40–1,000 P.M.
Librarian	Do.
Lecturer	300–30–600 P.M.

In addition to his pay as the Head of a Department, the Vice-Principal should be given a special allowance.

35. *Qualifications.*—All teachers should have high academic qualifications and practical experience or research experience.

XVI.—BUILDINGS AND EQUIPMENT

36. In accordance with the most modern practice abroad, the buildings should be constructed round the equipment and not *vice versa*. Secondly, the construction should be sufficiently flexible to allow not only for future extensions but also for alterations in room space from time to time to meet changes in requirements.

37. The Committee are of the opinion that to ensure that these principles are observed the persons who are to hold the posts of Principal and Heads of the main departments of the proposed institutions should be appointed at a sufficiently early stage for their advice to be available and their wishes made known to the architects and others responsible for the planning and equipment.

38. With regard to the actual preparation of plans doubts were expressed whether an open competition would produce the desired result. The general view was that careful enquiry shoud be directed to secure an architect with up-to-date experience in the planning of technical institutions and appoint him at the same time as the Principal and Heads of major departments.

XVII.—COST INVOLVED.

39. In view of what has been stated above in regard to the size and scope of institutions the Committee feel that they can only make a very approximate forecast of the estimate of cost, recurring and non-recurring, of each of these proposed institutions.

40. An approximate idea of the expenditure which may have to be incurred in each of these institutions may be seen from the annexed Memorandum (Part IV) on the establishment of the Eastern Higher Technical Institution prepared by the Secretary. In this Memorandum will be found notes on general principle in the design of under-graduate courses of study of workshop and practical training, methods of achieving efficiency of instruction, on education requirements, etc. as well as to detailed calculations of capital and recurring expenditure.

41. It will be seen that probable initial capital expenditure on apparatus, machine tools, furniture, laboratory, buildings etc., will come to about Rupees three crores as summarised below :

	Rs.
(1) Land Acquisition	8,00,000
(2) Water, Supply, Sewage Plant Roads, etc.	15,00,000
(3) College Building	55,13,500
(4) Equipment	1,02,30,000
(5) Furniture	9,40,000
(6) Students Hostel	66,30,000
(7) Staff Quarters	53,30,000
Total	3,09,43,500

42. While the recurring expenditure will come to about Rupees 68 lacs as shown below :—

	Rupees.
Salaries, Provident Fund	29,35,000
Other Charges	23,01,000
Interest, etc.	15,43,000
Tota	67,79,000

43. Against the recurring expenditure must be offset the estimated annual income of about Rs. 13 lacs. According to these figures the net expenditure per student per annum will probably be about one thousand eight hundred and twenty. The Committee is of opinion that this recurring expenditure of rupees one thousand eight hundred and twenty is quite moderate as compared with about rupees four thousand in similar institutions abroad.

44. It should be clearly understood that the estimates are purely tentative and should be regarded as only general indications. With the growth of research activities, the recurring expenditure may be expected to increase.

N. R. SARKER (*Chairman*)

*NAZIR AHMAD.	G. L. MEHTA.	SOBHA SINGH.
S. S. BHATNAGAR.	A. H. PANDYA.	J. K. SRIVASTAVA.
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W. W. LADDEN.	A. D. SHROFF.	R. D. T. WOOLFE.
S. LALL.		

S. R. SEN GUPTA (*Secretary*).

*Subject to note of dissent (please see Part II).

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dary).

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PART II

Note of Dissent by Dr. Nazir Ahmad

While fully realising the necessity of providing suitable facilities for Higher Technical Education in India, I feel that the Committee of High Grade Technological Institutions has not proceeded on the right lines. My reasons for taking this view are as follows :—

1. At the first meeting of the Committee when general principles to be followed were considered the Committee passed the following resolution :—

"Before deciding finally the scope and size of these institutions, it is desirable that the Committee should be in possession of all the information regarding facilities for such high technical education at present available in the country."

This resolution form a directive for the subsequent work of the Sub-Committee appointed to go into this question in greater detail, and I submit that it was completely binding upon them. Nevertheless, the Sub-Committee made very little attempt to explore the facilities which are already available in the country and which can be developed for the purpose of higher technical education. Instead, they proceeded forthwith to prepare plans for two such institutions, one to be established at Calcutta and the other at Bombay. Both these institutions are to be absolutely new and do not take into account any facilities that may already be available in these areas.

2. The Committee was definitely of the opinion that considering the size of the country, the complexities of the problems and the number of technically trained men required in the post-war period, at least four large institutions are absolutely necessary. The Sub-Committee appointed to draw the plans or prepare plans only for two such institutions and have not made any recommendations regarding the scope, size, etc., of the other two institutions envisaged by the full Committee.

3. It is certain that a very large number of technically trained men will be required if all the plans for the industrial development of India for the post-war period materialise. Even with the establishment of four new institutions, it would be impossible to satisfy the total requirements of the country which were stated to be several thousands technicians. Thus a big gap would be left between the actual requirements and the numbers of trained men turned out from these institutions.

4. In real planning for the future, we must take into account the existing resources and must try to build upon them. This process has always been followed in Europe and America where, whenever the need has arisen, the possibility of developing the existing institutions has first been explored before putting up new institutions. If this process is not followed, the existing institutions are likely to stagnate and decay while the newer institutions will work in an atmosphere of isolation.

5. Following the above line of argument which seems quite sound to me I feel that the right course for the Sub-Committee should have been to proceed on the following lines :—(*a*) They should have first of all determined the type and number of trained men in different subjects which would be required say in the next 5 years. This would be the target to be aimed at both in respect of quality and numbers of trained men. (*b*) They should have then written to the existing institutions such as engineering colleges, technological institutions, etc. informing them of the target which is aimed at and enquiring from them as to what additional help by

way of staff, equipment, buildings etc., they require in order to produce these men in sufficient numbers. (c) The Committee should then have considered the claims and requirements of the existing institutions for further expansion with a view to turning out the right type of men in sufficient numbers and if satisfied that the existing institutions when properly developed and expanded can turn out these men, they should have made recommendations of grants to be given to these institutions for the expansion and development. (*d*) If on an examination of the data supplied by the existing institutions, the Committee had come to the conclusion that even after development and expansion, some of them were not able to turn out suitably trained men in specialized fields, they should have then recommended the establishment of new institutions for these specialized fields.

The process outlined above, which to my mind seems to be the right and natural process followed in other countries, would result in utilizing fully the existing institutions, in giving them an opportunity to develop and expand, in economising expenditure on certain basic items such as buildings, workshops etc., which are already available and in turning out a much larger number of trained men than would be possible on the basis of one or two new institutions.

The exploration of the existing institutions with a view to their further development and expansion would also have the advantage that all parts of India would benefit from this scheme and expansion. If on the other hand, attention is concentrated only on the establishment of one or two new institutions, their benefits would be extremely limited leaving vast regions of the country out of the scope of their utility. In this connection consideration must be paid to the difficulty of students from very far off areas taking advantage of educational facilities at distant centres in view of large distances, high cost of education, difference in social customs etc. All these difficulties would be avoided if the existing institutions in the various provinces were developed and expanded so as to be within easy reach of the peoples of all parts of India.

Since the majority of the Members of the Committee have not found it possible to agree with my views, I am placing them before the Government for consideration before the final decision on the matter.

In case after a full decision it is decided to establish one or two High Grade Technical Institutions say in Calcutta and Bombay, I propose that quotas should be assigned to different provinces for purposes of education of students in these institutions so that the inhabitants of all the provinces may be in a position to share their benefits. These institutions would be established from all India funds and it is therefore only logical that the people of the country as a whole should have an equal share in the facilities provided in these institutions.

NAZIR AHMAD.

OFFICE OF THE INDIAN TARIFF BOARD,
BALLARD ESTATE, BOMBAY.
9th March 1946.

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PART III

Copy of Brigadier Woolfe's letter No. 5714/7/MG/CGI-IB, dated the 12th April, 1945, to Dr. John Sargent, Education Adviser to the Government of India regarding technical Education in India.

In thinking over yesterday's Committee meeting I can't help feeling a bit unhappy at the trend of our deliberations and I think this feeling is shared by some of the other members.

2. There can be no doubt that the scientist members of the Committee steered the discussions very ably into channels with which they were very familiar with the result that emphasis was all in the direction of academic scientific training with the result that the first 2½ lines of the agenda has been very largely relegated to the background.

3. No doubt large numbers of engineers and chemists will be required for post-war industries but these are the very industries which come into conflict with overseas competition already developed on much more efficient lines than India can ever hope to achieve.

On the other hand industries already developed or capable of development in India have been left out entirely or catered for only indirectly and it is to the expansion and improvement of these that the main effort should be directed.

4. The Committee decided in favour of basic training as opposed to specialist training but I notice that at least ten of the Departments at the Massachusetts Institute of Technology out of 22 deal with specialized branches of engineering. If this is necessary in the engineering field it is even more necessary in the field of chemistry, physics and botany.

What I am so afraid of is that the weakness of the present system will be continued and the market will be flooded with B.Sc.'s whom no one will employ. Give me a Fuel technologist or a Dye Chemist and I know what to do with him but difficulties arise at once when I am asked to employ a B.Sc. with chemistry or physics as his special subject.

5. Following is a list of Indian Industries, developed, partially developed, or capable of development which require specialized training and which are not catered for by the Committee's proposals :—

TEXTILES . .	*Jute.*—Probably adequately catered for by the industry except in the field of textile engineering and dyeing. *Cotton.*—There is room in every branch for men with specialized training and there is practically nothing to cater for this need. *Wool.*—Includes sheep breeding, grading, marketing, textile chemistry, textile engineering, dye chemistry, finishing, and there is nothing to cater for this. *Silk.*—Sericulture from mulbery cultivation to designing of fabrics is not catered for.
FIBRES . .	There is a wide undeveloped field in the case of hard fibres from aloe to hemp which is not catered for. Requires a knowledge of botany and processing.
VEGETABLE DRUGS, DYES & CHEMICALS.	Ranges from strychnine to tan extract and is a field in which India is particularly rich. Requires a knowledge of botany and processing. Not catered for.
LUMBER . .	Ranges from Forestry, lumber mills, seasoning, carpentry and cabinet making to plywood and packaging. Woodworking of all types is poor in India, it is still in the adze and bow drill stage. The Woodworking School of Bareilly has had some influence towards good work but purely local, Woodworking can of course be said to belong to the technical High School but Forestry and Utilization belongs to the Institute.

DETERGENTS AND EDIBLE OILS.	A specialized branch of chemistry very much to the fore just now owing to the popularity of vegetable ghee. Catered for indirectly.
PHARMACY .	The promulgation of the Pure Drugs Act will open up employment for large numbers of pharmacists. Each chemist shop must employ one and the establishment of a pharmaceutical drug industry will call for many more in addition to Chemical engineers. Not catered for.
COAL TAR	Distillation of coal and wood covers a very wide range calling for specialized training. Catered for only indirectly.
FUEL . . .	With the development of the oil industry fuel technologists and lubrication engineers will be required. Not catered for.
TANNING . .	Leather Chemistry is a specialized subject which has been catered for only indirectly.
CERAMICS & GLASS	Not catered for.
MINING ENGINEERING.	It is understood that the Geological Survey is to be strengthened considerably and will result in greater mining activities. Oil of course is a branch of this.

There are no doubt other industries which I cannot think of at the moment but enough has been said to illustrate my point, *i.e.*, that the Committee's proposals do not to my mind " ensure an adequate supply of technical personnel for post-war industrial development ".

6. One further point is the question of numbers. Sir J. C. Ghosh mentioned the figure of 4,000 per year. I have forgotten his formula which I think was based on the cost of the Bombay plan.

The Committee's proposals visualize 2,000 per year after 7 or 8 years, *i.e.*, 3 years planning & building and 4 years course. A number of these will be absorbed in the teaching profession and in research. The regional Institutes will follow later at an unspecified date. Is this sufficient to meet industries' requirement ? I doubt it and think more could be done.

For instance a textile Institute on the Lines of the Manchester Institute of Technology could be started at the same time as the Central one without interfering or competing with it in any way and its courses could be filled with graduates and nominations from the industry. I have a feeling that this industry will not be prepared to wait 8 years for trained technicians but will take the initiative themselves specially when they find they can get only chemists, physists and engineers from the Central Institute with no specialized training.

PART IV

MEMORANDUM PREPARED BY THE SECRETARY ON THE ESTABLISHMENT OF THE EASTERN HIGHER TECHNICAL INSTITUTION FOR ABOUT 3,000 STUDENTS.

Introduction

1. As recommended by the sub-committee, a plan has been drawn up to provide facilities for instruction of about 2,000 under-graduate and 1,000 post-graduate students. In the under-graduate stage, instruction up to Honours standards will be provided. The length of the courses will be of four years' duration. A minimum number of 380 graduates (the number in different branches is shown below*), is expected from this College every year. The estimated sizes of different classes in under-graduate departments are shown in Appendix II. Although it is difficult to forecast the annual output from the post-graduate department, nevertheless it would be safe to anticipate an annual out-put of 100 highly qualified research workers in the different branches.†

2. In order to arrive at an estimate of minimum recurring and capital expenditure, it was found necessary to map out the rough outline of courses of under-graduate study. Although no claim to perfection in this design is made, it is hoped that the general make up will not be found to be very defective, since the outline has been drawn up following certain accepted general principles (embodied in Appendix I). The list of subjects and the relative importance attached to each will be found in Appendix III. The corresponding under-graduate teaching load calculations and the minimum staff requirements are shown in Appendix IV.

3. The possible composition of the post-graduate student body and the minimum additional staff required are shown in Appendix V.

4. The Appendix VI shows the minimum required strength of the teaching and administrative staff.

5. The possible minimum recurring expenditure on staff salaries is estimated to be Rs. 26,68,200 as shown in Appendix VII and that on laboratory, workshops, scholarships etc. to Rs. 23,01,000 as shown in Appendix VIII. The gross recurring expenditure including 5 per cent interest charge on capital outlay works out to Rs. 67,79,000 only as shown below :—

	Rs.
Salaries, Provident Fund	29,35,000
Other Charges	23,01,000
Interest etc.	15,43,000
Total	67,79,000

Against this must be offset the estimated annual income of Rs. 13,16,000 shown in Appendix X.

6. The net expenditure per student per annum will probably be about Rs. 1,820 which is very modest as compared to about Rs. 4,000 in similar institutions abroad.

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* Aeronautical Engineering (40) ; Civil and Sanitary Engineering (40) ; Chemical Engineering (60) ; Electrical Engineering (60) ; Mechanical Engineering (60) ; Building Construction (60) ; Metallurgy (20) ; Geology and Geophysics (20) ; Botany (10) ; and Meteorology (10).

† Fuel Technology ; Pharmaceuticals and Fine Chemicals ; Regional Planning ; Paper Technology ; Glass and Ceramics ; Plastics ; Paints and Pigments Hydraulic and River Research ; Transportation ; Structural Engineering ; Design of Electrical Machinery ; Radio Engineering ; Refrigeration and Air Conditioning ; Automobile Engineering ; Machine Tools ; Design of Machinery and Instruments ; Light Alloys ; Industrial Physics ; Electronics, Economic Botany ; Geology and Geophysics Mineralogy ; Meteorology.

7. The minimum requirements of accommodation in the College building are shown in Appendix XII (and summarised in Appendix XIII), and those of residential accommodation for students and staff in Appendix XIV. The probable initial capital expenditure on apparatus, machine tools, furniture, library etc. are shown in Appendix XV. Tne total capital exdenditure comes to about Rs. 3,09,43,500 as summarised below :—

	Rs.
(1) Land Acquisition	8,00,000
(2) Water Supply, Sewage Plant, Roads, etc.	15,00,000
(3) College Building	55,13,500
(4) Equipment	1,02,30,000
(5) Furniture	9,40,000
(6) Students Hostel	66,30,000
(7) Staff quarters	53,30,000
Total	3,09,43,500

8. It should be clearly understood that the plan is only a tentative one, and that the estimated capital and recurring expenditure are only indications of the expenditure likely to be required in the near future. With the growth of research activities, the recurring expenditure will certainly increase.

APPENDIX I

General Considerations

I. General Principles in the Design of Under-Graduate Course of Study.

1. The general nature and method of work of engineers have undergone considerable changes during recent years. No institution for higher engineering and technical education can be regarded as fulfilling its functions adequately unless it produces young men and women reasonably well equipped to meet the altered requirements.

2. The course of study in an institution should hence be designed to provide a combination of a fundamental scientific training with a broad human outlook which will afford the students the type of collegiate education endorsed by leading engineers—one which avoids on the one hand the narrowness common among students in technical colleges and, on the other, the superficiality and lack of purpose noticeable in many of those taking academic college courses.

3. The guiding principles should be :—

(*i*) to assist in the development of character, outlook and mental ability in a student so that he may become a useful citizen ;

(*ii*) to teach him the fundamental principles and theories of engineering so that an individual student can apply these with confidence many years later ;

(*iii*) to equip him with tools and inspire in him the desire to continue, after the end of the student's formal training, the independent study of practical processes, technical principles, administrative organisation and advanced theory ;

(*iv*) to give him, during formal training, such knowledge of practical work as would assist the student in realistic appreciation of engineering principles as applied in practice ;

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desire to continue, after the
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neering principles as applied

(*v*) to teach him sound general methods of experimentation and thus enable him to arrive at prompt and reliable conclusions ; and

(*vi*) to develop his ability to write clear and concise technical reports and the ability to participate in verbal discussion on technical matters.

4. Certain points of rather important detail should not be passed over without mention.

(*a*) In addition to sound training in basic sciences, general engineering and in the humanities, a student should be given a thorough grounding in the fundamentals of his chosen branch of engineering and he should be free to elect special subject for more intensive study.

(*b*) The project and design work in the final year should take the form of a thesis so that the student will have opportunities for exercising initiative and thought and will not merely rely on his ability to do calculations of set design problems.

(*c*) Even during his academic studies, the student should be brought face to face with porblems of engineering practice and should be taught to realize the full implications of his theoretical studies in relation to practical problems.

II. Workshop and Practical Training.

1. Although an engineer is not a craftsman nor is expected to possess the same degree of manual skill as an artisan, yet he must have an intimate knowledge of workshop processes and methods. And since the bulk of the student body will be drawn from a population with an essentially rural and agricultural background, the question of a student's workshop and practical training assumes an importance of greater significance here than in the West.

2. It is necessary to provide in the College facilities for instruction in elementary workshop processes and methods either prior to academic instruction or during the college course. A post-school and pre-college workshop training is considered by some authorities to be the proper place for it in a training programme, while others regard this as objectionable educationally on the ground of the resultant long gap between the lower and higher stages of education. A compromise has been practised in most Indian colleges by providing basic workshop training as an integral part of the College course. Although this is not entirely free from objections either, adoption of this system appears to be the best solution under the present conditions.

3. In addition to this, adoption of the following training programme is recommended :--

(*a*) A student should take continuous workshop training in the College for one term each year during the first two years of his college course. Students who have had previous workshop training should spend his period on outside works.

(*b*) At the end of the third year, all students should spend one term on outside works under the guidance of college teachers.

(c) Graduates in all branches must spend one year after their final examination on practical training. This training should conform to a pre-arranged plan and every graduate-trainee should submit monthly reports to a special officer of the College whose duty it will be to ensure that the training period is being properly utilized.

(*d*) Field trips, lectures by eminent specialists should, of course, form part of the regular instruction, and be not regarded as an extra-curricular activity.

III. Efficient Instruction, Teaching Staff, Size of Classes.

1. No matter how good the course of study and the training programme, the quality of the product of a college will depend on the quality of instructions ; and this depends in the first degree on the quality of the teaching staff. There is an essential difference between the teacher of a technical subject and a teacher of purely academic subjects. The former is and must continue to be a technical man.

2. By allowing the teachers to undertake a limited amount of consulting practice and by encouraging them to conduct research and to go back to industry periodically, it should be possible to keep them as live-wires ; this will indubitably improve the standard of instruction. Exchange of technical men between colleges and industry, if possible, would also prove to be of mutual benefit.

3. In order to attract the best men to teaching posts, the salaries and prospects of technical men who devote themselves to teaching should be commensurate with those open to them if they followed an industrial career.

4. The teaching load on a teacher should not be so heavy as to leave him no time for study and research.

5. Personal contact between the teacher and the taught is necessary to achieve the best results. The size of lecture classes should thus be limited to 30 students, and that of laboratory, drawing and tutorial and guided study classes to 10 students per teacher.

VI. Admission Requirements, Selection, Scholarships.

1. Facilities for up-to-date and efficient instruction will not, however, produce the best results unless means are devised to ensure that they are made available to the right type of persons. The efficient engineer is one who is alert in mind and thoroughgoing in application. Therefore, only those applicants whose evidence of academic fitness and professional promise indicate that they are likely to pursue the college course with profit should be admitted to this college.

2. An Entrance Board should conduct written examination to test the applicants' academic fitness and psychological tests and *viva-voce* examination to gauge his professional promise. The subjects of written examination should be English Composition, Mathematics, Science, Drawing and Sketching.

3. In general, admission should be made in order of merit. But some proportion of the seats should be reserved for educationally backward people so that, in due course the general level of education throughout the country may be raised.

4. To enable and encourage poor but meritorious students to pursue the college course a sufficient number of scholarships (400 provided for in the estimate) should be provided.

APPENDIX II

Possible Size of Classes (under-graduate)

Class Year	1	2	3	4	Total	Annual Out-turn of Graduates
SUBJECT						
Aeronautical Engineering	60	50	45	42	197	40
Civil and Sanitary Engineering	,,	,,	,,	,,	197	40
Chemical Engineering	90	80	70	65	305	60
Electrical Engineering	,,	,,	,,	,,	305	60
Mechanical Engineering	,,	,,	,,	,,	305	60
Building Construction	,,	,,	,,	,,	305	60
Metallurgy	30	26	23	21	100	20
Geology, Geophysics	,,	,,	,,	,,	100	20
Botany*	15	13	12	11	51	10
Meteorology†	,,	,,	,,	,,	51	10
Total	570	498	440	408	1,916	380
Excess provision					84	
TOTAL					2,000	

* It would be possible to take a few more students in these departments.
† With careful selection, the wastage will be considerably reduced.

APPENDIX II (a)

Number of Under-graduate Sections

Class Year	1	2	3	4
SUBJECT.				
Aeronautical Engineering	2	2	2	2
Civil and Sanitary Engineering	2	2	2	2
Chemical Engineering	3	3	3	3
Electrical Engineering	3	3	3	3
Mechanical Engineering	3	3	3	3
Building Construction	3	3	3	3
Metallurgy	1	1	1	1
Geology and Geophysics	1	1	1	1
Botany	1	1	1	1
Meteorology	1	1	1	1
Total	20	20	20	20

APPENDIX III

Curricula and Hours devoted to each subject

1. Against each subject listed below ;
(L) stands for lecture hours per week,
(GST) stands for Guided Study and Tutorial,
(L.D.F.W.) stands for Laboratory, Drawing, Field Work, Workshop hours per week, and (Prep) stands for Home preparation hours per week.

2. The academic session will consist of terms of 12 weeks, six weeks and 12 weeks each, commencing from July and ending in March.

3. The fourth term April and May to be spent on practical training : eight weeks.

4. Course designed on the basis of 30 hours of instruction per week (exclusive of workshops practice), during the term.

5. The courses have been so designed that students may change the branch of study at the end of the second year if they should choose to do so.

APPENDIX III (*a*)

First Year Course (Common to all Branches of Engineering.)

Subject	(L)	(GST)	(LDF)	(TL)	(Prep.)
Mathematics (I)	4	4	..	8	4
Physics	2+1	1	2+1	5	2
Chemistry	2+1	1	2+1	5	2
Drawing (I)	1+1	..	5+1	6	2
English	2	2	..	4	2
Career Lectures and Current events—					
Civics	2	..	..	2	2
Total	13	8	9	30	14
Workshop (one full and one half day)	..	..	..	9	
Physical Instructions and Games	..	..	..	3	

Six weeks on Carpentry,
Six weeks on Blacksmithy,
Six weeks on Fitting,
Six weeks on Tinsmithy,
Six weeks on Masonry,

(The Fourth term to be spent on Workshop training in the college or practical training outside).

APPENDIX III (*b*)

Second Year Course (Common to all Branches of Engineering)

Subject	(L)	(GST)	(LDF)	(TL)	(Prep.)
Surveying	1	..	1½	2½	1
Details of Construction and Estimating	1	..	1½	2½	3
Drawing and Graphics	..	..	5	5	1
Elements of Heat Engines (I)	2	1	2	5	2
Elements of Electrical Technology (I)	2	1	2	5	2
Applied Mechanics (I)	2	1	2	5	2
Mathematics	2	1	..	3	2
Sociology, Industrial Relation and Industrial Hygiene	2	..	..	2	2
Total	12	4	14	30	15
Workshop (one full and one half day)	..	..	..	9	
Physical Instruction and Games—3 hours	..	..	..	3	

(Students in Civil Engineering and Building Construction will devote the fourth term to Field Survey in camps and others to workshop practice in the college.)

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choose to do so.

(a)

anches of Engineering.)

(GST)	(LDF)	(TL)	(Prep.)
3	..	8	4
1	2+1	5	2
1	2+1	5	2
..	5+1	6	2
2	..	4	2
..	..	2	2
8	9	30+5	14
..	..	9	
..	..	3	

raining in the college or practical

ches of Engineering)

(GST)	(LDF)	(TL)	(Prep.)
..	1½	2½	1
..	1½	2½	3
..	5	5	1
1	2	5	2
1	2	5	2
1	2	5	2
1	..	3	2
..	..	2	2
4	14	30	15
.	..	9	
.	..	3	

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op practice in the college.)

APPENDIX III (c)

Third Year Civil Engineering Course

Subject	(L)	(GST)	(LDF)	(TL)	(Prep.)
Applied Mechanics II	3	2	3	8	5
Structures and Design (I)	2	2	3	7	4
Geodesy	1	..	2	3	1
Roads and Pavements	1	..	..	1	1
General Civil Engineering and Estimating	2	..	2	4	2
Engineering Geology	2	..	2	4	2
Economics and Accounts	3	..	..	3	2
Total	14	4	12	30	17
Workshop (one full day)	..	..	..	6	

(The fourth term will be spent on outside work pertaining to his own elective.)

APPENDIX III (d)

Fourth Year Civil Engineering Course

Subject	(L)	(GST)	(LDF)	(TL)	(Prep.)
Hydraulics	2	..	3	5	2
Reinforced Concrete, Foundation and Structures	4	..	5	9	5
Project Preparations, Analysis and Organisation	2	..	..	2	2
Planning and Layout	2	..	2	4	4
Elective	2	..	3	5	3
Project and Thesis	1	..	7	8	7
Total	13	..	20	33	23

Electives :

Railways.

Sanitary Engineering.

Irrigation and Flood Control.

Water Power Engineering.

Earthquake Proof Structures.

Advanced Structures.

Mobile Field Equipment.

High Way Engineering.

APPENDIX III (*e*)

Third Year Mechanical Engineering Course

Subject	(L)	(GST)	(LDF)	(TL)	(P
Applied Mechanics II	3	1	3	7	
Machine Design	1	..	6	7	
Heat Engines	3	1	1½	5½	
Electrical Technology	2	1	1½	4½	
Meteorology and Workshop Methods	2	..	1	3	
Economics and Accounts	3	..	..	3	
Total	14	3	13	30	
Workshops (one full day)	..	..	..	6	

(The fourth term to be spent on outside work pertaining to his own elective.)

APPENDIX III (*f*)

Fourth Year Mechanical Engineerig Course

Subject	(L)	(GST)	(LDF)	(TL)	(Prep
Hydraulic Machinery	2	..	3	7	
Theory of Machines	2	..			
Heat Engines	3	..	3	6	
Workshop Theory	2	..	..	2	
Planning, Layout Production	2	..	3	5	
Elective	2	..	3	5	
Project and Thesis	1	..	7	8	
Total	14	..	19	33	2

Electives :

Production Engineering.

Machine Tools.

Automobile Engineering.

Refrigeration and Air-Conditioning.

Mobile Equipment.

Industrial Plants.

Steam Turbines.

Metallurgy.

Design Problems

III (*e*)

ngineering Course

	(GST)	(LDF)	(TL)	(Prep.
	1	2	7	3
	..	6	7	3
	1	1½	5½	3
	1	1½	4½	2
	..	1	3	1
	..	..	3	2
	3	13	30	15
	..	..	6	

ork pertaining to his own elective.)

I (*f*)

Engineerig Course

	(GST)	(LDF)	(TL)	(Prep.)
	..	3	7	2
	..			2
	..	3	6	3
	..	..	2	2
	..	3	5	4
	..	3	5	3
	..	7	8	6
	..	19	33	22

APPENDIX III (*g*)

Third Year Building Construction Course

SUBJECT	(L)	(GST)	(LDF)	(TL)	(Prep.)
Architectural Principles	2	1	5	8	4
Roads and Pavement	1	..	..	1	1
Building Construction	4	2	5	11	4
Sanitation	1	1	..	2	1
Heating and Ventilation	1	..	..	1	1
Engineering Geology	2	..	2	4	2
Economics and Accounts	3	..	..	3	2
TOTAL	14	4	12	30	15
Workshops (one full day)	..	..	..	6	

(The fourth term to be spent on outside work pertaining to his own elective.)

APPENDIX III (*h*)

Fourth Year Building Construction Course

SUBJECT	(L)	(GST)	(LDF)	(TL)	(Prep.)
Architectural Design	1	..	10	11	6
Accoustics Illumination	2	..	..	2	2
Principle of City Planning	2	..	3	5	2
Project Preparation, Analysis Organisation	2	..	..	2	2
Elective	2	..	3	5	3
Project and Thesis	1	..	7	8	7
TOTAL	10	..	23	33	22

Electives :

History of Architecture.
Reinforced Concrete Structures.
Steel Structures.
City and Regional Planning.
Valuation.

APPENDIX III (*i*)

Third Year Metallurgical Engineering Course

SUBJECT	(L)	(GST)	(LDF)	(TL)	(Prep.)
Refractories, Furnaces and Dressing of Minerals	2	..	1	3	2
General Metallurgy	3	1	..	4	2
Fuels	1	1	2	4	2
Physical Chemistry	2	..	1½	3½	2
Advanced Chemistry	2	..	3	5	2
Geology	2	..	2	4	2
Electrical Technology	1	1	1½	3½	2
Economics and Accounts	3	..	..	3	2
TOTAL	16	3	11	30	16
Workshops (one full day)	16		16		

(The fourth term to be spent on out side work pertaining to his own elective.)

APPENDIX III (*j*)

Fourth Year Metallurgical Engineering Course

Subject	(L)	(GST)	(LDF)	(TL)	(Prep
Metallurgy of Iron and Steel	3	..	..	3	3
Non-Ferrous Metallurgy	2	..	..	2	2
Assaying	1	..	2	3	2
Electro-Metallurgy	1	..	..	1	1
Metallography, Heat Treatment and Pyrometry	3	..	5	8	3
Mechanical Testing and Working of Metals	1	..	2	3	1
Furnace Design	..	..	5	5	4
Elective	2	..	2	4	2
Thesis	1	..	3	4	4
Total	14	..	19	33	22

Electives :

Metallurgy of Alloy steels.

Advanced Metallurgy of Non-Ferrous Alloys.

Surface Treatment.

X-Ray Metallography.

Physics of Metals.

Powder Metallurgy.

APPENDIX III (*k*)

Third Year Electrical Engineering Course

Subject	(L)	(GST)	(LDF)	(TL)	(Prep.)
Applied Mechanics	3	1	3	7	3
Workshop Methods and Metrology	2	..	1	3	1
Heat Engines	2	1	1½	4½	3
Mathematics	2	..	..	2	1
Electrical Technology	4	2	4½	10½	5
Economics and Accounts	3	..	..	3	2
Total	16	4	10	30	15

(The fourth term to be spent on outside work pertaining to his own elective.)

APPENDIX III (*l*)

Fourth Year Electrical Engineering Course

Subject	(L)	(GST)	(LDF)	(TL)	(Prep.)
Generation	2	..	1½	3½	3
Transmission and Distribution	4	..	1½	5½	3
Electrical Machine Design	2	..	4	6	3
Power System Planning and Layout	2	..	3	5	4
Elective	2	..	3	5	3
Project and Thesis	1	..	7	8	6
Total	13	..	20	33	22

II (*j*)

Engineering Course

L)	(GST)	(LDF)	(TL)	(Prep
	..	..	3	3
	..	..	2	2
	..	2	3	2
	..	..	1	1
	..	5	8	3
	..	2	3	1
	..	5	5	4
	..	2	4	2
	..	3	4	4
	..	19	33	22

ıs Alloys.

II (*k*)

gineering Course

	(GST)	(LDF)	(TL)	(Prep.)
	1	3	7	3
	..	1	3	1
	1	1½	4½	3
	..	..	2	1
	2	4½	10½	5
	..	..	3	2
	4	10	30	15

rk pertaining to his own elective.)

I (*l*)

gineering Course

	(GST)	(LDF)	(TL)	(Prep.)
	..	1½	3½	3
	..	1½	5½	3
	..	4	6	3
	..	3	5	4
	..	3	5	3
	..	7	8	6
	..	20	33	22

Electives :

Electrical Communication.
Electric Traction.
Illumination Engineering.
Electronics.
Plastics.
Refrigeration and Air Conditioning.
Production Engineering.
Instruments.
Design Problems.

APPENDIX III (*m*)

Third Year Course in Aeronautical Engineering

Subject	(L)	(GST)	(LDF)	(TL)	(Prep.)
Applied Mechanics	3	1	2	6	5
Heat Engines	2	1	1½	4½	2
Electrical Engineering	2	1	1½	4½	2
Machine Drawing	1	..	3	4	..
Aerodynamics and Aeroplane Structures	4	1	3	8	4
Economics and Accounts	3	..	..	3	2
Total	15	4	11	30	15
Workshop (one full day)	..	..	..	6	

(The fourth term to be spent on outside work.)

APPENDIX III (*n*)

Fourth Year Course in Aeronautical Engineering

Subject	(L)	(GST)	(LDF)	(TL)	(Prep.)
Aero Engines, Aeroplane Performance, and Aeroplane Stability and Control	6	..	4	10	8
Aeroplane Design Practice, Aeroplane Structures	2	..	8	10	6
Elective	2	..	3	5	3
Thesis	1	..	7	8	5
Total	11	..	22	33	22

Electives :

Meteorology.
Advanced Aerodynamics.
Advanced Structure.
Production Methods.
Automotive Engines.
Metallurgy.
Plastics.

APPENDIX III (*o*)

Third Year Course in Chemical Engineering

Subject	(L)	(GST)	(LDF)	(TL)	(Prep.)
Inorganic, Organic and Physical Chemistry	5	2	11	18	10
Physical Metallurgy	1	1	..	2	1
Fuels and Combustion	1	..	1	2	1
Engineering Drawing and Design	1	..	4	5	1
Economics and Accounts	3	..	..	3	2
Total	11	3	16	30	15
Workshop (one full day)	..	..	..	6	

(The fourth term to be spent on the outside work.)

APPENDIX III (*p*)

Fourth Year Course in Chemical Engineering

Subject	(P)	(GST)	(LDF)	(TL)	(Prep.)
Unit operations of Chemical Engineering	4	..	8	12	6
Chemical Plant Design and Thesis	1	..	9	10	6
Heat Transmission	1	..	1	2	1
Transport and Storage of materials	1	..	..	1	1
Power Generation and Distribution	1	..	..	1	1
Factory Layout and Construction Organisation and Management	2	..	..	2	2
Elective	2	..	3	5	5
Total	12	..	21	33	22

Electives :

Heavy Chemicals.

Light Chemicals.

Pharmaceutics.

Plastics.

Fuel Technology.

Ceramics.

Metallurgy.

APPENDIX III (*q*)

First Year Course (Common to Geology, Botany, Meteorology)

Subject	(L)	(GST)	(LDF)	(TL)	(Prep.)
Mathematics	4	2	2	8	4
Chemistry	3	1½	3	7½	3
Physics	3	1½	3	7½	3
English	2	2	..	4	2
Drawing and Sketching	1	..	..	1	1
Career Lectures, Current Events, Civics	2	..	..	2	3
Total	15	7	8	30	16
Physical Instruction and Games	..	..	..	3	..

(o)

l Engineering

(GST)	(LDF)	(TL)	(Prep.)
2	11	18	10
1	..	2	1
..	1	2	1
..	4	5	1
..	..	3	2
3	16	30	15
..	..	6	

the outside work.)

p)

l Engineering

(GST)	(LDF)	(TL)	(Prep.)
..	8	12	6
..	9	10	6
..	1	2	1
..	..	1	1
..	..	1	1
..	..	2	2
..	3	5	5
..	21	33	22

)

Botany, Meteorology)

ST)	(LDF)	(TL)	(Prep.)
2	2	8	4
1½	3	7½	3
1½	3	7½	3
2	..	4	2
..	..	1	1
..	..	2	3
7	8	30	16
..	..	3	..

APPENDIX III (*r*)

Second Year Course in Geology and Geophysics

Subject	(L)	(GST)	(LDF)	(TL)	(Prep.)
Geology and Mineralogy	4	2	6	12	6
Zoology	2	1	3	6	2
Botany	2	1	3	6	2
Physical Chemistry	1	..	1	2	1
Palæontology	1	..	1	2	1
Language	2	..	..	2	3
Total	12	4	14	30	15
Physical Instruction and Games	..	..	..	3	..

(The fourth term to be spent on field work.)

APPENDIX III (*s*)

Third Year Course in Geology and Geophysics

Subject	(L)	(GST)	(LDF)	(TL)	(Prep.)
Geology and Mineralogy	7	3	9	19	7
Palæontology	1	..	1	2	1
Language	3	..	..	3	3
Physics	3	..	..	3	2
Mathematics	3	..	..	3	2
Total	17	3	10	30	15

(The fourth term to be spent on field work.)

APPENDIX III (*t*)

Fourth Year Course in Geology and Geophysics

Subject	(L)	(GST)	(LDF)	(TL)	(Prep.)
Geology, etc.	7	..	8	15	7
Elective	5	..	5	10	7
Thesis	1	..	7	8	8
Total	13	..	20	33	22

Electives:

Economics.

Geology.

Structural Geology of Petroleum.

Palæontology.

Geophysics.

Petrology.

APPENDIX III (*u*)

Second Year Course in Botany

Subject	(L)	(GST)	(LDF)	(TL)	(Prep.)
Botany	4	2	6	12	6
Zoology	2	1	3	6	2
Geology	2	1	2	5	2
Biochemistry	1	..	2	3	1
Palæontology	1	..	1	2	1
Language	2	..	..	2	3
Total	12	4	14	30	15
Physical Instruction and Games	..	..	..	3	..

(The fourth term to be spent on field work.)

APPENDIX III (*v*)

Third Year Course in Botany

Subject	(L)	(GST)	(LDF)	(TL)	(Prep.)
Botany	6	3	12	21	8
Ecology	2	..	..	2	1
Algæ	2	..	..	2	1
Genetics	1	..	..	1	1
Taxonomy	1	..	..	1	1
Language	3	..	..	3	3
Total	15	3	12	30	15

(The fourth term to be spent on field work.)

APPENDIX III (*w*)

Fourth Year Course in Botany

Subject	(L)	(GST)	(LDF)	(TL)	(Prep.)
Botany	7	..	8	15	7
Elective	5	..	5	10	7
Thesis	1	..	7	8	8
Total	13	..	20	33	22

Electives :

Physiology of Plants.

Morphology and Physiology of Fungi.

Physiology of Parasitism.

Soil Bacteriology.

General Bacteriology.

I (*u*)

in Botany

(GST)	(LDF)	(TL)	(Prep.)
2	6	12	6
1	3	6	2
1	2	5	2
..	2	3	1
..	1	2	1
..	..	2	3
4	14	30	15
..	..	3	..

; on field work.)

(*v*)

Botany

(GST)	(LDF)	(TL)	(Prep.)
3	12	21	8
..	..	2	1
..	..	2	1
..	..	1	1
..	..	1	1
..	..	3	3
3	12	30	15

on field work.)

(*w*)

Botany

(GST)	(LDF)	(TL)	(Prep.)
..	8	15	7
..	5	10	7
..	7	8	8
..	20	33	22

APPENDIX III (*x*)

Second Year Course in Meteorology

Subject	(L)	(GST)	(LDF)	(TL)	(Prep.)
Applied Mechanics	2	..	2	5	2
Machine tools Laboratory	..	1	4	5	1
Physics	3	2	3	8	4
Mathematics	5	3	..	8	5
Drawing	2	..	..	2	..
Language	3	..	..	3	3
Total	15	6	9	31	15
Physical Instruction and Games	..	..	..	3	..

(The fourth term to be spent on field work.)

APPENDIX III (*y*)

Third Year Course in Meteorology

Subject	(L)	(GST)	(LDF)	(TL)	(Prep.)
Mathematics	3	2	..	5	3
Physics	3	..	3	6	2
Language	3	..	..	3	3
Meteorology	7	2	7	16	7
Total	16	4	10	30	15

(The fourth term to be spent on field work.)

APPENDIX III (*z*)

Fourth Year Course in Meteorology

Subject	(L)	(GST)	(LDF)	(TL)	(Prep.)
Meteorology	7	..	8	15	7
Elective	5	..	5	10	7
Thesis	1	..	7	8	6
Total	13	..	20	33	20

APPENDIX IV

1. For the purposes of calculation of teaching load on each department it has been assumed that the number of students in Lecture classes will not exceed 30 each and that for guided study, tutorial, laboratory and drawing classes a teacher will be required for every 10 students.

2. Here again (L) stands for Lecture classes, (GST), (LDF) stand for guide study, tutorial and laboratory classes.

3. For the purposes of fixing the number of teaching staff, the following distribution of work has been assumed :—

Senior Professor or Head of Department	L	7	hours/week.
Professor	L	8	do.
	GST	4	do.
Asstt. Professor	L	8	do.
	GST	6	do.
Lecturer	L	12	do.
	GST	3	do.
Instructor	GST	20	do.

This will leave the staff some time for study and research and for occasional post-graduate teaching.

APPENDIX IV (A)

Teaching Load on the Department of Mathematics

Class	(L)	(GST)	(LDF)	(SECTION)
1st year Engineering	4	4	..	17
2nd year Engineering	2	1	..	17
3rd year Electrical Engineering	2	..	..	3
1st year Science	4	4	..	3
3rd year Geology	3	..	..	1
2nd year Meteorology	5	3	..	1
3rd year Meteorology	3	2	..	1

Lecture Load=$(4\times17) + (2\times17) + (2\times3) + (4\times3) + (3\times1) + (5\times1) + (3\times1)$=131 hours/week.

G.S.T. Load=$3\,[(4\times17) + (1\times17) + (4\times3) + (2\times1) + (3\times1)]$=$3\,(102)$=306 hours/week.

STAFF REQUIRED

One Professor of Applied Mathematics	L(7)
One Professor of Statistics	L(8), GST(6)
One Asstt. Professor of Pure Mathematics	L(8), GST(6)
Nine Lecturers	L(12), GST(3) each
Fourteen Assistants	GST(20) each

APPENDIX IV (B)

2. Teaching Load on the Department of Physics

Class	(L)	(GST, LDF)	(SECTION)
1st year Engineering	2	3	17
1st year Science	3	$4\frac{1}{2}$	3
2nd year Meteorology	3	5	1
3rd year Meteorology	3	3	1
3rd year Geophysics	3	..	1
4th year Building Construction	2	..	3

Lecture Load=$(2\times17) + (3\times3) + (3\times1) + (3\times1) + (1\times3) + (2\times3)$= 58 hours/week.

G.S.T. and L.D.F. Load=$3\,[(3\times17) + (4\frac{1}{2}\times3) + (5\times1) + (3\times1)]$=$3\times73$= 219 hours/week.

STAFF REQUIRED

One Professor	L (7)
One Asstt. Professor	L (8) GST (6)
Four Lecturers	L (11) GST (5) each
Ten Assistants	GST (20) each

f teaching staff, the following distri-

..... 7 hours/week.
..... 8 do.
GST.....4 do.
..... 8 do.
GST.....6 do.
.....12 do.
GST..... 3 do.
GST..... 20 do.

dy and research and for occasional

(A)
ent of Mathematics

(L)	(GST)	(LDF)	(SECTION)
4	4	..	17
2	1	..	17
2	..	..	3
4	4	..	3
3	..	..	1
5	3	..	1
3	2	..	1

3) + (4×3) + (3×1) + (5×1)

+ (2×1) + (3×1)]=3 (102)=306

4
3), GST(3)
3), GST(6)
2), GST(3) each
T(20) each

(B)
nent of Physics

	(L)	(GST, LDF)	(SECTION)
.	2	3	17
.	3	4½	3
.	3	5	1
.	3	3	1
.	3	..	1
.	2	..	3

+ (3×1) + (1×3) + (2×3) =

3) + (5×1) + (3×1)]=3×73=

each

APPENDIX IV (C)

Teaching Load on the Department of Chemistry

Class	(L)	(GST, LDF)	(SECTIONS)
1st year Engineering	2	3	17
3rd year Metallurgy	4	5	1
2nd year Botany	1	2	1
3rd year Chemical Engineering	5	13	3
1st year Science	3	4½	3
2nd year Geology	1	1	1

Lecture Load=(2×17)+(4×1)+(1×1)+(5×3)+(3×3)+(1×1)=64 hours/week.

GST and LDF Load=3[(3×17)+(5×1)+(2×1)+(13×3)+(4½×3)+(1×1)] =3×112=336 hours/week.

STAFF REQUIRED

One Professor	L (7)	
One Asstt. Professor	L (8)	GST (6)
Four Lecturers	L (12)	GST (4) each
Sixteen Assistants		GST (20) each

APPENDIX IV (D)

Teaching Load on the Department of Humanities

ENGLISH AND LANGUAGE

Class	(L)	(GST)	(SECTIONS)
1st year Engineering and Science	2	2	20
2nd year Science	2	..	3
3rd year Science	3	..	3

Lecture Load=(2×20)+(2×3)+(3×3)=55 hours/week.

GST Load =3×2×20=120 hours/week.

STAFF REQUIRED

Four Lecturers in English	L (10)	GST (6)
One Lecturer in German	L (6)	GST (10)
One Lecturer in French	L (9)	GST (7)
Four Assistants in English		GST (17)

APPENDIX IV (Di)

Economics, Accounts, Civics, Sociology

Class	(L)	(GST)	(SECTIONS)
1st year Engineering and Science	2	..	20
2nd year Engineering	2	..	17
3rd year Engineering	3	..	17

Lecture Load=(2×20)+(2×17)+(3×17)=125.

STAFF REQUIRED

One Professor	L (7)
One Asstt. Professor	L (13)
Six Lecturers	L (17)

APPENDIX IV (E)

Teaching Load on the Department of Drawing

Class	(L)	(GST, LDF)	(SECTION
1st year Engineering	1	5	17
2nd year Engineering	..	5	17
1st year Science	1	..	3
2nd year Meteorology	2	..	1

Lecture Load=(1×17)+ (1×3)+ (2×1)=22 hours/week.

LDF Load=3 [(5×17)+(5×17)]=510 hours/week.

STAFF REQUIRED :

One Asstt. Professor	L (10)	GST (4)
One Lecturer	L (12)	GST (4)
Twenty Five Assistants		GST (20)

APPENDIX IV (F)

Teaching Load on the Department of Applied Mechanics

Class	(L)	(GST, LDF)	(SECTIONS
2nd year Engineering	2	3	17
3rd year Civil Engineering	3	5	2
4th year Civil Engineering	2	3	2
3rd year Mechanical Engineering	3	4	3
4th year Mech. Engineering	4	3	3
3rd year Electrical Engineering	3	4	3
3rd year Aeronautical Engineering	3	3	2
2nd year Meteorology	2	4	1

Lecture Load=(2×17)+ (3×2)+(2×2)+(3×3)+(4×3)+(3×3)+(3×2)+(2×
=82 hours/week.

GST, LDF Load=3[(3×17)+(5×2)+(3×2)+(4×3)+(3×3)+(4×3)+(3×2)
(4×1)].=3×110=330 hours/week.

STAFF REQUIRED :

One Professor	L (6)	GST (2)
One Asstt. Professor	L (7)	GST (6)
Six Lecturers	L (12)	GST (4) each
Fifteen Assistans		GST (20) each

APPENDIX IV (G)

Teaching Load on the Deptt. of Civil Engineering.

Class	(L)	(GST, LDF)	(SECTIONS)
2nd year Engineering	2	3	17
3rd year Civil Engineering	6	9	2
4th year Civil Engineering	9	14	2
4th year 6 Electives	12	18	..
3rd year Building Construction	2	..	3

Lecture Load = (2×17)+(6×2) + (9×2)+ (12)+ (2×3) = 82 hours/week.

GST, LDF Load=3 [(3×17)+(9×2)+(14×2)+(18)]=3 (115)=345 hours/week.

STAFF REQUIRED :

One Professor	L (7)	
One Professor	L (8)	GST (4)
Four Asstt. Professors	L (8)	GST (6) each
Three Lecturers	L (12)	GST (4) each
Fifteen Assistants		GST (20) each

APPENDIX IV (H)

Teaching Load on the Deptt. of Mechanical Engineering

Class	(L)	(GST, LDF)	(SECTIONS)
2nd year Engineering	2	3	17
3rd year Mech. Engg.	6	9	3
4th year Mech. Engg.	8	13	3
4th year 6 Electives	12	18	..
3rd year Electrical Engg.	4	4	3
3rd year Aeronautics	3	4	2
2nd year Meteorology	..	4	1
3rd year Chemical Engg.	1	4	3

Lecture Load = $(2\times17)+(6\times3)+(8\times3)+(12)+(4\times3)+(3\times2)+(1\times3)$
$=190$ hours/week.

GST, LDF Load $=3[(3\times17)+(9\times3)+(13\times3)+(18)+(4\times3)+(4\times2)+(4\times1)+(4\times3)]$
$=3\times171=513$ hours/week.

STAFF REQUIRED :

One Professor	L (7)	
One Professor	L (8)	GST (4)
Six Asstt. Professors	L (8)	GST (6) each
Three Lecturers	L (12)	GST (4) each
Twenty Three Assistants		GST (20) each

APPENDIX IV (I)

Teaching Load on the Deptt. of Electrical Engineering

Class	(L)	(GST, LDF)	(SECTION)
2nd year Engineering	2	3	17
3rd year Mech. Engineering	2	3	3
3rd year Metallurgy	1	2	1
3rd year Electrical Engineering	4	6	3
4th year Electrical Engineering	11	17	3
4th year 6 Electives	12	18	..
3rd year Aeronautics	2	3	2

Lecture Load $=(2\times17)+(2\times3)+(1\times1)+(4\times3)+(11\times3)+(12)+(2\times2)$
$=102$ hours/week.

GST, LDF Load $=3[(3\times17)+(3\times3)+(2\times1)+(6\times3)+(17\times3)+(18)+(3\times2)]$
$=3\times155=465$ hours/week.

STAFF REQUIRED :

One Professor	L (7)	
One Professor	L (8)	GST (4)
Six Asstt. Professors	L (8)	GST (6) each
Three Lecturers	L (13)	GST (3) each
Twenty One Assistants		GST (20) each

(E)

partment of Drawing

(L)	(GST, LDF)	(SECTIONS)
1	5	17
..	5	17
1	..	3
2	..	1

2 hours/week.
urs/week.

(10) GST (4)
(12) GST (4)
GST (20)

(F)

of Applied Mechanics

(L)	(GST, LDF)	(SECTIONS)
2	3	17
3	5	2
2	3	2
3	4	3
4	3	3
3	4	3
3	3	2
2	4	1

$)+(4\times3)+(3\times3)+(3\times2)+(2\times1)$

$+(4\times3)+(3\times3)+(4\times3)+(3\times2)+$

) GST (2)
) GST (6)
2) GST (4) each
GST (20) each

G)

il Engineering.

(L)	(GST, LDF)	(SECTIONS)
2	3	17
6	9	2
9	14	2
12	18	..
2	..	3

$+(2\times3)=82$ hours/week.

$18)]=3(115)=345$ hours/week.

GST (4)
GST (6) each
GST (4) each
GST (20) each

APPENDIX IV (J)

Teaching Load on the Deptt. of Building Construction

Class	(L)	(GST, LDF)	(SECTIONS)
3rd year Building Construction	7	13	3
4th year Building Construction	6	20	3
4th year 6 Electives	12	18	..

Lecture Load=$(7\times3)+(6\times3)+12=51$ hours/week.

GST, LDF Load=$3\,[(13\times3)+(20\times3)+(18)]=3\times117=351$ hours/week.

STAFF REQUIRED :

One Professor	L (7)	
One Professor	L (8)	GST (4)
Four Asstt. Professors	L (9)	GST (5) each
Seventeen Assistants		GST (20) each

APPENDIX IV (K)

Teaching Load on the Deptt. of Metallurgical Engineering

Class	(L)	(GST, LDF)	(SECTIONS)
3rd year Metallurgy	6	5	1
4th year Metallurgy	12	17	1
4th year 6 Electives	12	12	..
3rd year Chemical Engineering	2	2	3

Lecture Load=$(6\times1)+(12\times1)+(12)+(2\times3)=36$ hours/week.

GST, LDF Load=$3\,[(5\times1)+(17\times1)+(12)+(2\times3)]=3\times40=120$ hours/week.

STAFF REQUIRED :

One Professor	L (7)	
Four Asstt. Professors	L (8)	GST (6) each
Five Assistants		GST (20) each

APPENDIX IV (L)

Teaching Load on the Deptt. of Aeronautical Engineering

Class	(L)	(GST, LDF)	(SECTIONS)
3rd year Aeronautics	4	4	2
4th year Aeronautics	9	19	2
4th year Electives	8	12	..

Lecture Load =$4\,(4\times2)+(9\times2)+(8)=34$ hours/week.

GST, LDF Load =$3\,[(4\times2)+(19\times2)+(12)]=3\times58=174$ hours/week.

STAFF REQUIRED :

One Professor	L (7)	
Three Asstt. Professors	L (8)	GST (6) each
One Lecturer	L (3)	GST (13)
Seven Assistants		GST (20)

APPENDIX IV (M)

Teaching Load on the Deptt. of Chemical Engineering

Class	(L)	(GST, LDF)	(SECTIONS)
4th year Chemical Engineering	10	18	3
4th year 6 Electives	12	18	..

Lecture Load=(10×3)+(12)=42 hours/week.

GST, LDF Load=3[(18×3)+18]=3×72=216 hours/week.

STAFF REQUIRED :

One Professor	L (7)	
One Professor	L (8)	GST (6)
Four Asstt. Professors	L (7)	GST (7) each
Nine Assistants		GST (20) each

APPENDIX IV (N)

Teaching Load on the Deptt. of Geology and Geophysics

Subject	(L)	(GST, LDF)	(Prep.)
3rd year Civil Engg.	2	2	2
3rd year Building Construction	2	2	3
3rd year Metallurgy	2	2	1
2nd year Botany	2	3	1
2nd year Geology	5	9	1
3rd year Geology	8	13	1
4th year Geology	8	15	1
4th year 6 Electives	30	30	..

Lecture Load=(2×2)+(2×3)+(2×1)+(2×1)+(5×1)+(8×1)+(8×1)+30
=65 hours/week.

GST, LDF-Load=3 [(2×2)+(2×3)+(2×1)+(3×1)+(9×1)+(13×1)+(15×1)
+30]=3×82=246 hours/week.

STAFF REQUIRED :

One Professor	L (7)	
Three Asstt. Professors	L (8)	GST (6) each
Three Lecturers	L (11)	GST (5) each
Nine Assistants		GST (20) each

APPENDIX IV (O)

Teaching Load on the Deptt. of Botany

Class	(L)	(GST, LDF)	(SECTIONS)
2nd year Geology	4	8	1
2nd year Botany	7	13	1
3rd year Botany	12	15	1
4th year Botany	8	15	1
4th year Electives	20	20	..

Lecture Load=4+7+12+8+20=51 hours/week.

GST, LDF Load=3 [(8+13+15+15+20)]=3×71=213 hours/week.

STAFF REQUIRED :

One Professor	L (7)	
Three Asstt. Professors	L (8)	GST (6) each
Two Lecturers	L (10)	GST (6) each
Ten Assistants		GST (20) each

APPENDIX IV (P)

Teaching Load on the Deptt. of Meteorology

Class	(L)	(GSD, LDF)	(SECTIONS)
3rd year Meteorology	7	9	1
4th year Meteorology	8	15	1
4th year 4 Electives	20	20	..

Lecture Load=7+8+20=35 hours/week.

GST, LDF-Load=3 (9+15+20)=3×44=132 hours/week.

Staff Required :

One Professor	L (8)	
Three Asstt. Professors	L (9)	GST (5) each.
Six Assistants		GST (20) each.

APPENDIX IV (Q)

Teaching Load on Workshops

1st year class about 500 students.

2nd year class about 240 students.

Shops :—

1. Carpentry 2. Smithy 3. Welding and Tin Smithy 4. Masonary 5. Fitting	120 seats in each shop. 10 Instructor in each.
6. Foundry and Pattern Making 7. Machine Shops 8. Mill Wright	80 seats in each shop 10 Instructors in each.
9. Instrument makers 10. Engine and Boiler House 11. Electrician	40 seats in each shop. 5 Instructors in each.

Staff Required :

One Workshop Superintendent.

Eleven Foremen Instructors.

Twelve Store Keepers.

Eighty Five Artisan Instructors.

Note.—It may be possible to train about 600 trade apprentices in addition to providing practical instruction to students.

APPENDIX V

Possible Strength of Post Graduate Departments

	Students
Chemical Engineering Chemistry Metallurgy etc.	400
Civil Engineering Regional Planning	150
Mechanical Engineering	150
Electrical Engineering	200
Applied Physics, Meteorology, Geophysics	50
Botany and Biological Sciences	50
Total	1,000

APPENDIX V (*i*)

Provisional Additional Staff Requirements for Post Graduate Work

Chemical Technology	4	Associate Professors.
Civil Engineering and Building	2	,, ,,
Mechanical Engineering	2	,, ,,
Electrical Engineering	3	,, ,,
Applied Physics etc.	1	,, Professor
Botany and Biological Science	1	,, ,,
		and 100 Research Assistants.

APPENDIX VI

Teaching Staff Requirements

Department	Senior Professors	Professors	Associate Professors	Asstt. Professors	Lecturers	Instructors or Asstts.	Research Asstts.
1. Mathematics and Statistics	..	2	..	1	9	14	5
2. Physics	..	1	1	1	4	10	5
3. Meteorology	1	..	..	3	..	6	5
4. Chemistry	..	1	4	1	4	16	
5. Chemical Engineering	1	1		4	..	9	25
6. Metallurgy	1	..		4	..	5	
7. Humanitics	..	..	..	2	12	4	..
8. Drawing	..	..	..	1	1	25	..
9. Applied Mechanics	1	..	..	1	6	15	10
10. Civil and Sanitary Engineering	1	1	2	4	3	15	10
11. Building Construction	1	1					
12. Mechanical Engineering	1	1	2	4	..	17	
13. Electrical Engineering	1	1	3	6	3	23	10
14. Aeronautical Engineering	1	..	..	6	3	21	15
15. Geology and Geophysics	1	..	..	3	1	7	5
16. Botany, Biology etc.	1	..	1	3	3	9	5
TOTAL	11	9	13	47	51	206	100

WORKSHOP STAFF REQUIREMENT

	Supdt.	Foremen	Storekeepers	Artisans Instructors
Workshop	1	11	12	85

ADMINISTRATIVE STAFF

Officers :— Principal
Registrar
Secretary
Officer in charge of Practical Training
Six Assistants to officer in charge of Practical Training
Librarian
Medical and Welfare Officers

Others :— Twelve Physical Training Instructors.
Head Clerk
Two Accountants
Sixteen Departmental Clerks *cum* Librarian for Sub Libraries
Twelve Library Assistants
Sixteen Clerks
Hundred Bearers, etc.

APPENDIX VII

Expenditure on Salaries to Staff (per month)

	Scale	Minimum	Maximum
	Rs.	Rs.	Rs.
Principal	3,000—4,000	3,000	4,000
Eleven Senior Professors	1,500—2,000	16,500	22,000
Nine Professors	1,000—1,500	9,000	13,500
Sixty Assistant Professors	600—1,000	36,000	60,000
Fifty-one Lecturers	300—600	15,300	30,600
Three hundred and six Instructors and Assistants	200—300	61,200	91,800
Workshop Superintendent	1,000—1,500	1,000	1,500
Eleven Foremen	300—600	3,300	6,600
Eighty-five Artisan Instructors or Assistants	80—100	6,800	8,500
Registrar	1,000—1,500	1,000	1,500
Secretary	300—600	300	600
Training Officer	1,500—2,000	1,500	2,000
Six Assistants to Training Officers	300—600	1,800	3,600
Librarian	600—1,000	600	1,000
Welfare Officer	600—1,000	600	1,000
Twelve P. T. Instructors	100—200	1,200	2,400
Four senior clerks	300—400	1,200	1,600
Forty-three junior clerks	100—300	4,300	12,900
Twelve Store Keepers	100—300	1,200	3,600
Hundred Bearers, etc.	50	5,000	5,000
		1,70,800	2,73,500

	Rs.
Mean expenditure per month	2,22,150
Annual mean salaries	26,65,800
Leave Reserve, Provident fund, staff sabbatical study expenses (10%)	2,66,580
TOTAL	29,32,380

APPENDIX VIII

Probable Recurring Laboratory, Workshop, Scholarship and other charges, etc.

	Rs.
1. Workshop stores, Power Charges, etc.	6,00,000
2. Apparatus Replacement, etc., Rs. 20,000 per department	3,20,000
3. Laboratory contingency Rs. 20,000 per department	3,20,000
4. Library	60,000
5. Gas, Electricity, etc.	20,000
6. Conservancy	60,000
7. Municipal Charges	60,000
8. Technical Journals (College Bulletins)	25,000
9. Athletic Grant at Re. 1 per month per student	36,000
10. Office expenses	40,000
11. Travelling Allowances, etc., for excursions and visits	40,000
12. 200 Research Scholarships at Rs. 100 p.m.	2,40,000
13. 200 Practical Training Scholarships at Rs. 75 p.m.	1,80,000
14. 400 Poverty Scholarships at Rs. 50 p.m.	2,40,000
15. Miscellaneous	60,000
Total	23.01.000

er month)

Scale	Minimum	Maximum
Rs.	Rs.	Rs.
000—4,000	3,000	4,000
500—2,000	16,500	22,000
000—1,500	9,000	13,500
600—1,000	36,000	60,000
300—600	15,300	30,600
200—300	61,200	91,800
000—1,500	1,000	1,500
300—600	3,300	6,600
80—100	6,800	8,500
000—1,500	1,000	1,500
300—600	300	600
500—2,000	1,500	2,000
300—600	1,800	3,600
600—1,000	600	1,000
600—1,000	600	1,000
100—200	1,200	2,400
300—400	1,200	1,600
100—300	4,300	12,900
100—300	1,200	3,600
50	5,000	5,000
	1,70,800	2,73,500

	Rs.
. . .	2,22,150
. . .	26,65,800
staff sabbatical	
. . .	2,66,580
TOTAL .	29,32,380

hip and other charges, etc.

	Rs.
. . . .	6,00,000
. . . .	3,20,000
. . . .	3,20,000
. . . .	60,000
. . . .	20,000
. . . .	60,000
. . . .	60,000
. . . .	25,000
. . . .	36,000
. . . .	40,000
. . . .	40,000
. . . .	2,40,000
. . . .	1,80,000
. . . .	2,40,000
. . . .	60,000
Total .	23,01,000

APPENDIX IX

Summary of Recurring Expenditure

	Rs.
1. Salaries to Staff, Provident Fund, etc.	29,32,380
2. Other charges	23,01,000
3. Interest and Sinking Fund at 5% on Capital	15,47,175
TOTAL .	67,80,555

APPENDIX X

Anticipated Income

	Rs.
1. Tuition fees from 2,000 students at Rs. 200 per year	4,00,000
2. Seat, furniture rent paid by 2,500 students at Rs. 100 per year	2,50,000
3. House rent by deduction of 10% from salaries of staff	2,66,000
4. Income from workshops	4,00,000
TOTAL .	13,16,000

APPENDIX XI

Net Recurring Expenditure

	Rs.
Gross expenditure	67,80,555
Income	13,16,000
NET EXPENDITURE .	54,64,555

Thus expenditure per student per annum is expected to be about Rs. 1,820 which compares favourably with that at similar institutions abroad, for example, in English Universities, the average cost is £125 per student per annum to the institution and while in American Universities it is considerably more, about Rs. 4,000.

APPENDIX XII

Accommodation in College Buildings.

I. ADMINISTRATIVE

Principal	600 sq. ft.
Vice-Principal	400 ,,
Registrar	200 ,,
Secretary	200 ,,
Practical Training	400 ,,
Practical Training Assistants	600 ,,
Welfare Officer	300 ,,
Typists' Room	600 ,,
General Office	800 ,,
Waiting Room	600 ,,
Hall	600 ,,
Board or Committee Room, etc.	600 ,,
Workshop Superintendent	600 ,,
TOTAL .	6,500 ,,

II. Social Accommodation

Assembly Hall for 3,000 persons allowing 10 sq. ft. per person and Providing High Table or Dias	30,000	sq. ft.
This would be used as Refectory and Examination Hall for about 1,500 persons	1,500	,,
Students' Representative Council	1,000	,,
Students' Common Room	4,000	,,
Students' Refectory, Kitchen, etc.	8,000	,,
Students' Stationery and Bookshop	4,000	,,
Staff Room	4,000	,,
Gymnasium	6,000	,,
Total	58,500	,,

III. Library

Main Library	10,000	sq. ft.
Reading Rooms	10,000	,,
Total	20,000	,,

IV. General

Main Exhibition Hall and Model Room	10,000	sq. ft.

V. Store Room

Office Store	900	sq. ft.
General Stores	1,700	,,
Sixteen Departmental Stores	10,000	,,
Total	12,600	,,

VI. Teaching Room

Six Lecture galleries each for about 120 persons allowing 15 sq. ft. per person	10,800	sq. ft.
Eighty class rooms for 30 persons in each allowing 16 sq. ft. per person	38,400	,,
Total	49,200	,,

VII. Drawing Office

Ten Drawing Offices each for 60 students allowing 25 sq. ft. per person	15,000	sq. ft.
Fifteen Senior Drawing Offices for 30 students in each allowing 40 sq. ft. per person	18,000	,,
Total	33,000	,,

VIII. Junior Laboratory Accommodation

Junior Physics Laboratory for 60 students allowing 50 sq. ft. per person	3,000	sq. ft.
Junior Chemistry Laboratory for 60 students allowing 60 sq. ft. per person	5,000	,,
Junior Geology Laboratory for 30 students	1,500	,,
Junior Electrical Laboratory for 60 students	3,600	,,
Junior Heat Engine Laboratory for 60 students	4,000	,,
Junior Mechanics Laboratory for 60 students	3,600	,,
Total	20,700	,,

IX. Senior Laboratory

Strength of material laboratory for 30 students allowing 200 sq. ft. per person	6,000 sq. ft.
Hydraulics Laboratory for 30 students	9,000 ,,
Heat Engine Laboratory	6,000 ,,
Meteorology Laboratory	1,000 ,,
Electrical Laboratory	8,000 ,,
Metallurgical Laboratory	4,000 ,,
Chemical Engineering Laboratory	9,000 ,,
Botany Laboratory	4,000 ,,
Building Construction Laboratory	6,000 ,,
Geology	4,000 ,,
Meteorology	3,000 ,,
Aeronautics	4,000
Total	64,000 ,,

X. Research

80 Research Rooms each 500 sq. ft.	40,000 sq. ft.

XI. Departmental Accommodation

33 Professors' Rooms each 300 sq. ft.	9,900 sq. ft.
50 Assistant Professors' Rooms each 300 sq. ft.	15,000 ,,
16 Sub Libraries each 600 sq. ft.	9,600 ,,
16 Departmental Model Rooms and Exhibition Halls each 1,000 sq. ft.	16,000 ,,
Total	50,500 ,,

XII. Workshop Accommodation

Ten Workshops 4,000 sq. ft.	40,000 sq. ft.
Power House	8,000
Total	48,000 sq. ft.

APPENDIX XIII

Summary of Accommodation in the College Building

Administration	6,500 sq. ft.
Social Accommodation	58,500 ,,
Library	20,000 ,,
Exhibition Hall	10,000 ,,
Stores	12,600 ,,
Teaching Rooms	49,200 ,,
Drawing Office	33,000 ,,
Junior Laboratories	20,700 ,,
Senior Laboratories	64,000 ,,
Research Rooms	40,000 ,,
Departmental Accommodation	50,500 ,,
Workshops	48,000 ,,
Total	4,13,000 ,,
Adding 1/3rd for walls, passage, cloak rooms, stair cases, etc.	1,37,700 sq. ft. (round)
Grand Total	5,50,700 sq. ft.

APPENDIX XIV

Residential Accommodation

I. Students

(*i*) Bed Study room for 3,000 students allowing 120 sq. ft. per person	3,60,000	sq. ft.
(*ii*) Dining Room at 25 sq. ft. per person for 3,000 students	75,000	,,
(*iii*) Kitchen, Stores, etc.	20,000	,,
(*iv*) 50 Wardens' Rooms 400 sq. ft. each	20,000	,,
(*v*) Hospital, Dispensary, etc.	12,000	,,
(*vi*) Sports Pavilion	10,000	,,
Total	4,97,000	,,
Adding 1/3rd	1,66,000	,,
Grand Total	6,63,000	,,

II. Staff Quarters

Principal	3,000	sq. ft.
35 Senior Staff, each, 2,000 sq. ft.	70,000	,,
120 Junior Staff, each 1,500 sq. ft.	1,80,000	,,
250 Bachelor quarters, each 400 sq. ft.	1,00,000	,,
150 Ministerial Staff quarters 1,000 sq. ft.	1,50,000	,,
200 Servant quarters 150 sq. ft.	30,000	,,
Total	5,33,000	,,

Summary of Residential Accommodation

Students	6,63,000	sq. ft.
Staff	5,33,000	,,
Total	11,96,000	,,

APPENDIX XV

Probable Initial Capital Expenditure on Laboratory and Workshop, Equipment, and Library

	Expenditure in Rupees
1. Mathematics	30,000
2. Physics	2,00,000
3. Meteorology	3,00,000
4. Chemisty	6,00,000
5. Chemical Engineering	10,00,000
6. Metallurgy	6,00,000
7. Drawing	1,00,000
8. Applied Mechanics	6,00,000
9. Civil and Sanitary Engineering	4,00,000
10. Building Construction	6,00,000
11. Heat Engineering	6,00,000
12. Hydraulics	4,00,000
13. Electrical Engineering	12,00,000
14. Aeronautical Engineering	3,00,000
15. Geology and Geophysics	3,00,000
16. Botany	3,00,000
17. Workshops	25,00,000
18. Library	2,00,000
Total	1,02,30,000

Probable Cost of Furniture

	Rs.
Hostel Furniture at Rs. 200 for 3,000	6,00,000
Class Room furniture at Rs. 50 for 3,000	1,50,000
Office	40,000
Library	60,000
Students' Dining room at Rs. 20	60,000
Assembly Hall Rs. 10	30,000
TOTAL	9,40,000

APPENDIX XVI

Summary of Initial Capital Expenditure

I. BUILDINGS

	Rs.
(*i*) College Building and workshop 5,51,350 sq. ft.	55,13,500
(*ii*) Students Residential accommodation 6,63,000 sq. ft.	66,30,000
(*iii*) Staff quarters 5,33,000 sq. ft.	53,30,000
(*iv*) Apparatus, Machine tools, Library, etc.	1,02,30,000
(*v*) Furniture	9,40,000
(*vi*) Acquisition of 400 acres of land at Rs. 2,000 per acre	8,00,000
(*vii*) Water Supply, Roads and sewage plants, etc.	15,00,000
GRAND TOTAL	3,09,43,500

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