REPORT

OF

HIGH POWER COMMITTEE

FOR

FACULTY DEVELOPMENT

IN

TECHNICAL INSTITUTIONS

Submitted to

All India Council for Technical Education

July, 2006

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EXECUTIVE SUMMARY

The AICTE has justly recognized that the gravest problem bedeviling our country's system of technical education is the woeful shortage of competent teaching staff. The number of technical institutions imparting education and research skills in Engineering & Technology has risen to 1475 with an annual intake of nearly 5,00,000. It is likely that the magnitude of the intake will be about 15,00,000 i. e., threefold by the year 2011-12 (at a projected annual growth rate of 20%). Currently, based on the established AICTE norms of student : teacher ratio (1:15) and the cadre ratio of 1:2:6 for Professors : Readers : Lecturers, the total shortage of teaching staff is over 40,000 and the shortage in the different cadres is Professors – 4531, Readers – 9063 and Lecturers - 27187. The shortage of Ph. D.s exceeds 30,000 while the Masters' shortfall is over 24,000. The shortage in the faculty and the inadequacy of the existing faculty in several instances are further reflected in the alarming failure rate in a large number of technical institutions. For example, in about 150 of the 229 engineering colleges in Tamil Nadu, the failure rate was as large as nearly 65%. In order to address the shortage of qualified faculty, a Committee was appointed under the Chairmanship of Prof. P. Rama Rao.

The **Committee comprises**:

- Prof. M. Anandakrishnan
- Prof. M.S. Ananth
- Prof. Ashoke Dutta
- Prof. S.G. Dhande
- Prof. S..P.Parashar

The office order of the appointment of the Committee is appended to this Report. The Committee has deliberated on several issues concerning the faculty shortage and has identified the most **serious lacunae** as follows:

(a) teachers not having post graduate/ doctoral qualification and sustained research accomplishments;

(b) serious lack of research culture in most of the institutions and

(c) considerable asymmetry in the number of students in the different branches of Engineering & Technology and

(d) large regional disparity in the number of technical institutions in the country.

The Committee has made several **recommendations**, the most important of which are summarized below.

Strengthening Existing AICTE Programmes / Schemes

Among the existing AICTE programmes directed at faculty development, the Committee recommends that the following schemes should be continued with significantly enhanced provisions which have been spelt out in the Report:

- National Doctoral Fellowship,
- PG Scholarship Scheme for GATE qualified M. Tech. Students
- Quality Improvement Programme (QIP),
- Visiting Professorship,
- AICTE-INAE Distinguished Visiting Professorship,
- Emeritus Fellowship
- Other existing schemes such as Induction Training Programme, Seminar Grant, Staff Development Programme, Career Award for Young Teachers, Financial Assistance to Professional Societies & Bodies and Travel Grant

Proposed Novel Institutional Initiatives and Schemes

The Committee has also suggested several novel institutional initiatives and schemes.

The **novel institutional initiatives** recommended by the Committee are

(i) identification of one hundred (100) Mentor Institutions for faculty development;

(ii) (ii) establishment of an International Centre on the model of the International Centre for Theoretical Physics (ICDP), Trieste, Italy with the objective of eliciting the services of distinguished faculty from within the country and abroad for conducting short duration courses on selected topics and for undertaking research projects, for the benefit of existing teachers in technical institutions in the country; and

(iii) (iii) setting up a Virtual Technical University.

The **proposed novel schemes** include:

(a) Curriculum based faculty training;

(b) Technology Enhanced Distance Education Programme (TEDEP);

(c) Sequential Summer Programme;

(d) a substantial number of visiting and adjunct faculty from Industry, National Laboratories and other advanced academic institutions.

The Committee has also suggested the enhancement of the age of retirement upto 65 years, re-employment of retired faculty upto 70 years of age and offering attractive remuneration packages/ incentives / allowances for outstanding performers.

A Separate Board

The Committee has finally and most importantly suggested that in order to implement the recommendations of the Committee in letter and spirit, the AICTE should set up a separate Board dedicated to this all-important task of faculty improvement. This Board should be allocated a separate budget based on the broad figures of the financial requirements (of the order of Rs. 2,000 crores) given in the Report and annexed to this executive summary for its operations concerned with implementation of the recommendations of the Committee. The Board should be compact in size headed by an eminent academic with a small number (not exceeding five) of supporting members. The Board should also be endowed with suitable powers in order to achieve successful implementation in the shortest possible manner. The Chairman and the members of the empowered Board may prioritize a selected number of these recommendations for implementation at the earliest.

The Committee would like to record its grateful thanks to Prof. Damodar Acharya, Chairman, AICTE for the whole hearted support extended to the Committee.

1. PREAMBLE

The All India Council for Technical Education (AICTE) constituted a High Power Committee (Annexure X) with the following members:

Prof. P. Rama Rao ISRO Dr. Brahm Prakash Distinguished Professor ARCI, Hyderabad	..	Chairman
Prof. M. Anandakrishnan Former Vice Chancellor Anna University, Chennai	..	Member
Prof. S. G. Dhande Director IIT Kanpur	..	Member
Prof. M. S. Ananth Director IIT Madras	..	Member
Prof. Ashoke Dutta Director Indian Institute of Social Welfare & Business Management Kolkata	..	Member
Prof. S. P. Parashar Director IIM Indore, Calcutta	..	Member

At the outset the committee would like to place on record its appreciation of the help and support extended to it by Dr. Swadesh K. Gupta, Advisor (RID), AICTE, and his colleagues in RID.

Prof. Damodar Acharya, Chairman, AICTE, kindly made himself available at all the meetings of the Committee. He explained the terms of reference of the Committee, which were designed to explore all aspects relating to the development of faculty with a view to address meaningfully the problem of serious shortage of faculty in the engineering institutions. At all stages, thereafter, he provided all the AICTE inputs for the benefit of the Committee. The Committee took into account the various schemes that have been adopted by AICTE for faculty development. The Committee held detailed discussions on the issues related to the shortage of faculty in terms of numbers as well as qualifications, and the possible strategies to attract and retain faculty including training programmes for up-gradation of qualifications. The Committee met

thrice on 2nd December 2005, 3rd February 2006 and 9th June 2006. This report contains the assessment of the nature and intensity of the shortage of faculty and offers detailed recommendations to bring about the much-needed improvement in the present grim situation.

1.1 Growth Trends

The growth in the number of technical institutions in India during the past two decades has not been guided by any discernable policy. As the governments were rapidly withdrawing their involvement in establishing new higher educational institutions, the permissions to the private investors to fill the void were mostly *ad-hoc.* The result is that a large number of engineering colleges as well as a significant number of university level technical institutions, such as private deemed universities and private universities established by the State legislatures, have come into existence in recent years.

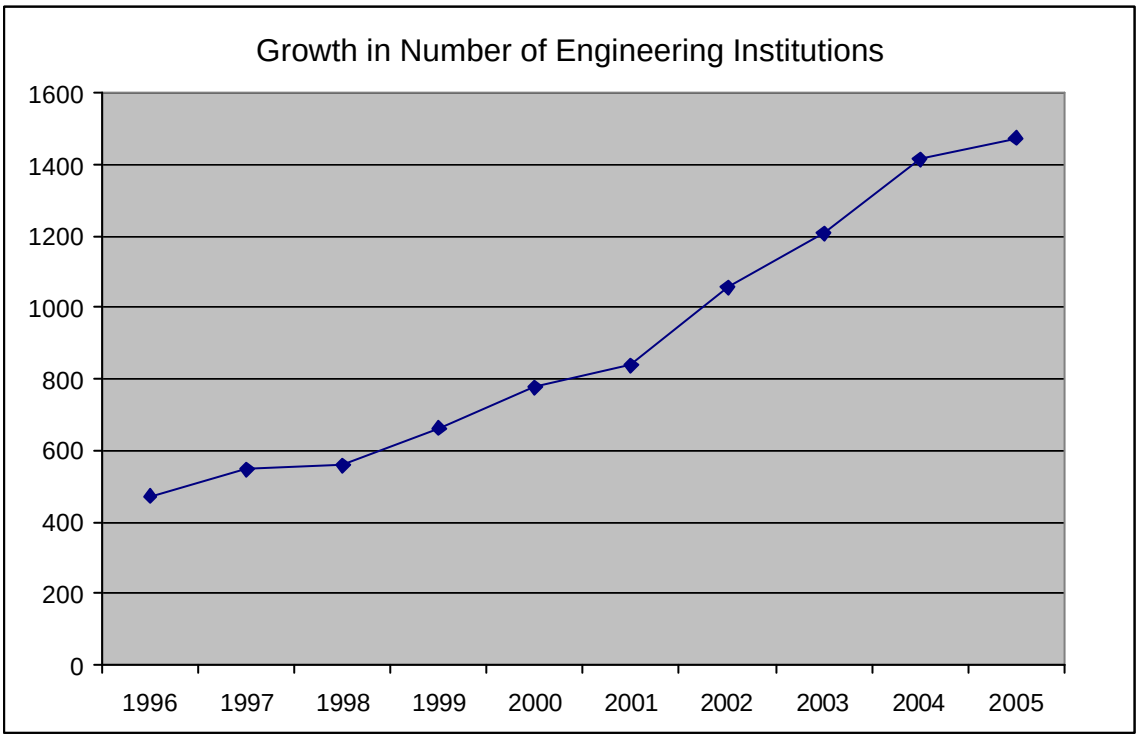

Figure 1 : Growth in the number of Engineering Institutions

Among the many issues that have cropped up as a result of the rapid expansion, such as national enrolment capacity, programme focus, regional balance, ownership pattern, modes of delivery, degree of regulation, etc., the one that deserves immediate

attention relates to the quality of the teaching and learning aspects in the technical institutions. This issue is fundamentally related to the availability of adequate number of well-qualified and experienced members of the teaching faculty at various levels. Even though the AICTE was conscious of the implications of this inadequacy, and had attempted to initiate several schemes for this purpose, the problem of shortage of teachers has persisted and has grown even bigger with the accelerating growth in the number of new institutions and their intake capacities. (Figures 1 and 2)

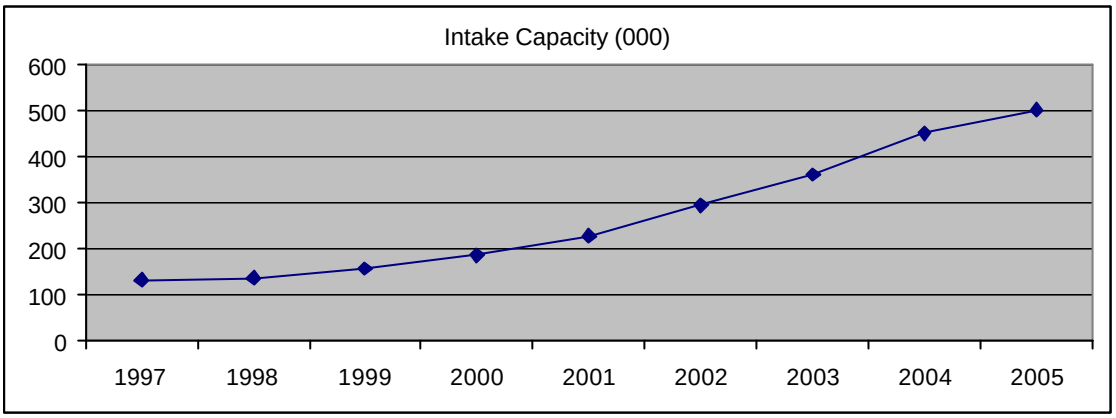

Figure 2: Growth in Intake Capacity in Engineering Institutions

1.2 Quality of Teachers

The objective of higher education is to acquire sufficient knowledge and skill so as to function as a creative and productive member of the society. With unprecedented developments in science, technology and other knowledge oriented systems, the conventional structure and processes associated with higher education are undergoing major transformations. Global competitiveness in acquiring knowledge as well as in its application is being enlarged.

The globalization process has introduced a high degree of competition thereby challenging the higher educational institutions in India. No less demanding are the compulsions of the industries and businesses to measure up to the world standards. The abilities to stand up to this competition will depend on the capabilities of the human resource to perform with context-sensitive maturity. In coping with these new roles, the higher education system should devote attention to the importance of creating and sustaining a large pool of talented teachers.

There are many privately funded and managed institutions that are committed to educational excellence and are conscious of their responsibility to their students. A

substantial number of them are known for transparency and academic commitment. An analysis of such institutions reveals that their governing bodies consist of eminent persons, known for their integrity and knowledge of educational systems and are keen on securing the services of best talents for teaching responsibilities in their institutions. They allow considerable autonomy to the head of the institution and the faculty and treat them with dignity so that competent teachers are attracted to such institutions.

At the same time there is a large number of private institutions that do not attach sufficient value to the necessity of having competent teachers and are inclined to satisfy merely the numbers and not the capabilities to adequately meet the challenging requirements of the academic programmes. The excuse for this situation is the non-availability of teachers with the prescribed qualifications. This is also becoming a convenient reason for employing unqualified and underpaid teaching staff. Similar serious deficiencies in the shortage of teachers are not uncommon in the governmental institutions, usually on account of non-allocation of funds from the government and complex recruitment procedures.

This issue has become the major cause of frustration among the students in a large number of technical institutions. The failure rate is alarming in many of the institutions due to inadequate and incompetent teaching staff. In Tamil Nadu the failure rate was nearly 65% in about 150 engineering colleges out of a total of 229 institutions. (Table 1)

Table 1
Failure Rate in Engineering Colleges of Tamil Nadu (2004)

Pass % Range	Number of Colleges	Number Appeared	Number Passed	Average Pass %
80-100	0	-	-	-
70-80	5	6669	4983	74.7
60-70	21	24826	15872	63.9
50-60	22	21861	11866	54.3
40-50	31	24457	11168	45.7
30-40	66	42502	15087	35.5
20-30	52	26680	6926	26.0
10-20	27	10364	1629	15.7
0-10	5	1343	132	9.8
Total	**229**	**158702**	**67663**	**42.6**

Source: Anna University

1.3 Regional Imbalance

The requirements of teachers will vary considerably from region to region in view of sharp differences in the number of institutions and their enrolments. Those States with a critical shortage would have to take special measures to meet the current shortfall and the proposed expansion.

Table 2

State-wise Growth in Intake capacity in Engineering Degree

Sl. No.	States/UTs	1990-91	2003-04	2005-06
1.	Arunachal Pradesh	210	210	198
2.	Andhra Pradesh	8070	66205	97942
3.	Assam	660	720	901
4.	Bihar	2375	2375	2673
5.	Chatisgarh	--	3495	5120
6.	Delhi	1290	3800	5727
7.	Goa	154	740	740
8.	Gujarat	2780	10325	14336
9.	Haryana	1085	10105	14132
10.	Himachal Pradesh	210	970	1242
11.	Jammu & Kashmir	480	1245	1461
12.	Jharkhand	---	2070	2483
13.	Karnataka	19452	40920	48515
14.	Kerala	4512	19868	25543
15.	Madhya Pradesh	2265	15920	24630
16.	Maharashtra	20425	47450	50267
17.	Manipur	---	115	120
18.	Meghalaya	---	135	240
19.	Mizoram	---	120	120
20.	Orissa	1325	10695	11517
21.	Punjab	1508	10701	15345
22.	Rajasthan	1629	10785	16198
23.	Sikkim	---	420	420
24.	Tamil Nadu	12855	79302	102322
25.	Tripura	120	160	190
26.	Uttaranchal	---	2350	3011
27.	Uttar Pradesh			37110
28.	West Bengal			13305
29.	Chandigarh	465	720	1423
30.	Pondicherry	300	1950	2466
	Grand Total			**4,99,697**

It can be seen from table 2 above that five states, namely Tamilnadu, Andhra Pradesh, Maharashtra, Uttar Pradesh and Karnataka, account for an intake of 336156 i.e. 67% of the total intake of 4,99,697. Another set of 8 states namely Kerala, M.P. Rajasthan, Punjab, Gujarat, Haryana, Orissa and West Bengal account for an intake of 135006 i.e. 27%. The remaining 16 states have a meagre 6% of the total intake. This is a measure of the wide regional disparity amongst various states in the country.

1.4 Statutory Responsibility

As the statutory agency that approves the expansion in the number and intake capacity of technical institutions, it has become imperative for the AICTE to take necessary measures to develop a reliable system for supply of qualified teachers in adequate numbers. It should insist upon compliance to the norms relating to teaching and learning in private as well as government institutions, (as is being done by the AICTE this year through the appraisal process). The Student-Teacher ratio should be strictly followed. The practice of *adhoc* or daily-wage teachers should be banned. There should not be more than 15% vacancy in teachers' positions. The performance and accountability of teachers should be enforced. The appointment of teachers should be based on merit through transparent norms.

In order to set good models on standards, the educational institutions under the responsibility of Governments should conform to all norms for quality education. Otherwise they loose their legitimate authority to insist on quality norms in private institutions. Government institutions that do not conform to such norms should be de-recognized; or disaffiliated by the appropriate authority without any special consideration.

2. MAJOR ISSUES

In light of the rapid expansion mentioned in the previous section the Committee identified a number of issues that would require urgent and serious attention.

- There is an acute shortage of teachers. The number of teachers required is as large as 118608 in the nearly 1475 institutes with an enrollment capacity close to 5 lakhs in the year 2005-2006.

- The number of teachers lacking PG qualifications is also large and is a serious lacuna in the system
- The number of faculty, who possess doctoral level qualifications required for higher level teaching positions in these institutions, is significantly low.
- Only a small proportion of the existing institutions offer PG programmes either for want of demand or due to lack of qualified faculty to offer PG programmes. Nearly 90% of the institutions in the country do not have any worthwhile research programmes leading towards doctoral qualifications.
- There is a considerable skew in the number of students enrolled in different branches thereby necessitating the need for more qualified teachers in a few branches than in others.
- In view of a high degree of regional imbalance in the growth of technical institutions in the country, the shortage of teachers is more acutely felt in those regions where the growth has been particularly rapid.

During the deliberations, the committee decided to

a. review the programmes that are being offered by the AICTE for faculty development and suggest ways and means of modifying them to fulfill their requirements at least partially.
b. review the problems relating to the up-gradation of the qualifications of the existing faculty through different approaches.
c. Support as a deliberate measure, a selected number of institutions which are presently engaged in quality improvement programmes as also some additional institutions which have capabilities to participate in different aspects of improving the quality and capabilities of the teachers while addressing the shortage in numbers.
d. explore other innovative options such as virtual university, partnership programmes, adjunct faculty, joint degree programmes etc.
e. consider the scope for relaxing the age restrictions for retirement of teachers and for employing emeritus faculty.

Based on these discussions, the suggestions and recommendations of the committee are given in the following sections.

3. SUGGESTIONS AND RECOMMENDATIONS

3.1 Existing Programmes of AICTE

3.1.1 ***Scholarship for GATE qualified students***. It would be desirable that the present scheme of offering scholarship to GATE qualified students be continued. Those who opt to pursue a teaching career should be given additional course in pedagogy besides the core disciplines. Special incentives may be offered to such students who opt for the teaching career.

3.1.2 National Doctoral Fellowship (NDF) : Currently only about 50 Ph.D. fellowships are offered by AICTE to bright scholars. This is totally inadequate considering the large demand. The number of Ph.D. fellowships should be increased to 500 with the value of Rs.15,000 per month along with a grant of Rs.50,000/- per year as contingency. The duration of the scholarship should be a minimum of 3 years and should be extended by 2 more years where justified.

3.1.3 Quality Improvement Programme (QIP) : The QIP is designed to facilitate up-gradation of the qualifications of in-service teachers so as to acquire ME, M.Tech. and Ph.D. qualifications. At present a total of about 450 teachers are being supported under this scheme. These programmes are generally carried out in the IITs and several other selected institutions in the country.

There is considerable scope for increasing the number of institutes including several private institutes who have the capabilities to participate in the QIP. The number of beneficiaries of the QIP should be doubled to 1000 teachers per year. The parameters for choosing the institutions that offer QIP should be carefully evolved. The features of QIP are described in **Annexure-I**. The remuneration offered to the serving teachers who benefit from the QIP should be the same as NDF when they pursue PhDs. When they go for ME and M.Tech. it should be the same as available to GATE qualified candidates. This becomes necessary in view of the fact that most institutions are unwilling to bear the salary component of the teachers deputed for QIP.

3.1.4 Emeritus Fellowship

Retiring and retired teachers are the most valuable resource that we have in our technical educations system. Their expertise must be used to train and develop future teachers in their respective area of specialization. Each AICTE Emeritus Fellow should at least train two batch of teachers in his/her area of specialization.

Each such training course shall be of 10 days duration, consisting of four lectures hours and up to 2 tutorial and discussion hours. For each such batch, AICTE should support up to Rupees One Lakh to meet the Course material preparation and honorarium, TA/DA etc for any support faculty. The Emeritus Professor and the Supporting Teacher Could be given honorarium of Rs 20,000/- and Rs 10,000/-respectively.

The identified Academic Staff Colleges may be used for this purpose. The list of Emeritus Professors, subject-wise, shall be made available by AICTE. AICTE should provide for at least 100 Emeritus Professor positions. This facility should also be available to distinguished researchers and teaching personnel from Industries.

3.1.5 Visiting Professorship: Until such time a satisfactory supply of teachers are available, it is essential to utilize the rich expertise of experienced faculty as well as experts now serving in the industry, national laboratories and elsewhere willing to offer their services for teaching functions for extended periods. Accordingly, the guidelines for utilizing the services of visiting professors should be evolved and articulated taking into account the remuneration to the visiting faculty, age criteria, experience etc. (**Annexure-II**).

3.1.6 AICTE – **INAE Distinguished Visiting Professorship**. This scheme for attracting experienced industry professionals to devote short periods in engineering institutions should be continued. It is essential that the services of eminent people under this scheme should be exclusively available to the Technical Institutes other than the IITs and NITs. The number of AICTE-INAE DVP should be increased to 200 from the present strength of 40. The remuneration should be Rs.50,000/- per month plus travel or Rs.25,000/- plus pension in the case of those who have retired from service.

3.1.7 Induction Training Programme (ITP)

AICTE is taking steps to have Induction Training Programmes (ITP) for new teachers through the four National Institutes of Technical Teachers' Training & Research (NITTTRs). These NITTTRs should be supported to produce Video and Web based learning resources for Induction Training Programmes. Also, these institutes should develop materials for pedagogy, learning resource planning, testing and evaluation. These materials should be mandatorily available to all teachers. They should be made available through EDUSAT. They could be also downloaded from NITTTR websites. The NITTTRs should be equipped to handle this load. MHRD should support these Institutes in this effort.

3.1.8 *Other Existing Schemes*

Other existing schemes of AICTE such as Seminar Grant, Staff Development Programme, Travel Grant, Career Award for Young Teachers and Financial Assistance to Professional Societies & Bodies also need further strengthening through enhanced provisions.

As far as the role of ISTE is concerned, the programmes that were conducted by various institutions for faculty development under the ISTE support should be reviewed and some of the suggestions contained herein may be implemented by availing the resources of the ISTE.

3.2 Anticipated Demand of Faculty

The projected demand for teaching positions is given in figure 3 in thousands. In fact the projected growth and enrollment up to the end of the 11^{th} plan assuming 15% and 20% growth rates in the intake capacity in various disciplines are given in **Annexure III**. From the present annual intake of nearly 5,00,000 for engineering, it is likely that the magnitude of the intake will be about 15,00,000 i. e., threefold by the year 2011-12 (at a projected annual growth rate of 20%).

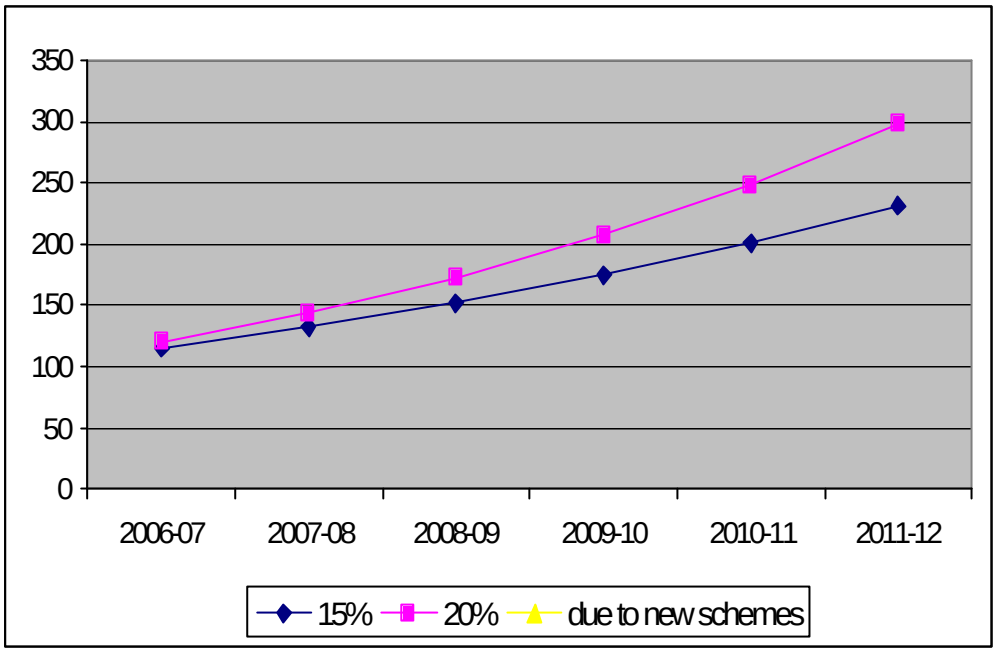

Figure 3: Estimated demand for teachers in 1000s.

As seen from these tables, 15% growth rate would result in an intake capacity of 11.5 lakhs in the year 2011-2012 and about 15 lakhs assuming 20% annual growth rate. It is estimated that approximately between 2 and 3 lakhs of teachers would be required to fulfill the minimal teaching needs in engineering disciplines (estimating the student teacher ratio of 20:1).

According to the data available, the number of available faculty in the existing institutes in the year 2005-06 in engineering and technology is 497607. The anticipated shortage in the total number of faculty will be of the order of 231166 by the year 2011-12. Almost 90% of the shortage will be in market-driven disciplines like computer science, IT and Electrical Sciences.

It is necessary that a well-organized faculty development programme should anticipate the distribution in various cadres of lecturers, assistant professors and professors. For purpose of estimation, it may be assumed that those in the position of Professors should be Ph.Ds and those in the position of Assistant Professors and Lecturers should possess a Masters degree. Assuming a ratio of 1:2:6 among Professors, Assistant Professors and Lecturers, the total requirement in the different categories (for 2005-06) is follows: Professors – 7907 (12438 in Engg. & Arch.), Assistant Professors – 15814 (24877 in Engg. & Arch.) and Lecturers – 47443 (74630 in Engg. & Arch.). The available number of faculty with

Ph.D. in engineering and technology as shown in **Annexure VIII** is 6829 against a requirement of 36,963. The shortage of Ph. D.s is thus presently over 30,000 and is likely to go beyond 70,000 in the year 2010-2011 (**Annexure IX**).These data indicate the intensity of faculty development required in different disciplines and at different levels. Currently, based on the established AICTE norms of student : teacher ratio (1:15) and the cadre ratio of 1:2:6, the total shortage of teaching staff is over 40,000 and the shortage in the different cadres is Professors – 4531, Readers – 9063 and Lecturers - 27187. The existing schemes are inadequate to meet the estimated shortages. This illustrates the need for new schemes and augmentation of the existing schemes to meet the shortages.

3.3 *Proposed Novel Schemes*

3.3.1 *Curriculum Based Faculty Training*

The age and experience distributions of faculty in Engineering Colleges are bi-modal with a large peak around 23-25 and another peak over 60. The Government Engineering Colleges have also large number of contractual faculty within the age group of 23-25. Retired faculties constitute the other peak in most private colleges. A good percentage of the young faculties are simple B.Techs. They all lack basic training in pedagogy, learning resource development, testing and evaluation. The understanding of the teachers on the subject they teach is also not up to the mark. A close look at the results of university examinations shows that failure rate of students in subjects that require (i) understanding and formulation of the problems and (ii) analytical skills for their solution is very high. Private Coaching in Engineering Colleges is as rampant as it is in Schools. The attrition rate of teachers, particularly in disciplines like Computer Sciences, Electronics, Electrical Engg, Information Technology etc is over 30 percent. Non-availability of senior level faculty at Professor/ Assistant Professor level with Masters and Ph.D qualification is also a huge problem. Given the above situation, continuous training and retraining of faculty is essential to ensure that some quality teaching is done at the college level. Through the National Programme on Technology Enhanced Learning (NPTEL), video and web-based learning resource packages have been developed by IITs and IISc for the five disciplines.

- Civil Engineering
- Mechanical Engineering
- Electronics and Communication engineering
- Electrical Engineering
- Computer Science and Engineering

For each subject, learning material modules have been developed, keeping in mind the Syllabi of typical universities. A university has the option to choose appropriate modules. Some of the best faculty members available in the country have developed material for about 220 courses.

These material could be used for imparting curriculum based training at their place of work using EKALAVYA EDUSAT (if the institute has EDUSAT Connectivity), through Video or DVD, otherwise,. The facilities available at National Institutes of Technical Teachers' Training & Research NITTTRs) may be used to transmit these materials through EDUSAT. The material also could be downloaded and stored in the electronics library for use by the students and faculty in Individual Institutions.

For Clear understanding and development of necessary competence in teaching, Contact between a Master Trainer (Concerned Faculty who developed the material or such other competent faculty) and the other trainers (Faculty from other colleges) are essential. The Contact could be reduced to 4 to 5 days of 6 hours a day, if a trainer will have exposure to the learning material package before had.

AICTE should take steps to identified Potential (Preferably Accredited) Institutes that can create facility to provide such contact programmes to teachers from a cluster of colleges. Typically a cluster could consist of up to 30 colleges from the nearby areas. For each cluster of colleges, there should be one college that shall be designated as Academic Staff College. Technical Universities should also be encouraged to develop Academic Staff Colleges. One time grant up to Rs 50.00 lakhs could be given to each such University to develop the facility. Cluster of Colleges may contribute two lakhs each to develop the Academic Staff College. AICTE should take the responsibility of providing EDUSAT and/or Video conferencing facilities to these colleges. Each of the NITTTRs may be connected up to 5 Staff Colleges for the purpose of

Video conferencing. This will cut down the faculty requirement for contact classes. AICTE shall take the responsibility of preparing a directory of Master Trainers for Curriculum based training on each subject. A staff college shall be free to use any of the Master trainers. A master trainer shall be entitled to an honorarium of Rs 15,000/-, local hospitality and the Travel expenses for each contact programmes. The Cost for each programme shall be borne by the participating institute. Thus for each teacher participant, the cost to a colleges shall be his/her TA/DA and plus Rs 2000/- for *5* days of contact programme.

The MHRD should be requested to support NPTEL (Phase II) for development of learning resource for the remaining programmes.

The Industry is looking for graduate engineers who are sound in basics, who have good analytical, communication and soft skills besides very good problem solving capabilities. These are also some of the qualities from a teacher that one looks for. For obvious reason, such students choose industrial jobs first. Teaching is much lower in their priority list. After some teaching experience, if a teacher picks up some of the capabilities and skills required by industry, he/she finds his/her way into industry. This explains the high attrition rate of the faculty in Engineering Colleges. Non-availability of Ph.Ds and M.Techs in large number is adding to the shortage of qualified and competent teachers.

3.3.2 *Technology Enhanced Distance Education Programme (TEDEP)*

In order to assist the serving teachers to acquire PG qualifications without their necessarily being dislocated for fulltime education in regular mode, it is desirable to establish a virtual learning system that will offer PG degree using flexible credit system and admission should be available not only to teachers in the engineering colleges but also professionals working in companies who may wish to avail this scheme. The course will deal not only in technical subjects but also pedagogy, counseling and communication skills. The course will cover the areas of Engineering Science, Medical Sciences and Social Sciences. The basic structure of the programme will consist of Public – Private partnership in establishing and managing the scheme. The partner institutes, which develop the teaching and learning materials would assist in delivery and dissemination.

3.3.3 *Sequential Summer Programme*

The proposed Sequential Summer Programme (SSP) is in line with the Sequential Summer School Programme leading to Master's Degree in Engineering and Technology that existed about a couple of decades ago. AICTE has recommended reintroduction of the programme with the objective of meeting the need for a substantial increase in slots available for up-gradation of the quality of a large number of teachers in both public and private engineering colleges. With the goal of improving the quality of technical education in engineering colleges in India, IITs and some of the NITs may start the SSP for teachers of these colleges. Each IIT/NIT may decide on the disciplines in which the sequential programme will be offered and the intake per batch. (**Annexure-V**)

3.3.4 *Meeting Shortage of Senior Faculty*

Shortage of Senior (Professor/Assistant Professor) level faculty is adversely affecting the quality of teaching learning. This issue requires immediate attention. Some of the steps that may be taken by AICTE to mitigate this Shortage are:

(i) *Increasing the Retirement age of existing Faculty*.

This is a viable option toady as the average life expectancy has considerably gone up. The faculty members who are retiring now at the age of 60 (or 62 in Universities and Central Institutions) are still physically fit and mentally alert. With experience, their teaching effectiveness is also at their peak. AICTE may consider increasing the normal retirement age of faculty up to 65. Those who are otherwise fit may be re-employed up to age of 70.

(ii) *Adjunct Professor Scheme*

Professionals with Ph.D/M.Tech from reputed industries, R & D establishments, Defence, PSUs etc., with proven track record on research, design, manufacturing and occupying senior positions (Professor or equivalent) may be appointed as Adjunct Professor on invitation. An Adjunct Professor would plan, and organize and teach up to 50 percent of a subject. The remaining will be handled by a regular teacher. He will also involved in paper testing evaluation and assessment of assignments. An

adjunct Professor will provide the much needed practical input to a course. An Adjunct Professor may be associated with a maximum of up to two course in a semester.

(iii) *Adjunct Faculty from the Industry*

The suggested scheme and guidelines for evolving the services of Adjunct professors, industry experts is given in **Annexure VI.**

3.3.5 *Innovative Approaches to Attracting, Retaining and Developing Faculty*

Attracting, retaining and developing faculty has been perceived as the most critical component of the process of development and growth of the entire technical education system.

Across all the institutions, there is a serious shortage of faculty. Recently, many institutions have undertaken expansion, and have found that faculty recruitment has been quite difficult, with variations across institutes as well as across disciplines.

It is recommended that the following steps and measures would create the culture and the environment that are deemed necessary for attracting and retaining competent faculty in the technical education system as well as to prevent/ minimize attrition and to effectively cope with the pressing shortage of faculty:

a. Devise innovative strategies, schemes and programmes to attract, recruit and retain competent faculty in the technical education system in the country.
b. Deploy aggressive fast track recruitment strategies along with attractive packages including handsome joining allowance, relocation grant, job for spouse, assured admission for children, etc.
c. The Institutes should be given enough flexibility to decide upon the compensation package of the faculty, including leased housing. Attractive packages may be given even outside the defined salary structure. The respective Board of Governors may be empowered to take decisions in this behalf.

d. While recruiting the faculty, the cadre ratio may be kept flexible so that appropriate persons are recruited at whatever levels they are available.

e. The retirement age of the existing faculty should be immediately raised to 65 years, subject to an internal review by the Board of Governors.

f. The Institutes should be allowed to re-employ retired faculty upto the age of 70 years on terms to be determined by each Board.

g. Teachers willing to take extra load should be given suitable compensation as determined and approved by the respective Board of Governors.

h. Implement Prof. U.R.Rao Committee Report of the Board on Faculty Development especially with regard to temporary relaxation of teacher to student ratio from 1:15 to 1: 20 as well as of the relative proportion of Professors, Asstt. Professors and Lecturers from 1:2:4 to 1:2:6.

3.4 Proposed Novel Institutional Initiatives

The novel initiatives recommended by the Committee are (i) identification of one hundred (100) Mentor Institutions for faculty development; (ii) establishment of an International Centre on the model of the International Centre for Theoretical Physics (ICDP), Trieste, Italy with the objective of eliciting the services of distinguished faculty from within the country and abroad for conducting short duration courses on selected topics and for undertaking research projects, for the benefit of existing teachers in technical institutions in the country; and (iii) setting up a Virtual Technical University.

3.4.1 *Identification & Involvement of Mentor Institutions For Faculty Development*

Up until now, AICTE has depended upon a limited number of QIP Centers for up-gradation of qualifications of faculty members from degree colleges in engineering disciplines, to acquire Master's and Doctoral degrees. The Major QIP Centres are located in the seven IITs at Delhi, Kanpur, Kharagpur, Madras, Mumbai and Rookee. Eighteen more institutions have been recognized as Minor QIP Centres. These are 1. NIT-Allahabad, 2. UVCE-Bangalore, 3. NIIE-Mumbai, 4.Jadavpur University, Kolkata, 5. NIT-Calicut, 6. PSG College of

Technology, Coimbtore, 7. ISM-Dhanbad, 8. BESU-Kolkata, 9.GSITS-Indore, 10.College of Engineering, Anna Universiity-Chennai, 11.A.C.College of Technology, Anna University-Chennai, 12.SJCE-Mysore, 13.NIT-Nagpur, 14. NIT-Rourkala, 15. NIT-Surat, 16.NIT-Trichy, 17. IT-BHU, Varanasi and 18.NIT-Warangal.

Considering the massive demand for up-gradation of qualification of the existing teachers in more than 1500 degree level engineering institutions approved by AICTE, and the acute shortage of teachers in most of them, it is imperative that many more competent engineering institutions from among those under the purview of the AICTE are identified to undertake the task in upgrading the existing faculty members and also produce new post-graduate in engineering disciplines. Undoubtedly there are many such institutions. In the first instance it proposed that 100 such institutions are carefully chosen spread over different parts of the country. These may be designated as Mentor Institutions.

3.4.1A Attributes of Mentor Institutions.

The Mentor Institutions should be identified on the basis of well defined academic attributes. For this purpose the following attributes are suggested:

1. Number of years of existence of the institutions.
2. Number of Master's Degree Programmes offered and their disciplines
3. M.E/M.Tech output during the past five years.
4. Number of faculty members with Ph.D. qualifications and their specializations/departments.
5. Number of faculty members with M.E./M.Tech qualifications and their departments.
6. Ph.D. output during the past five years in Engineering Disciplines/Sciences/Humanities .
7. Publications of faculty members in refereed journals in India and abroad during the last five years.
8. Publications of faculty members in conferences in India and abroad during the last five years.
9. Funds generated by the Institution through sponsored research and special grants.
10. Funds generated by the Institution through Consultancies.
11. Student-Teacher Ratio in the engineering departments.
12. Accreditation status.
13. Governance System (Government / Aided / Public Society or Trust / Private Society or Trust).
14. Special Honours/ Recognitions of faculty members.
15. Academic Infrastructure (class-rooms, laboratories etc).

3.4.1B Role of Mentor Institutions

3.4.1B *(i) Upgrading the qualifications*.

Each of the Mentor Institutions will act as the nodal Institution for a cluster of about 15 engineering colleges in their vicinity. They would offer the following types of programmes for the existing teachers in their clusters.

1. Two-year ME/MTech programmes in those disciplines in which they have adequate facilities. At the intake rate of 20 per disciplines in about three disciplines, each Mentor Institution will produce about 300 Master's degrees in five years. The 100 Mentor Institutions together will thus help 30,000 teachers to upgrade their qualifications to Master's level in engineering.

2. The Mentor Institution will organize e-learning programmes of different durations for certificate/diploma/ degree credits to the teachers in the college cluster.
3. The Mentor Institutions as a system will serve to develop new curriculum and learning resources for college teachers.
4. Some of the Mentor Institutions may also offer the sequential summer programmes to the teachers in their cluster.

3.4.1B *(ii) Producing New Post-Graduates*.

Some of the Mentor Institutions may be permitted to offer 5-year integrated dual degree (B.Tech-M.Tech) in engineering disciplines for candidates with 10+2 higher secondary qualifications, with the approval of the universities to which they are affiliated. For this purpose a set of 50 Mentor Institutions may be identified. Each of them may be permitted to admit about 180 candidates (in three specified disciplines) in addition to their 4-year degree programmes. These candidates will receive a stipend like M.Tech students during their fifth year.

After five years, the fifty Mentor Institutions together will produce every year 9000 Master's degree holders in engineering. Most likely a significant proportion of them will opt for teaching profession.

If carefully designed, the curriculum of the 5-year integrated dual degree programme (see description below) can offer the flexibility of wider choice of inter disciplinary electives, incorporation of higher levels of science and humanities content, scope for inculcating soft skills and meaningful project work. There is a greater probability of these 5-yr M.Techs sticking to the engineering profession than the 4-yr B.Techs

3.4.1B *(iii) Doctoral Schemes*

Some of the Mentor Institutions can also offer the facility for pursuing Ph.D. programmes for teachers from the cluster institutions in a convenient manner. Depending on the availability of qualified guides and the concurrence of the parent university, about 20 such Mentor Institutions may be identified with the offer of about 10 research fellowships per year. This will result in an output of about 200 Ph.Ds in engineering per year from these Institutions.

The institutions selected for offering Ph.D, programmes may be given a one-time grant of Rs.2 crores every five years for up-gradation of their academic fund research facilities.

In addition to the above programmes for enhancement of qualifications, the Mentor Institutions cal also run the following programmes:

3.4.1B (iv) The Dual Degree Programme

In recent years, the IITs have introduced a Dual Degree Programme which allows their carefully selected students to obtain an M.Tech. Degree along with a B.Tech. Degree in a five year period. This has been quite successful in the IITs because of their excellent faculty, infrastructure and well established Masters' and Ph.D programmes.

The Dual Degree Programme can be extended to other institutions as well which have a reasonable record of running Masters' programmes and to some extent Ph.D programmes. Such institutions should also be known for good practices in governance and other aspects of technical education. Among the 100 odd Mentor Institutions, AICTE could initially select about 10 institutions as a pilot exercise which would qualify in aspects mentioned above. The number can be later increased to 50. This could be done by a mechanism of selection involving senior IIT faculty. The objectives and salient features of the Dual Degree Programme are described below:

The Dual Degree Programme has the following **objectives:**

1. Bright students can be given research exposure through a 14 month project work. Such a project should result in publications in refereed journals.

2. Bright students can earn two degrees – a Bachelor's and a Master's degree – in 5 years instead of the conventional six years.

3. Students acquiring a Master's degree have a significantly greater inclination enter the teaching profession than those acquiring a Bachelor's degree alone.

Its **salient features** are:

- Two degree certificates (B.Tech. and M.Tech) will be given at the end of 5 years. Dual degree students will not be eligible for the B.Tech. degree at the end of 4 years since the requirements for the B.Tech. degree will not be completed by these students at the end of their 4^{th} year. Project work will be carried out by dual degree students in summer of 4^{th} year and the entire 5^{th} year (14 months).
- B.Tech. degree will be in the major discipline eg. B.Tech. (Electrical Engineering). M.Tech degree will be in the name of specialization eg. M.Tech. (Communication systems).
- Dual degree students will be eligible for scholarship in their fifth year like M.Tech. students provided they qualify in the Graduate Aptitude Test in Engineering with a minimum score prescribed by the Senate.
- Dual degree students will have a common courses up to second year. Third year onwards electives for dual degree students will be in the specialization that they opt for in M.Tech. programme. The curriculum should preferably include a Minor stream in an area different from the student's Major area of specialization.

The programme should be designed so that the student earns the B.Tech. and M.Tech. degrees on the basis of about 15% less semester credits compared to those who earn the two degrees sequentially.

3.4.1B (v) Faculty Development Program for Excellence in Technical Education

It is proposed that AICTE may establish Faculty Development Cells/ Centres (FDC) in the 100 identified Technical Institutions called Mentor Institutions and nominate 100 AICTE Fellows/ Teaching Scholars/ Ambassadors as FDC National Coordinators/ Facilitators/ Mentors/ Advisors/ Coaches with the following objectives:

1. To interface with the industry
2. To facilitate foreign collaboration
3. To help build inclusive academic networks with government bodies, academic institutions and research laboratories
4. To mentor/ coach/ develop faculty, staff and students
5. To improve and strengthen academic curricula,
6. To promote and nurture excellence in teaching-learning process

7. To support faculty in carrying out original, innovative and high quality research
8. To facilitate and coordinate FD&RID programs
9. To identify/ generate new strategic/ business opportunities for the institution
10. To ensure good institutional governance

There would be coordination amongst the AICTE National Mentors / Fellows at the local, regional and national levels.

The Staff Development Programme may be organized at the following four levels:

(i) For newly recruited fresh faculty members, the proposed two-week **Induction Training Programme (ITP)** would enable the young teachers to better orient and equip themselves for the teaching profession. The proposed induction training may include **Essential Teaching Workshops** that would provide educators with an opportunity to improve their teaching abilities. The workshops would focus on basic skills and include seminars typically addressing the following topics:

- Principles of effective teaching and learning
- Learning styles
- Communication Skills
- Learning objectives
- Class organization and course organization
- Development of interpersonal rapport with students
- Teaching with technology
- Inspiring faculty to integrate technology into their teaching
- Using Web Tools in Teaching and Learning
- Technology-Enhanced Education Through Collaborative Partnership
- Getting to 'Win-Win' with Faculty and Administrators
- Building a legacy of leadership in teaching, research and service
- Mentoring younger colleagues
- Striking balance between research, teaching and public service
- Networking with national laboratories and industry;
- Inter-group sharing of successful research and academic experiences
- Enhancing faculty competencies such as
    1. Engaging in needs assessment activities

2. Designing and developing strategies that promote individual, pedagogical, curricular, and organizational growth
3. Organizing and implementing specific programs, projects, and studies
4. Planning and delivering oral presentations
5. Producing print and non-print communications
6. Conducting research about teaching and learning
7. Establishing and maintaining consulting relationships

(ii) For mature experienced faculty members, Refresher Programmes may be organized stream-wise to cover all subject areas;

(ii)For specialized areas, seminars/conferences/symposia can be organized in advanced/high-tech areas

(iv)For faculty, students and staff at all levels, Entrepreneurship / management / Leadership Development Programmes can be organized regularly for over all objective of turning faculty members into academic leaders.

The Staff / Faculty Development Programmes may be organized/ coordinated by the Faculty Development Centres of the Mentor Institutions.

3.4.1B (vi) Award for Excellence in Technical Education and Research

The report of the Board on Faculty Development has recommended for institution of the award for individual faculty members and technical institutions. In line with the recommendations of the report of the Board on faculty development, the AICTE may start the schemes which would be named as 'Best Technical Teacher Award for Excellence in Technical Education and R&D as well as 'Best Technical Institute Award' starting from the financial year 2006-07. The schemes of awarding best technical teachers and best technical institution awards would definitely enhance and boost the moral of the faculty in achieving the overall excellence in their respective fields.

Three awards - @ Rs. 50,000/-, Rs. 30,000/- and Rs. 20,000/- for first, second and third prize respectively – may be given each year in each of the 100 Mentor institutions for five years.

3.4.1B (vii) Technical Education Industrial Consortium

In order to propel industry and industry associations like CII to play a greater and more proactive role, it is proposed that AICTE may sign an MoU with CII, ASSOCHAM, FICCI etc. and foreign bodies/ societies/ associations with the following objectives:

1. To establish institute-industry interaction/ exchange/ partnership programmes
2. To encourage contract research, joint technology development and sponsored R&D programmes.
3. To foster cross sharing of innovation best practices between industry and academia.
4. To institute faculty development industry training programmes
5. To facilitate leading industries (such as BHEL, WIPRO, ECIL, BEL, HMT) to start UG/ Polytechnic Courses relevant to their industries, instead of sanctioning such courses to Educational Societies.
6. To urge corporate and private enterprises to finance technical education
7. To ask industries to adopt institutions in their neighborhood
8. To institute industry chairs in academic institutions
9. To promote industry participation in course design

An AICTE Technical Education Industrial Consortium Fund to the tune of Rs. 100 Crores may be created for this purpose with Rs. 20,00,000/ being given to each of the 100 Mentor Institutions each year over a period of five years.

3.4.1B (viii) Faculty National / International Collaboration

It is proposed that AICTE may facilitate and enable the 100 Mentor Institutions to

1. Establish strong National/ International Technical Education and Research Networks of academic institutions, industry, government/ private organizations, NGOs national labs & R&D institutions (including DRDO & CSIR) as well as alumni associations and people of Indian origin (PIO) as communities of engineers/ experts / consultants/ researchers for sharing knowledge/ expertise/ resources / facilities /equipment.

2. Establish strategic alliances/ collaborative ventures/ networks with leading national and international institutions/ laboratories.
3. Tie up and collaborate with International societies/ professional bodies such as the American Society of Mechanical Engineers (ASME), American Society of Civil Engineers (ASCE), the American Institute of Chemical Engineers (AIChE), the Institute of Electrical and Electronic Engineers (IEEE), and the United Engineering Foundation (UEF) etc.that have been premier providers of continuing education courses and products for the practicing engineers and other technical professions.

In the beginning, a Faculty Exchange Programmes between technical institutions may be established.

3.4.1B (ix) *Other Activities of Mentor Institutions*

The Mentor Institutions would also conduct other programmes and activities such as Seminars/Symposia, Teaching Summer Retreats, Summer/Winter Industrial Training/Research and Industry Based Projects.

3.4.2. *Establishment of an International Centre of Excellence for Faculty Development*

Since it is difficult to make every university in India a research university, it is better to think of other ways by which those who desire to be engaged in research are provided opportunities for doing so for some time of the year, each year. An ICTP (International Centre for Theoretical Physics) like centre should be established. The main goals of such centres would be two-fold as explained below.

1. The first function of the proposed Centre is to enable, through a variety of schools, conferences and workshops, a set of university teachers to come to speed in various branches of science and mathematics. One can organize and run, through the cooperation of a number of interested researchers in premier institutions in India and elsewhere, some thirty conferences each year on different aspects of science, for each of which some 50 university teachers can be chosen from those who apply. These programs have to be

run at a world-class level and broadcast live to universities that show the needed interest. The programs will change from one year to another, and could form the basis for the needed incentive. They provide the needed background for independent research.

2. The second function of the proposed Centre is to provide facilities for a set of medium-term visitors, numbering something like 30 each year, for something like two months each year, extending over a period of some six years, for doing research at the Centre. These visitors will be chosen on the basis of merit and ability. They will be provided stipend for those two months accommodation, computing and library facilities, and, in cooperation with other research institutions in the country, experimental facilities. These visitors will spend time doing research, participating in discussions and seminars, collaborating with local scientists, etc.

The two functions should not be detached form each other.
The Centre should have a dynamic director and a small number of permanent researchers of great distinction and dedication, but would create a large network of scientists from all over the world, especially from research institutions in the country. The Centre will draw instructors and program directors from this large pool of active scientists. The goal is to mix active researchers with those that are dormant , so there is benefit for each party.

There are additional aspects that can be included, but the basic functions are the two just discussed.

Now it is best to setup such a Centre as an autonomous institution but loosely attached to an existing institute of excellence. (Possibly one among the best research-performing universities) so the large-scale facilities such as the library and laboratories can be shared. It should be possible to create the best of both worlds from this combination. The costs can be worked out if the principle of the Centre is accepted.

3.4.3 *Setting up Virtual Technical University*

A Virtual Technical University (VTU) should be created to serve as a nodal agency for quality improvement of teachers in various engineering and management colleges in the fields of science, technology, management, architecture, pharmacy and other applied areas. The University will provide flexible credit based courses to all registered participants using modern technology. The modern technology will involve (i) Video courses (ii) Web-based learning material and (iii) live lectures using satellite and Internet based technologies. The aim of the VTU is to serve as an agency of quality improvement to a large section of teachers serving in Government engineering colleges, private engineering colleges, Government / Private colleges involved in science education. (See **Annexure IV** for detailed implementation)

3.5 Resource Requirements

The financial requirements for the suggestions and recommendations in this report are presented at **Annexure-VII**.

4. CONCLUSION

It is anticipated that the various schemes suggested in this report would be implemented in letter and spirit and not in piece meal. Unless the scheme is taken up in a concerted manner with sufficient resources being made available and a viable management structure is created, it is quite likely that the crisis of the existing shortage will not be adequately addressed. The total financial requirements indicated in Section 3.4 and presented in **Annexure VII** above should be made available as a separate and distinct grant for faculty development and not as a part of the annual grant of AICTE to prevent its diversion to other programmes.

It is also necessary that these resources be placed at the disposal of an autonomous body within the framework of AICTE, which should have the authority to design the detailed aspects of the various recommendations contained in this report. For this purpose a National Board of Faculty Development (NABFAD) is to be created which should be headed by a senior academic of repute, with members drawn from experienced community of both teachers and industrialists. The scheme should be

monitored in the initial phases very closely and the report furnished to the AICTE Governing Council every quarter. The Secretariat of the National Board should be exclusively devoted for the implementation of the faculty development scheme with sufficient number of senior professors recruited for this purpose. The Chairman and the members of the empowered Board may prioritize a selected number of these recommendations of the Committee for implementation at the earliest.

The focus of the Committee was on faculty development in engineering and technology. A similar exercise should be undertaken for other disciplines such as MBA, MCA, hotel management and catering technology, architecture, pharmacy and applied areas which come under the purview of the AICTE and which face similar shortages if not of the same magnitude as in engineering and technology.

ANNEXURE-I

Quality Improvement Programme (QIP) to facilitate in-service regular technical teachers to acquire ME/ MTech/ PhD

AI.1 Preamble:

The Quality Improvement Programme (QIP) of AICTE is one of most significant educational initiatives in the country. It has brought about a sea change in the academic ambience of a large number of NITs and Government Engineering Colleges. A large number of teachers in various engineering colleges have successfully made career advancement in the fields of science, technology, and management through QIP. In view of this, the scope of the QIP has to be broadened so that the entire population of young teachers serving in various Government and private engineering colleges are benefited from the programme.

AI.2 Revision of existing norms:

AICTE is keen on extending the domain of activities of QIP. It is felt that the teachers in the private engineering colleges have to be given opportunity to advance their career through QIP. Currently about 100 PhD positions and close to 400 MTech/ ME slots per year are supported by the QIP. This can straightway be extended to 1000 PhD positions and about 2000 MTech/ ME slots. The current scholarship, contingency etc. have to be revised. Typically the modifications could be as the following

Category	First year	Second Year	Third year
M.Tech./ M.E.	Scholarship: Rs 5000/-pm Contingency: Rs 15000 per year	Scholarship: Rs 5000/-pm Contingency: Rs 15000 per year	Not Applicable
Ph.D.	Scholarship: Rs 10000/-pm Contingency: Rs 15000 per year	Scholarship: Rs 11000/-pm Contingency: Rs 20000 per year	Scholarship: Rs 12000/-pm Contingency: Rs 25000 per year

Usually, the teachers from the Government Engineering Colleges obtain sponsorship (full salary) from the parent institutions while working as a QIP scholar. The sponsorship is based on the condition that the teachers go back to the parent institutions on completion of the PhD and serve for a period of minimum 3 years. The teachers from the private engineering colleges usually do not enjoy this benefit. Therefore securing a sponsorship from the parent institute will cease to be the mandatory requirement for participation in the QIP programme. However, it will be a firm binding to each PhD scholar under the QIP scheme that he/ she has to serve an academic institute of the country for a period of at least five years on completion of his/ her Ph.D. For the QIP scholars at the master's level this binding will be there for three years. After completion of PhD, it should be mandatory for the QIP scholar to guide at least one student for PhD at the institution where he is employed. A detailed plan of this has been outlined below.

AI.3 Post Doctoral Work on Project Mode:

Creativity comes from an inner drive to accomplish novelty. Only when we seek excitement and do things for the sheer fun of it, can we create a break-though. But the inner self-expression needs a proper atmosphere which unfortunately does not prevail in many Government/ private engineering colleges. The QIP scholars train themselves well and pick up ideas during their stay in the Institutes of higher learning. Often they become stagnant on their return to the parent Institutes because of lack of facilities and encouragement. It is suggested that each QIP scholar, who has successfully completed PhD, be given a project. The proposal submitted by the former scholar will undergo a scrutiny and it will be sanctioned, if found reasonable. The project will have the budget allocation for equipment/ computational facility (as appropriate), contingency and travel. In many situations, the equipment grant is crucial since the laboratories in most colleges are poorly endowed in terms of experimental facilities. More importantly, the project will support a PhD student. Basically there will be provision for a JRF with a scholarship of Rs10000 per month for a period of 3 years extendable by one more year. The former scholar may like to involve his erstwhile thesis advisor in the project, if needed. The upper limit of funding for each project can be up to Rs 20 lakhs. This will bring about a new research ambiance and the group of young enthusiastic faculty members will be able to produce spectacular results commensurate with the present day competitive environment.

AI.4 Conclusion

Recent developments in the understanding of functioning of human brain and the learning styles indicate that key to quality education is generating passion for learning. In order to generate passion for learning, AICTE and other Government Institutions have to adopt a

proactive role. QIP is a very successful initiative, but it has been rather limited in its scope. During the next phase, QIP has to take the responsibility of grooming the faculty members across the country. It has to review and redefine goals and targets for continuous improvement of qualified teachers in adequate numbers. In order to encourage innovation in teaching, teaching methodology and research, the issue of career advancement of the teachers at various engineering colleges is of paramount importance. The Quality Improvement Programme (QIP) has to enter into a new paradigm. The quality of technical education in the entire country will reach a level of excellence, if the moral of the teaching community remains enthusiastic, innovative and inquisitive. All these will be possible if more teachers get the opportunity to pursue their doctoral studies (PhD) at the well known Institutes of higher learning. The Government Institutions and AICTE have to share a fundamental focus -- the development of intellectual human capital.

ANNEXURE - II

VISITING FACULTY

In order to augment the availability of qualified and experienced faculty, AICTE should

One, reimburse the Institution employing visiting faculty as follows:

(a) Honorarium (for Superannuated! Non-superannuated faculty) should be paid Rs 15,000 per UG course, and Rs 30,000 per PG course. A course should mean minimum 30 hours of class contact and related evaluation

(b) House Rent Allowance as per (last job/current job) eligibility

(c) Actual traveling expenses, to and fro, as per (last job/current job) eligibility

Two, 180 hours of class contact by visiting faculty should be counted as one full time faculty, and/or proportionately.

Implementation Mechanism:

1. To begin with, a budget provision of at least ONE Crore should be made.
2. Proposals regarding employing visiting faculty by AICTE approved institutions should be invited by March end each year.
3. A committee should decide institutional allocations keeping in mind proposed requirements, availability, and suitability of faculty.

ANNEXURE – III

Projected Growth in Admission to Technical Institutions

Projected Annual Growth Rate=20 percent

YEAR	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
Degree in Engg.	380,803	439,689	499,697	599636	719564	863476	1036172	1243406	1492087	1790505	214860
Degree in CSE and IT			214488	257386	308863	370635	444762	533715	640458	768549	92225
Degree in Electrical Sc. Group (ES)			200883	241060	289272	347126	416551	499861	599833	719800	86376
Degree in other discipline			84326	101191	121429	145715	174858	209830	251796	302155	36258
MCA	56338	56766	55548	66658	79989	95987	115184	138221	165865	199039	23884
MBA	71251	75048	80464	96557	115868	139042	166850	200220	240264	288317	34598
Projected Manpower Availability=100 % CSE & IT + 70 % in ES + 30% in other Engg. Degree enrolment + 100% of MCA + 20 % of MBA				***377501**	***426610**	**463,059**	**559,653**	**677,139**	**812,528**	**931,879**	**1,118,24**

Projected Annual Growth Rate=15 percent

YEAR	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
Degree in Engg.	380,803	439,689	499,697	574656	660849	759977	873973	1005069	1155830	1329204	152858
Degree in CSE and IT			214488	246662	283660	326209	375141	431412	496124	570542	65612
Degree in Electrical Sc. Group (ES)			200883	231015	265668	305518	351346	404047	464655	534353	6145(
Degree in other discipline			84326	96975	111521	128249	147487	169610	195052	224309	25795
MCA	56338	56766	55548	63880	73462	84482	97154	111727	128486	147759	16992
MBA	71251	75048	80464	92534	106414	122376	140732	161842	186119	214036	24614
Projected Manpower Output Availability=100 % CSE & IT + 70 % in ES + 30% in other Engg. Degree enrolment + 100% of MCA + 20 % of MBA				***377501**	***426024**	**465566**	**535402**	**615711**	**707937**	**814278**	**93642**

ES include Electrical Engg.+ Electronics & Electrical Comm. Engg+ Applied Electronics & Instr. + Electrical & Electronics etc.

*80% of Degree in Engg (4 Years duration) + 100% MCA (3 Years duration) + 20% MBA (2 Years duration)

Note : From 2006-07 onwards, we are likely to have more than adequate supply of IT Manpower till 2011at projected growth rate of 15%/20% as given in above tables.

Annexure IV

Some Initial Steps for the Implementation of the Concept of Virtual Technical University (VTU)

AIV.1 Preamble:

The proposed Virtual Technical University (VTU) shall serve as a nodal agency for quality improvement of teachers in various engineering and management colleges in the fields of science, technology, management, architecture, pharmacy and other applied areas. The University will provide flexible credit based courses to all registered participants using modern technology. The modern technology will involve (i) Video courses (ii) Web-based learning material and (iii) live lectures using satellite and Internet based technologies. The aim of the VTU is to serve as an agency of quality improvement to a large section of teachers serving in Government engineering colleges, private engineering colleges, Government / Private colleges involved in science education.

AIV.2 Operations:

VTU will endeavor to be a world class institution for providing post-graduate education to teachers and professionals of India as well as overseas countries.

All post-graduate programs of VTU will be administered using (i) a repository of Video courses created by very well known experts in the field (ii) a website that will host the web-based learning material and (iii) the live lectures delivered in distance learning mode based on satellite and Internet technologies. The primary responsibility of VTU will be management of these courses and maintaining the infrastructure with high level of reliability.

VTU will develop course material using the expertise available in the country as well as in partnership with the national programs, such as NPTEL. The course material will be in the form of video tapes, web based learning information as well as course ware in the form of reference material. For the creation of all the course ware, VTU will engage a

large pool of talented faculty members from IITs, NITs, IISc and other national technological institutions including superannuated faculty**.**

As such the huge reserve of well known superannuated faculty members from the IIT system, and IISc will play a vital role in content creation.

AIV. 3 Curriculum:

VTU will have the five broad Schools covering different areas of expertise. Each School will float a suitable number of courses in order to cater to the need of various disciplines associated with the school. It is envisaged that VTU shall have at least 300 courses for the second school in the list.

The following five different schools can be delineated:

1. School of Education

The school will cater to the need of all the Departments in various engineering colleges. The school will be emphatic about developing teaching methodology. The school will cultivate the following

- developing inner and outer strength of the individuals
- nurturing higher level of cognition up to creativity
- development of emotional intelligence, and
- fostering the spirit of inquiry, adventure and exploration both at problem solving and conceptual advancement.

2. School of Engineering Sciences

The school wi ll cater to the need of the following Departments:

- Chemical Engineering
- Civil Engineering
- Mechanical Engineering and Mechatronics
- Materials and Metallurgical Engineering
- Computer Science and Engineering
- Electronics and Communication Engineering
- Electrical Engineering
- Environmental Science and Engineering

3, School of Natural Sciences

The school will cater to the need of the following Departments:

- Department of Chemistry
- Biological Sciences
- Department of Mathematics and Statistics
- Department of Physics

4. School of Management Sciences

The school will cater to the need of the

- Department of Industrial and Management Engineering

5. School of Human Sciences

The school will cater to the need of the following Departments

- Economics
- Department of Humanities and Social Sciences

AIV. 3.1 Specialization in various Disciplines

The Disciplines mentioned above have several specializations. In this section, we shall identify some such specializations in each of the disciplines.

Chemical Engineering: (i) Polymer and Petrochemical Engineering (ii) Transport Processes (iii) Separation Science and Engineering (iv) Reaction Engineering, Thermodynamics and Catalysis

Mechanical Engineering: (i) Fluid and Thermal Sciences (ii) Solid Mechanics and Design (ii) Manufacturing Sciences (iv) Robotics and Mechatronics

Civil Engineering: (i) Structural Engineering (ii) Geotechnical Engineering (iii) Geo Informatics (iv) Geological Sciences (v) Hydraulics and Water Resources (vi) Transportation Engineering

Materials and Metallurgical Engineering: (i) Process Metallurgy (ii) Physical Metallurgy (iii) Materials Science and New Materials

In some departments, specializations are not so much pronounced. Generally, in the area of Computer Science and Electronics, the specializations are so intensely interlinked that the departments are almost boundary-free. However, following specializations are available with the aforementioned disciplines

Computer Science and Engineering: (i) Theoretical Computer Science (ii) Systems (iii) Network Computing (iv) Applications
Electronics and Communications: (i) Microwave Theory (ii) Microelectronics (iii) Communications (iv) Integrated Circuits and High Speed Devices
Electrical Engineering (i) Power Systems (ii) Electrical Drives (iii) Power Electronics (iv) Controls

For all the Departments a basket of post-graduate course will be prepared covering the specializations mentioned above, in order to train the students in their post-graduate endeavor.

VTU will also provide courses in the pedagogy of teaching through the School of Education. It should be necessary for the teachers of engineering colleges to complete a minimum number of credit hours on teaching pedagogy so as to obtain a degree from VTU.

The students at VTU are primarily expected to be young teachers at various Institutes or Universities. They may like to attend the schools of their choice and clear the courses that are close their areas of interest. A course under this scheme would comprise of some hours of lectures (instructions), some hours of tutorials, some hours of home work and some hours of tests. Typical credit assignments could be as follows:

Lectures (hours)	Tutorials (hours)	Homework (hours)	Tests (hours)	CREDITS
10	2	8	1	1
20	4	16	2	2
30	6	24	3	3
40	8	32	4	4

The tutorials would be used to clarify doubts, assign home work, provide necessary help in sorting out difficulties in solving the problems. For this, live interaction would be preferable.

The first task of the implementation team will be to identify post graduate program for each of the above mentioned disciplines. The courses needed for the masters' degree in each of the disciplines are to be identified. The courses of the disciplines will form the base line courses available in any given school. The VTU will depend heavily on the expertise of the subject matter creators of the premier institutions. The well known teachers and scholars, who have superannuated, can be invited to participate in the content creation. As a matter of fact they can be engaged in the best possible way to promulgate the quality education. It is expected that the VTU will leverage existing infrastructure and organizational strengths of NITTTRs. However, VTU can also depend on the NPTEL infrastructure (Video and Web studios) in various IITs and IISc for the content creation. In order to develop the linked network, VTU will establish MOUs with several organizations in India. Through these MOUs, it will be able to draw upon the strengths available in the country.

AIV. 4 Content creation within announced time frame

Content creation is the biggest challenge in any such initiative. At the outset, the implementation committee should announce a time frame in order to be ready with at least 150 Video and Web based courses in the School of Engineering Sciences. Once the repository of the courses is in place, the VTU can think about evolving a credit system.

The university will offer courses of flexible credit hours. Each course will have assignments as well as examinations. Letter grades will be awarded to students. Based on the credits acquired by students, it is possible to award either a certificate or a diploma or a degree. This will allow for many professionals working in industry to join the university as well. Thus, the target population of students is not simply teachers but professional engineers, managers as well as supervisors. The minimum qualification for entry into VTU shall be a Bachelor's degree from a recognized University.

AIV. 5 Partnership between the University and Private Entrepreneurs

A set of live lectures from each school will be delivered at designated class rooms in the country using EDUSAT. Also the satellite connectivity can be purchased from the private service-providers. A partnership with the Federation of Indian Chambers of Commerce & Industry (FICCI) may play a vital role in this endeavor. The remote

classrooms at different engineering colleges can perhaps be created and maintained by the private entrepreneurs. A part of the fees collected from the students can be used for the maintenance of the infrastructure.

The students may have to pay for the access to the digital library separately. It is also expected that examination fee, certificate fee and other miscellaneous fees will be charged separately.

AIV. 6 Part-time Sponsorship using E-learning

During the past ten years or so it has been seen that the private colleges are unwilling to release their faculty for further studies. The preoccupation of the faculty members with the system is continued without adding new input to the existing knowledge. Following is the solution of this heretofore unattended problem. Many of these faculty members may be encouraged to attend advanced courses using (i) a repository of Video courses created by very well known experts in the field (ii) a website that hosts the web-based learning material and (iii) the live lectures delivered in distance learning mode based on satellite and internet technologies. Recently proposed Virtual Technical University (VTU) will play a major role in this initiative.

It is expected that VTU will develop course material using the expertise available in the country. The course material will be in the form of video tapes, web based learning information as well as course ware in the form of reference material. As mentioned earlier, the students at VTU are primarily teachers at various Institutes or Universities, who are unable to obtain study leave as full time students. They may like to attend the courses of their choice and earn credit for the courses that are close their areas of interest. A course of 1 credit under this scheme would comprise of 10 hours of lectures (instructions), 2 hours of tutorials, 8 hours of home work and 1 hour of test. The tutorials would be used to assign home work, provide necessary help in sorting out difficulties in solving the problems. A course of 2 credits would have 20 hours of lecture, 4 hours of tutorial, 16 hours of home work and 2 hours of test. Likewise a course of 4 credits would have 40 hours of lecture, 8 hours of tutorial, 32 hours of home work and 4 hours of test.

It is proposed that VTU will provide a credit pass book for every student. Every course will be entered in the book along with the grade obtained by the student. The students may wish to conclude a program with the accumulation of some credits. Depending on the level of credits accumulated by a student, he or she will be awarded a certificate in an area or a diploma. In case, a student has completed sufficient number of credits and also has carried out a project, he or she will be awarded a post-graduate degree. In this way, VTU will provide different exit routes for its students.

AIV.7 Some Immediate Measures

Since VTU may take time to come into operation, a scheme has to be identified that would be readily applicable to the teachers at the private engineering colleges. The Video and Web-based lectures prepared by the IIT and IISc faculty for the NPTEL program, can be supplied to the private engineering colleges. The young teachers can become facilitators-cum-instructors for such lectures. Also a provision can be made for an open-house (once in a semester) where the teachers involved in using a NPTEL course ware will get opportunity to meet the content creator. They will be allowed to brainstorm over several aspects of the course in such workshops.

Another suggested scheme is as the following. Some selected faculty members of the private engineering colleges will be invited to IISc/ IIT s/ Institutes that have QIP Centres each year during the summer. The selection procedure will ensure that everyone interested gets a chance to participate in the programme. The invited faculty members will participate in the summer schools on the specific topics organized by the host institutes. The summer schools will cover the important subject areas related to Mechanical Sciences, Electrical Sciences, Mathematical Sciences, Physical Sciences, Chemical Sciences and Pedagogy. Each summer school will have comprehensive teaching material on a specified theme, starting from basic underlying principles to advanced applications. These programmes will follow the philosophy of Sequential Summer Schools that were quite popular some twenty years ago. The participating teachers will earn credit for attending such summer schools.

ANNEXURE - V

SEQUENTIAL SUMMER PROGRAMME

The proposed Sequential Summer Programme (SSP) is in line of the Sequential Summer School Programme leading to Master's Degree in Engineering and Technology that existed about a couple of decades ago. AICTE has recommended re-introduction of the programme with an objective to meet "the need for a substantial increase in slots available for up-gradation of the quality of a large number of teachers in both public and private engineering colleges." With the goal of improving the quality of technical education in engineering colleges in India, IITs may start the SSP for teachers of these colleges. Each IIT may decide on the disciplines in which the sequential programme will be offered and the intake per batch.

AV.1 Academic Curricula

The proposed SSP programme will spread over a period of 3 years and 2 months with 4 eight-week summer (May/June) terms and 2 four-week winter (December) terms. The programme will consist of course work and a project. The course work can be completed within the third summer term. The project work can start in the second summer term.

The credit requirement for the SSP-based M.Tech degree will be the same as that for the two-year M.Tech degree programme in the particular IIT. The total credits are divided between course credits and project credits.

We use the following credit structure and credit requirements (using 16-week semester) for illustration purposes:

Lectures - One hour per week is assigned 2 credit.
Tutorials - One hour per week is assigned 1 credit.
Practical - two hours per week is assigned 1 credit.

A 6-credit lecture course will have 48 contact hours including mid-term and end-term examinations. Under the above credit structure the credit requirement for the SSP-based M.Tech programme is:

Total Minimum Credits - 96
Minimum Course Credit - 48
Minimum Project Credit - 32

A model structure based on the above requirements is given below:-

Course Structure for Sequential Summer Programme leading to the Master of Technology degree at Indian Institutes of Technology

Course Credits - 48
Project Credit - 48
Total Credits for the Programme- 96

Summer Term – 1

Course/Project	Credits
Course	18
Project	0
Total	**18**

Weekly contact hour 18

Summer Term – 2

Course/Project	Credits
Course	18
Project	4
Total	**22**

Weekly contact hour 26

Winter Term – 1

Course/Project	Credits
Course	0
Project	6
Total	**6**

Weekly contact hour 12

Summer Term – 3

Course/Project	Credits
Course	12
Project	12
Total	**24**

Weekly contact hour 36

Winter Term – 2

Course/Project	Credits
Course	0
Project	8
Total	**8**

Weekly contact hour 16

Summer Term – 4

Course/Project	Credits
Course	0
Project	18
Total	**18**

Weekly contact hour 36

AV.2 Residential Requirement

A student will have to be present at the III for the entire summer and winter terms in which he/she registers for credits. He/she will have to make the following additional short visits to the IIT during normal semester time:

1. Semester immediately before the second summer term for identification of the project and the project supervisor
2. Semester immediately before the third summer term - for project work
3. Semester immediately before the fourth summer term - for project work

AV.3 Budget Requirement:

The programme will demand additional teaching loads for course instructors during summers and winters. It will also call for involvement of the project guide for the entire project period. Incentives may be given to the faculty members involved in the programme similar to the payment for the instructors of summer-term course in the IlTs. The programme will require budget allocation in the following heads:

1. Honorarium to course instructors credits = Rs. 10,000 per course of 6 (@Rs.250 per class hour)
2. Remuneration to Project Supervisor (s) = Rs. 20000 per student
3. Contingency = Rs.80,000/-per year
4. Institute overhead for laboratory, computational and project work = Rs. 30,000 per student

The following table gives the details of budget requirement for the entire SSP programme in one discipline with 8 courses for a batch of 10 students.

Head	Total Amount
Honorarium to the course Instructors	**Rs. 80,000/-**
Remuneration to Project Supervisor(s)	Rs. 2,00,000/-
Contingency	Rs. 1,60,000/-
Institute overhead for laboratory	Rs. 3,00,000/-
Total	**7,40,000/-**

ANNEXURE - VI
ADJUNCT FACULTY FROM INDUSTRY

A Scheme for Talent Hunt from Research Wings of Industrial Units for Academic and Teaching Assignments In Universities, Management and Technical Institutes

Currently there is a shortage of competent faculty with good doctoral background in Universities, Management and Technical institutes. This need is being keenly felt in the teaching of engineering curriculum. A possible way of addressing the problem will be to outsource talents from the engineering industry in the corporate sector having a good R&D wing employing engineers and scientists with Doctoral and Post Doctoral qualifications. The concept is that the universities / institute should so to say adopt that corporate house to provide, faculty for a fixed term to mitigate the shortage of competent faculty on an ongoing basis. Such qualified industry professionals could take up assignments with that university / institute in terms of a memorandum of understanding for mutual benefit. The professionals would get a much sought after break and can interact profitably with students and faculty and the academicians of university / institute could benefit from exchange, of views with such professionals by obtaining industry's perspective. The concept essentially is one of "**Reverse sabbatical**". Instead of industry adopting an university / institute for sourcing the necessary expertise from the academicia it would be for the university / institute sourcing the faculty from industry having a full of talents in its R&D wing. A case in point is to source industry professionals from R&D division of Ranbaxy industries. It could be easily worked out with a little effort and skill to engage on a **rotational** basis three to four Research Scientists from that corporate to take up teaching assignments in the university / institute for every semester.

Since such industry professionals engaged in' industry have an academic bend of mind and natural instinct for academic pursuit they could be easily motivated to take up short time fixed assignments by giving a suitable designation such as **Chair professorship, Visiting professors, Adjunct faculty and Emeritus Fellowship.**

A detailed scheme would involve determination of:

Eligibility and qualification:

The assignment is open to talented scientists and engineers in the corporate sector of India.

The candidate should possess .a higher degree or equivalent, such as PhD in Science / Engineering, Master in Engineering or Technology / MD in medicine etc and have adequate profession experience.

These assignments are very selective and those who have a proven / outstanding record as evident from their research publications and recognitions would be eligible.

Methodology of Selection:

This should be spelt out in the memorandum of understanding to be entered into by the industrial unit and the academic institute.

It should be flexible enough without compromising on the quality of the intake and should be transparent enough.

A selection board drawn from the industrial unit and the academic institute may be entrusted with the task of selection.

Scale of pay:

Depending upon the seniority in the industry professional experience and qualifications a ceiling and a floor should be laid down. Ideally a gradation should be made with appropriate remuneration such as **Chair Professorship, Visiting Professors, Adjunct Faculty and Emeritus Fellowship.**

Duration of the tenure :

Ideally it will be short and for a fixed term. Ideally it **should be semester specific** that means six months.

Certificate:

University / institute should grant the industry professional a certificate on the completion of the teaching assignment.

Reward from the industrial unit:

A system of **offering both tangible and intangible** reward may be worked out for the industry professional once the person returns to the original position in the industrial unit.

ANNEXURE-VII

Table A.VII : Resource Requirement

Summary of Total Expenditure envisaged under various programmes proposed by High Power Committee on Faculty Development

S.No.	Name of the Scheme/ Programme	Expenditure per year (Rs. In Lakh	Total expenditure for 5 years (Rs. In Lakh)
Existing Schemes of AICTE			
1.	PG Education & Research Scheme for Scholarship to GATE qualified M.Tech Students	-	40000
2.	National Doctoral Fellowship Scheme	1150	5750
3.(a)	QIP - M.Tech. /Ph.D fellowships & contingency	1500	20000
(b)	QIP – Short Term Courses	3000	15000
4.	Emeritus Fellowship Scheme & Visiting Professorship scheme including INAE scheme/Adjunct Faculty.	1000	5000
Other Existing Schemes			
5.(a)	Seminar Grant	800	4000
(b)	Staff Development Programme	750	3750
(c)	Travel Grant	400	2000
(d)	Career Award for Young Teachers	250	1250
(e)	Financial Assistance to Professional Societies & Bodies	500	2500
Proposed Novel Scheme			
6.	Technology Enhanced Distance Learning /Education Programme/TEDEP	10000	50000
Proposed Novel Institutional Initiatives			
7.	**Mentor Institutions**		
(a)	Induction Training Programme (ITP)/FDP	1200	54900
(b)	Seminar /Workshop/Conference (advance technology programmes)	1200	
(c)	Refresher courses for faculty development in various disciplines (including FDP/SDP/MDP/LDP and EDP) – Including Curriculum Based Training	1200	
(d)	Devpmt. of research infrastructure, curriculum, LRM, e-content, IPR Cell etc.	4000	
(e)	Technical Education Industrial Consortium scheme	1000	
(f)	Faculty National/International Collaboration /Networking Programme	1000	
(g)	Remuneration to AICTE National Mentor – Coordinator	180	
(h)	M. Tech.Ph. D & PDF Fund for Teachers without leaving parent institute (Including Sequential Summer/Dual Degree Programme) & SRG	1000	
	Total	**10780**	
8.	**International Centre of Excellence**	1000	5000
9.	**Virtual Technical University**	1000	5000
Grand Total			**214150**