

REPORT OF
THE REVIEW COMMITTEE
ON
POST-GRADUATE EDUCATION & RESEARCH
IN
ENGINEERING & TECHNOLOGY

JUNE 1980



MINISTRY OF
EDUCATION & CULTURE

GOVERNMENT OF INDIA
NEW DELHI

The Manorama Press, Madras-600 014.

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GLOSSARY OF ABBREVIATIONS

1. AICTE All India Council for Technical Education
2. BHU-IT Banaras Hindu University-Institute of Technology
3. BITS Birla Institute of Technology and Sciences
4. CSIR Council of Scientific and Industrial Research
5. CSIO Central Scientific Instruments Organisation
6. DGS&D Directorate General of Supplies and Disposals
7. DST Department of Science and Technology
8. FICCI Federation of Indian Chambers of Commerce and Industry
9. FRG Federal Republic of Germany
10. GNP Gross National Product
11. GATE Graduate Aptitude Test in Engineering
12. HBTI Harcourt Butler Technological Institute
13. IBM International Business Machines
14. IISc Indian Institute of Science
15. IIT Indian Institute of Technology
16. INSDOC Indian National Scientific Documentation Centre
17. ISI Indian Standards Institution
18. ISM Indian School of Mines
19. MIT Massachusetts Institute of Technology
20. NCST National Committee on Science & Technology
21. NISSAT National Information System for Science and Technology
22. NITIE National Institute for Training in Industrial Engineering
23. PAUT Perarignar Anna University of Technology

- 24. PWD Public Works Department
- 25. QIP Quality Improvement Programme
- 26. R & D Research and Development
- 27. REC Regional Engineering College
- 28. RSIC Regional Sophisticated Instruments Centre
- 29. S & T Science and Technology
- 30. SPA School of Planning and Architecture
- 31. TCDC Technical Cooperation among Developing Countries
- 32. UDCT University Department of Chemical Technology
- 33. UGC University Grants Commission
- 34. U K United Kingdom
- 35. UPSC Union Public Service Commission
- 36. VJTI Victoria Jubilee Technological Institute

CHAIRMAN'S PREFACE

It is now well recognised that science and technology are catalysts for growth and propellants for progress. It becomes imperative for each country to develop a well-integrated technical education system for sustained growth. Postgraduate education and research are but a normal part of engineering education.

India is fortunate to have the third largest scientific and technical manpower in the world with a large infrastructure for higher technical education, research and development. Yet the fond hope that the fruits of science and technology will diffuse to improve the economic well-being of all people has not materialised: instead the gap has only widened between the urban elite and the rural poor. Obviously there is a mis-match between educational objectives and social needs.

Similarly employment opportunities commensurate with the advanced knowledge and skills of highly trained personnel are still quite limited resulting in unemployment, underemployment and brain drain. There is thus also a mis-match between university products and industry's needs.

It becomes clear that the goal of post-graduate education and research in engineering must include 'development' philosophy to remove the existing imbalances. There is room to believe that an engineer should be trained as a 'practising' engineer in parallel to a practising doctor-or a 'development engineer' with entrepreneurial ability. Development is a transdisciplinary process requiring transdisciplinary approach. The individual 'lone-wolf' approach in education and research should give way to transdisciplinary, trans-organisational task force approach to resolve problems.

Similarly the ambivalent attitude of academicians should change towards 'relevance'. Problems of the poor could be equally intellectually challenging and professionally satisfying. Societal problems should be the legitimate concern of engineering and science. Post-graduate institutions must accept 'public service' as one of their primary functions and 'extension service' as a 'third dimension' in addition to training and research.

Presently, neither 'private profit' nor 'public good' is enshrined in higher education. When once the goals of development education are clear and accepted, post-graduate institutions may bring about the much needed changes within and outside the education system. Greater attention has to be paid to curriculum production and utilization of trained personnel and firm linkages between the trinity: industry, research and education.

Today industry's involvement in higher education is limited and the total technical manpower employed is small. It is time for the industry to realise that "to bring less than the most up-to-date and powerful engineering skills to bear on the problems of an emerging country is to restrict severely the rate of its technological development. The problems may be old, but they deserve the most modern solutions we can find". Polite persuasion and concealed compulsion are called for to legitimize industry's involvement in post-graduate education and research.

A considered thought is needed on the present and future trends and needs. A sense of urgency has been felt by the Government of India to review the whole system of post-graduate education and research in engineering and technology. This Report has been prepared based on the careful scrutiny of discussions and debates on several documents and reports published, practices obtained within and outside the country, comments and suggestions received from a large number of students, researchers, academicians, educators, industrialists, administrators and policy makers and the cumulative rich experience and wide knowledge of the distinguished members of the Committee. I am particularly grateful to a number of individuals who have shown keen interest in this work and offered valuable guidance.

A number of recommendations made herein are specific and readily implementable. Some require new initiatives. For others the first steps to be taken to achieve identified objectives have been given. Where the issues are highly complex, further detailed studies have been indicated. One important single recommendation linked to many others is that the Government should set up a new statutory organisation—a National Authority—to advance and promote technological developments by maintaining high standards of engineering and technological education and research. The case for such an Authority is a recognition of the need for an organisation accountable for

ensuring action both on this Report and in the light of changing technological and social needs.

It was a privilege for this Committee to work together on this important assignment. I thank all the members for their willing Co-operation and determined efforts and time put in to make this Report possible. No praise is adequate for the drive, dynamism and devotion of the ever enthusiastic Member-Secretary of the Committee Dr. Gopalan.

It is sincerely hoped that this Report would prove interesting to all connected with post-graduate education and research and that the implementation of these recommendations would have positive impacts on the country's Progress.

JUNE 2, 1980.

Sd/- Y. NAYUDAMMA

SUMMARY AND RECOMMENDATIONS

In June 1978 the Government of India appointed the Committee to review the progress so far made by the country in the area of Post-graduate education & research in engineering and technology and to report on all aspects of its further development. In order to fulfil the task assigned to it, the Committee collected relevant information from almost all institutions offering Postgraduate programmes, held extensive discussions with students, teachers, academicians, industrialists, researchers, administrators etc. in various parts of India, consulted a large number of documents and reports and also looked into the trends and practices in other parts of the world. This report is based on all these discussions and exercises. While bringing to focus the major issues, problems and suggestions relating to post-graduate education & research, the report also points out some of the limitations the Committee had. The main findings and recommendations are briefly summarised below for quick reference:

(1) While there has been considerable expansion of the system of post-graduate education & research in the country during the past three decades, and it has done quite a lot of good to national development, the shortcomings in the implementation of the recommendations made by the earlier reviews have been responsible for many of its ills today. Post-graduate education & research is a matter of national concern and therefore should get continuous and serious attention on a priority basis. (2.1, 2.5, 3.8.4, 5.1 and 5.2).

(2) Today the S & T content in the Indian society and the extent of India's involvement in R & D are very low. The capacity for generating and sustaining technological growth within the country has to be strengthened considerably and vigorous steps taken for the continual improvement of that capacity. This means that the Indian national investment in scientific and technological education and research should increase many fold to meet the growing needs of the changing social system (4.1.2, 4.1.5, 4.13.5, 5.4 and 5.6).

(3) The performance of about half-a-dozen institution in the area of Post-graduate education and research has been quite good mainly because of

the deliberate efforts and liberal investments in promoting them. In spite of the considerably lower inputs, about 20 other institutions have also done creditably well. The performance of the remaining 50 or so institutions is poor, even though they also have succeeded in developing certain areas/disciplines well. The physical facilities in many of these institutions are inadequate (3.1-3.8 and 5.5).

(4) For a variety of reasons, it has not been possible to attract sufficiently large number of bright people for post-graduate education. To ensure that only bright and motivated people are admitted to Post-graduate courses, admission to these programmes should be restricted to only those who come through the GATE, as detailed in this report. The Government should impose requirements on industry and Government departments to sponsor their engineers and technologists for post-graduate education & research in the respective areas of their interest (4.4.3 and 4.14.3).

(5) Post-graduate scholarships for ME/M Tech should be enhanced from the present value of Rs. 400/- p.m. to Rs. 600/-p.m. and should be given to all those who are admitted through the GATE. However, sponsored candidates who are paid by their employers would be eligible to get only 75% of the value of the scholarship.

Fellowships for doctoral aspirants should be raised from the present value of Rs. 500/-p.m. to: first year Rs. 700/-p.m.; second year Rs. 800/- p.m. and third year Rs. 900/-p.m. The fellowship should be enhanced by Rs. 50/- after submission of the thesis and should be continued for 3 more months or till the 'viva' is over, whichever is earlier. Values of all scholarships/fellowships should be reviewed once in every 3 years (4.4.3 and 5.9).

(6) The one-year post-graduate diploma courses have not been found to be popular and successful. They need not be offered as regular programmes unless they are specifically asked for and paid for by interested agencies (4.2.2, 4.5.1, 4.5.2 and 5.10).

All existing post-graduate degree programmes which are stereotyped and unpopular should be wound up. Wherever possible should be redesigned to include relevant and emerging (4.5.11 and 5.11).

All ME/M Tech. programmes should be of three semesters duration consisting of two semesters course work (including core and elective subjects) and one semester dissertation work.

The concept of joint guides for supervising project / dissertation work should be encouraged. These programmes should be offered in suitable modules with credit system. Post-graduate Curriculum Development Centres should be set up to revise, redesign and update the curricula of Post graduate programmes on a continuing basis. The curricula, should be dynamically designed and should have flexibility to include new ideas and developments as and when necessary (3.2, 4.3, 4.5.2, 4.5.3, 5.12 and 5.13.)

The minimum duration for doctorate after ME/M Tech. degree should be two years of full-time study and research. In exceptional cases when BEs/B Techs are admitted directly for doctoral programmes, the minimum duration of the course should be 3 years. All aspirants for doctorate should invariably go through some advanced course relevant to the specific area of research. 'Candidate-based Doctoral Committees' should assess the candidate's competence and identify his deficiencies (4.5.5, 4.10.5 and 5.14.)

In many emerging areas which are science-based, but heavily technology oriented, there is need to train scientist-technologists who can handle the twin responsibilities of scientific research and innovative application. A separate stream of post-graduate courses of 3 semesters duration after MSc in science should be developed on the pattern of ME / M Tech. programmes (4.15.1 — 4.15.4 and 5.15.)

Under no circumstances should further proliferation of existing programmes, in conventional or irrelevant areas be permitted. Neighbouring academic and research institutions should be encouraged not only to conduct post-graduate programmes jointly, but also to share jointly the facilities such as faculty, library, equipment etc. (4.7.1, 4.7.2 and 5.16.)

(7) Introduction of part-time post-graduate programmes especially in Industrialised areas should be encouraged. New techniques and arrangements should be devised for extending high quality post-graduate education to engineers / technologists employed at locations remote from established campuses (4.16.1 — 4.16.3, 5.17 and 5.18.)

The Government and industry should work together within a major national programme of training and retraining of employed engineers and technologists to develop the skills and support needed to implement and sustain new technologies. While assessing staff requirements of institutions, their activities in continuing education programmes should also be taken to account (4.17.1, 4.17.5, 5.19 and 5.20.)

(8) It is necessary to recognise publicly and to publicise widely that in today's world post-graduate studies at master's degree level are a normal part of basic engineering education. The unreasonably restrictive conception that a bachelor's degree is sufficient preparation for most engineering work should not be perpetuated (4.2.1, 4.22 and 5.21.)

It should be made mandatory to prescribe post-graduate degree as the minimum qualification for recruitment to many positions in the engineering profession in industry, R & D organisations, Electricity Boards, PWDs, Post and Telegraphs, Railways etc. The present policy and practice of recruiting graduate engineers at the lowest levels (single point entry) to many services should be discontinued. As an incentive and mark of recognition it should be mandatory to give not less than 2 advance increments whenever post-graduate degree holders are recruited (4.2.3 and 5.22.)

The Government should take effective measures to link up all developmental projects and industrial expansion with the requirement of induction of competent post-graduate engineers and technologists into the respective projects. Industrial establishments should be asked to institute regular 'engineering manpower audits' to ensure that they make the best use of these personnel as their key assets. Proper utilisation and deployment of scientific and technical manpower are important (4.20.1, 4.20.5, 4.18.5 and 5.23.)

A reliable national information system for the storage, updating, retrieval and analysis of manpower information should be established to assist technical education planning (1.4.4, 4.21 and 5.24.)

It is necessary to study the employment pattern of post-graduates in industry, Government, education etc. and also to make inter-comparisons regarding their characteristics, attitudes and performance (1.4.5 and 5.25.)

(9) Next to the student body, the faculty is the most important factor in assuring success of any engineering education programme. Possession

of a doctorate degree or equivalent qualification representing an advanced level of intellectual attainment and creative endeavour should be made a pre-requisite for post-graduate teaching. Industrial experience should be prescribed as an essential qualification for recruitment to teaching positions at post-graduate level. All recruitments to teaching positions should be made only on all-India basis. Mobility and exchange of faculty between academic institutions, R & D organisations and industrial establishments should be encouraged to prevent in-breeding (4.8.1 — 4.8.3, 5.26 and 5.27.)

A rigorous 'staff appraisal scheme' to assess teachers annually should be introduced in every post-graduate institution. Such staff appraisal records should be looked into at every stage of promotion. Suitable merit promotion schemes should be introduced in all institutions (4.8.4, 4.85 and 5.28,)

(10) It is necessary to create in some of the higher technological institutions an infra-structure for training in the instrumentation area with particular reference to repairs and maintenance of sophisticated equipment. Institutions like IITs should ensure that they are capable of maintaining and repairing their/own equipment and those of others in their region. A specialist cadre of maintenance technicians/engineers with proper status and attractive scales of pay should be built up at least on a regional basis (4.6, 4.9.1, 4.9.6, 5.29 and 5.30).

(11) Government should impose requirements on industry as well as on post-graduate institutions to collaborate with each other on the basis of the various suggestions made in this report. The tendency on the part of industry to look to the advanced countries for technical know-how should be discouraged. Tax should be levied on any know-how imported from outside. A research cess should be levied (if necessary through legislative action) on each industry. A 133% tax deduction should be allowed on all payments/contributions/investments made by industry to promote post-graduate education and research (3.5, 4.3, 4.10, 4.14 and 5.33).

(12) There is urgent need to take deliberate action to prevent enormous wastage of resources on repetitive and irrelevant reasearch projects. Academic research at all levels should emphasise work done in the context of socio-economic development. The culture of sponsored research projects should be further developed (4.10.1-4.10.3).

Institutional consultancy should be encouraged and individual consultancy permitted on the basis of predetermined norms. The money earned from sponsored and consultancy projects should be utilised for further developing the research capability of the institutions (4.10.3, 4.10.4, 4.14.3, 5.35 and 5.36).

Multi-disciplinary, trans-disciplinary and trans-organisational research with emphasis on design and development should be encouraged at all levels. Problems of industry should be documented and distributed to post-graduate institutions on a continuing basis. It is recommended that a national level R & D Newsletter should be published regularly giving information on all research projects for the benefit of post-graduate institutions, R & D organisations and industry. It would be good to organise atleast once in every two years an all-India Conference on post-graduate projects and to document them area/discipline-wise (4.4, 4.10.5, 4.10.6, 4.14.3 and 5.37).

Those institutions which have competence to undertake sponsored research projects on a large scale should be permitted to recruit a core of competent scientific staff on permanent basis with all service benefits (4.10.4, 4.11.1, 4.11.2, and 5.38).

(13) Immediate action should be taken to revise the norms of funding to provide physical and other facilities in post-graduate institutions on the basis of guidelines suggested in this report. The recommendation of grants for new post-graduate programmes should be based on the overall post-graduate activities of the departments concerned and not a narrow truncated basis of specific post-graduate courses proposed by an institution (4.12.6 and 5.40).

While it is necessary to undertake in a phased manner the need-based consolidation of all institutions (including modernisation of laboratories and replacement of obsolete equipment), it is strongly recommended that such consolidation be undertaken on a priority basis in those institutions which-despite poor funding-have proved their merit by their past performance. These institutions should serve as nuclei for technological development in their respective regions. A provision of about Rs.20 crores may be made available for this purpose during the Sixth Plan period (1980-85) (4.12.7 and 5.41).

It is imperative that funding post-graduate education and research in engineering and technology in all engineering institutions including University Departments should be a 100% Central Government responsibility and that the existing dichotomies/disparities in funding should be eliminated as suggested in this report (4.13.1-4.13.6, 4.18.5 and 5.42)

In the case of institutions of national importance which are to be maintained and further developed as pacesetters, funding should be based on integrated infrastructural development as at present. However, even in their cases assistance to various departments should be performance-based (4.13.7 and 5.43)

Since non-Plan provisions have been approved from 79-80 for meeting the recurring liability in respect of on-going post-graduate programmes, the Central Government should advise the State Governments to extend retirement and other service benefits to post-graduate staff in institution which are governed by the State Government grant-in-aid rules (4.12.5 and 5.44)

(14) One of the biggest stumbling blocks in the path of scientific and technological research and development in India is the lack of proper data banks/information services. There is immediate need to educate and train information users by introducing user education/training programmes in the post graduate institutions and Research Centres (4.19.1 - 4.19.3 and 5.45).

India is importing bibliographical data bases along with appropriate software to develop computerised information retrieval system in the country. It is necessary to absorb this imported 'information technology' and develop it further to suit local needs (4.19.4, 4.19.5, and 5.46).

It is strongly recommended that a couple of National Data Centres with all the major data bases of S & T in the form of computer readable magnetic tapes should be established in India as a matter of urgency (4.19.6, 4.19.7 and 5.47).

(15) This Committee's most important single recommendation linked to many other proposals in various sections in this report is that the Government should make the AICTE/Post-graduate Board a new statutory organisation-a National Authority-with powers granted to it by Parliament to advance and promote the technological development of this country by

maintaining high standards of engineering and technological education and research. The proposed Authority should optimise the utilisation of all available resources and provide impetus to all the centres engaged in Post-graduate programmes and research. Evaluation and accreditation of Post-graduate courses should be done atleast once in five years by a suitable national agency (2.4.2, 4.18.4 - 4.18.7, 4.20.2 and 5.48 - 5.50).

Methods should be developed for the performance-based audit of Post-graduate institutions with a view to facilitate comprehensive reviews of their various programmes. The present system of financial expenditure audit should be replaced (4.18.8 and 5.51).

(16) India has a leading role to play in the new concept of TCDC. In her own interest India should formulate a coherent 'country training policy' for training overseas students in emerging areas of engineering and technology (4.22.1, 4.22 2, and 5 52).