# *Study*

*on*

# Quantitative & Qualitative Assessment of Gaps of Engineering Graduates in Select Infrastructure Industries

*for*

## NATIONAL SCIENCE & TECHNOLOGY MANAGEMENT INFORMATION SYSTEM (NSTMIS), MINISTRY OF SCIENCE & TECHNOLOGY GOVERNMENT OF INDIA

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# PREFACE

National Science and Technology Management Information System **(NSTMIS)**, Ministry of Science & Technology, Deptt. of Science & Technology , Govt. of India, entrusted National Foundation of Indian Engineers **(NAFEN)** to undertake the following study:-

***"To assess the gaps in demand and supply position of Engineering Graduates for the next five years (1999-2004) in specified branches of Engineering (Electrical, Mechanical, Production and Industrial) and specified select infrastructure industries (Power, Oil, Gas, Petroleum, Steel/Aluminium, Automobile and Railways)".***

Data was collected on all India basis from the Engineering Institutes, imparting education in the specified branches of engineering and from specified select infrastructure industries. A detailed questionnaire was prepared separately for demand side (industries) and supply side (academics), after holding four Brainstorming Sessions at Delhi, Bombay, Calcutta, and Bangalore. In these Brainstorming Sessions leading experts from industries and academics participated. Since the study had to assess both quantitative and qualitative gaps, the questionnaire was very carefully prepared.

On the **Academic Side**, 3 questions were to assess **quantity status** and 25 questions were to assess **quality status**.

Similarly on the **Industry Side**, 3 questions were to assess **quantity status** and 22 questions were to assess **quality status**.

**The study indicates that the quantitative gaps can be easily met. Number of qualitative gaps have been observed and it is felt that the academic institutes must reorient themselves to meet the qualitative demands of the industries in an effective manner in the next few years.**

A Local Advisory Committee was constituted under the chairmanship of Dr. Laxman Prasad, Adviser-NSTMIS. The members of the Local Advisory Committee were from academics and industries.Three Meetings of the Local Advisory Committee were held to take their expert guidance and advice from time to time in conducting this study.

## LIMITATIONS OF THE STUDY

- Respondents (both in *Academics & Industry*) were not willing to give details since they had to dig the past data and also work out the future projections. There was resistance, both in Industry & Academics.

- In many cases, particularly on the industry side, future projections were not available.
- At the entry level, most of the industries do not distinguish between Mechanical, Industrial and Production Engineering. Most of them treat it as Mechanical Engineering only.
- At the time of recruitment, industry does not allocate specialization.
- AMIE population not considered since they did not respond inspite of repeated requests and reminders.
- Some engineers may not go far employment after B.E. They may go for higher studies like M.E., M.Tech, Ph.D. MBA etc., in India or abroad.
- SIROs did not respond, inspite of repeated requests and reminders. Only 4 SIROs responded and they too indicated that they do not recruit graduate engineers.
- Analysis of data on pages 57 to 70 is based on the details furnished by 41 organisations from select infrastructure industries who have by and large recruited engineers from institutions like IITs, BITs (Pilani and Ranchi), IISc, University of Rookee, RECs.
- There is more emphasis on I.T. areas like computers, electronics, communications, C&I and automation. These specialization were not within the scope of this study. Demand is therefore less for electrical engineers.

P. K. Gupta

**(Dr. P.K. Gupta)**
Principal Investigator

New Delhi
*30th September, 1999*

# *Acknowledgements*

NAFEN is deeply obliged to all the members of the Local Advisory Committee. NAFEN is highly grateful to **Dr. Laxman Prasad**, Adviser-NSTMIS and **Mr. Parveen Arora**, Principal Scientific Officer, Deptt. of Science & Technology, Ministry of Science & Technology, **Dr. B.S.K. Naidu**, Director (Tech.), Rural Electrification Corporation, New Delhi and **Prof. P.B. Sharma**, Vice Chancellor, Rajiv Gandhi Technical University, Bhopal (M.P.). Without their help, guidance and motivation from time to time, it would not have been possible for NAFEN to complete this study.

NAFEN is also extremely grateful to **Dr. Abid Hussain,** India's Former Ambassador, USA and Member, Planning Commission, Govt. of India and Founder Patron-in-Chief of NAFEN, **Dr. Y.S.R. Prasad**, Chairman & Mg. Director, Nuclear Power Corpn., **Mr. S.P.Mukherjee**, Managing Director, BIECCO Lawrie, **Dr. K. Kasturirangan,** Chairman, ISRO, who chaired the Brainstorming Sessions at Delhi, Bombay, Calcutta and Bangalore respectively. Their interaction and suggestions in framing the questionnaire and methodology to be adopted for this study were highly appreciated by all.

NAFEN would also like to specially thank all the respondents, who spared their valuable time in filling the questionnaire and also discuss with our Research Executives.

NAFEN is equally obliged to all the colleagues in NAFEN, who participated in the study and helped NAFEN in completing this study within the stipulated time.

P. K. Gupta

**(Dr. P.K. Gupta)**
Principal Investigator

New Delhi
*30th September, 1999*

# Executive Summary

**National Science & Technology Management System (NSTMIS), Govt. of India entrusted National Foundation of Indian Engineers (NAFEN) to carry out the following study:-**

***"To assess the gaps in demand and supply position of Engineering Graduates for the next five years (1999-2004) in specified branches of Engineering (Electrical, Mechanical, Production and Industrial) and specified select infrastructure industries (Power, Oil, Gas, Petroleum, Steel/Aluminium, Automobile and Railways)".***

## 1.00 SCOPE OF THE STUDY

This study covers the following scope:-

### *Supply Side (Academics)*

- Electrical Engineering
- Mechanical Engineering
- Production Engineering
- Industrial Engineering

### *Demand Side (Infrastructure Industries)*

- Power
- Oil, Gas & Petroleum
- Steel & Alumminum
- Automobile
- Railways

## 2.00 OBJECTIVES

- To estimate gaps (**+or -**) in requirement of engineers (Quantity- wise) in specified branches of engineering and for specified industries.
- To estimate gap in terms of qualitative requirements.

## 3.00 METHODOLOGY

- Through questionnaire & personal visits, interviews and discussions with the concerned officials. Questionnaire were framed & finalized after holding 4 Brainstorming Sessions at Delhi, Mumbai, Calcutta & Bangalore.

# 4.00 SAMPLE SIZE

*Industry : 66% (41 Organisations out of 62 Nos.)*

*Academics : 35% (148 Engg. Institutes out of 418 in 1998)*

# 5.00 ANALYSIS

## *A. Quantitative Analysis*

### *The Position on various parameters emerges as follows:*

- There is a steady increase of **Engineers actually graduated** from 1994-98. The average increse per year is **55%** for Electrical Engineers, **56.56%** for Mechanical Engineers, **64%** for Production Engineers and **40%** for Industrial Engineers. *(Base year 1994).*

- There is a steady increase of **Engineers actually recruited** by the select infrastructure industries from the year 1994-98, except for industrial Engineers, which is constant. The average increase per year for Electrical Engineers is **217%**, Mechanical Engineers **12%**, Production & Industrial Engineers **27%**. *(Base year 1994).*

- The average increase per year for **Engineers likely to graduate** for Electrical Engineers is 3**2.6%**, Mechanical Engineers **40.2%**, Production Engineers **44.5%** and Industrial Engineers **56.2%**. *(Base year 1999).*

- The average increase per year for **Engineers likely to be recruited** by the select industries is **57%** for Electrical, **10.3%** for Mechanical, and **42.3%** for Production & Industrial. *(Base year 1999).*

- For future demand, in Electrical Engineering, Production Engineering, Industrial Engineering, there is a **surplus** with respect to the select infrastructure industries. It varies from 1176 Nos. in 1999 to 1784 Nos. in 2003 in **Electrical Engineering**. Similarly it varies from 1777 in 1999 to 3599 in 2003 in **Production & Industrial Engineering**.

- In **Mechanical Engineering Branch**, there is a **shortfall**. In 1999 it is 2462 Nos. and 1846 Nos. in 2003. However, this is reduced to 685 Nos. in 1999 and in 2003, it becomes Surplus to 1753 Nos., if **Mechanical, Production & Industrial Engineering is considered together**.

## *B. · Qualitative Analysis*

### *The Position on various parameters emerges as follows:-*

- Faculty Student ratio, both Academic & Industry want it to be as **1:10**. This is as per present norms of AICTE.
- Both Academic & Industry want teachers to be retrained after **every 3 years**.
- Both Academic & Industry want Faculty Summer training to be of **8 Weeks** duration.
- Industry want revision of Engineering Curriculum **every 3 years** where as Academics **every 5 years**.
- Industry wants Students' minimum summer training period of **16 weeks** and Academics want **12 weeks**.
- **69%** of Industry and **64%** of Academic Institutes want **Internship** before award of degree.
- **80%** of Industry and **68%** of Academic Institutes want an **Aptitude Test** before admission.
- **85%** of Industry and **56%** of Academic Institutes want **Cross Migration** during studies
- **85%** of Industry and **54%** of Academic Institutes want a **Competitive Exams** before the selection of faculty.
- **94%** of Industry and **99%** of Academic Institutes want a **Code of Conduct** and ethics for engineers.
- **64%** of Industry and **77%** of Academic Institutes wants a **Licensing System** for engineers.
- **62%** of Industry and **96%** of Academic Institutes want a **Resource Networking** between Academic Institutes and Industry.
- **62%** of Industry want **%age Marking System** and not grading system, where as **58%** of Academic Institutes want **Grading System**.
- **62%** of Industry and 35% of Academic Institutes want **External Evaluation System** (Outsider as evaluator). **65%** of Academic want **Internal Evaluation System.**

# *Chapter -1*

## 1.01 INTRODUCTION

Fifty two years ago, the administration and management of this subcontinent was handed over to the people of this country. Complete freedom to plan and execute the designs for development had become available to serve the needs of the large human society inhabiting this ancient country. Rich in natural resources, Indian has been the abode of a civilized, scientifically elevated and environmentally conscious human race for over five millions. However, the legacy of foreign rule left little or no infrastructural base for the utilisation of the vast resources.

After 52 years, India today stands in the community of nations as one of the agro-industrial giants having a sound base of mechanised agriculture alongside with advanced manufacturing capabilities, in some areas of world standards. If one looks at our five decades of development, one gets the felling that what India has achieved, is primarily because of a ***planned strategy*** well supported by a committed science & technology oriented educational system. It is the ***Five Years plans***, which have earned India a place among the first ten industrialised nations of the world.

In the post-independence period, our emphasis is on ***self reliance in key sectors of economy*** namely agriculture, heavy industries and the power sector. Growth of institutions, industries and production within the country is the hall mark of our planned strategy. As a result, we have now reached a stage when we produce almost everything we need within the country.

***Manpower planning*** aims at development, utilization, improvement and preservation of human resources of a nation. The main purpose or advantage of ***manpower planning*** is to enable the concerned authorities to discover the critical areas of shortages or the inefficient use of available force so that corrective measures can taken be well in advance.

The contribution of ***scientific and technical manpower*** to the country economic growth and development is well known. It is through the utilization of scientific and technical manpower in the productive activities and the incorporation of the latest technological advancements that economic development and growth can be achieved. Technical manpower is developed by a large number of technical education institutions. Any shortage of facilities for technical education will have its ***adverse impact on the industrial development.*** On the other hand, if there is over-production of these categories of manpower without regard to the absorption capacity of economy, it will result in ***unemployment.*** Such situations will lead to many other ***social and economic*** problems also.

Indian economy opened up in 1991 with ***liberalization, privatization & globalization (LPG)***. Competition has increased manifold. Number of MNCs have entered the arena particularly in the specified industries of this study. This calls for products & services of international standards. Product & Services cannot be of international standards if we don't produce human resource of world class standards. It is, therefore, essential that we ***plan*** in advance and improve the ***quality*** of our engineering graduates.

With the above in view, ***National Science & Technology Management Information System (NSTMIS),*** Ministry of Science & Technology, Deptt. of Science & Technology, Govt. of India entrusted National Foundation of Indian Engineers ***(NAFEN)*** to carry out a study on the following topic:

***"TO ASSESS THE GAPS IN DEMAND AND SUPPLY POSITION OF ENGINEERING GRADUATES IN THE NEXT FIVE YEARS",***

The study covers both ***Supply side*** *(Engineering Institutes)* and ***Demand side*** *(Specified Industries)*.

## 1.02 OBJECTIVES

- To estimate gaps (+or -) in requirement of engineers (Quantity- wise) in specified branches of engineering and for specified industries.
- To estimate gap in terms of qualitative requirements.

## 1.03 QUESTIONNAIRE

Detailed questionnaire were framed after holding 4 brainstorming sessions at Delhi, Mumbai, Calcutta and Bangalore. These brainstorming sessions were chaired as follows:

| | | |
|---|---|---|
| **Delhi** | *12th May, 1998* | **Dr.Abid Hussain**, Ex-Vice Chairman, Rajiv Gandhi Foundation |
| **Mumbai** | *22nd June, 1998* | **Dr. Y.S.R. Prasad**, CMD Nuclear Power Corporation |
| **Calcutta** | *27th July, 1998* | **Mr. S.P. Mukherjee,** M.D. BIECCO Lawrie Limited |
| **Bangalore** | *24th August, 1998* | **Dr. K. Kasturirangan**, Chairman Indian Space Research Organisation (ISRO). |

In these brain storming sessions, experts from engineering institutes and specified industries participated and deliberated in detail.

The detailed questionnaire both for Supply Side and Demand Side are enclosed as *Annexure -I* & *Annexure - II*.

## 1.04 LOCAL ADVISORY COMMITTEE

A local Advisory Committee was formed to advise and guide NAFEN from time to time during the study. The composition of the local advisory committee is as follows:

**Chairman**

| | | |
|---|---|---|
| Dr. Prasad Laxman | Advisor | DST |

**Members**

| | | |
|---|---|---|
| Mr. Arora Parveen | PSO | DST |
| Mr. Bajaj H.L. | Director (Commercial) | NTPC |
| Mr. Prasad C.R. | Chairman & Managing Director | GAIL |
| Mr. Murthy E.N. | Secretary General | ASSOCHEM |
| Mr. Rajan Y.S. | Sr. Advisor(T) | CII |
| Mr. Sarobar Mohit | Sr. Advisor | CII |
| Mr. Khadar S.A. | Dy. D.G. (Mgt. Services) | NPC |
| Mr. Jaganathan G. | E.D. (Personnel) | SAIL |
| Dr. Naidu B.S.K. | Director (Tech.) | REC |
| Prof. Sharma P.B. | V.C. | RTU |
| Mr. Taneja J.C. | Chief Executive | S & C Ltd. |
| Mr. Gupta R.K. | Chief Engineer | DSIDC |
| Mr. Jain Satish | President | NAFEN |
| Dr. Gupta P.K. | Secy. General & Principal Investigator | NAFEN |
| Mr. Kumar Rishi | General Manager & Co-Investigator | NAFEN |

# *Chapter -2*

## 2.01 SCOPE OF THE STUDY

The conceptual framework of the Study is enclosed in ***Annexure -III***.

This study covers the following scope:-

***Supply Side (Academics)***

- Electrical Engineering
- Mechanical Engineering
- Production Engineering
- Industrial Engineering

***Demand Side (Infrastructure Industries)***

- Power
- Oil, Gas & Petroleum
- Steel & Alumminum
- Automobiles
- Railways

***Past Period (1994 - 1998) -5 years***

***Future Period (1999 - 2000) -5 years***

## 2.02 METHODOLOGY

- Questionnaire having closed ended questions.
- Through personal visits, interviews and discussions with the concerned officials, wherever required.
- To assess the gaps of future requirements of the specified industries, a %age was worked out of the past five years (1994-98) of ***actual recruitment.*** The same % age is applied to the engineering graduates likely to be recruited in the next five years (1999-2004). This is compared against the actual demand as worked out from the data supplied by the industry.
- Similar procedure is followed to work out gaps ***rank-wise*** i.e. Distinction holders, 1st Class & 2nd Class and also for ***sector-wise analysis***.

## 2.03 SAMPLE SIZE

- On the Academic side, a sample size of ***35%*** of the total population was selected, 148 Engineering Institutes out of 418 in 1998. Questionnaire was mailed to all the population
- On the Industry side, a sample size of ***66%*** of the total population was selected i.e. 41 organisations out of 62.

# *Chapter-3*

## 3.00 ANALYSIS

As per the scope and objectives of the study, both ***quantitative & qualitative*** gaps had to be assessed. Study reveals the following:-

### *A. Quantitative Analysis*

*3.01* **Engineers likely to Graduate**

| Branches | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|
| Electrical | 23285 | 26504 | 30948 | 35048 | 38692 |
| Mechanical | 22218 | 25324 | 30528 | 37315 | 40460 |
| Production | 9897 | 11368 | 14336 | 16790 | 19118 |
| Industrial | 2490 | 2980 | 3588 | 4715 | 5675 |
| **Total** | **57890** | **66176** | **79400** | **93868** | **1,03,945** |

*3.02* **Engineers likely to be Recruited**

| Branches | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|
| Electrical | 365 | 405 | 655 | 665 | 777 |
| Mechanical | 4297 | 4632 | 4788 | 4943 | 5042 |
| Production & Industrial | 825 | 1040 | 1070 | 1328 | 1610 |
| **Total** | **5487** | **6077** | **6513** | **6936** | **7429** |

*3.03* **Gaps on overall basis**

The table below shows the ***quantitative gaps*** on the ***overall basis***:-

| Year | Position | Electrical | Mechanical | P&I |
|---|---|---|---|---|
| 1999 | Supply (S)<br>Demand (D) | 1541<br>365 | 1835<br>4297 | 2602<br>825 |
| | **Gaps (S-D)** | **1176** | **-2462** | **1777** |

| Year | Position | Electrical | Mechanical | P&I |
|---|---|---|---|---|
| **2000** | Supply (S)<br>Demand (D) | 1755<br>405 | 2092<br>4632 | 3014<br>1040 |
| | **Gaps (S-D)** | **1350** | **-2540** | **1974** |
| **2001** | Supply (S)<br>Demand (D) | 2049<br>655 | 2522<br>4788 | 3766<br>1070 |
| | **Gaps (S-D)** | **1394** | **-2266** | **2696** |
| **2002** | Supply (S)<br>Demand (D) | 2320<br>665 | 3082<br>4943 | 4518<br>1328 |
| | **Gaps (S-D)** | **1655** | **-1861** | **3190** |
| **2003** | Supply (S)<br>Demand (D) | 2561<br>777 | 3196<br>5042 | 5209<br>1610 |
| | **Gaps (S-D)** | **1784** | **-1846** | **3599** |

The above gaps have been worked out on the following basis:-

| S.No. | Branch | Avg. %age of recruitment by industry from 94-98 |
|---|---|---|
| 1 | Electrical | 6.62 |
| 2 | Mechanical | 8.26 |
| 3 | P & I | 21.01 |

As far as Electrical, Production and Industrial Engineers are concerned, there is ***surplus***. For Mechanical Engineers, there is shortage. As stated above, the industry does not distinguish between M, P & I engineers and, therefore, this ***shortage*** is based on the %ages worked out from the trend. **However, the total number of Mechanical Engineers graduating is much more and in case there is demand, Mechanical Engineers will join since they will prefer these specified industries (these industries are key for India's economic development & growth).**

*3.04* **Gaps rank-wise**

Gaps (±) have also been worked out ***rank-wise on overall basis*** in three categories viz. Distinction, 1st Class, 2nd Class:-

| Branches | Years | Gaps (±) | | |
|---|---|---|---|---|
| | | Distinction | 1st | 2nd |
| **Electrical** | 1999 | 316 | 642 | 245 |
| | 2000 | 363 | 735 | 279 |
| | 2001 | 361 | 770 | 290 |
| | 2002 | 433 | 906 | 343 |
| | 2003 | 462 | 980 | 369 |
| **Mechanical** | 1999 | -1035 | -1471 | 74 |
| | 2000 | -1080 | -1531 | 101 |
| | 2001 | -1001 | -1403 | 168 |
| | 2002 | -881 | -1210 | 260 |
| | 2003 | -881 | -1209 | 274 |
| **P & I** | 1999 | 673 | 601 | 503 |
| | 2000 | 752 | 640 | 582 |
| | 2001 | 1142 | 951 | 732 |
| | 2002 | 1201 | 1112 | 877 |
| | 2003 | 1360 | 1229 | 1010 |

These have been worked out on the following basis.

| Branches | Average %age of Recruitment by Industries from 1994-98 in various sectors | | |
|---|---|---|---|
| | Distinction | 1st | 2nd |
| Electrical | 34 | 47 | 19 |
| Mechanical | 38 | 56 | 6 |
| P & I | 32 | 66 | 2 |

*3.05* **Gaps sector-wise**

The table below shows the quantitative gap analysis ***sector wise:-***

| Branches | Years | Total Gaps | | | |
|---|---|---|---|---|---|
| | | Power# | Oil* | Steel** | Automobile |
| **Electrical** | 1999 | 917 | 116 | 135 | -27 |
| | 2000 | 1038 | 177 | 48 | 42 |
| | 2001 | 1128 | -64 | 180 | 94 |
| | 2002 | 1144 | 133 | 203 | 108 |
| | 2003 | 1422 | 169 | 157 | -41 |
| **Mechanical** | 1999 | -2573 | 153 | 61 | -16 |
| | 2000 | -2845 | 310 | 64 | 25 |
| | 2001 | -3122 | 811 | 106 | 46 |
| | 2002 | -2574 | 861 | -79 | 56 |
| | 2003 | -1374 | 824 | -305 | -687 |
| **P & I** | 1999 | 369 | 283 | 546 | 580 |
| | 2000 | 427 | 236 | 816 | 495 |
| | 2001 | 534 | 439 | 847 | 875 |
| | 2002 | 641 | 531 | 937 | 1081 |
| | 2003 | 739 | 714 | 1107 | 1039 |

* ***Oil means Oil, Gas & Petroleum.***

\# ***Power means Conventional & Non conventional both.***

** ***Steel includes Aluminium also.***

The above gaps have been worked out on the following basis:-

| Branches | Average %age of Recruitment by Industries from 1994-98 in various sectors | | | |
|---|---|---|---|---|
| | Power | Oil | Steel | Automobile |
| Electrical | 4.59 | 0.85 | 0.58 | 0.33 |
| Mechanical | 3.42 | 4.14 | 0.80 | 0.15 |
| P & I | 2.98 | 2.88 | 7.45 | 7.70 |

## *B. Qualitative Analysis*

Qualitative analysis is based on the following **paramaters**:-

a) **%age emphasis in the engineering curriculum on the following skills:- (Majority Assessment)**

- **Analytical Skills**
- **Communication Skills**
- **Other Skills like**
  - **Team Spirit**
  - **Commitment**
  - **Dedication**

*Results based on the Majority assessment are as follows:-*

| **Particulars** | **Academics** | **Industry** |
|---|---|---|
| Analytical Skills | 30 | 30 |
| Communication Skills | 15 | 20 |
| Interpersonal Skills | 20 | 20 |
| Other Skills | 35* | 30* |
| a) Team Spirit* | 10 | 5 |
| b) Commitment* | 10 | 10 |
| c) Dedication* | 15 | 15 |

**Industry wants more emphasis on communication skills.**

**(b) %age of emphasis in the engineering curriculum in the emerging areas:- (Majority Assessment)**

- Business Process Reengineering (BPR)
- Total Quality Management (TQM)
- Project Management (PM)
- Intellectual Property Rights (IPR)
- ISO etc.
- Basic Sciences vs. Application Side

*Results based on the Majority assessment are as follows:-*

| Particulars | Academics % | Industry % |
|---|---|---|
| Business Process Re-engineering (BPR) | 8 | 20 |
| Total Quality Management (TQM) | 42 | 25 |
| Project Management (PM) | 25 | 25 |
| Intellectual Property Regime (IPR) | 8 | 10 |
| ISO | 17 | 20 |
| Basic Sciences vs. Application Side | 70:30 | 50:50 |

Industry wants more emphasis in Engineering Curriculum on BPR, IPR, ISO and equal emphasis on Basic Science vs. Application Side.

**(c) Overall Assessment:-**

***This included following factors:-***

- Technical Know-how
- General Knowledge
  - National
  - International
  - Sports
- Intelligence Quotient
- Mental Quotient

*Results based on the Majority assessment are as follows:-*

***Technical Know-how***

***(Excellent)***

Industry has rated higher than the Academic Institutes. The reason is that these specified industries recruit the ***Cream*** of the engineers and further train them for one-two years to suit their specific needs.

***(Very Good)***

Industry has rated lower than Academic Institutes.

***General Knowledge -National***

***(Excellent)***

Industry has rated higher than the Academic Institutes. The reason is that these specified industries recruit the ***Cream*** of the engineers.

***(Very Good)***

Almost equal.

***Sports***

No firm view since sports is not given any importance either in Industry & Academics Institutes.

***General Knowledge - International***

Industry has rated higher than the Academic Institutes. The reason is that these specified industries recruit the ***Cream*** of the engineers.

***Intelligence Quotient***

Industry has rated lower than the Academic Institutes.

***Mental Quotient***

Industry has rated higher since they recruit the ***Cream.***

***Note:***The above *analysis of data is based on the details furnished by 41 organisations from select infrastructure industries who have by and large recruited engineers from institutions like IITs, BITs (Pilani and Ranchi) IISc, Univ. of Rookee, RECs.*

**(d) Placement/ Campus Selection**

*The position is as follows:-*

- Same organisation visited 25% of the same Institute 6 times.
- Same organisation visited 46% of the same Institute once.
- Same organisation visited 8% of the same Institute Twice.
- Same organisation visited 13% of the same Institute Thrice.
- Same organisation visited 8% of the same Institute Four times.

**(e) Chair in the Institute.**

- Only 10% of the Colleges have chairs constituted by the Industry.
- 12% of industry adopted any laboratories in Institutes.
- 60% Industries visited 3 Engineering Colleges in a year for placement. More than half i.e. 52% visited I.I.Ts only.

**(f) Visit of Executives from Industry.**

The following table indicates the position:-

| *Year* | *Academic interaction with Industry (Nos.)* | *Industry interaction with Academic (Nos.)* |
|---|---|---|
| *1994* | *260* | *312* |
| *1995* | *465* | *358* |
| *1996* | *656* | *390* |
| *1997* | *986* | *390* |
| *1998* | *975* | *486* |

**More Academicians are visiting Industry then Industry Executives visiting Engineering Institutes.**

g) **There is steady increase of Faculuty Members attending courses.**

(h) **Other Factors**

*Results based on the Majority assessment are as follows:-*

(i) **Faculty Student ratio.**

- *Faculty Student Ratio* ***1:10***

***(This is as per the present norms of AICTE)***

(ii) **Teachers retrained.**

- *Teachers Retraining* ***After Every 3 years***

(iii) **Faculty Summer training.**

- *Faculty Summer Training Period* ***8 Weeks.***

(iv) **Revision of Engineering Curriculum.**

- Industry want revision ***every 3 years*** where as Academics ***every 5 years***.

(v) **Students' Summer training.**

- *Industry want minimum summer training period of* ***16 weeks*** *& Academics want* ***12 weeks.***

(vi) **One year Internship in industry before Award of Degree.**

- **69%** of Industry and **64%** of Academic Institutes want Internship.

(vii) **Aptitude test for admission.**

- **80%** of Industry and **68%** of Academic Institutes want an aptitude test before admission.

(viii) **Cross Migration during Studies.**

- **85%** of Industry and **56%** of Academic Institutes want Cross Migration.

(ix) **Faculty Selection through an all India Competitive Exams.**

- **85%** of Industry and **54%** of Academic Institutes want a competitive exams before the selection of faculty.

(x) **Code of Conduct & Ethics for engineers.**

- **94%** of Industry and **99%** of Academic Institutes want a code of conduct and ethics for engineers.

(xi) **Licensing System for engineers.**

- **64%** of Industry and **77%** of Academic Institutes want a licensing system for engineers.

(xii) **Resource Networking.**

- **62%** of Industry and **96%** of Academic Institutes want a resource networking between Academic Institutes & Industry.

(xiii) **%age Marking System Vs. Grading System.**

- **62%** of Industry want %age marking system and not grading system, where as **58%** of Academic want **Grading System**.

(xi) **Evaluation System.**

- **62%** of Industry and 35% of Academic Institutes want **external** evaluation system (Outsider as evaluator).

# Chapter-4

## 1.00 Build up of Engineering Institutes

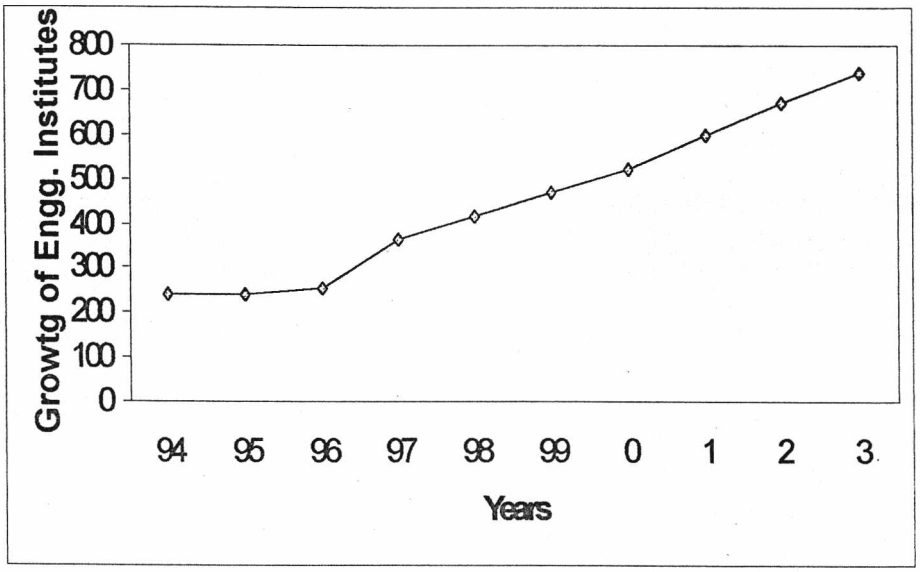
| *Year* | *Existing Number of Institutes* | *New Approvals by AICTE* | *Number of ** Institutes for E,M,P & I* |
|---|---|---|---|
| *1994* | *240* | | *240* |
| *1995* | *240* | | *240* |
| *1996* | *254* | *60* | *254* |
| *1997* | *439* | *94* | *364* |
| *1998* | *503* | *88* | *418* |
| *1999* | | *80** | |
| *1999* | *566* | -- | *470* |
| *2000* | *566 + 60 = 626* | -- | *520* |
| *2001* | *626 + 94 = 720* | -- | *598* |
| *2002* | *720 + 88 = 808* | -- | *671* |
| *2003* | *808 + 80*=888* | -- | *737* |

* *Projections.*

** *83% for Electrical, Mechanical, Production & Industrial Engineers based on 1997-98. list of AICTE.(1) (2) (3)*

***E*** *= Electrical,* ***M*** *= Mechanical,* ***P*** *= Production &* ***I*** *= Industrial*

***Source:*** *AICTE & IIP Director (4)*



## 2.00 Build up of Specified Industries

| *Sector* | *Number of Organisation* | |
|---|---|---|
| | *1999 - 2000* | *1994 - 1998* |
| *Power* | *30* | *15* |
| *Oil, Gas & Petrolum* | *10* | *09* |
| *Steel & Aluminum* | *12* | *10* |
| *Automobile* | *10* | *07* |
| *Total* | *62* | *41* |
| *Railways* | *01* | *01* |

*Source: Indian Infrastructure & Powerline (5&6)*

## 3.00 Actual Average Ratio of Recruitment

a) **Electrical** **6.62%**

b) **Mechanical** **8.26%**

c) **Production & Industrial** **21.01%**

### a) Electrical

| *Year* | *Engineers actually graduated (1)* | *Engineers actually recruited by Specified Industries (2)* | *%age of 2/1* |
|---|---|---|---|
| *1994* | *7404* | *235* | *3.17* |
| *1995* | *8155* | *741* | *9.08* |
| *1996* | *9576* | *887* | *9.26* |
| *1997* | *14709* | *898* | *6.10* |
| *1998* | *17493* | *966* | *5.52* |
| | | *Average* | *6.62%* |

## b) Mechanical

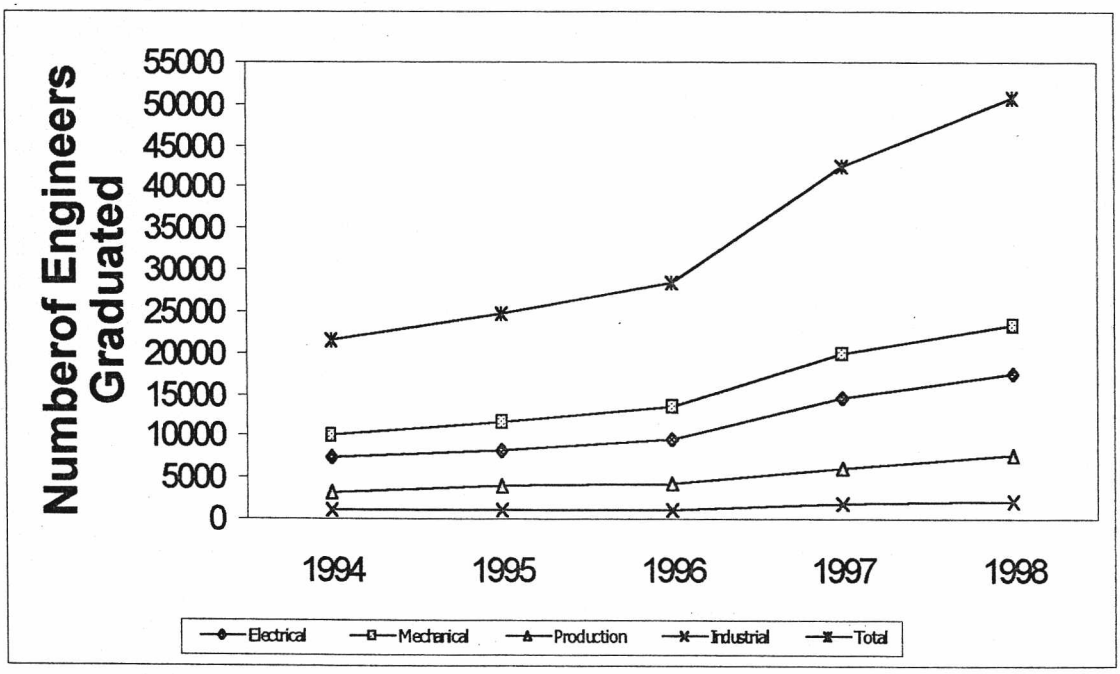
| *Year* | *Engineers actually graduated (1)* | *Engineers actually recruited by Specified Industries (2)* | *%age of 2/1* |
|---|---|---|---|
| *1994* | *10043* | *1188* | *11.83* |
| *1995* | *11687* | *792* | *6.77* |
| *1996* | *13497* | *1128* | *8.38* |
| *1997* | *19983* | *1592* | *7.96* |
| *1998* | *23362* | *1492* | *6.38* |
| | | *Average* | *8.26%* |

## c) Production & Industrial

| *Year* | *Engineers actually graduated (1)* | *Engineers actually recruited by Specified Industries (2)* | *%age of 2/1* |
|---|---|---|---|
| *1994* | *4082* | *1018* | *24.90* |
| *1995* | *4986* | *1218* | *24.42* |
| *1996* | *5428* | *1112* | *20.48* |
| *1997* | *7947* | *1492* | *18.77* |
| *1998* | *9852* | *1624* | *16.48* |
| | | *Average* | *21.01%* |

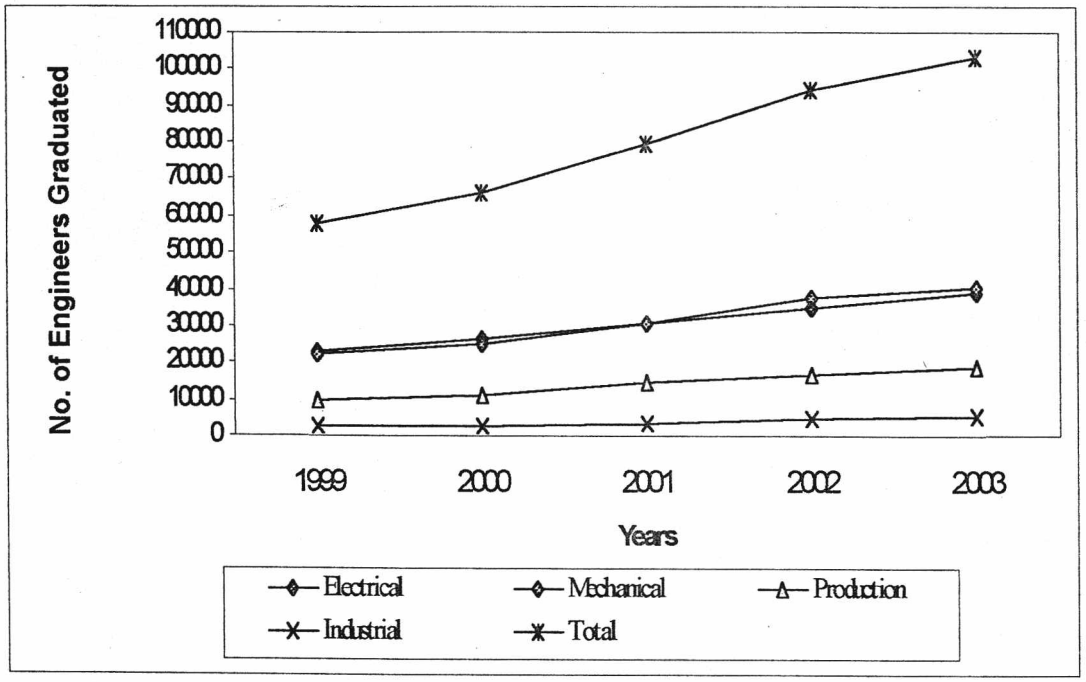
## 4.00 Engineers Actually Graduated (1994-98)

| *Branches* | *1994* | *1995* | *1996* | *1997* | *1998* |
|---|---|---|---|---|---|
| *Electrical* | *7404* | *8155* | *9576* | *14709* | *17493* |
| *Mechanical* | *10043* | *11687* | *13497* | *19983* | *23362* |
| *Production* | *3107* | *4004* | *4320* | *6210* | *7821* |
| *Industrial* | *975* | *982* | *1108* | *1737* | *2031* |
| *Total* | *21529* | *24828* | *28501* | *42639* | *50707* |
| *%age increase over 1994* | *–* | *15.32* | *32.38* | *98.05* | *135.52* |



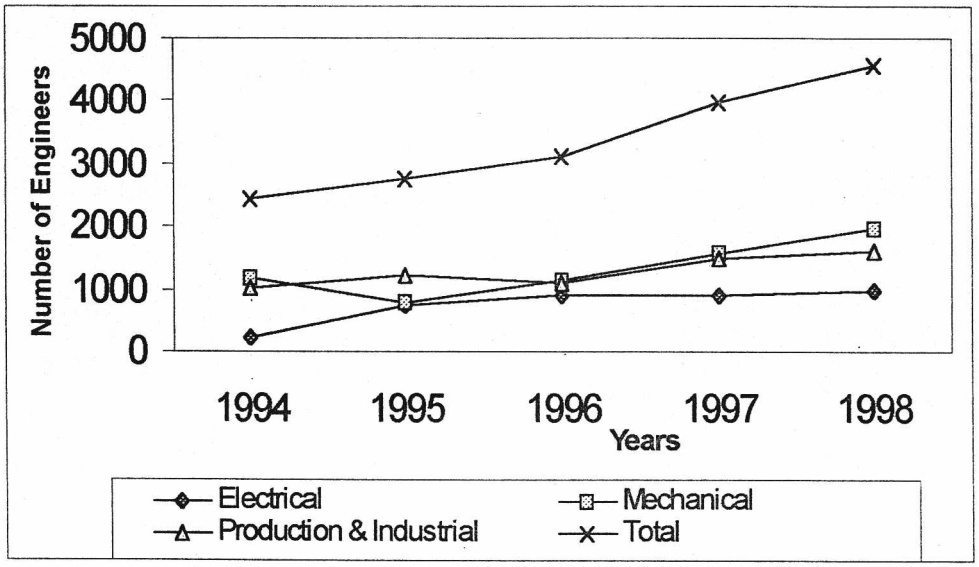
## 5.00 Engineers Likely to Graduate (1999-2003)

| *Branches* | *1999* | *2000* | *2001* | *2002* | *2003* |
|---|---|---|---|---|---|
| *Electrical* | *23285* | *26504* | *30948* | *35048* | *38692* |
| *Mechanical* | *22218* | *25324* | *30528* | *37315* | *40460* |
| *Production* | *9897* | *11368* | *14336* | *16790* | *19118* |
| *Industrial* | *2490* | *2980* | *3588* | *4715* | *5675* |
| *Total* | *57890* | *66176* | *79400* | *93868* | *1,03,945* |
| *%age increase over 1994* | *–* | *14.31* | *37.16* | *62.14* | *79.56* |



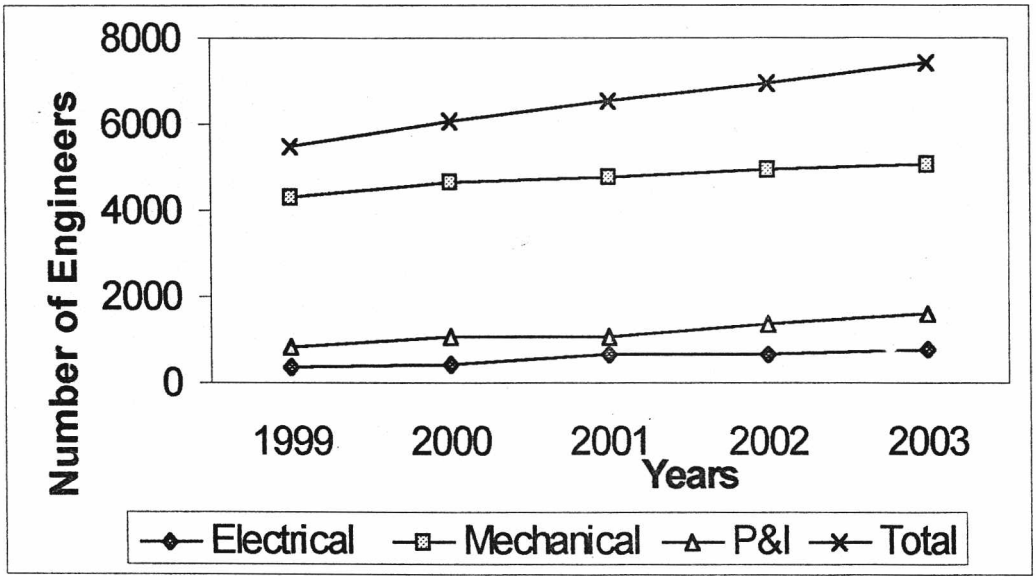
## 6.00 Engineers Actually recruited by the Specified Industry (1994-1998)

| *Branches* | *1994* | *1995* | *1996* | *1997* | *1998* |
|---|---|---|---|---|---|
| *Electrical* | *235* | *741* | *887* | *898* | *966* |
| *Mechanical* | *1188* | *792* | *1128* | *1592* | *1965* |
| *Production & Industrial* | *1018* | *1218* | *1112* | *1492* | *1624* |
| *Total* | *2441* | *2751* | *3127* | *3982* | *4555* |



## 7.00 Engineers likely to be recruited by the Specified Industry (1999-2003)

| *Branches* | *1999* | *2000* | *2001* | *2002* | *2003* |
|---|---|---|---|---|---|
| *Electrical* | *365* | *405* | *655* | *665* | *777* |
| *Mechanical* | *4297* | *4632* | *4788* | *4943* | *5042* |
| *Production & Industrial* | *825* | *1040* | *1070* | *1328* | *1610* |
| *Total* | *5487* | *6077* | *6513* | *6936* | *7429* |



# 8.00 Overall Gap Analysis

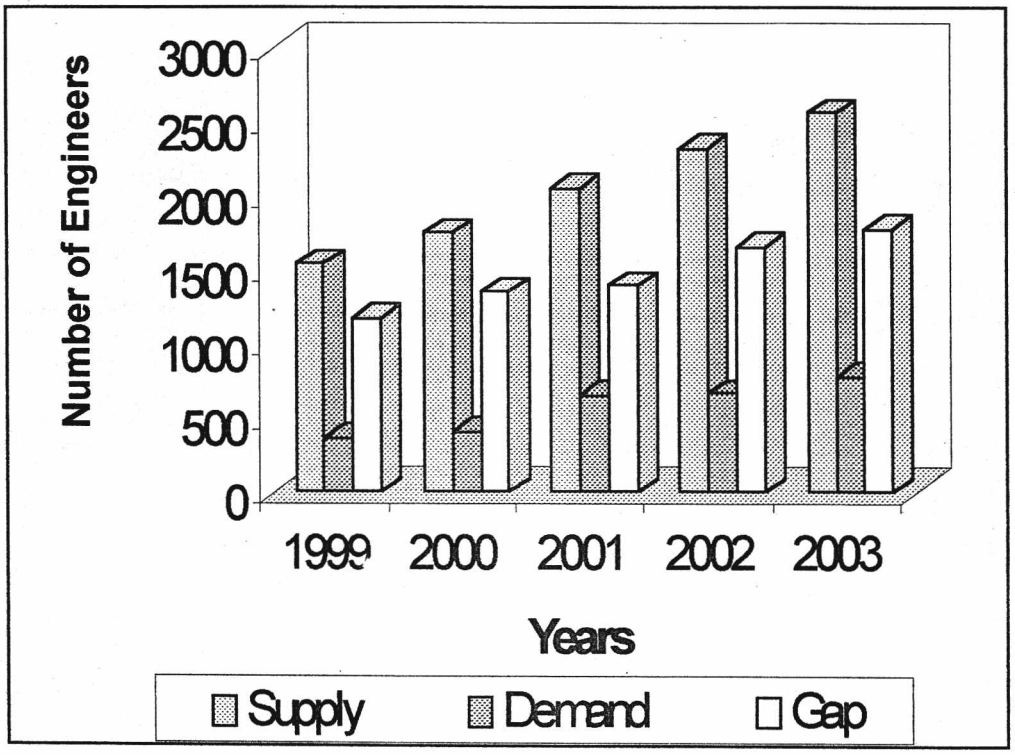
| Year | Position | Electrical | Mechanical | P&I |
|---|---|---|---|---|
| 1999 | Supply (S) | 1541 | 1835 | 2602 |
| | Demand (D) | 365 | 4297 | 825 |
| | **Gaps (S-D)** | **1176** | **-2462** | **1777** |
| 2000 | Supply (S) | 1755 | 2092 | 3014 |
| | Demand (D) | 405 | 4632 | 1040 |
| | **Gaps (S-D)** | **1350** | **-2540** | **1974** |
| 2001 | Supply (S) | 2049 | 2522 | 3766 |
| | Demand (D) | 655 | 4788 | 1070 |
| | **Gaps (S-D)** | **1394** | **-2266** | **2696** |
| 2002 | Supply (S) | 2320 | 3082 | 4518 |
| | Demand (D) | 665 | 4943 | 1328 |
| | **Gaps (S-D)** | **1655** | **-1861** | **3190** |
| 2003 | Supply (S) | 2561 | 3196 | 5209 |
| | Demand (D) | 777 | 5042 | 1610 |
| | **Gaps (S-D)** | **1784** | **-1846** | **3599** |

S – Number of Engineers available for recruitment for Industry based on the past %age (for e.g. 23285 x 6.62%).

D – Number of Engineers likely to be recruited by the Industry based on the actual data in Table No. 7.

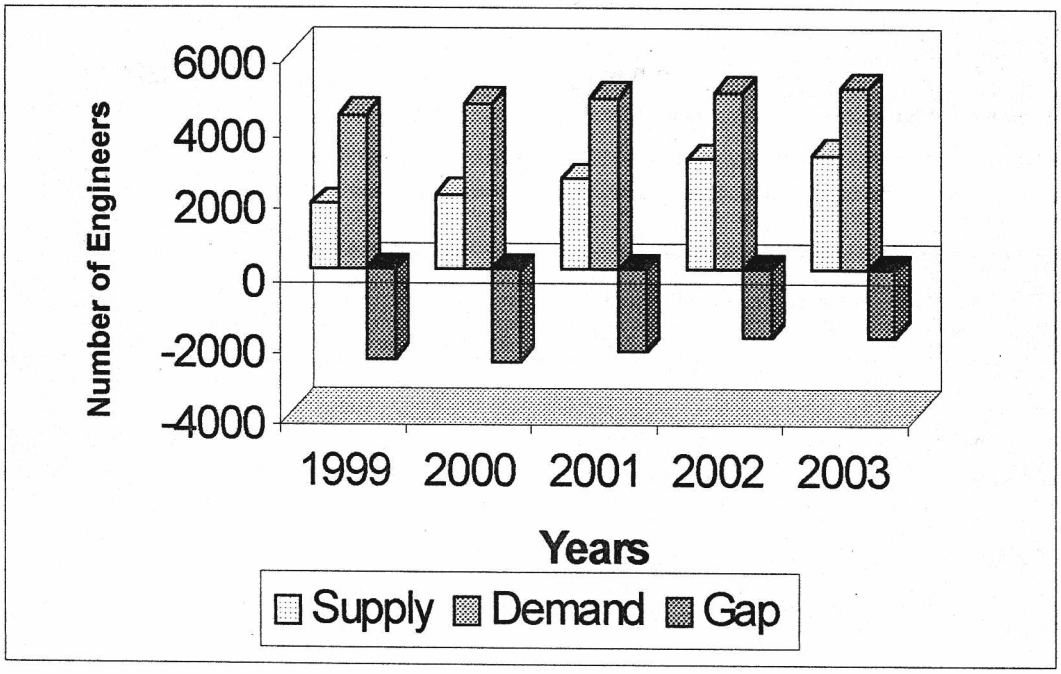
# Overall Gap Position

## (a) Electrical Branch



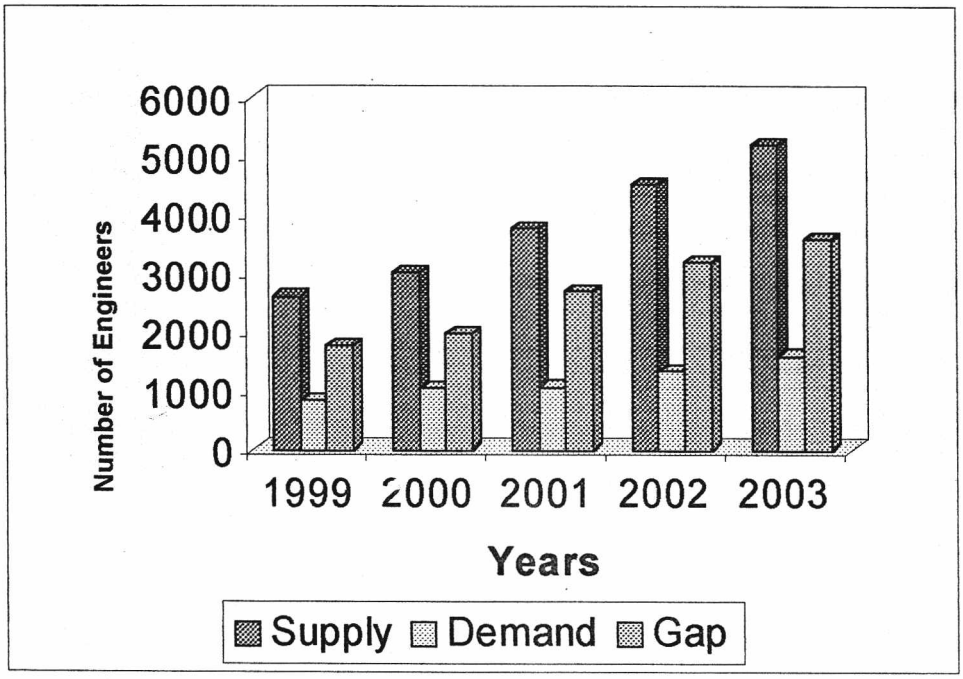
# Overall Gap Position

## (b) Mechanical Branch



# Overall Gap Position

## (c) Production & Industrial Branch



## 9.00 Overall Gap Analysis (Rank-wise)

### a) Engineers Actually Graduated in Electrical Branch (1994-98)

| Year | Distinction | 1st | 2nd | Total |
|---|---|---|---|---|
| 1994 | 1629 *(22%)* | 3702 *(50%)* | 2073 *(28%)* | 7404 *(100%)* |
| 1995 | 2120 *(26%)* | 4241 *(52%)* | 1794 *(22%)* | 8155 *(100%)* |
| 1996 | 3064 *(32%)* | 4788 *(50%)* | 1724 *(18%)* | 9576 *(100%)* |
| 1997 | 5001 *(34%)* | 7649 *(52%)* | 2059 *(14%)* | 14709 *(100%)* |
| 1998 | 4898 *(28%)* | 9446 *(54%)* | 3149 *(18%)* | 17493 *(100%)* |
| Avg. % | 28% | 52% | 20% | |

### b) Engineers Actually Recruited in Electrical Branch (1994-98).

| Year | Distinction | 1st | 2nd | Total *(Ref. Page32 )* |
|---|---|---|---|---|
| 1994 | 70 *(33%)* | 107 *(50%)* | 37 *(17%)* | 214 *(100%)* |
| 1995 | 238 *(33%)* | 360 *(50%)* | 122 *(17%)* | 720 *(100%)* |
| 1996 | 275 *(33%)* | 376 *(45%)* | 183 *(22%)* | 834 *(100%)* |
| 1997 | 346 *(40%)* | 346 *(40%)* | 174 *(20%)* | 866 *(100%)* |
| 1998 | 312 *(33%)* | 473 *(50%)* | 161 *(17%)* | 946 *(100%)* |
| Avg. % | 34% | 47% | 19% | |

# Gap Analysis (Rank-wise)

## c) Engineers Actually Graduated in Mechanical Branch (1994-98)

| Year | Distinction | 1st | 2nd | Total |
|---|---|---|---|---|
| 1994 | 2912 *(29%)* | 4922 *(49%)* | 2209 *(22%)* | 10043 *(100%)* |
| 1995 | 3272 *(28%)* | 5844 *(50%)* | 2571 *(22%)* | 11687 *(100%)* |
| 1996 | 4724 *(35%)* | 6749 *(50%)* | 2024 *(15%)* | 13497 *(100%)* |
| 1997 | 6594 *(33%)* | 9991 *(50%)* | 3808 *(17%)* | 19983 *(100%)* |
| 1998 | 8878 *(38%)* | 11447 *(49%)* | 3037 *(13%)* | 23362 *(100%)* |
| Avg. % | 32% | 50% | 18% | |

## d) Engineers Actually Recruited in Mechanical Branch (1994-98).

| Year | Distinction | 1st | 2nd | Total *(Ref. Page 32)* |
|---|---|---|---|---|
| 1994 | 375 *(32%)* | 740 *(63%)* | 59 *(5%)* | 1174 *(100%)* |
| 1995 | 249 *(32%)* | 498 *(64%)* | 31 *(4%)* | 778 *(100%)* |
| 1996 | 540 *(49%)* | 508 *(46%)* | 56 *(5%)* | 1104 *(100%)* |
| 1997 | 695 *(45%)* | 758 *(49%)* | 93 *(6%)* | 1546 *(100%)* |
| 1998 | 621 *32%)* | 1164 *(60%)* | 155 *(8%)* | 1940 *(100%)* |
| Avg. % | 38% | 56% | 6% | |

## e) Engineers Actually Graduated in Production & Industrial Branch (1994-98)

| Year | Distinction | 1st | 2nd | Total |
|---|---|---|---|---|
| 1994 | 1347 *(33%)* | 1592 *(39%)* | 1143 *(28%)* | 4082 *(100%)* |
| 1995 | 1845 *(37%)* | 2094 *(42%)* | 1047 *(21%)* | 4986 *(100%)* |
| 1996 | 1846 *(34%)* | 2551 *(47%)* | 1031 *(19%)* | 5428 *(100%)* |
| 1997 | 2622 *(33%)* | 3974 *(50%)* | 1351 *(17%)* | 7947 *(100%)* |
| 1998 | 3645 *(37%)* | 4532 *46%)* | 1675 *(17%)* | 9852 *(100%)* |
| Avg. % | 36% | 44% | 20% | |

## f) Engineers Actually Recruited in Production & Industrial Branch (1994-98).

| Year | Distinction | 1st | 2nd | Total *(Ref. Page 32 )* |
|---|---|---|---|---|
| 1994 | 305 *(30%)* | 703 *(69%)* | 10 *(1%)* | 1018 *(100%)* |
| 1995 | 365 *(30%)* | 840 *(69%)* | 13 *(1%)* | 1218 *(100%)* |
| 1996 | 322 *(49%)* | 768 *(46%)* | 22 *(5%)* | 1112 *(100%)* |
| 1997 | 492 *(33%)* | 955 *(64%)* | 45 *(3%)* | 1492 *(100%)* |
| 1998 | 584 *(36%)* | 1007 *(62%)* | 33 *(2%)* | 1624 *(100%)* |
| Avg. % | 32% | 66% | 2% | |

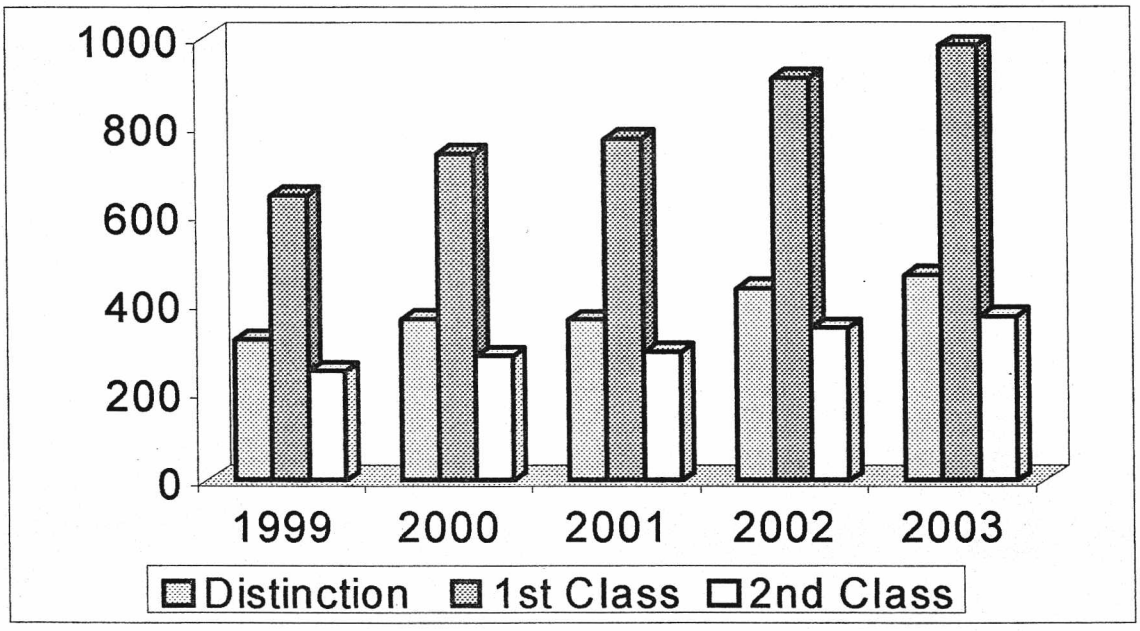
***Note:*** ***Railways recruit their engineers through UPSC examinations. They do not maintain data rank-wise. Hence, the rank-wise a1`nalysis does not cover Railways. (Applicable for Pages 26 to 31 ).***

## 10.00 Future Gap Analysis (Rank-wise)

### a) Electrical Branch

| Year | Supply | | | Demand | | | Gaps (+,-) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Dis | 1st | 2nd | Dis | 1st | 2nd | Dis | 1st | 2nd |
| 1999 | 431* | 801 | 309 | 115# | 159 | 64 | 316 | 642 | 245 |
| 2000 | 491 | 913 | 351 | 128 | 178 | 72 | 363 | 735 | 279 |
| 2001 | 574 | 1065 | 410 | 213 | 295 | 120 | 361 | 770 | 290 |
| 2002 | 650 | 1206 | 464 | 217 | 300 | 121 | 433 | 906 | 343 |
| 2003 | 717 | 1332 | 512 | 255 | 352 | 143 | 462 | 980 | 369 |

*(* for e.g. 1541 x 28%)* *(# for e.g. 338 x 34%)*

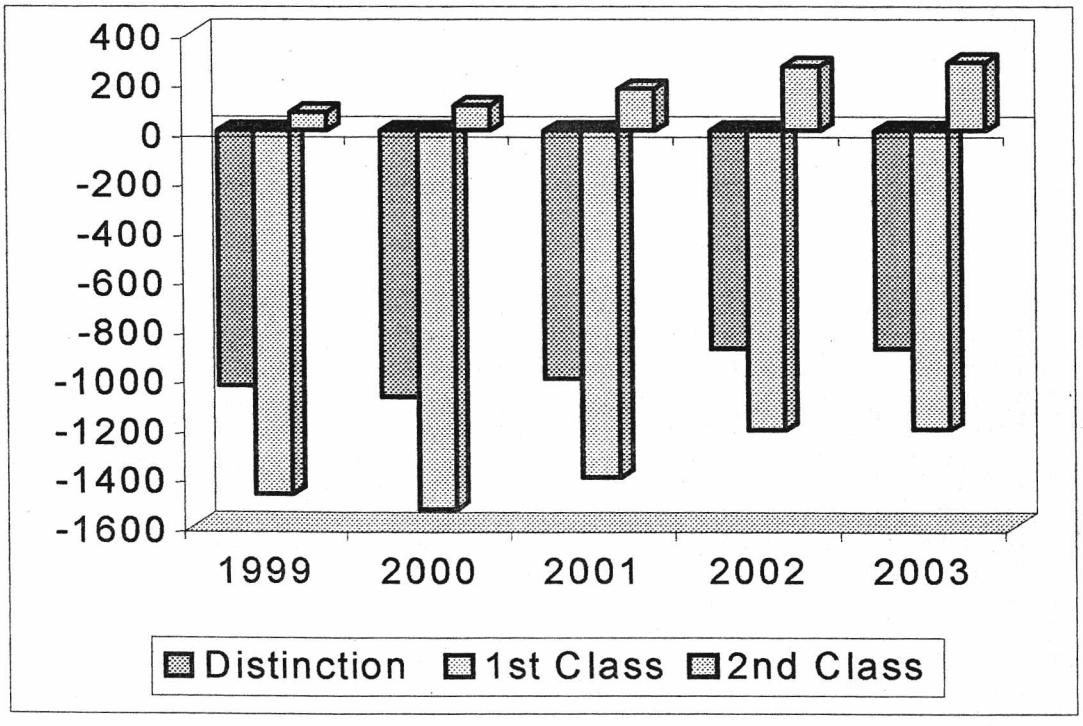


# Future Gap Analysis (Rank-wise)

## b) Mechanical Branch

| Year | Supply | | | Demand | | | Gaps (+,-) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Dis | 1st | 2nd | Dis | 1st | 2nd | Dis | 1st | 2nd |
| 1999 | 587* | 918 | 330 | 1622 | 2389 | 256 | -1035 | -1471 | 74 |
| 2000 | 669 | 1046 | 377 | 1749 | 2577 | 276 | -1080 | -1531 | 101 |
| 2001 | 807 | 1261 | 454 | 1808 | 2664 | 286 | -1001 | -1403 | 168 |
| 2002 | 986 | 1541 | 555 | 1867 | 2751 | 295 | -881 | -1210 | 260 |
| 2003 | 1023 | 1598 | 575 | 1904 | 2807 | 301 | -881 | -1209 | 274 |

*(* for e.g. 1835 x 32%)*

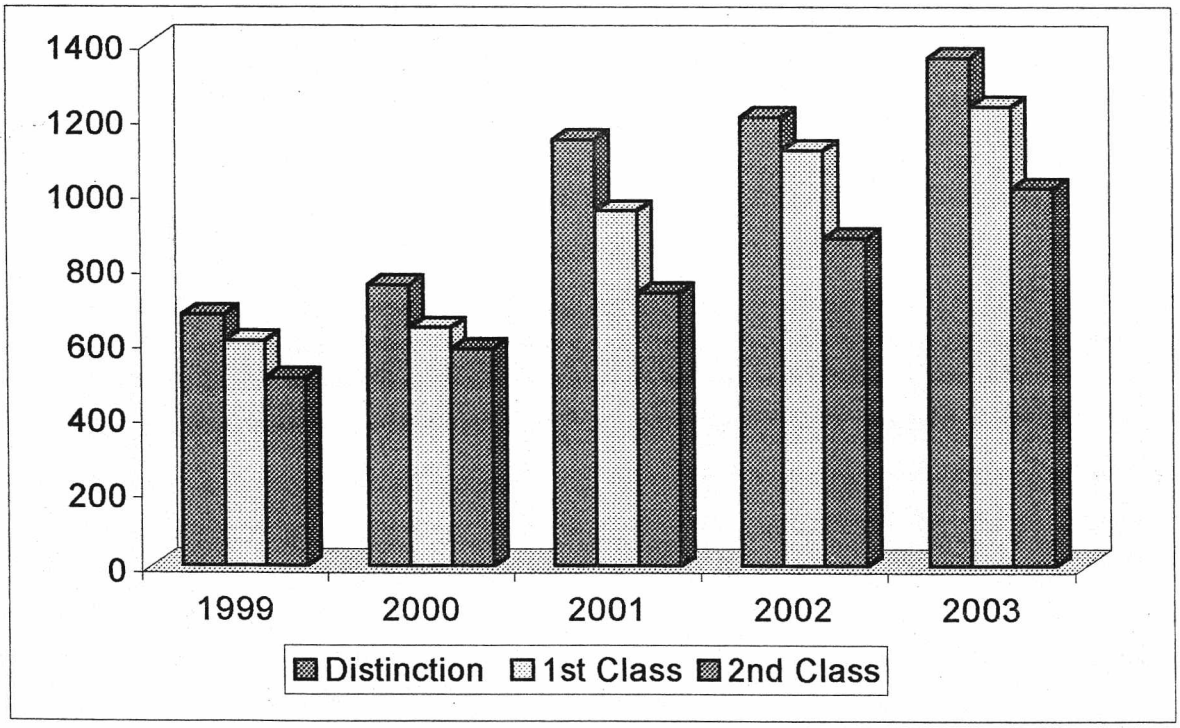


# Future Gap Analysis (Rank-wise)

## c) Production & Industrial Branch

| Year | Supply | | | Demand | | | Gaps (+,-) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Dis | 1st | 2nd | Dis | 1st | 2nd | Dis | 1st | 2nd |
| 1999 | 937* | 1145 | 520 | 264 | 544 | 17 | 673 | 601 | 503 |
| 2000 | 1085 | 1326 | 603 | 333 | 686 | 21 | 752 | 640 | 582 |
| 2001 | 1356 | 1657 | 753 | 214 | 706 | 21 | 1142 | 951 | 732 |
| 2002 | 1626 | 1988 | 904 | 425 | 876 | 27 | 1201 | 1112 | 877 |
| 2003 | 1875 | 2292 | 1042 | 515 | 1063 | 32 | 1360 | 1229 | 1010 |

*(* for e.g. 2602 x 36%)*



## 11.00 Gaps Analysis (Sector-wise)

### a) Engineers actually recruited in the past by the industry

| Industry | | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|---|
| Power Conventional & Non Conventional | Electrical | 107 | 535 | 635 | 639 | 693 |
| | Mechanical | 573 | 307 | 222 | 635 | 920 |
| | P & I | 174 | 160 | 200 | 190 | 136 |
| Oil,Gas & Petroleum | Electrical | 85 | 79 | 103 | 112 | 56 |
| | Mechanical | 461 | 379 | 812 | 746 | 727 |
| | P & I | 128 | 289 | 60 | 150 | 246 |
| Steel & Alluminium | Electrical | | 80 | 83 | 84 | 80 |
| | Mechanical | 117 | 65 | 58 | 134 | 276 |
| | P & I | 363 | 384 | 424 | 561 | 568 |
| Automobile | Electrical | 22 | 26 | 13 | 31 | 117 |
| | Mechanical | 23 | 27 | 12 | 31 | 17 |
| | P & I | 353 | 385 | 428 | 591 | 674 |
| Total | Electrical | 214 | 720 | 834 | 866 | 946 |
| | Mechanical | 1174 | 778 | 1104 | 1546 | 1940 |
| | P & I | 1018 | 1218 | 1112 | 1492 | 1624 |

*Note: Railways do not recruit through open market. All their recruitment is through UPSC examinations. Hence Railways not covered in the Sector-wise analysis..*

# Gaps Analysis (Sector-wise)

## b) Electrical Engineers actually recruited by specified industry

| Year | Actually Graduated | Actually Recruited by | | | |
|---|---|---|---|---|---|
| | | Power | Oil | Steel | Automobile |
| 1994 | 7404 | 107 *(1.44%)* | 85 *(1.14%)* | -- | 22 *(0.30%)* |
| 1995 | 8155 | 535 *(6.56%)* | 79 *(0.97%)* | 80 *(0.98%)* | 26 *(0.32%)* |
| 1996 | 9576 | 635 *(6.63%)* | 103 *(1.08%)* | 83 *(0.87%)* | 13 *(0.14%)* |
| 1997 | 14709 | 639 *(4.34%)* | 112 *(0.76%)* | 84 *(0.57%)* | 31 *(0.21%)* |
| 1998 | 17493 | 693 *(3.96%)* | 56 *(0.32%)* | 80 *(0.46%)* | 117 *(0.67%)* |
| | **Avg. %age** | **4.59** | **0.85** | **0.58** | **0.33** |

*Note: Majority of the Electrical Engineers recruited by Power Industry.*

## c) Mechanical Engineers actually recruited by specified industry

| Year | Actually Graduated | Actually Recruited by | | | |
|---|---|---|---|---|---|
| | | Power | Oil | Steel | Automobile |
| 1994 | 10043 | 573 *(5.7%)* | 461 *(4.6%)* | 117 *(1.16%)* | 23 *(0.23%)* |
| 1995 | 11687 | 307 *(2.62%)* | 379 *(3.24%)* | 65 *(0.55%)* | 27 *(0.23%)* |
| 1996 | 13497 | 222 *(1.64%)* | 812 *(6.02%)* | 58 *(0.43%)* | 12 *(0.08%)* |
| 1997 | 19983 | 635 *(3.18%)* | 746 *(3.73%)* | 134 *(0.67%)* | 31 *(0.16%)* |
| 1998 | 23362 | 920 *(3.94%)* | 727 *(3.11%)* | 276 *(1.18%)* | 17 *(0.07%)* |
| | **Avg. %age** | **3.42** | **4.14** | **0.80** | **0.15** |

*Note: Majority of the Mechanical Engineers recruited by Oil Industry and followed by Power Industry.*

# Gaps Analysis (Sector-wise)

## d) P & I Engineers actually recruited by specified industry

| Year | Actually Graduated | Actually Recruited by | | | |
|---|---|---|---|---|---|
| | | Power | Oil | Steel | Automobile |
| 1994 | 4082 | 174 *(4.26%)* | 128 *(3.13%)* | 363 *(8.89%)* | 353 *(8.64%)* |
| 1995 | 4986 | 160 *(3.20%)* | 289 *(5.79%)* | 384 *(7.70%)* | 385 *(7.72%)* |
| 1996 | 5428 | 200 *(3.68%)* | 60 *(1.11%)* | 424 *(7.81%)* | 428 *(7.88%)* |
| 1997 | 7947 | 190 *(2.39%)* | 150 *(1.89%)* | 561 *(7.06%)* | 591 *(7.44%)* |
| 1998 | 9852 | 136 *(1.38%)* | 246 *(2.50%)* | 568 *(5.77%)* | 674 *(6.84%)* |
| | **Avg. %age** | **2.98** | **2.88** | **7.45** | **7.70** |

*Note:* ***Majority of the Production & Industrial Engineers recruited by Automobile Industry and followed by Steel Industry.***

# Gaps Analysis (Sector-wise)

## e) Engineers likely to be recruited in the future by specified industry

| Industry | | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|---|
| Power Conventional & Non Conventional | Electrical | 152 | 179 | 293 | 465 | 354 |
| | Mechanical | 3333 | 3711 | 4166 | 3851 | 2758 |
| | P & I | | | | | |
| Oil,Gas & Petroleum | Electrical | 82 | 48 | 327 | 165 | 160 |
| | Mechanical | 767 | 739 | 453 | 684 | 851 |
| | P & I | 74 | 177 | 77 | 88 | |
| Steel & Aluminium | Electrical | | 106 | | | 67 |
| | Mechanical | 117 | 139 | 139 | 378 | 629 |
| | P & I | 377 | 253 | 488 | 665 | 740 |
| Automobile | Electrical | 104 | 45 | 8 | 8 | 169 |
| | Mechanical | 50 | 13 | | | 747 |
| | P & I | 374 | 610 | 505 | 575 | 870 |
| Total | Electrical | 338 | 378 | 628 | 638 | 750 |
| | Mechanical | 4267 | 4602 | 4758 | 4913 | 4985 |
| | P & I | 825 | 1040 | 1070 | 1328 | 1610 |

*Note: Railways do not recruit through open market. All their recruitment is through UPSC examinations. Hence Railways not covered in the Sector-wise analysis.*

# Gaps Analysis (Sector-wise)

## f) Future Gaps of Electrical Engineers in Power Sector

| Year | Total Engineers Likely to Graduate (A) | Electrical Engineers available (A x 4.59%) (B) | Engineers Required in Power Sector (C) | Gaps (B-C) |
|---|---|---|---|---|
| 1999 | 23285 | 1069 | 152 | 917 |
| 2000 | 26504 | 1217 | 179 | 1038 |
| 2001 | 30948 | 1421 | 293 | 1128 |
| 2002 | 35048 | 1609 | 465 | 1144 |
| 2003 | 38692 | 1776 | 354 | 1422 |

## g) Future Gaps of Electrical Engineers in Oil Sector

| Year | Total Engineers Likely to Graduate (A) | Electrical Engineers available (A x 0.85%) (B) | Engineers Required in Oil Sector (C) | Gaps (B-C) |
|---|---|---|---|---|
| 1999 | 23285 | 198 | 82 | 116 |
| 2000 | 26504 | 225 | 48 | 177 |
| 2001 | 30948 | 263 | 327 | - 64 |
| 2002 | 35048 | 298 | 165 | 133 |
| 2003 | 38692 | 329 | 160 | 169 |

# Gaps Analysis (Sector-wise)

## h) Future Gaps of Electrical Engineers in Steel Sector

| Year | Total Engineers Likely to Graduate (A) | Electrical Engineers available (A x 0.58%) (B) | Engineers Required in Steel Sector (C) | Gaps (B-C) |
|---|---|---|---|---|
| 1999 | 23285 | 135 | -- | 135 |
| 2000 | 26504 | 154 | 106 | 48 |
| 2001 | 30948 | 180 | -- | 180 |
| 2002 | 35048 | 203 | -- | 203 |
| 2003 | 38692 | 224 | 67 | 157 |

## i) Future Gaps of Electrical Engineers in Automobile Sector

| Year | Total Engineers Likely to Graduate (A) | Electrical Engineers available (A x 0.33%) (B) | Engineers Required in Automobile Sector (C) | Gaps (B-C) |
|---|---|---|---|---|
| 1999 | 23285 | 77 | 104 | - 27 |
| 2000 | 26504 | 87 | 45 | 42 |
| 2001 | 30948 | 102 | 8 | 94 |
| 2002 | 35048 | 116 | 8 | 108 |
| 2003 | 38692 | 128 | 169 | - 41 |

# Gaps Analysis (Sector-wise)

## j) Future Gaps of Mechanical Engineers in Power Sector

| Year | Total Engineers Likely to Graduate (A) | Mechanical Engineers available (A x 3.42%) (B) | Engineers Required in Power Sector (C) | Gaps (B-C) |
|---|---|---|---|---|
| 1999 | 22218 | 760 | 3333 | - 2573 |
| 2000 | 25324 | 866 | 3711 | - 2845 |
| 2001 | 30528 | 1044 | 4166 | - 3122 |
| 2002 | 37315 | 1277 | 3851 | - 2574 |
| 2003 | 40460 | 1384 | 2758 | - 1374 |

## k) Future Gaps of Mechanical Engineers in Oil Sector

| Year | Total Engineers Likely to Graduate (A) | Mechanical Engineers available (A x 4.14%) (B) | Engineers Required in Oil Sector (C) | Gaps (B-C) |
|---|---|---|---|---|
| 1999 | 22218 | 920 | 767 | 153 |
| 2000 | 25324 | 1049 | 739 | 310 |
| 2001 | 30528 | 1264 | 453 | 811 |
| 2002 | 37315 | 1545 | 684 | 861 |
| 2003 | 40460 | 1675 | 851 | 824 |

# Gaps Analysis (Sector-wise)

## l) Future Gaps of Mechanical Engineers in Steel Sector

| Year | Total Engineers Likely to Graduate (A) | Mechanical Engineers available (A x 0.80%) (B) | Engineers Required in Steel Sector (C) | Gaps (B-C) |
|---|---|---|---|---|
| 1999 | 22218 | 178 | 117 | 61 |
| 2000 | 25324 | 203 | 139 | 64 |
| 2001 | 30528 | 245 | 139 | 106 |
| 2002 | 37315 | 299 | 378 | - 79 |
| 2003 | 40460 | 324 | 629 | - 305 |

## m) Future Gaps of Mechanical Engineers in Automobile Sector

| Year | Total Engineers Likely to Graduate (A) | Mechanical Engineers available (A x 0.15%) (B) | Engineers Required in Automobile Sector (C) | Gaps (B-C) |
|---|---|---|---|---|
| 1999 | 22218 | 34 | 50 | - 16 |
| 2000 | 25324 | 38 | 13 | 25 |
| 2001 | 30528 | 46 | -- | 46 |
| 2002 | 37315 | 56 | -- | 56 |
| 2003 | 40460 | 60 | 747 | - 687 |

# Gaps Analysis (Sector-wise)

## n) Future Gaps of P&I Engineers in Power Sector

| Year | Total Engineers Likely to Graduate (A) | P & I Engineers available (A x 2.98) (B) | Engineers Required in Power Sector (C) | Gaps (B-C) |
|---|---|---|---|---|
| 1999 | 12387 | 369 | -- | 369 |
| 2000 | 14348 | 427 | -- | 427 |
| 2001 | 17924 | 534 | -- | 534 |
| 2002 | 21505 | 641 | -- | 641 |
| 2003 | 24793 | 739 | -- | 739 |

**Note:** *Not required in this sector.*

## o) Future Gaps of P & I Engineers in Oil Sector

| Year | Total Engineers Likely to Graduate (A) | P & I Engineers available (A x 2.88%) (B) | Engineers Required in Oil Sector (C) | Gaps (B-C) |
|---|---|---|---|---|
| 1999 | 12387 | 357 | 74 | 283 |
| 2000 | 14348 | 413 | 177 | 236 |
| 2001 | 17924 | 516 | 77 | 439 |
| 2002 | 21505 | 619 | 88 | 531 |
| 2003 | 24793 | 714 | -- | 714 |

# Gaps Analysis (Sector-wise)

## p) Future Gaps of P&I Engineers in Steel Sector

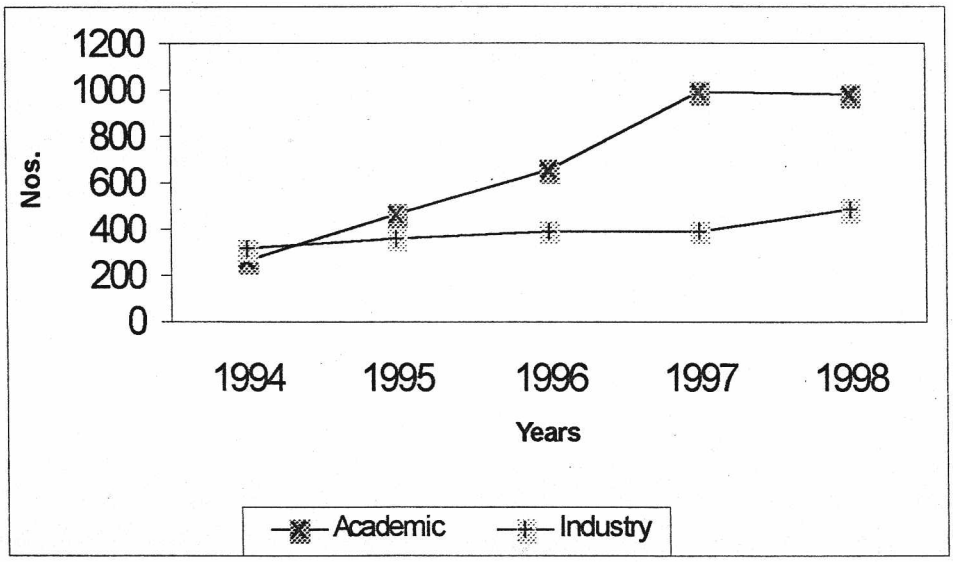
| Year | Total Engineers Likely to Graduate (A) | P & I Engineers available (A x 7.45%) (B) | Engineers Required in Steel Sector (C) | Gaps (B-C) |
|---|---|---|---|---|
| 1999 | 12387 | 923 | 377 | 546 |
| 2000 | 14348 | 1069 | 253 | 816 |
| 2001 | 17924 | 1335 | 488 | 847 |
| 2002 | 21505 | 1602 | 665 | 937 |
| 2003 | 24793 | 1847 | 740 | 1107 |

## q) Future Gaps of P & I Engineers in Automobile Sector

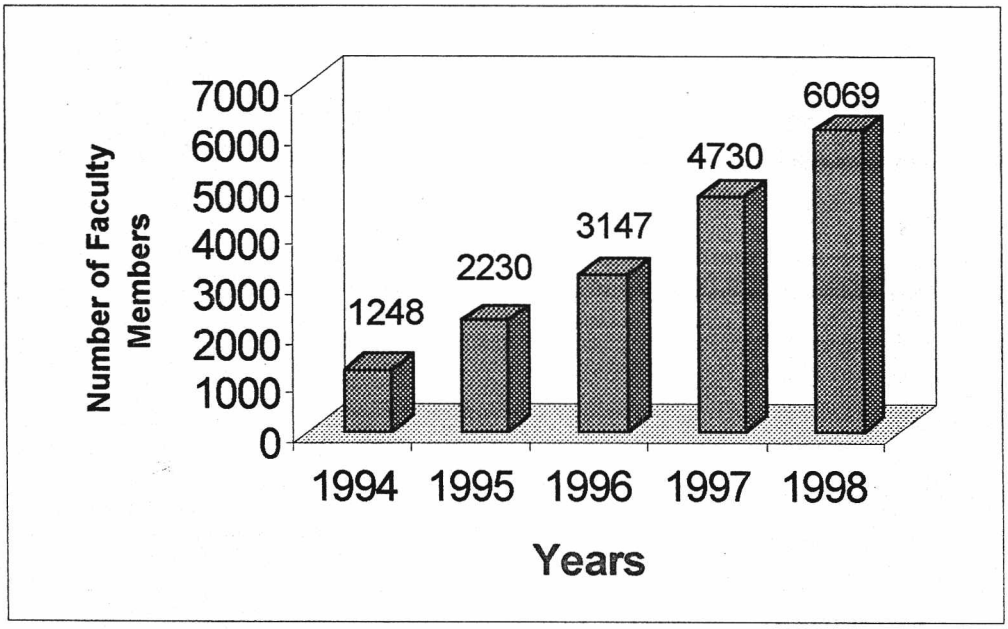
| Year | Total Engineers Likely to Graduate (A) | P & I Engineers available (A x 7.70%) (B) | Engineers Required in Automobile Sector (C) | Gaps (B-C) |
|---|---|---|---|---|
| 1999 | 12387 | 954 | 374 | 580 |
| 2000 | 14348 | 1105 | 610 | 495 |
| 2001 | 17924 | 1380 | 505 | 875 |
| 2002 | 21505 | 1656 | 575 | 1081 |
| 2003 | 24793 | 1909 | 870 | 1039 |

## 12.00 Interaction between Academics & Industry

| Year | Academic Interaction with Industry | Industry interaction with Academic |
|---|---|---|
| 1994 | 260 | 312 |
| 1995 | 465 | 358 |
| 1996 | 656 | 390 |
| 1997 | 986 | 390 |
| 1998 | 975 | 486 |



## 13.00 Faculty Members Attending Courses



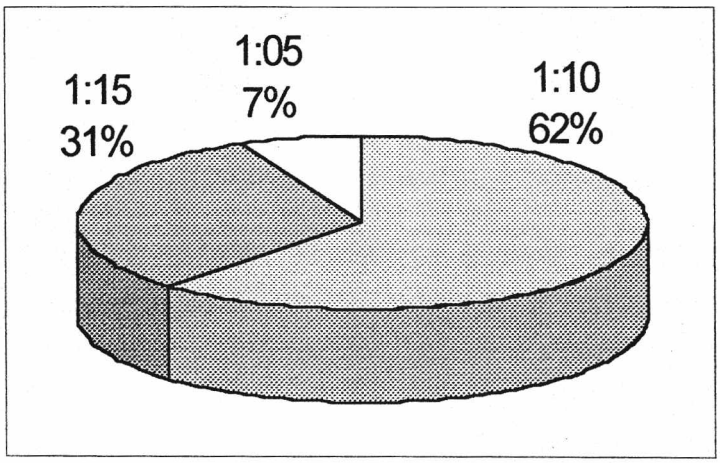
## 14.00 Qualitative Analysis based on Majority Assessment

### A. Type –I Factors (Skill Development)

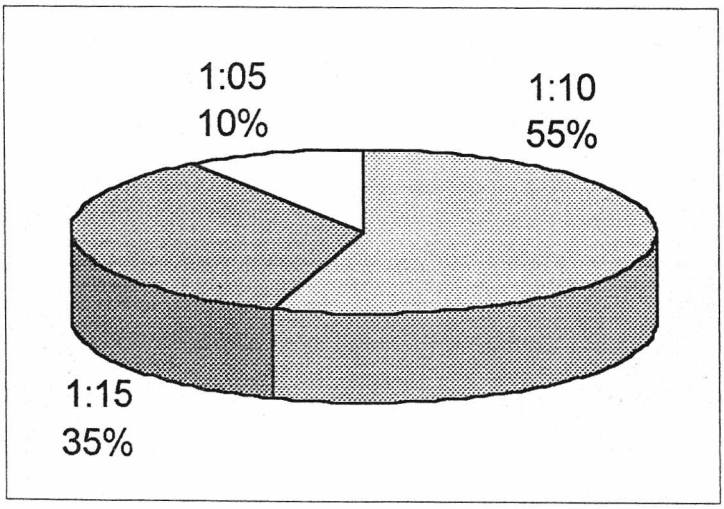
| Particulars | Academics | | Industry | |
|---|---|---|---|---|
| Faculty Student Ratio | 62% | 1:10 | 55% | 1:10 |
| Curriculum Revision | 68% | 5 years | 54% | 3 years |
| Teachers Retraining | 59% | 3 years | 90% | 3 years |
| Student Summer Training Period | 32% | 12 weeks | 37% | 16 weeks |
| Faculty Summer Training Period | 54% | 8 weeks | 47% | 8 weeks |

# A-1. Faculty Student Ratio

## Academics

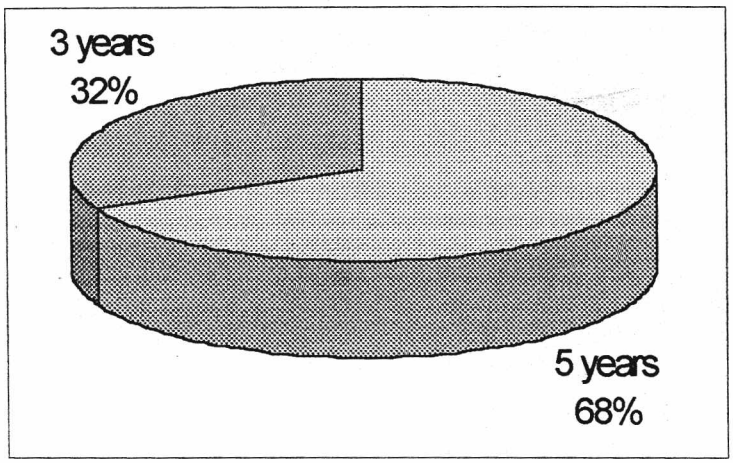



## Industry

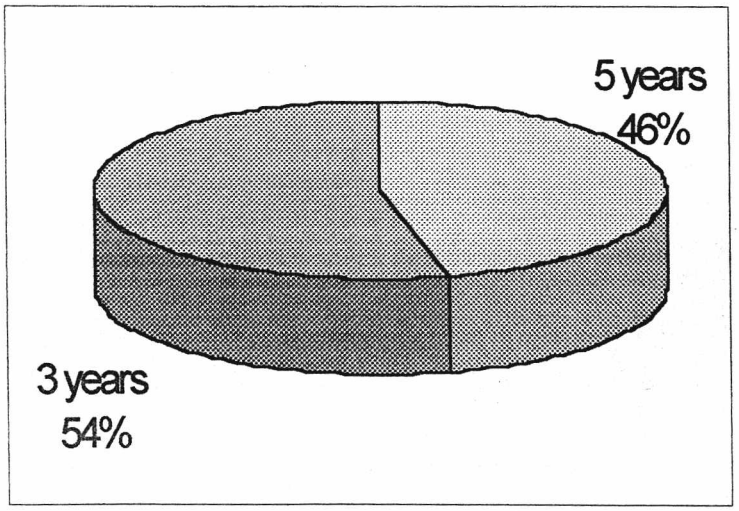


# A-2. Curriculum Revision

## Academics

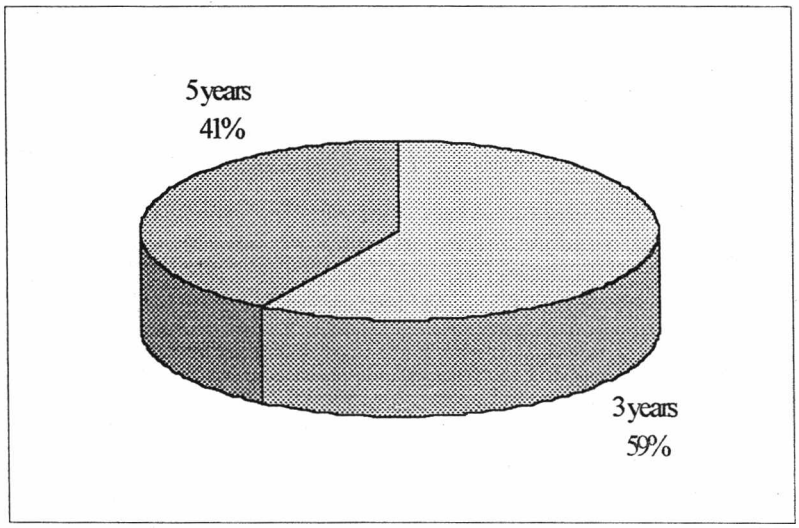



## Industry

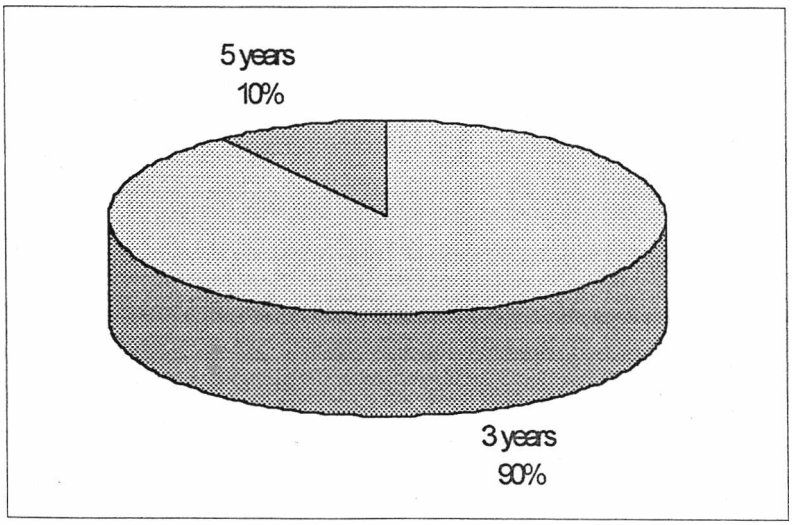


# A-3. Teachers Retraining

## Academics

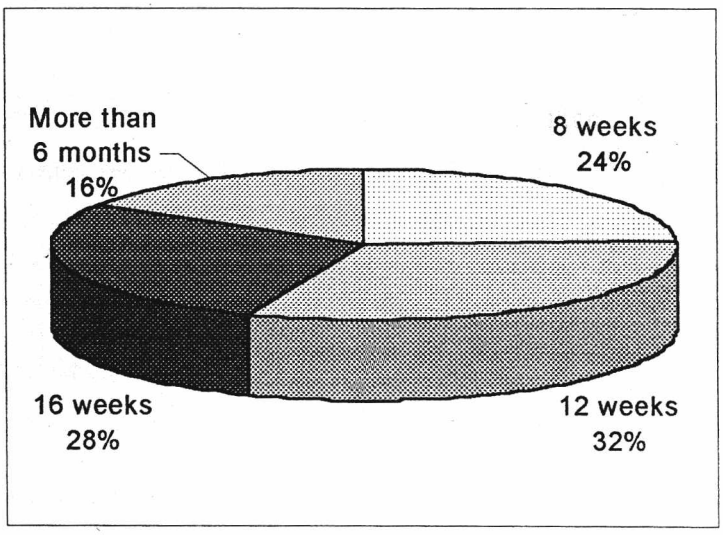



## Industry

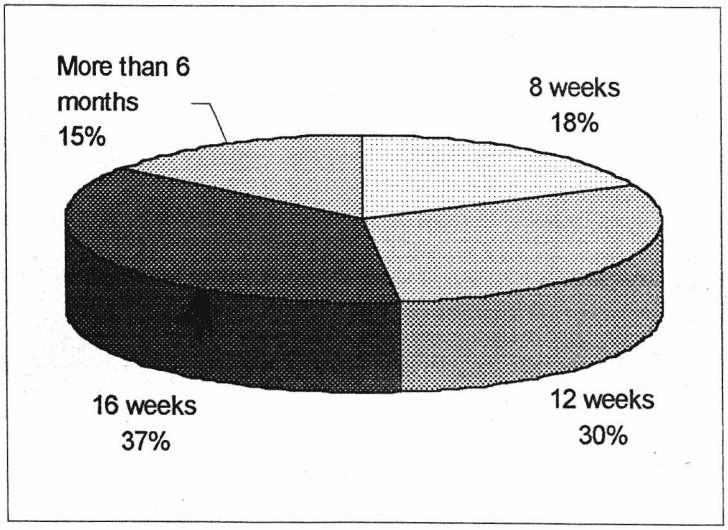


# A-4. Student Summer Training Period

## Academics

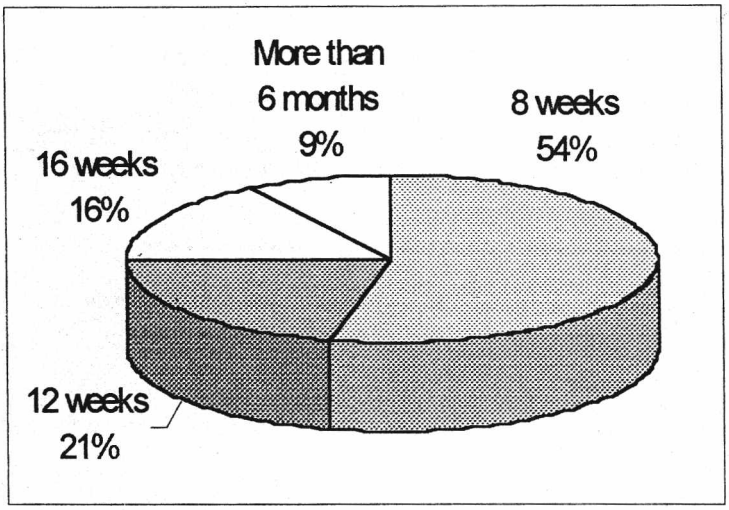



## Industry

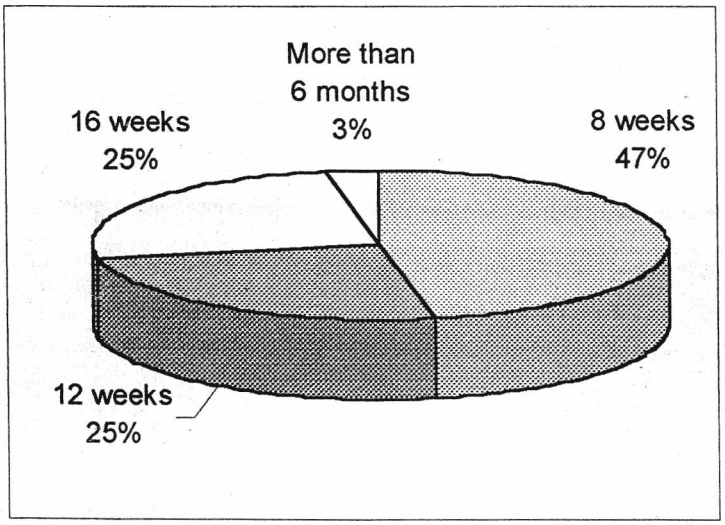


# A-5. Faculty Summer Training Period

## Academics




## Industry



## B. Type –II Factors (Managerial Skills)

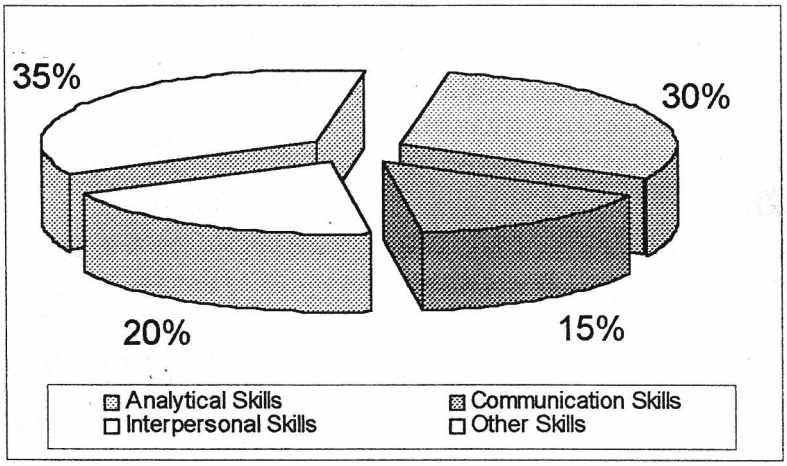
*- Majority Assessment*

**(%age)**

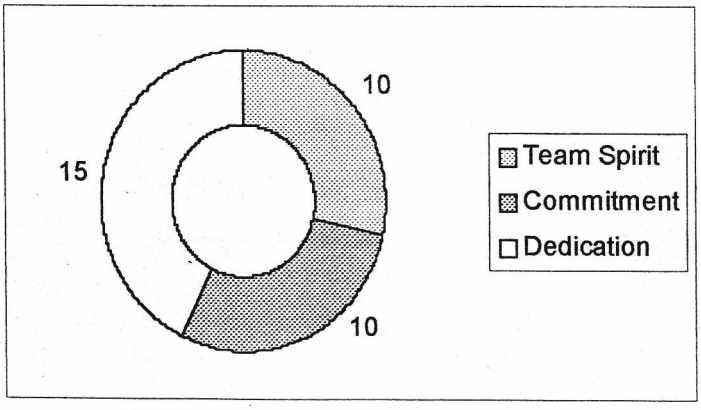
| Sno. | Particulars | Academics | Industry |
|---|---|---|---|
| 1. | Analytical Skills | 30 | 30 |
| 2. | Communication Skills | 15 | 20 |
| 3. | Interpersonal Skills | 20 | 20 |
| 4. | Other Skills | 35* | 30* |
| | *a) Team Spirit** | *10* | *5* |
| | *b) Committment** | *10* | *10* |
| | *c)# Dedication** | *15* | *15* |

***# Dedication also includes aspects like ethics and values etc.***

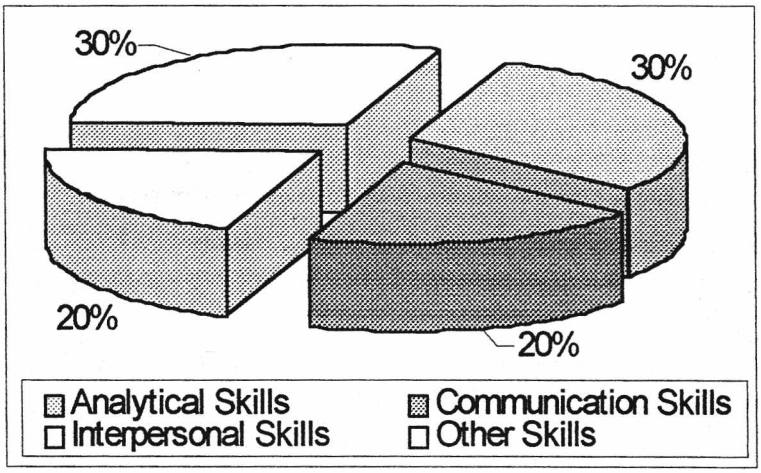
**B-1.** **%age emphasis in Engineering Curriculum for managerial skills based on majority of Academics.**



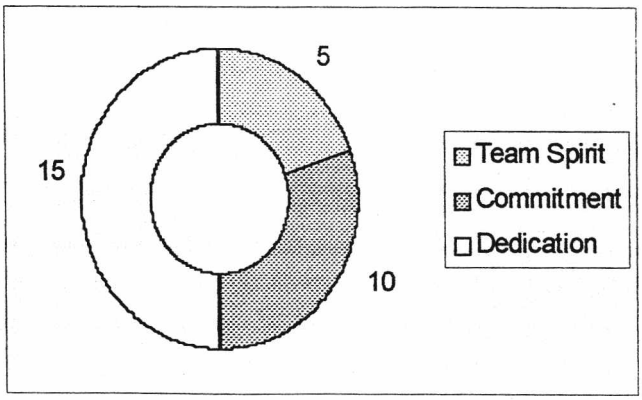

## Details of Other Skills



**B-2.** **%age emphasis in Engineering Curriculum for managerial skills based on majority of Industry.**




## Details of Other Skills



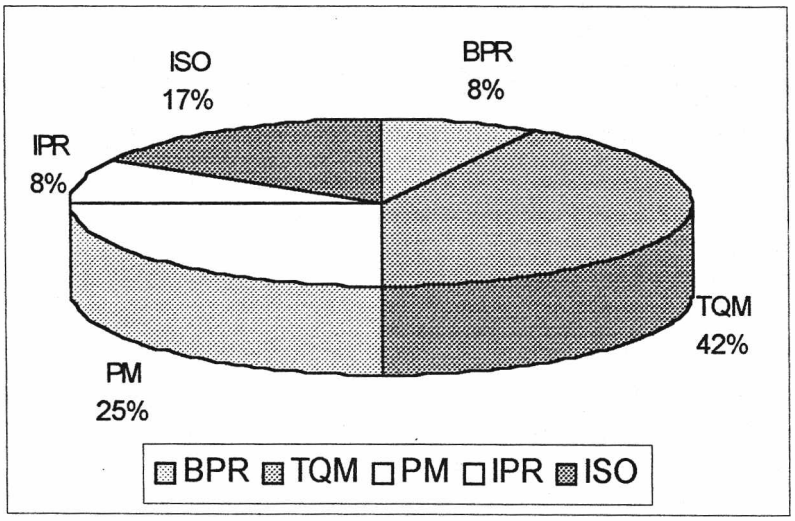
## C. Type –III Factors (Technical Skills)

### *- Majority Assessment*

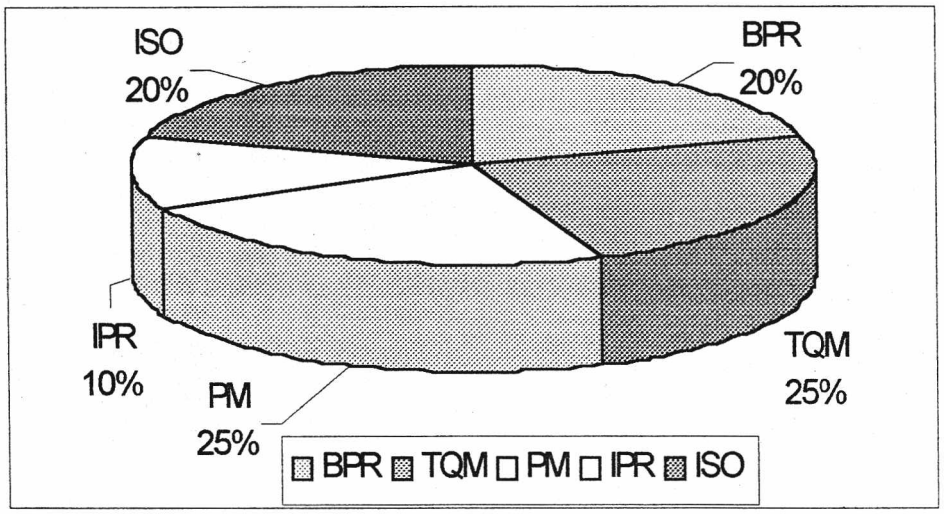
**(%age)**

| Sno. | Particulars | Academics | Industry |
|---|---|---|---|
| 1. | Business Process Re-engineering (BPR) | 8 | 20 |
| 2. | Total Quality Management (TQM) | 42 | 25 |
| 3. | Project Management (PM) | 25 | 25 |
| 4. | Intellectual Property Rights (IPR) | 8 | 10 |
| 5. | ISO etc. | 17 | 20 |
| 6. | Basic Sciences vs. Application Side | 70:30 | 50:50 |

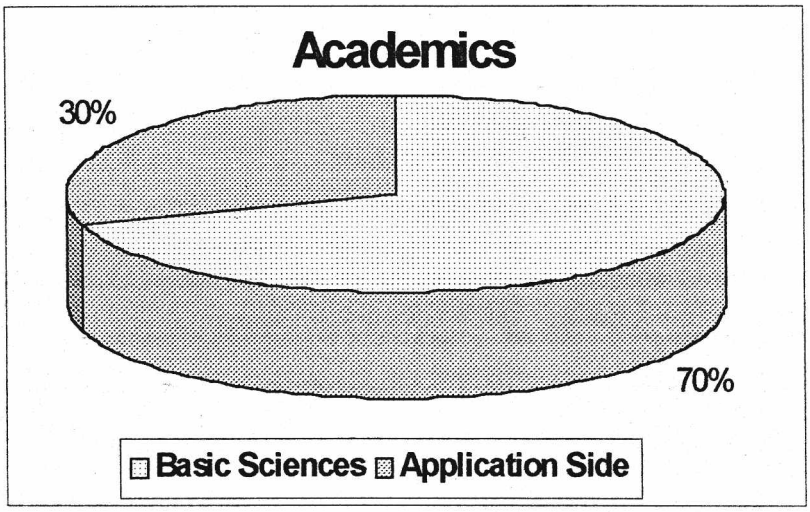
**C-1.** **%age Emphasis in Engineering Curriculum for Technical skills based on majority of Academics.**

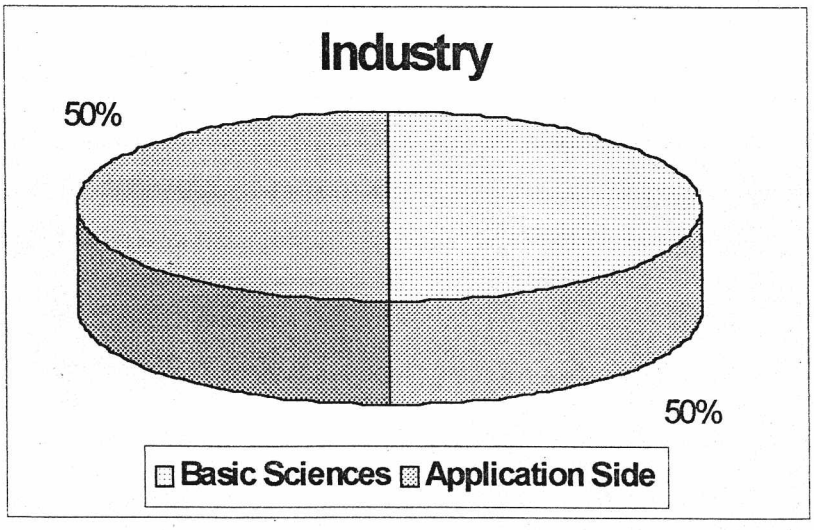


**C-2** **%age Emphasis in Engineering Curriculum for Technical skills based on Majority of Industries.**



## C-3. Ratio of Basic Sciences & Application Side



## D. Type-IV Factors (Knowledge based)

***- Majority Assessment***

### Technical Know-how

***(Excellent)***

Industry has rated higher than the Academic Institutes. The reason is that these specified industries recruit the ***Cream*** of the engineers and further train then for one to two years to suit their specific needs.

***(Very Good)***

Industry has rated lower than Academic Institutes.

### General Knowledge -National

***(Excellent)***

Industry has rated higher than the Academic Institutes. The reason is that these specified industries recruit the ***Cream*** of the engineers.

***(Very Good)***

Almost equal.

### General Knowledge – International

Industry has rated higher than the Academic Institutes. The reason is that these specified industries recruit the ***Cream*** of the engineers.

## Sports

No firm view since sports is not given any importance either in Industry & Academics Institutes.

## Intelligence Quotient

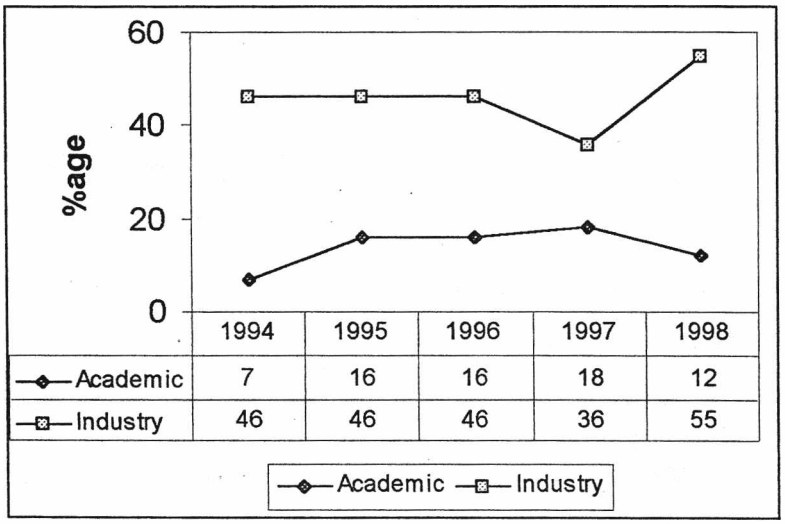
Industry has rated lower than the Academic Institutes.

## Mental Quotient

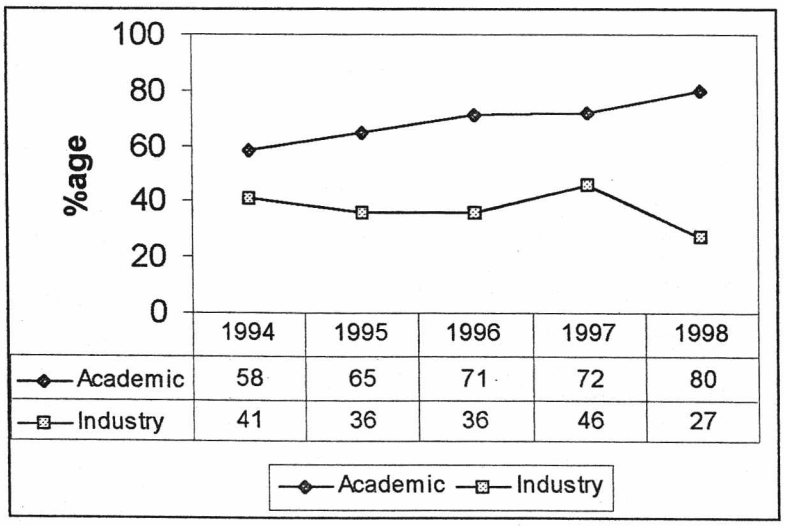
Industry has rated higher since they recruit the Cream.

# D-1. Technical Know-how

## Excellent

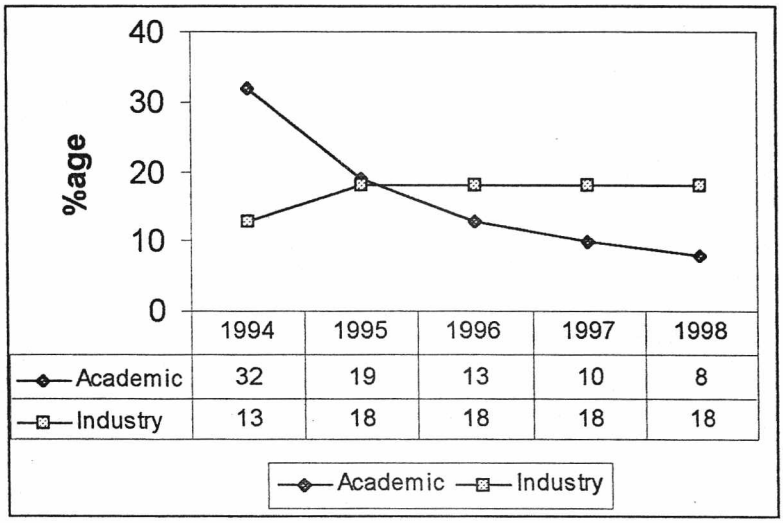



## Very Good

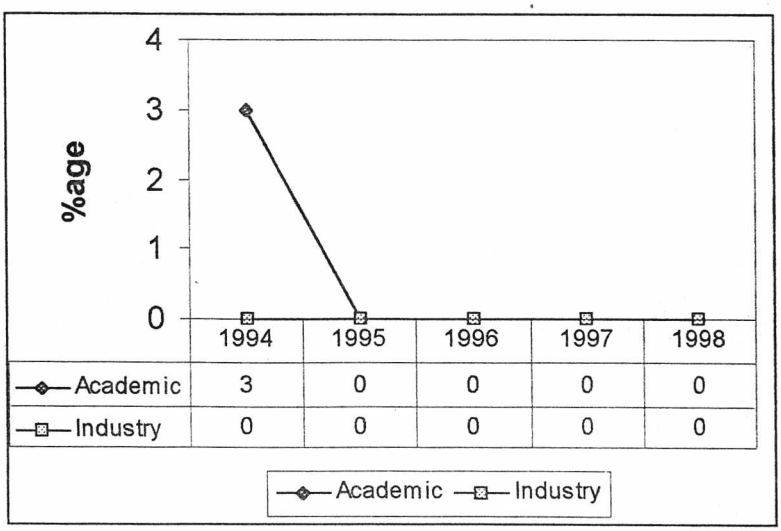


# Technical Know-how

## Good

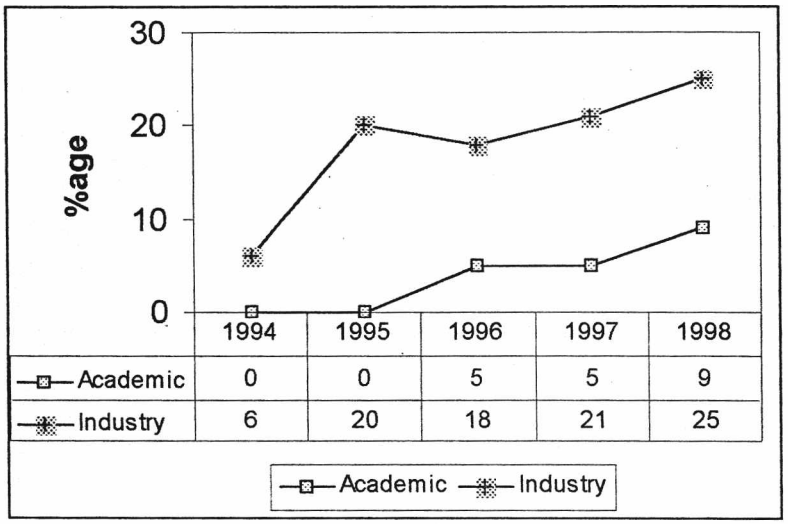



## Average

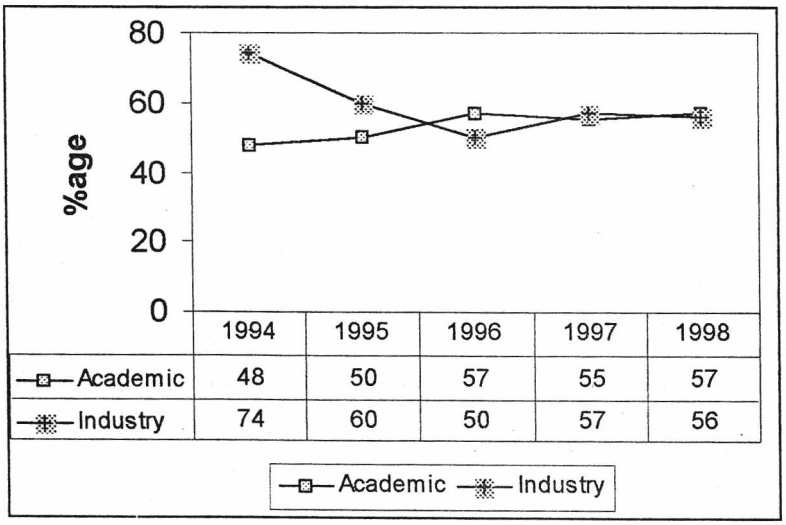


# D-2. General Knowledge -National

## Excellent

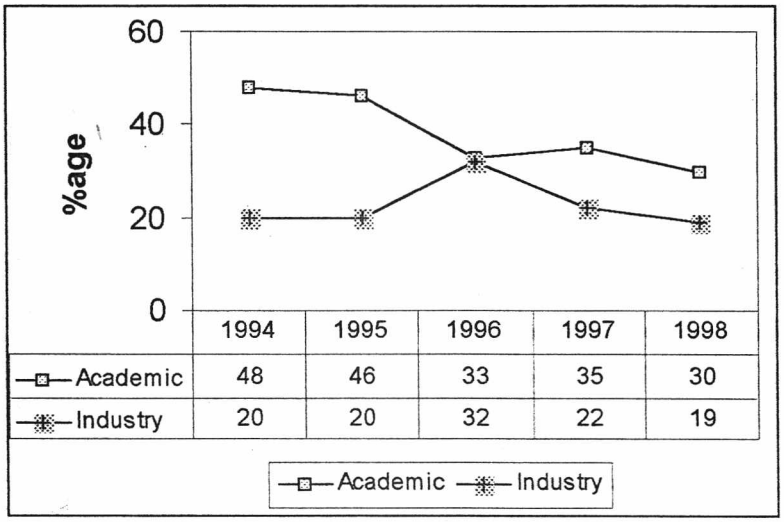



## Very Good

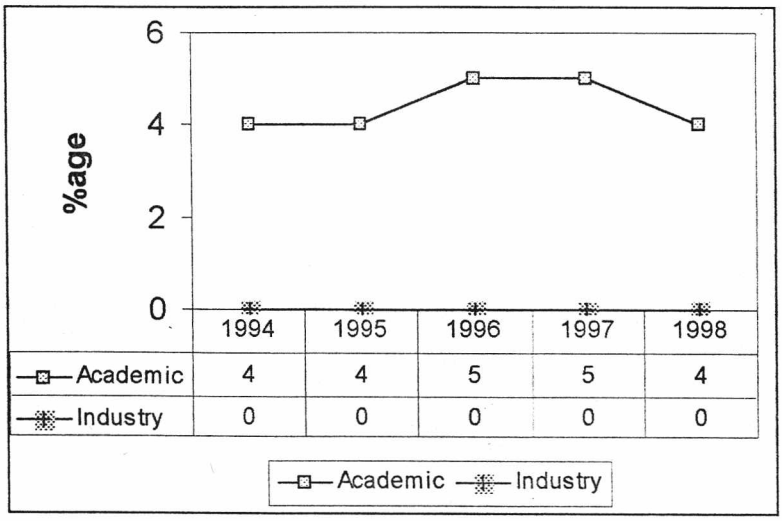


# General Knowledge -National

## Good

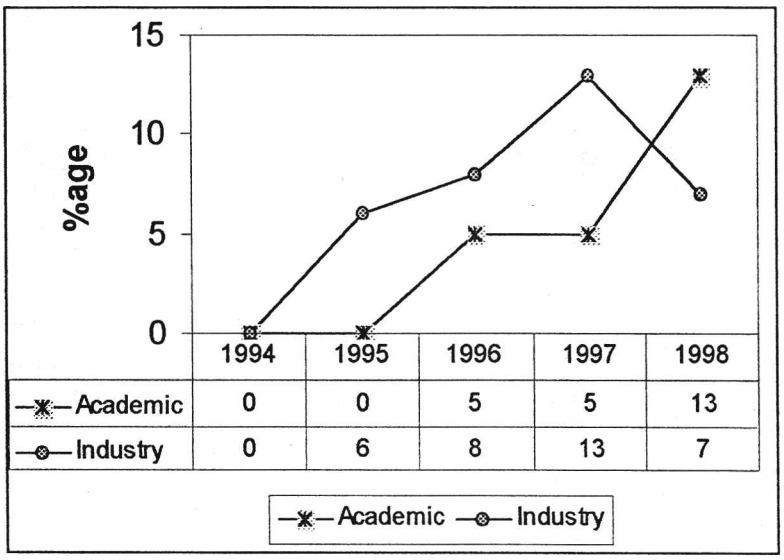



## Average

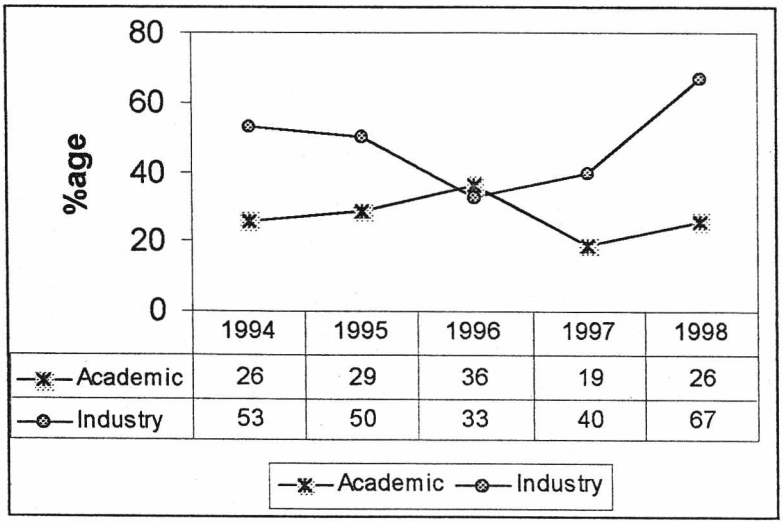


# D-3. General Knowledge -International

## Excellent

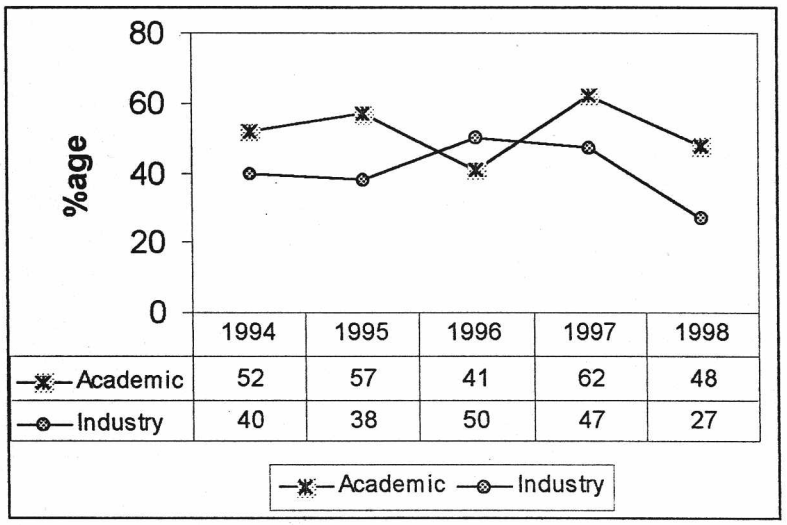



## Very Good

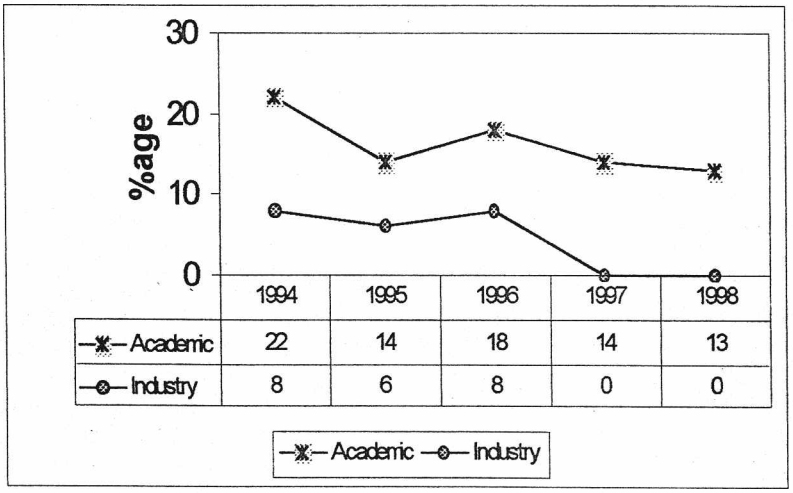


# General Knowledge -International

## Good

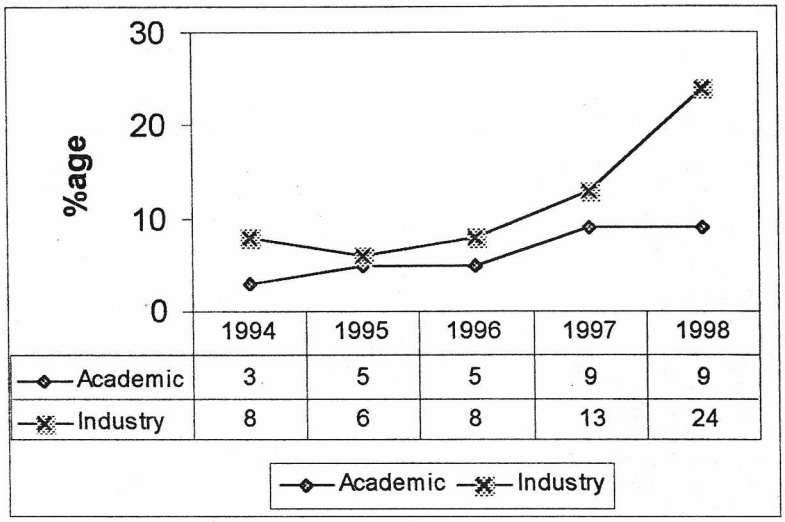



## Average

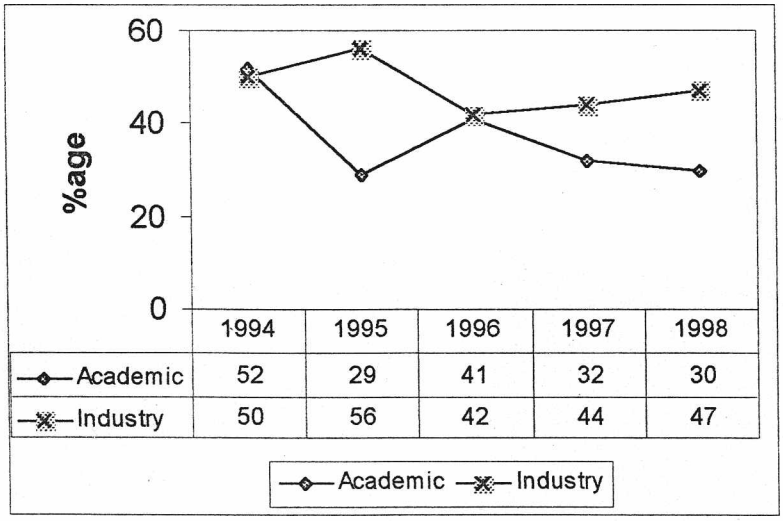


# D-4. Sports

## Excellent

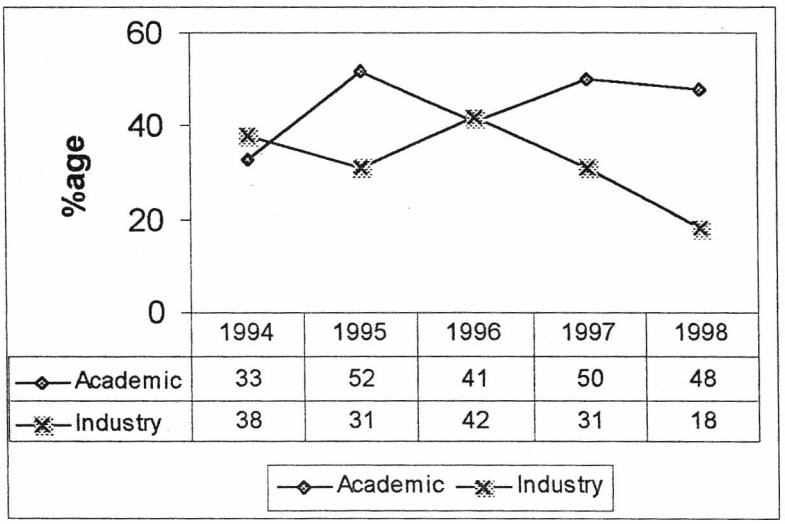



## Very Good

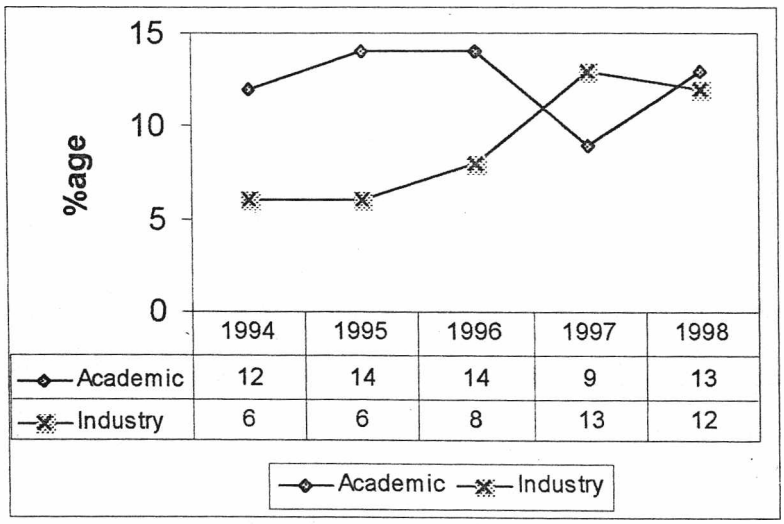


# Sports

## Good

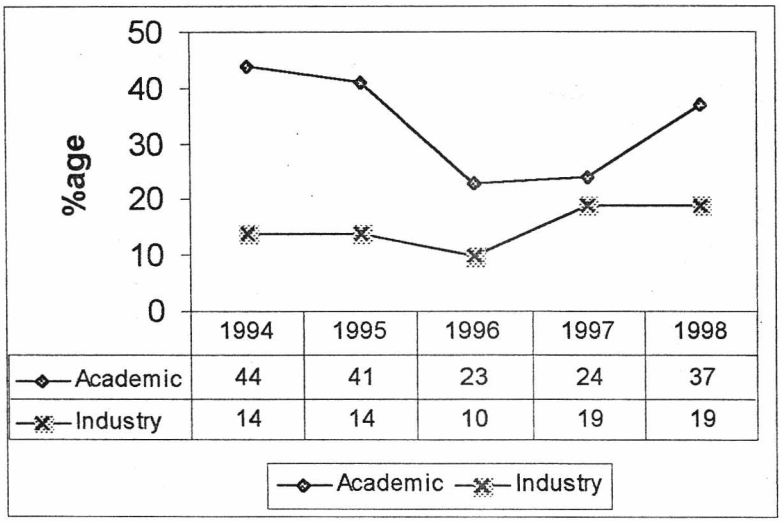



## Average

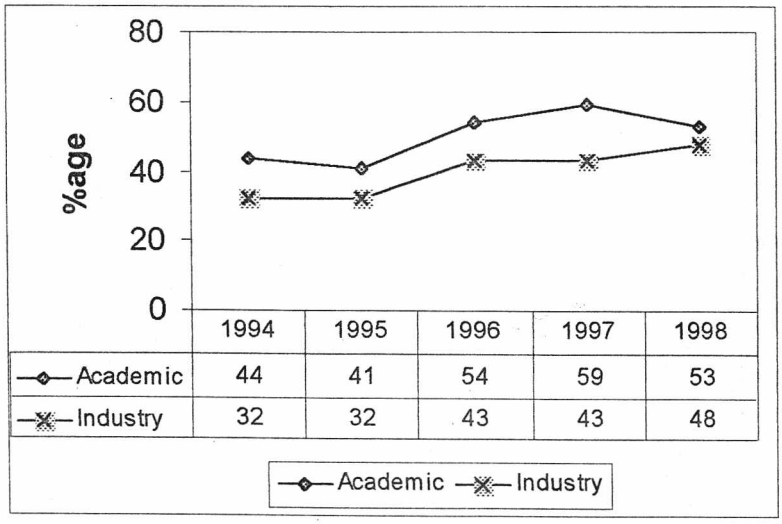


# D-5. Intelligence Quotient

## Excellent

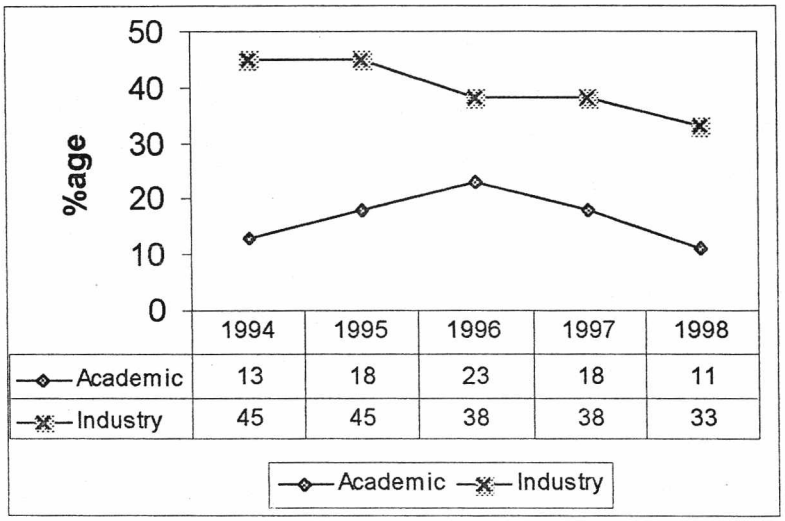



## Very Good

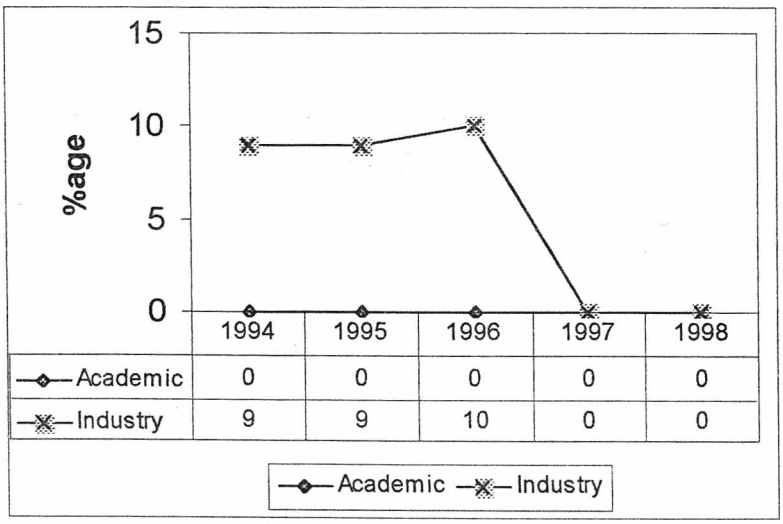


# Intelligence Quotient

## Good

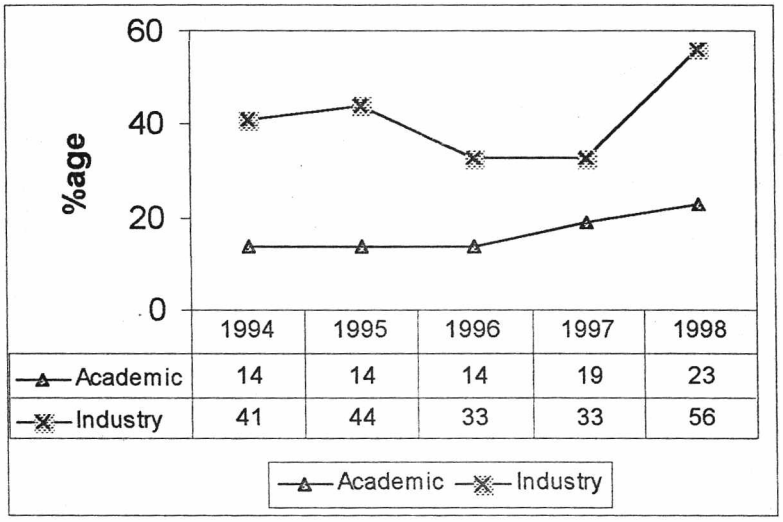



## Average

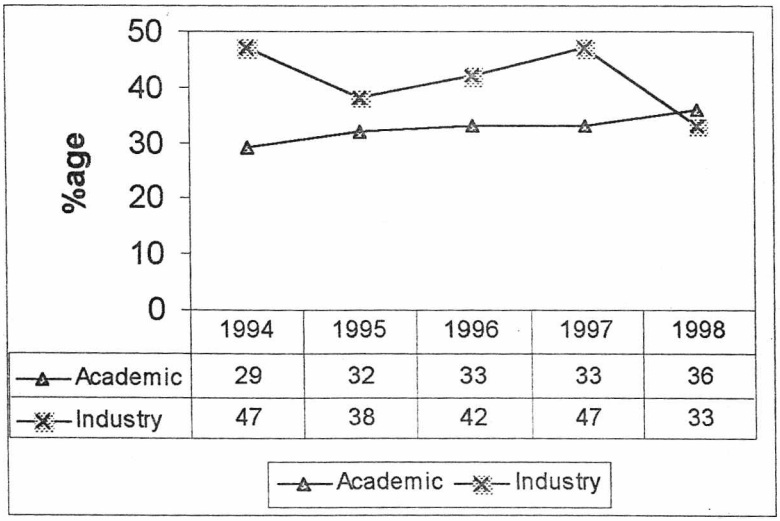


# D-6. Mental Quotient

## Excellent

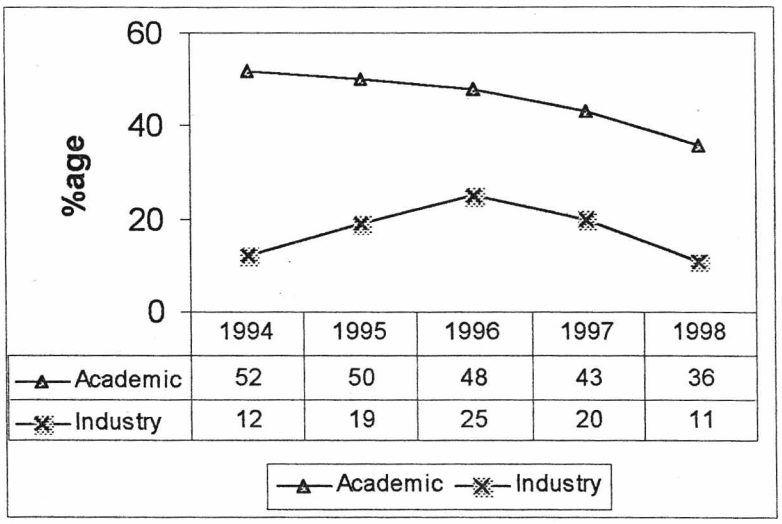



## Very Good

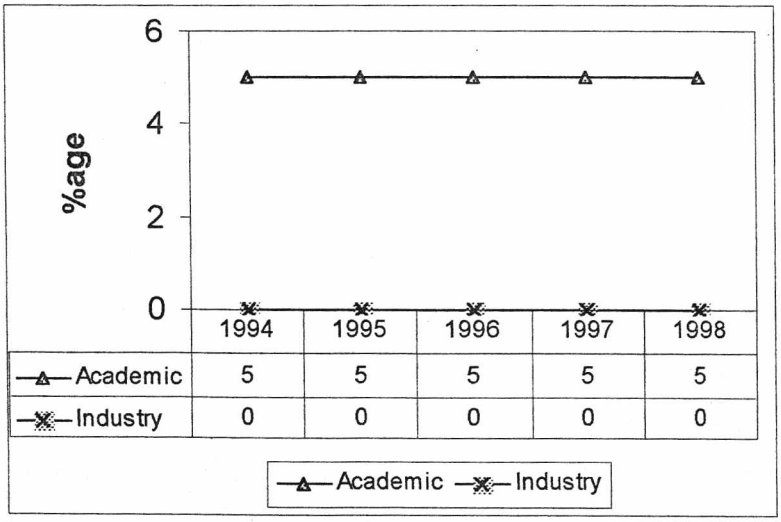


# Mental Quotient

## Good




## Average

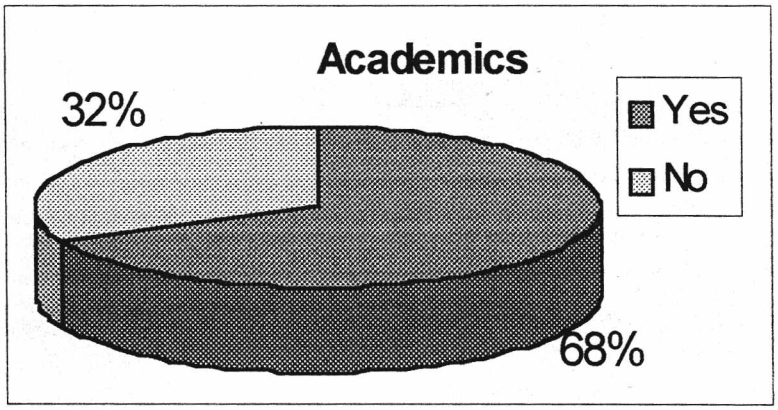


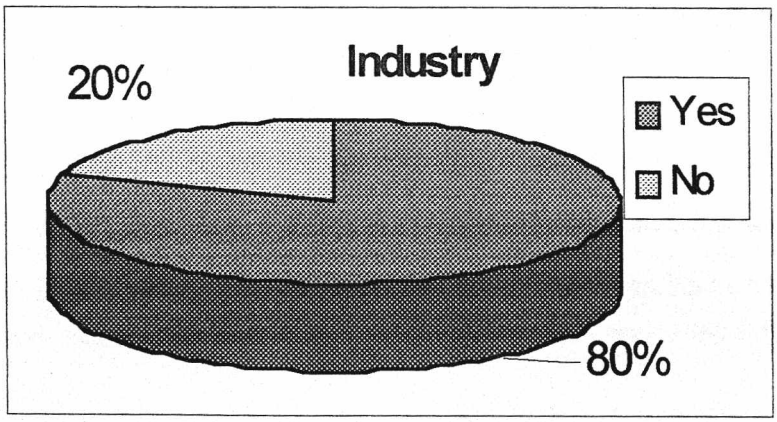

***Note:*** *Analysis of data on pages 59 to 70 is based on the details furnished by 41 organisations from select infrastructure industries who have by and large recruited engineers from institutions like IITs, BITs (Pilani and Ranchi) IISc, University of Rookee, RECs.*

# E. Type V Factors (General)

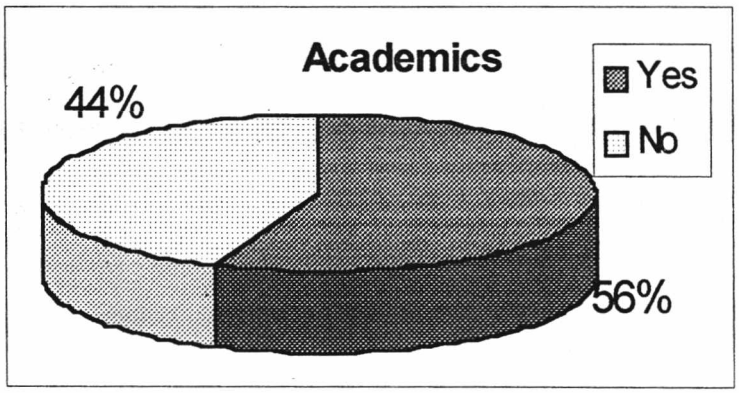
| Sno. | Items | Academics | Industry |
|---|---|---|---|
| 1. | **Before Admission** | | |
| | i) Aptitude Test for Admissions | 68% (Yes) | 80% (Yes) |
| 2. | **During Studies** | | |
| | i) Cross Migration during Studies | 56% (Yes) | 85% (Yes) |
| | ii) Marking System | 58% (Grading) | 62% (%age)) |
| | iii) Evaluation System | 65% (Internal) | 61% (External) |
| 3. | **After Studies** | | |
| | i) Internship before award of degree | 64% (Yes) | 69% (Yes) |
| | ii) Code of Conduct for Students | 99% (Yes) | 94% (Yes) |
| | iii) Licensing System for Students | 77% (Yes) | 64% (Yes) |
| 4. | **For Institutions** | | |
| | i) Competitive Exams for Faculty Selection | 54% (Yes) | 85% (Yes) |
| | ii) Resource Networking for Institutions | 96% (Yes) | 62% (Yes) |

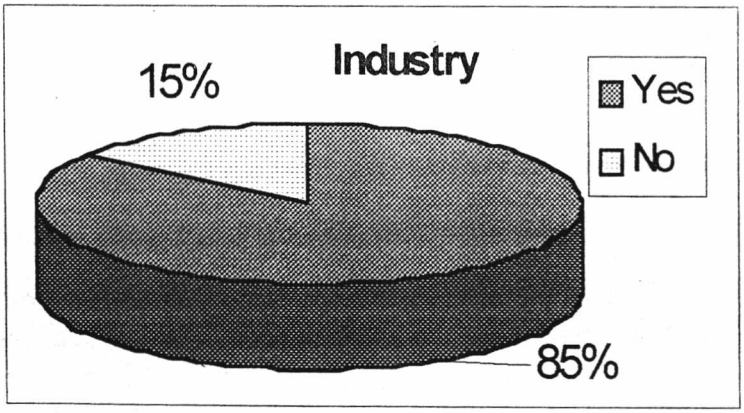
# E-1 (i). Aptitude Test for Admissions



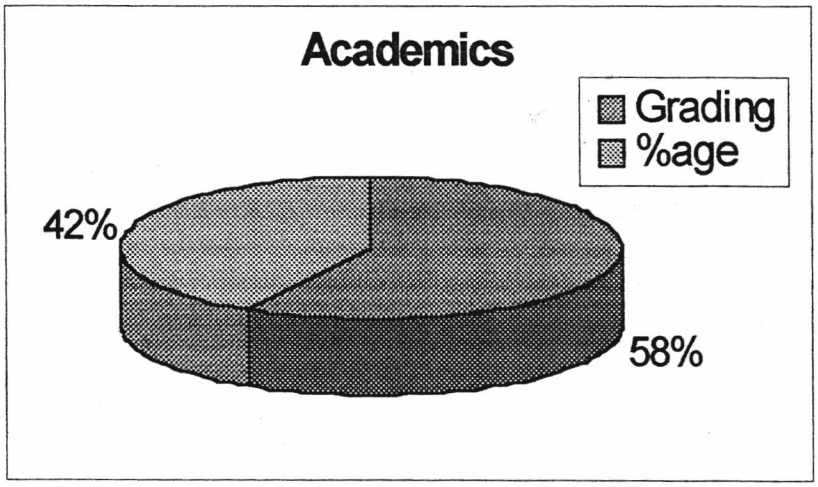



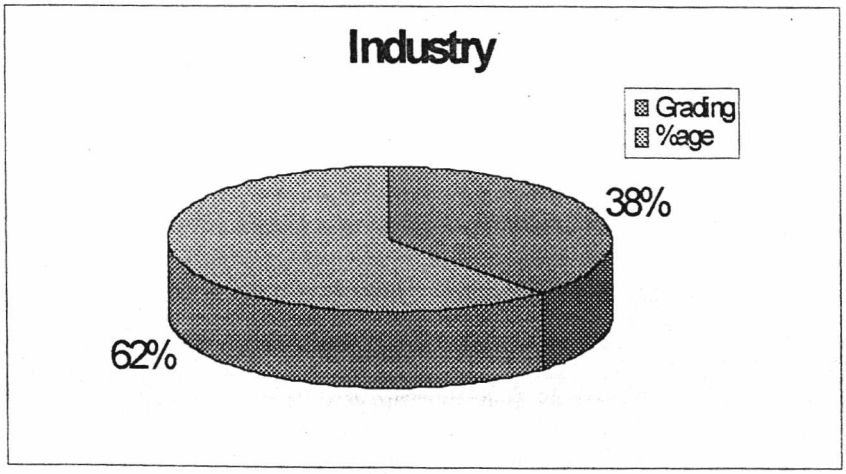
# E-2 (i) Cross Migration during studies



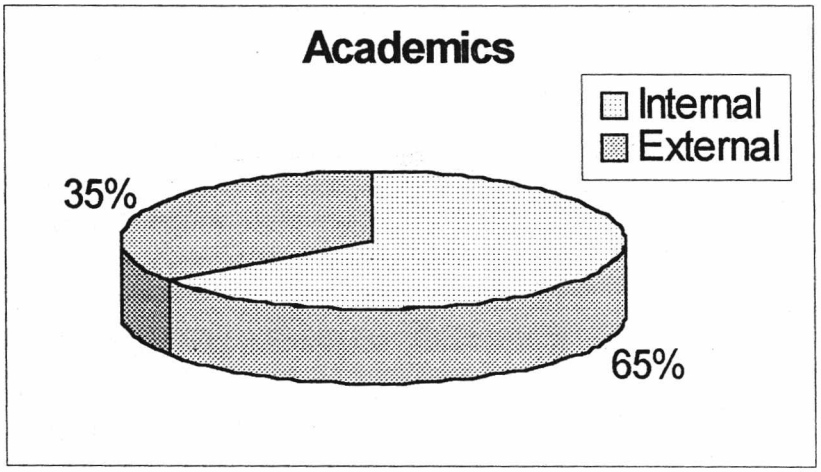



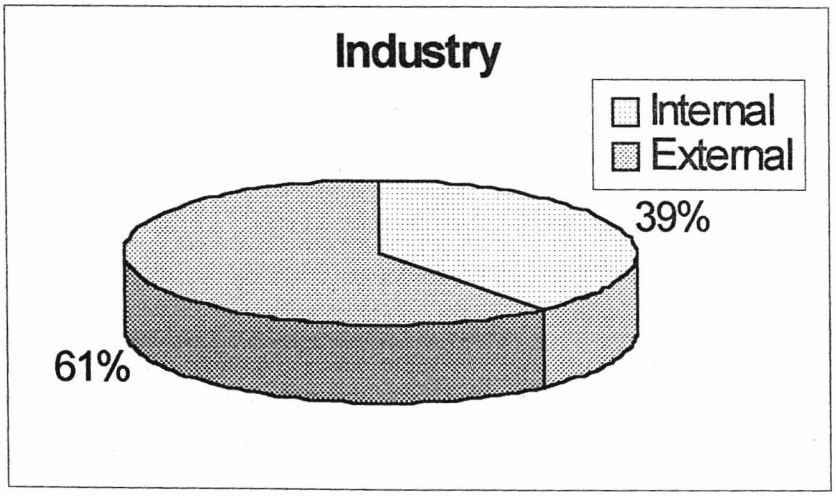
## E-2 (ii). Marking System - %age



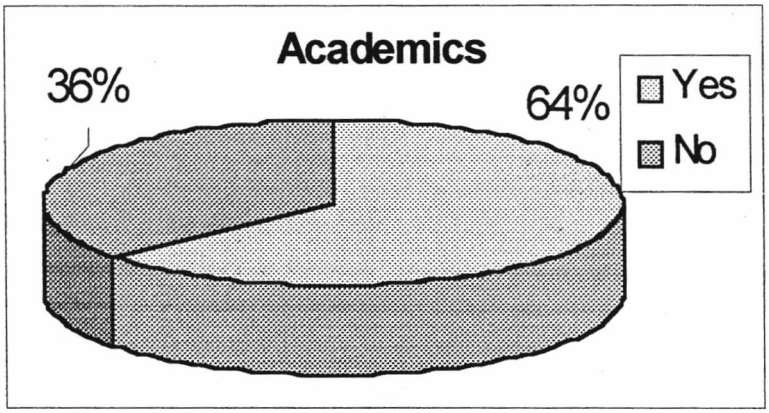



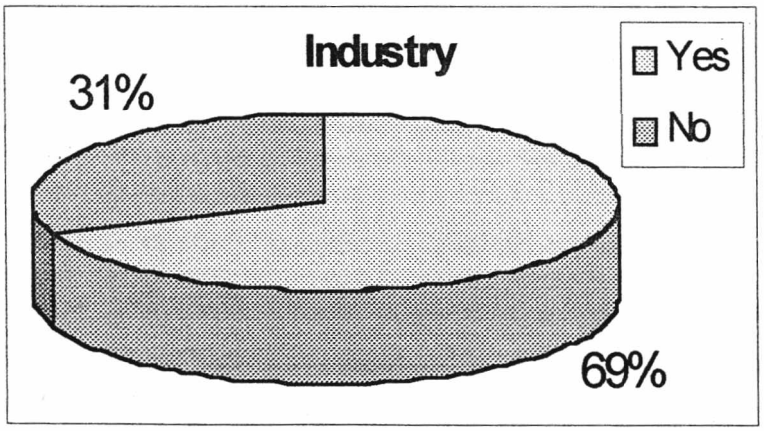
## E-2 (iii). Evalution System



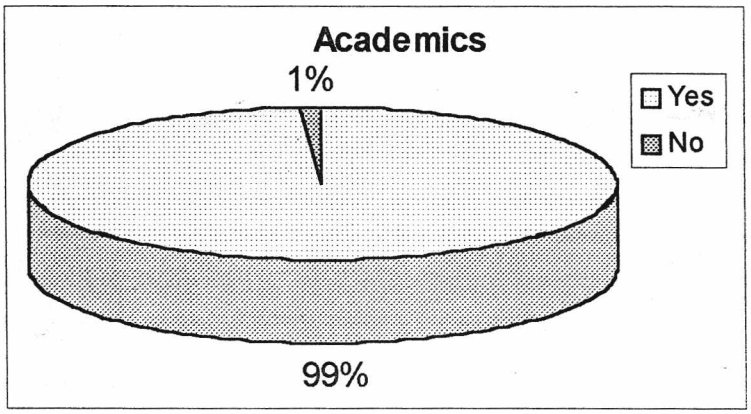



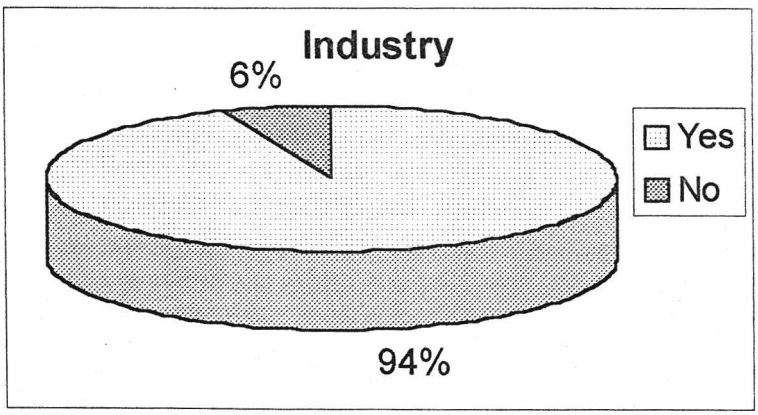
# E-3 (i). Internship before award of degree



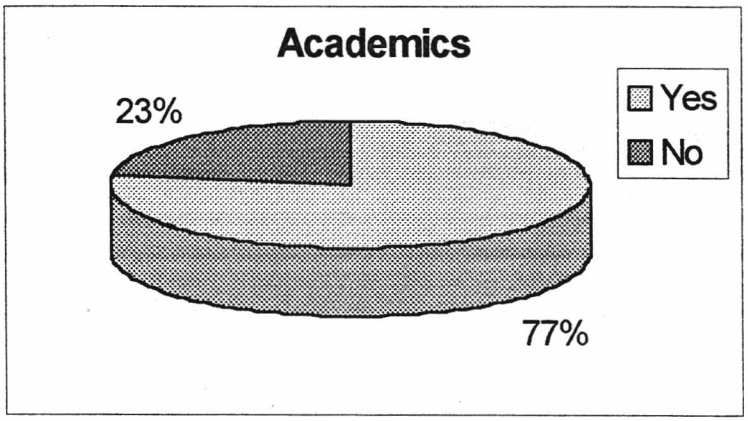



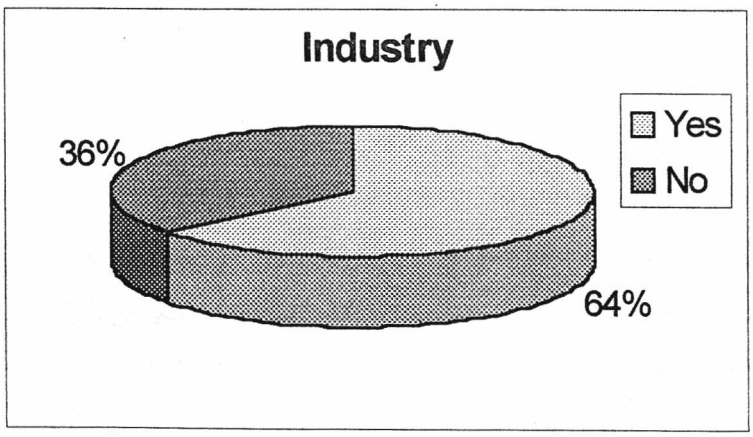
# E-3 (ii). Code of Conduct for Students



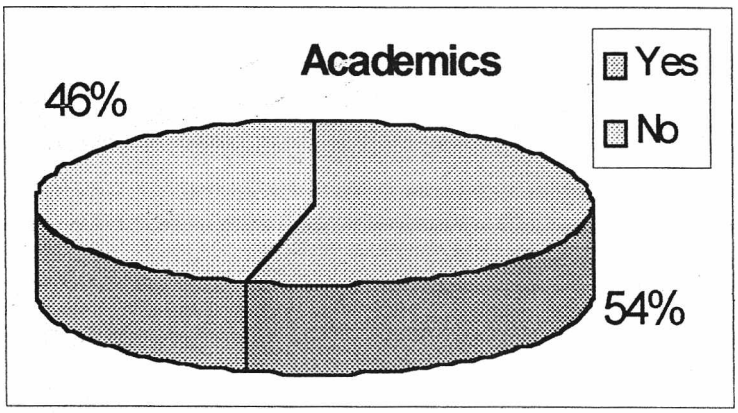



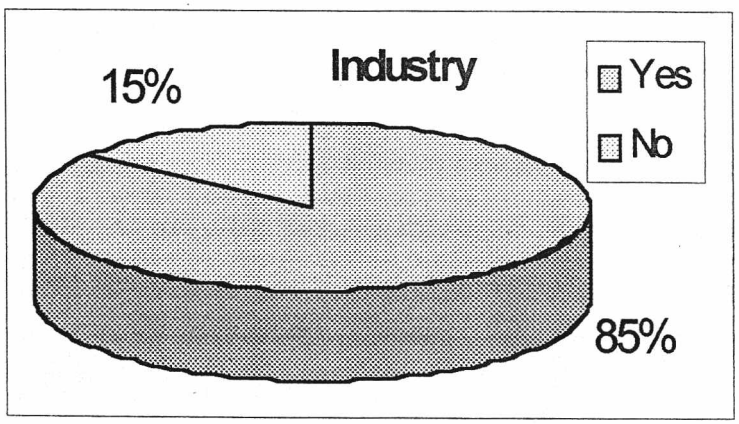
# E-3 (iii). Licensing System for Students



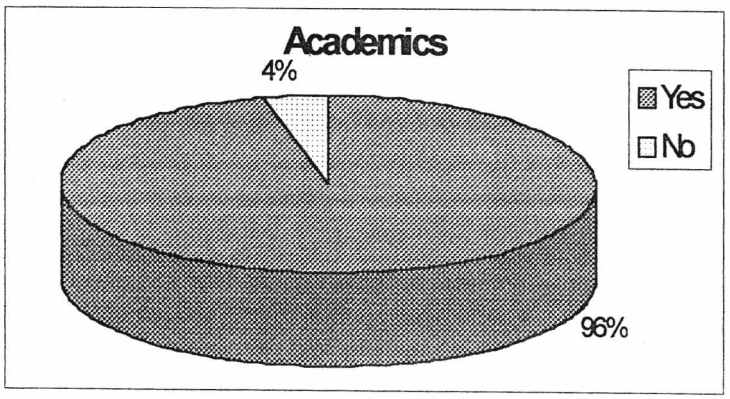



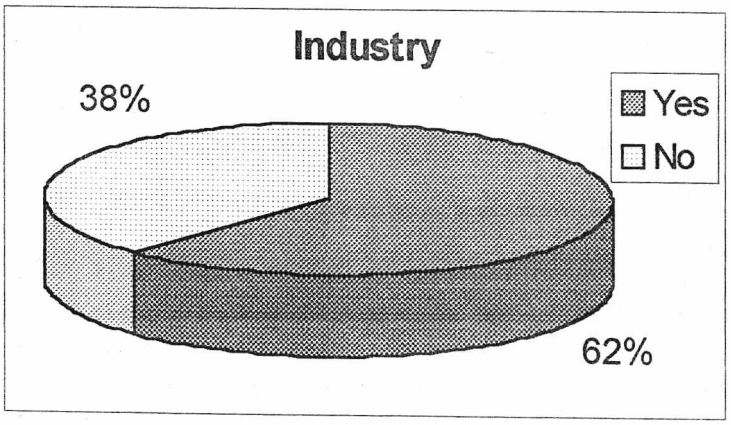
## E- 4 (i). Competitive Exams for Faculty Selection



## E-4 (ii). Resource Networking for Institutions



# *Chapter-5*

## 5.00 RECOMMENDATIONS

Due to liberalisation and opening of our economy, various organisations have to now compete not only among themselves; but with multinational companies. This has created awareness among the consumers. Customer has become very demanding and the entire economy is now **"Market Driven"**. Organisations have to offer most cost effective and competitive products and services. The Customer desires various options at various price levels and of varying quality. Organisations have to, therefore, resort to techniques like ***SWOT Analysis, PEST Analysis*** and are trying to develop their ***Value Chain*** based on their ***Core Competence***.

The above is the scenario in our country in the manufacturing and service sector. If the organisations have to compete successfully and take India into the 21st century, it is essential that our human resource, i.e. Engineers must be of matching international standards. One school of thought says that our Engineers are of top quality and it is only the lack of infrastructure facilities which prohibit them from giving their best. They further argue that when these Engineers get an opportunity to work abroad they do wonders. Another school of thought says that our engineering education, particularly at the graduate level, is not of high standards and, therefore, Engineers are not able to display their best. The percentage of Engineers, who get an opportunity abroad, is very small as compared to the number of Engineers who work within the country.

Based on the above analysis, following ***recommendations*** emerge:-

## 5.01 INDUSTRY-INSTITUTE INTERACTION

- ☞ Industry must constitute chairs in the institutes.
- ☞ There should be regular exchange between Academicians and Executives on yearly basis.
- ☞ Industry must come forward to support engineering profession, particularly in R & D and infrastructural facilities.
- ☞ Industry must adopt at least one lab. in an Engineering college.
- ☞ Engineering colleges must be attached to some industry or the other.

- ☞ Industry must give projects to students on commercial basis.
- ☞ There should be regular seminars held jointly by industry and institutes' on subjects of common interest.

## 5.02 CURRICULUM AND FACULTY

- ☞ More emphasis be laid on ***application side***.
- ☞ More emphasis be laid on ***BPR, IPR and ISO***.
- ☞ More emphasis be laid on ***Communication Skills and Commitment***.
- ☞ Curriculum be revised ***every three years*** and industry should be associated.
- ☞ Faculty Student ratio should be maintained as ***1:10.***
- ☞ Teachers should be retrained at least ***every three years*** in association with industry.
- ☞ Student summer training period should be atleast ***16 weeks***, 8 weeks at the end of 2nd year (general) and 8 weeks at the end of 3rd year (specialization).
- ☞ Faculty should be encouraged to go for summer training ***every year for 8 weeks.***

## 5.03 GENERAL

- ☞ There should be one year ***Internship*** for engineers before they are awarded degree. Medium and small scale industries should also come forward and take Engineers for internship.
- ☞ There should be ***cross migration*** of specialization after first 2 years of study.
- ☞ There should be an ***aptitude test*** before a student is admitted in the engineering course.
- ☞ There should be ***all India competitive exam*** for faculty recruitment.
- ☞ There should be a ***Code of Conduct & Ethics*** norms for engineers.
- ☞ There should be a ***Licensing System*** for engineers by a central authority.
- ☞ There should be ***Resource Networking*** of Institutes and major industries. There is a shortage of funds in the private engineering institutes. In order to overcome this, it is felt that there should be networking of resources at least in the first phase in major cities and subsequently on national basis with IITs.
- ☞ There should be ***%age marking system*** not grading system.

- There should be ***external marking and evaluation system***.
- More and more use of ***tele-conferencing and video-conferencing*** facilities be introduced.
- Proper ***teaching softwares*** be developed and mandatory for teachers to follow them.
- ***R&D component*** is very poor. We must follow the example of Japan where 20% R&D programmes are supported by Govt. and balance 80% supported by industry.
- An undertaking be taken from engineers that they will work in the ***engineering profession*** at least for ***10 years*** before they shift to the managerial profession.

# 6.00 CONCLUSIONS

## 6.01 QUANTITY POSITION

*The Status is as follows:-*

- Quantity shortages can be met. The engineering institutes can easily ***meet the needs*** of the industry.
- Even if the Indian economy picks up and these industries go in for substantial growth, the ***demand will be met.***
- It is anticipated that ***AICTE will approve more engineering institutes*** in the country in the next few years.
- ***More affiliating universities*** will be accorded sanctions.
- More and more engineers will graduate.

***Quantity-wise there are No Gaps w.r.t. Select Infrastructure Industries***

## 6.02 QUALITY POSITION

*The Status is as follows:-*

- Areas like BPR, IPR & ISO-9000 etc., need inclusion in the engineering curriculum.
- Evaluation system needs rethinking like external vs. internal evaluation, %age marking system vs. grading system.
- Period of Curriculum revisions to be decided.
- Faculty retraining to be introduced.
- Faculty Summer Training to be introduced.
- As regarding Faculty Members attending the courses, there is steady increase from 1994 to 1998. The number of engineering collages have increased **1.74 times**, whereas number of Faculty Members attending courses have increased **4.86 times**. This is a **+ive trend**.

- Summer training period of Students to be increased.
- Establishment of chairs by the industry in the institutes.
- Adoption of laboratories by the industry in the institutes.
- More emphasis on Application Side rather Basic Sciences.
- Intimate interaction between industry & institutes is required.

## *Following areas need immediate decisions:-*

- Internship before award of Degree.
- Code of Ethics for engineers.
- Aptitude test for engineers before admission.
- Faculty selection on the basis of All India Competitive exams.
- Resource Networking
- Licensing system for engineers
- Facility of Cross Migration after 2nd Year.
- The skills like Committment & Dedication have to be built in the curriculum. These must be introduced at the earliest since both Academic and Industry have full agreement (based on majority assessment).

Above are the areas where there is gap between industry and institutes. It is high time that the engineering institutes examine the above areas and gear themselves to meet the needs of the industry in order to produce engineers of international standards.

***Quality-wise Gaps exist; but can be met by restructuring of the Engineering Institutes and having more closer interaction with industry.***

# ***References***


1) *AICTE Anual Report for the year 1993-94.*

2) *AICTE Anual Report for the year 1994-95.*

3) *Directory of Approved Institutions for Degree Programmes in Engineering & Technology for the year 1997-98 by AICTE.*

4) *India Trade Pages Directory of Engineering Institutes in India for the year 1999*

5) *Magzine "Indian Infrastructure" December, 1998 issue.*

6) *Magzine "Powerline" December, 1998 issue.*

Annexure-I

**QUESTIONNAIRE**
**(SUPPLY SIDE)**

# Assessment of anticipated gaps in demand and supply position of Engineering Graduates.

*Study Sponsored by:*

**National Science & Technology Management Information System (NSTMIS)**

## Ministry of Science & Technology,
## Government of India


**National Foundation of Indian Engineers**
**Shanti Chambers, 11/6B Pusa Road,**
**New Delhi-110 005**

1. Name of the Institute : _____

2. Name of the Respondent : _____

3. Qualifications of the Respondent : _____

4. Experience *(in compeleted year)* : Academic ( ) Industry ( ) Total ( )

5. Designation : _____

6. Full Address : _____

7. Tel. (Off..) : _____
   (Res.) : _____
   E-mail : _____
   Cable : _____
   Fax : _____

8. Age (Completed Years) : _____

9. Number of **B.E. Level** Engineers **actually graduated** from your institute.

| 1994 | | | | 1995 | | | | 1996 | | | | 1997 | | | | 1998 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E | M | P | I | E | M | P | I | E | M | P | I | E | M | P | I | E | M | P | I |
| | | | | | | | | | | | | | | | | | | | |

10. Number of B.E. Level Engineers **likely to graduate** from your Institute, in future years.

| 1999 | | | | 2000 | | | | 2001 | | | | 2002 | | | | 2003 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E | M | P | I | E | M | P | I | E | M | P | I | E | M | P | I | E | M | P | I |
| | | | | | | | | | | | | | | | | | | | |

***E = Electrical  M = Mechanical  P = Production  I = Industrial***

11. Number of Engineers who graduated from your Institute **ranking-wise**

a) Electrical Engineering (E)
b) Mechanical Engineering (M)
c) Production Engineering (P)
d) Industrial Engineering (I)

| 1994 | | | 1995 | | | 1996 | | | 1997 | | | 1998 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | B | C | A | B | C | A | B | C | A | B | C | A | B | C |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |

*A = With Distinction B = 1st Class C = 2nd Class*

12. **Overall Assessment** of your Engineers in the following Areas:-
(Please tick mark ✓)

a) Technical Know-how
b) General Knowledge overall Know-how
   - *National*
   - *International*
   - *Sports*
c) Intelligence Questient
d) Mental Questient

| 1994 | | | | 1995 | | | | 1996 | | | | 1997 | | | | 1998 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E | VG | G | Ag | E | VG | G | Ag | E | VG | G | Ag | E | VG | G | Ag | E | VG | G | Ag |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
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| | | | | | | | | | | | | | | | | | | | |

*E = Excellent VG = Very Good G = Good Ag = Average*

13. What should be the weightage in **%age** in the syllabus to make it more useful to the industry: (Total to be 100%)

| Basic Sciences | R&D | Emerging Areas like: BPR, TQM PM & ISO | Managerial Skills | Project work - Industry oriented |
|---|---|---|---|---|
| | | | | |

***BPR** = Business Process Re-engineering **R&D**= Research & Development*
***TQM** = Total Qaulity Management **PM**= Project Management*
***ISO** = International Standards Organisation*

14. How many times the **same organisation** from industry has visited your institute for campus recruitment year after year? (Name three leading organisations).

1. _____
2. _____
3. _____

15. Chair in your institute? Give name of the organisations and since when. (please indicate year)

1. _____
2. _____
3. _____

16. Give name of the organisations which have **adopted Laboratory** in your engineering institute and since when.

1. _____
2. _____
3. _____

17. How many **Faculty Members** of your institute have **attanded courses** organised by industry? Nos.

| 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|
| | | | | |

18. What in your opinion should be the **%age emphasis** on follwing skills in engineering curriculum? ***(Presuming these managerial skills to be overall 100%).***

| | 5% | 10% | 15% | 20% | 25% | 30% |
|---|---|---|---|---|---|---|
| a) Analytical Skills | | | | | | |
| b) Communication Skills | | | | | | |
| c) Interpersonal Skills | | | | | | |
| d) Other Skills like | | | | | | |
| ❑ Team Spirit | | | | | | |
| ❑ Committment | | | | | | |
| ❑ Dedication | | | | | | |

19. What in your opinion should be emphasis on **emerging areas** in engineering curriculum like:

| | 5% | 10% | 15% | 20% | 25% | 30% |
|---|---|---|---|---|---|---|
| a) Business Process Reengineering (BPR) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| b) Total Quality Management (TQM) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| c) Project Management (PM) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| d) Intellectual Property Regime (IPR) related issues (Patent Copywrite) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| e) ISO etc. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

20. How much in your opinion should be the emphasis on **basic sciences** in engineering curriculum?

☐ 5% ☐ 10% ☐ 15% ☐ 20% ☐ 25% ☐ 30% ☐ 35% ☐ 40% ☐ More than 50%

21. How much in your opinion should be the emphasis on **application side** (Industry Orientation) in engineering curriculum?

☐ 5% ☐ 10% ☐ 15% ☐ 20% ☐ 25% ☐ 30% ☐ 35% ☐ 40% ☐ More than 50%

22. How often you **revise** the engineering curriculum?

☐ every 3 years ☐ every 5 year

23. What should be the **Faculty, Student** ratio?

☐ 1:5 ☐ 1:10 ☐ 1:15

24. How often teachers should be **retrained?**

☐ every 3 years ☐ every 5 year

25. How much minimum time **students** should spend on **summer training** in industry during 4 year's stay?

☐ 8 weeks ☐ 12 weeks ☐ 16 weeks ☐ More than 6 months

26. How much time minimum **Faculty** should spend in **summer training** in industry?

☐ 8 weeks ☐ 12 weeks ☐ 16 weeks ☐ More than 6 months

27. How many **industry experts** have visited your institute. to give lectures (Nos.)?

1994 ☐ 1995 ☐ 1996 ☐ 1997 ☐ 1998 ☐

**( ✓Tick mask follwing )**

28. Do you think that engineers should undergo minimum one year ***internship*** in industry before they are awarded degree? — ***Yes*** ☐ ***No*** ☐

29. Do you think that there should be an ***aptitude test*** before a student is given admission in an engineering college/ institute? — ***Yes*** ☐ ***No*** ☐

30. Do you agree that there should be ***cross migration*** of engineering branches allowed after 2nd year *(like elect. shifting to mech. engineering etc.)*? — ***Yes*** ☐ ***No*** ☐

31. Do you agree that faculty for engineering insitutes' be selected through all India ***competive exams.***, like I.A.S? — ***Yes*** ☐ ***No*** ☐

32. Do you think that there should be a ***code of conduct and ethics*** for engineers like for medical doctors? — ***Yes*** ☐ ***No*** ☐

33. Do you think that there should be a ***licensing system*** for engineers like medical doctors? — ***Yes*** ☐ ***No*** ☐

34. Do you agree that there should be ***resource networking*** between institutes' major citywise intially and then nationally? — ***Yes*** ☐ ***No*** ☐

35. Do you prefer ***%age marking system or grading system***? — ***%age Marking*** ☐ ***Grading System*** ☐

36. What type of ***evaluation sytstem*** you recommend for future?

    *a) Teacher who teaches*

    *b) Outsider as evaluator*

    a. ☐ b. ☐

37. ***Any other comments you would like to give which has relevance to this study:-***

Annexure-II

**QUESTIONNAIRE**
**(DEMAND SIDE)**

# Assessment of anticipated gaps in demand and supply position of Engineering Graduates.

*Study Sponsored by:*

**National Science & Technology Management Information System (NSTMIS)**

## Ministry of Science & Technology,
## Government of India


**National Foundation of Indian Engineers**
**Shanti Chambers, 11/6B Pusa Road,**
**New Delhi-110 005**

1. Name of the Organisation : _____

2. Name of the Respondent : _____

3. Qualifications of the Respondent : _____

4. Experience : Academic ( ) Industry ( ) Total ( )
   *(in compeleted year)*

5. Designation : _____

6. Full Address : _____

7. Tel. (Off..) : _____
   (Res.) : _____
   E-mail : _____
   Cable : _____
   Fax : _____

8. Age (Completed Years) : _____

9. Number of **B.E. Level** Engineers **actually recruited** in your Organisation.

***Code*** ***Description***

01 Electrical

02 Mechanical

03 Production

04 Industrial

| Code / Year | 01 | 02 | 03 | 04 |
|---|---|---|---|---|
| 1994 | | | | |
| 1995 | | | | |
| 1996 | | | | |
| 1997 | | | | |
| 1998 | | | | |

10. Number of B.E. Level Engineers **likely to be recruited** in your Organisation in future years.

***Code*** ***Description***

01 Electrical

02 Mechanical

03 Production

04 Industrial

| Code / Year | 01 | 02 | 03 | 04 |
|---|---|---|---|---|
| 1999 | | | | |
| 2000 | | | | |
| 2001 | | | | |
| 2002 | | | | |
| 2003 | | | | |

11. Ranking of **Engineers** recruited by you in the past in following areas:

Advance Manufacturing Techniques (Nos.)

01 Electrical

02 Mechanical

03 Production

04 Industrial

| 1994 | | | 1995 | | | 1996 | | | 1997 | | | 1998 | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | B | C | A | B | C | A | B | C | A | B | C | A | B | C | A | B | C |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |

*A = With Distinction B = 1st Class C = 2nd Class*

12. **Overall Assessment** of your Engineers in the following Areas (Nos.) (Please tick mark ( ✓ )

a) Technical Know-how

b) General Knowledge overall Know-how

- *National*
- *International*
- *Sports*

c) Intelligence Questient

d) Mental Questient

| | 1994 | | | | 1995 | | | | 1996 | | | | 1997 | | | | 1998 | | | | Total | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | E | VG | G | Ag | E | VG | G | Ag | E | VG | G | Ag | E | VG | G | Ag | E | VG | G | Ag | E | VG | C | AG |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | |

*E = Excellent VG = Very Good G = Good Ag = Average*

13. How many times your organisation has visited the **same** engineering college for campus selection? (Give three name of the colleges).

1. _____
2. _____
3. _____

14. Have you constituted any **Chair** in the institute? Give name of the engineering institute and since when.

1. _____
2. _____
3. _____

15. How many **Executives** from your organiation have visited any engineering college and delivered lectures?

| 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|
| | | | | |

16. What in your opinion should be the **%age emphasis** on follwing skills in engineering curriculum?
***(Presuming these managerial skills to be overall 100%).***

| | 5% | 10% | 15% | 20% | 25% | 30% |
|---|---|---|---|---|---|---|
| a) Analytical Skills | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| b) Communication Skills | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| c) Interpersonal Skills | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| d) Other Skills like | | | | | | |
| ❑ Team Spirit | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| ❑ Committment | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| ❑ Dedication | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

17. What in your opinion should be emphasis on **emerging areas** in engineering curriculum like:

| | 5% | 10% | 15% | 20% | 25% | 30% |
|---|---|---|---|---|---|---|
| a) Business Process Reengineering (BPR) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| b) Total Quality Management (TQM) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| c) Project Management (PM) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| d) Intellectual Property Regime (IPR) related issues (Patent Copywrite) | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| e) ISO etc. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

18. How much in your opinion should be the emphasis on **basic sciences** in engineering curriculum?

☐ 5% ☐ 10% ☐ 15% ☐ 20% ☐ 25% ☐ 30% ☐ 35% ☐ 40% ☐ More than 50%

19. How much in your opinion should be the emphasis on **application side** (Industry Orientation) in engineering curriculum?

☐ 5% ☐ 10% ☐ 15% ☐ 20% ☐ 25% ☐ 30% ☐ 35% ☐ 40% ☐ More than 50%

20. How often engineering curriculum be **revised**? **every 3 years** ☐ **every 5 year** ☐

21. What should be the Faculty Student **ratio**? **1:5** **1:10** **1:15**

22. How often teachers should be **retrained**? **every 3 years** ☐ **every 5 year** ☐

23. How much minimum time **students** should spend on **summer training** in industry during 4 year's stay? **8 weeks** **12 weeks** **16 weeks** **More than 6 months**

24. How much time minimum **Faculty** should spend in **summer training** in industry? **8 weeks** **12 weeks** **16 weeks** **More than 6 months**

(Please ✓ Follwing)

25. Do you think that engineers should undergo minimum one year ***internship*** in industry before they are awarded degree? ***Yes*** ***No***

26. Do you think that there should be an ***aptitude test*** before a student is given admission in an engineering college/ institute? ***Yes*** ***No***

27. Do you agree that there should be ***cross migration*** of engineering branches allowed after 2nd year *(like elect. shifting to mech. engineering etc.)*? ***Yes*** ***No***

28. Do you agree that faculty for engineering insitutes' be selected through all India ***competive exams.***, like I.A.S? ***Yes*** ***No***

29. Do you think that there should be a ***code of conduct and ethics*** for engineers like for medical doctors? ***Yes*** ***No***

30. Do you think that there should be a ***licensing system*** for engineers like medical doctors?

31. Do you agree that there should be ***resource networking*** between institutes' major citywise intially and then nationally? ***Yes*** ***No***

32. Do you prefer ***%age marking system or grading system?***

***%age Marking*** ☐ or ☐ ***Grading System***

33. What type of ***evaluation sytstem*** you recommend for future?

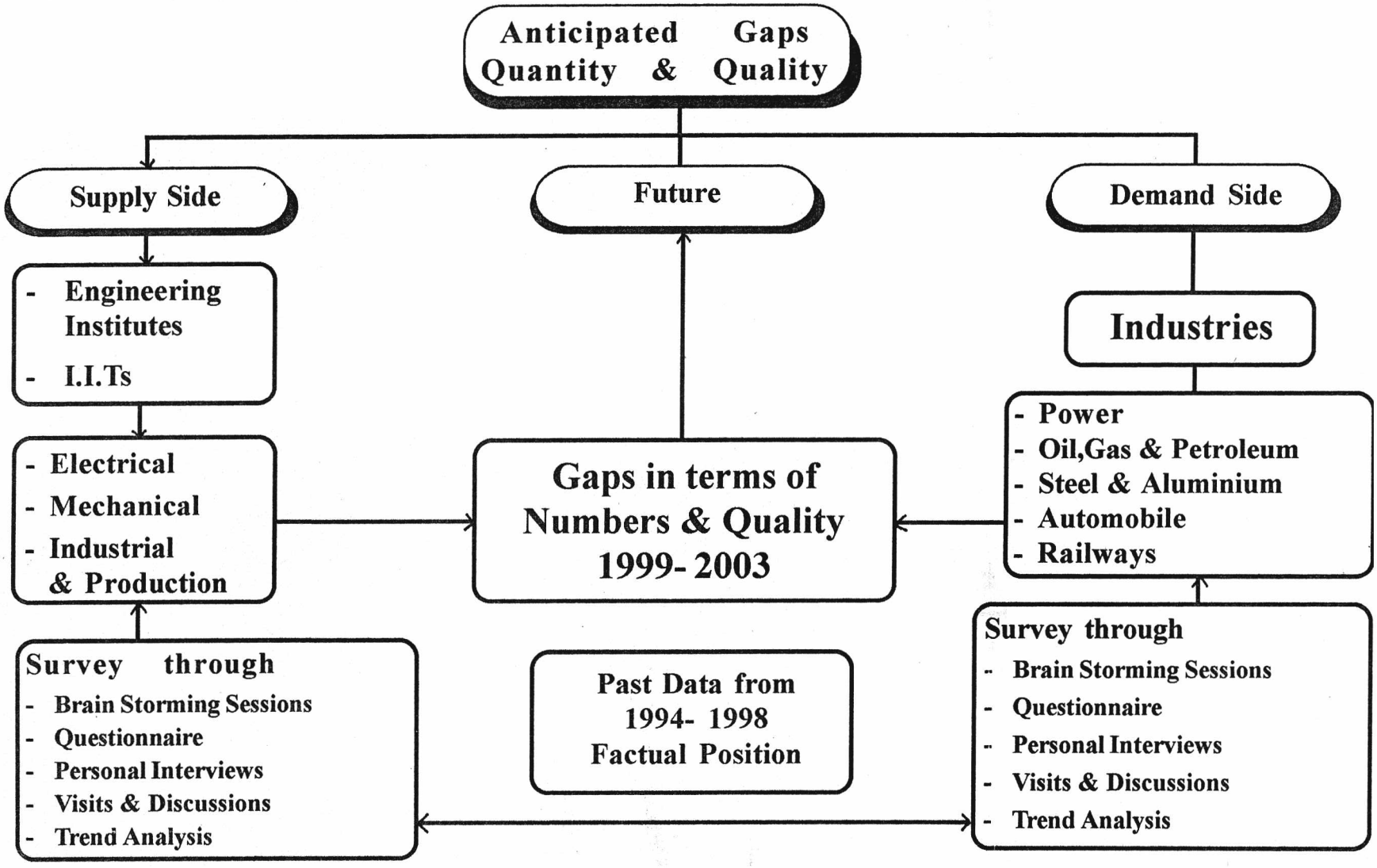
*a) Teacher who teaches*

*b) Outsider as evaluator*

**a.** or **b.**

34. ***Any other comments you would like to give relevance to this study:-***

# Conceptual Diagram for the Study



**Annexure-I**

भारत सरकार
विज्ञान और प्रौद्योगिकी मंत्रालय
विज्ञान और प्रौद्योगिकी विभाग
टेक्नोलाजी भवन, नया महरोली मार्ग, नई दिल्ली - ११००१६

GOVERNMENT OF INDIA
MINISTRY OF SCIENCE & TECHNOLOGY
Department of Science & Technology
Technology Bhavan, New Mehrauli Road, New Delhi -110016.

तार/Telegram : SCIENCTECH
दूरभाष/Telephone : 662135, [EPABX]
667373
टैलेंक्स/Telex 73381, 73317, 73280

फैक्स/Fax 661682, 6863847
6862418, 664567

DST/NSTMIS/05/03/97 Dated : 24.04.1998

## TO WHOM IT MAY CONCERN

**Sub : Assessment of anticipated gaps in demand and supply of Engineering Graduates.**

The National Science and Technology Management Information System (NSTMIS) under the Department of Science & Technology (DST) has sponsored the above research project to National Foundation of Indian Engineers (NAFEN), Shanti Chambers, 11/6B, Pusa Road, New Delhi -110005.

NAFEN is conducting a survey at national level to assess the gaps in demand and supply as well as quality of engineering graduates in various universities/colleges, industrial and commercial organisations through a set of standard questionnaires.

You are requested to provide a ***prompt response*** by filling in the survey questionnaire and return the same to the *National Foundation of Indian Engineers (NAFEN), Shanti Chambers, 11/6B, Pusa Road, New Delhi- 110005* as early as possible for the smooth conduct of the study.

Thanking you,

Yours faithfully,

**(PARVEEN ARORA)**
**PSO**
**NSTMIS,DST**

*Annexure-V*

**Record Note of the discussions of the 1st Brainstorming Session held at India International Centre, New Delhi, on 12th May, 1998 - Chaired by Dr. S. Abid Hussain, Former Indian Ambassador in USA.**

The list of participants is enclosed in *Annexure-V (A).*

The main points which emerged from the Brainstorming Session are as follows :

1. What are the new curricula which we would like to introduce in order to meet the emerging needs of the Indian Technical Education System for the 21st Century? Whether our Engineering Institutes are geared for this.
2. More harmony between institutes and industry.
3. What is the present level of our teachers? Are they in tune and capable to teach new emerging areas ?
4. Proper curricula on Indian ethos, culture and philosophy and value system to be introduced.
5. More emphasis to be made on skill development rather than giving heavy doses of knowledge.
6. Knowledge given is purely theoretical and very little emphasis on application side.
7. What opportunity the students are given to develop something innovative while they are studying?
8. How many Engineers become Entrepreneurs/self employed?
9. How many times the same companies visit year after year to recruit Engineers from a particular institutes?
10. Is there any industry chair in a particular institute?
11. Are students going in for sandwich courses organised by the industry?
12. Are Teachers going to industry organised courses.
13. 100% attendance to be made compulsory for students.
14. Why there is brain drain?
15. No R&D focus.
16. Value system to change.
17. Industry is not coming forward to support engineering profession in R&D and other infrastrucutral development.
18. Industry must tell what specialization they need.
19. Engineering has to be practised like medicine.
20. Engineering Colleges to be attached with some industry like medical College.

21. Engineering Colleges Workshops to do jobbing work with design and fabrication input to have value addition.

22. Institute of Engineers output also to be considered.

23. Proper emphasis should be laid in engineering curricula on personality development, attitude and mind-set.

24. Little follow up from Institute as to what kind of projects/ specialization industry needs.

25. proper networking of resources through internet and E-mail.

26. How to attract the best of the talent to teaching profession?

27. How many industry people visit Engineering institutes to share their knowledge/skills and experiences?

28. How to make teaching more attractive profession?

29. What is student's opinion regarding engineering professions?

30. What will be the new type of future organisations?

**List of Invitees to the 1st Brainstorming Session held on 12th May, 1998 at Indian International Centre, New Delhi Chaired by Dr. S. Abid Hussain, Former Indian Ambassador in U.S.A.**

1. Prof. P.B. Sharma
Principal
Delhi College of Engineering
Bawana Road, Samaipur Badli
Delhi-110 042

2. Prof. Prem Vrat
Dy. Director (Faculty)
Indian Institute of Technology
Hauz Khas, New Delhi-110 016

3. Dr. Rajnish Prakash
Principal
Punjab Engineering College
Chandigarh-12

4. Mr. T.R. Aggarwal
SSO
Deptt. of Science & Technology
Technology Bhavan
New Mehrauli Road, New Delhi-110 016

5. Mr. Ajay Dutta
Executive (Engg.)
Daewoo Motor India Ltd
A-1, Surajpur Indl. Area
Noida- Dadri Road
Gautam Budh Nagar
New Delhi

6. Mr. T.P. Singh
Prof & Head
Thapar Institute of Engg. & Technology
Patiala, Punjab

7. Dr. V.K. Gupta
Manager
Oil & Natural Gas Corporation
Jeevan Bharati Tower-II,
124, Connaught Place,
New Delhi-110 001

8. Shri Satish Jain
President
NAFEN

9. Mr. Salam Kureshy
Training & Placement Officer
Aligarh Muslim University
Aligarh, U.P.

10. Prof. N.K. Jain
Asst. Prof.
Delhi College of Engineering
Bawana Road, Samaipur Badli
Delhi-110 042

11. Dr. J. Dhar
Emr. Scientist
CSIR & INSA &
Coord., INSA Science Ed. Programme
Anusandhan Bhavan, Rafi Marg,
New Delhi-110 001

12. Mr. Praveen Arora
PSO
Deptt. of Science & Technology
Technology Bhavan
New Mehrauli Road, New Delhi-110 016

13. Mr. S.P. Agarwal
Jt. Adviser
Deptt. of Scientific & Industrial Research
Ministry of Science & Technology
Technology Bhavan
New Mehrauli Road, New Delhi-110 016

14. Dr. B.L. Dhoopar
Principal
Apeejay College of Engineering
Sohna, Haryana

15. Mr. H.N. Gupta
Prof.
Thapar Institute of Engg. & Technology
Patiala, Punjab

16. Ms. Namita Gupta
SSO-I
Deptt. of Science & Technology
Technology Bhavan
New Mehrauli Road, New Delhi-110 016

17. Dr. P.K. Gupta
Secy. Genral, NAFEN &
Project Investigator

18. Mr. Rishi Kumar
Cultrual Secretary, NAFEN &
Co-Project Investigator

*Annexure-VI*

**Record Note of Discussions of the 2nd Brainstorming Session held in the Conference Room of EU Chamber of Commerce, Y.B. Chavan Centre, Mumbai on 22nd June, 1998 - Chaired Mr. Y.S.R. Prasad, CMD, NPC, Mumbai.**

The life of participants is enclosed at *Annexure-VI(A).*

1. The main points which emerged from the Brainstorming Session are as follows :

   - ✡ There was a general feeling that the quality of our Engineers is not bad since when these very Engineers go abroad they perform very well. The problem lies in the following areas.
   - ✡ Environment abroad is different. In India infrastructure facilities are not adequate. Clarity of role is missing.
   - ✡ Lack of systems and procedures, particularly feed back system. Ability to when to do, what to do and how to do is missing.
   - ✡ Even industry does not know what type of Engineers they need. There is no systematic data.
   - ✡ The basic objective should be to provide goods and services to society in an efficient manner. of this objective is kept in mind, the Engineers obviously would be of high standards.
   - ✡ It is felt that due to allurement, 20-30% Engineers leave the engineering profession and go in for Courses like Management, IAS, IFS, IPS etc. Even after Management Degree of MBA, hardly very few Engineers come back of Engineering profession because of lack of respect to Engineers and poor emoluments.
   - ✡ 30-40% Engineers do not remain in engineering profession.

2. Engineering education must provide value addition.
3. Industry representatives felt that if they get Engineers who are good in the basic engineering, then they can train them to suit according to their requirements.
4. Many leading industries like Tats, Reliance, HPCL etc. are tieing with Mangaement Institutes, so that their Engineers are given Mangement inputs in house.
5. Indsutry must evolve a continuous process of training and re-training of Engineers.
6. Teaching Methodology and Technology always is 5-10 years behind the industrial requirements.
7. Many Engineers are produced in conventional areas like Mechanical, Electrical, Civil etc. but demand is more in emerging areas and the participants felt that the new emerging areas which NAFEN has identified in the study are in order.
8. The study must project regional imbalances.

9. Curriculum must be reviewed every 3-5 years, but it has associated impact in the following areas :

   - ✡ New equipment required in the Labs.
   - ✡ Teachers up-dated knowledge.
   - ✡ Examination System.

10 In the accredition process, private sector should also be associated and not only Govt. bodies.

12. There is lack of work culture in most of the Engineering Colleges in the private sector.

12. Proper ratio of student faculty should be maintained and should be realistic.

13. Industry must give proper support in order to retain Engineers in Engineering profession.

14. Approximately 26,000 Engineers are produced per annum by about 60 Engineering Colleges in Maharashtra alone and about 47 courses are offered.

15. Industry is not coming forward for proper industry-institute interaction and alliances.

16. Analytical ability is lacking in Engineers.

17. Case study and industrial project system of teaching is good, but should be given higher value/ weightage.

18. Students should be motivated to do self-learning.

19. Engineers with MBA Degree are better in skills.

20. The whole emphasis on engineering education is on design where as it should be on application based and industry must support.

21. Like Medical Colleges there should be a system of internship for Engineers also.

22. Our industry is market driven and not technology driven. In order to meet this objective, the education should be technology driven.

23. Proper emphasis on service sectors should also be given and concept of profit centres brought in.

24. Engineers should be exposed during education itself to standards like ISO, BIS, ASME etc.

25. Creativitity and innovativeness among Engineers is missing.

26. To meet the challenges of ligeralisation and advancement of technology, engineering education should be revamped.

*Annexure-VI(A).*

**List of Invitees to the 2nd Brainstorming Session held on 22nd June, 1998 at Y.B. Chauhan Centre, Mumbai Chaired by Dr. Y.S.R. Prasad, Chairman & Managing Director, Nuclear Power Corporation, Govt. of India**

1. Mr. A.S. Bhattacharya
General Manager (HRD)
Nuclear Power Corporation Ltd
Belapur Bhawan, 6th Floor
Plot No. 6, Sector -11, CBD Belapur
New Mumbai-400 614

2. Mr. A. Sanat Kumar
Director (Engineering)
Nuclear Power Corporation Ltd
Vikram Sarabhai Bhawan
Anushaktinagar, Mumbai-400 094

3. Mr. S.B. Sadananda
Director
National Productivity Council
Novelty Chambers, 7th Floor
Grant Road, Mumbai-400 007

4. Capt. Venkatramani
Asstt. Managar (HRD)
Dalal Consultants & Engineers Ltd
44, Dr. R.G. Thadani Marg
Worli, Mumbai-400 018

5. Mr. Profulia S. Shirke
Chairman & Managing Director
Maharashtra Renewable Energy Ltd
STC Employee's Co-op Housing Society
Prof. N.S. Phadke Marg
Western Express Highway
Andheri (E), Mumbai-400 069

6. Mr. R.N. Engineer
President
IBPL, Urja Research Foundation
701-C, Annie Besant Road
Worli, Mumbai-400 018

7. Mr. H. Panthank
Sr. Recruitment Manager
Hindustan Petroleum Corpn. Ltd.
17, J. Tata Road, Mumbai-400 001

8. Prof. V. Mohan Dass
F.R.C.R. College of Engineering
Bandra, Mumbai-400 050

9. Mr. V.K. Verma
Dy. General Manager (HRD)
TELCO
Geetanil, 13/19, Nagindas Haster Road
Hutatma Chowk, Mumbai-400 001

10. Dr. Anuradda Ganesh
Associate Prof.,
Indian Institute of Technology
Mumbai-400 026

11. Ms. D.B. Baldawala
Vice President
Urja Research Foundation
701-C, Poonam Chambers
Dr. A.B. Road, Worli
Mumbai-400 016.

12. Mr. P.B. Barode
Principal
Jawaharlal Nehru Engineering College
CIDCO, Aurangabad
Maharashtra

13. Mr. S. Bhargava
Regional Director
National Productivity Council
75, Floor Novelty Chambers
Grant Road, Mumbai-400 007

14. Prof. S. Sundraram
Vice Principal
V.J.T.I., Matunga
Mumbai-400 019

15. Dr. V. Maudgal
Asst. Prof., SPCE
Munshi Nagar, Mumbai 400 058

16. Mr. B.P. Gunaji
Executive Director
Council of EU Chamber of Commerce in India
Y.B. Chavan Centre, Nariman Point
Mumbai-400 001

17. Mr. T. Gopinath
General Manager
IBPL, Urja Research Foundation
701-C, Annie Besant Road
Worli, Mumbai-400 018

18. Mr. K.M. Govidan
Chief Manager (HRD)
Hindustan Petroleum Corpn. Ltd.
17, J. Tata Road, Mumbai-400 001

19. Dr. P.K. Gupta
Secy. General
NAFEN

20. Mr. T.K. Rao
Chief Engineer (Corporate Planning)
Bombay Textile Research Association
L.B.S. Marg, Ghatkopar (W)
Mumbai-400 086

*Annexure-VII*

**Record Note of Discussions of the 3rd Brainstorming Session held in the Conference Room of Bengal National Chambers of Commerce & Industry, Calcutta on 27th July, 1998**
**- Chaired by Shri S.P. Mukherjee, M.D., BIECCO Lawrie Ltd., Calcutta.**

The list of participants is enclosed at *Annexure-VII(A).*

The main points which emerged from the Brainstorming Session are as follows :

1. Future is uncertain because of fast changes in technology, Government Policy and environment.
2. Earlier the changes were slow, but now, due to revolution, like interent/E-mail, the changes are very fast.
3. Earlier 10 years were a long term period, but now 3-5 yeas are sufficiently long period.
4. Engineering education curriculum must take care of all the chances to meet the industry demands.
5. To meet the fast changes, the methods of teaching and coaching have to undergo radical changes.
6. Industry-Institute interaction has not progressed satisfactorily, as in countries like Germany, U.K. etc.
7. Industry should honour and respect the academic since academic institutions provide them human raw materials.
8. Industry feels that Engineering coming out of academic institutions are not upto their standards and they have to train them sufficiently.
9. The projects that Engineering students take up are not real life projects and are mainly theoretical and of academic interest only.
10. India is a country which has both the eh extremes, i.e. advance technologies as well as bullock-cart stage technologies. Engineers, therefore, should be trained to handle both the technologies
11. Industry feels that the Engineers produced are half baked.
12. Engineers are not interested in jobs in their profession, but they are interested in cushioned jobs where there is status and money.
13. Industry wants that institutions should come to them and institutions want that industry should come to them, who should come to whom is not yet settled.
14. Institutions should organise seminars jointly with industry, but not in the Campus, in order to have close interaction.
15. Old teachers do not want to leave old subjects and they continue teaching with their age old notes.

16. Summer training is not effective and a period of 4-6 weeks is not adequate.

17. Many Engineering Colleges do not have proper infrastructure.

18. The marketing System is diluted.

19. There is no system of licensing/accredition of Engineers as is the case with Medical Doctors.

20. Teachers' mindset is blocked. They have little exposure.

21. Teachers lack motivation. There should be enough managerial inputs in the Engineering curriculum itself.

22. There is degeneration of sense of values.

23. R&D is lacking both in industry and institutes.

24. Emerging subjects like Business Process Re-engineering, TQM, Project Management etc. be given proper emphasis in the Engineering curriculum.

25. Flexible curriculum be introduced in order to have cross migration. First year can be foundation courses and second year onward flexible choice of specialisation can be offered to the students.

26. Summer training should be every year, so that students spend more time in industry.

27. Similar summer training programmes should be organised for faculty also.

28. Marking be by Grades only, so that a class or group emerges.

29. Teachers must be well paid and given proper facilities.

30. Different marking given by different Engineering Colleges be brought on one standard level by working out some grading factory, so that the students of one University/ College are not put to any disadvantage or advantage over others.

*Annexure-VII(A)*

**List of Invitees to the 3rd Brainstorming Session held on 27th July, 1998 at Conference Room of Benal national Chambers of Commerce & Industry 23, R.N. Mukherjee Road, Calcutta Chaired by Mr. S.P. Mukherjee, Managing Director, Biecco Lawrie Ltd**

1. Mr. Sutanu Sinha
Company Secretary
Biecco Lawrie Limited
P-54, Hide Road Extn.,
Calcutta-700 088

2. Prof. B.N. Jha
Associate Professor
Birla Institute of Technology
Mesra, Ranchi-835 215
Bihar

3. Mr. M. Halder
Chief Adviser
NUTRISHELL
26, C.R. Avenu, 1st Floor
14, N.S. Road, Calcutta-700 034

4. Prof (Dr.) R.N. Mukherjee
Hony. Director
Process Engineering
Design Development Institute
A-D161, Salt Lake City
Calcutta -700 064

5. Mr. T.K. Roy
Dy. General Manager (Contracts)
Biecco Lawrie Limited
P-54, Hide Road Extn.,
Calcutta-700 088

6. Mr. P.K. Sarkar
AGM (Er-T)
Biecco Lawrie Limited
P-54, Hide Road Extn.,
Calcutta-700 088

7. Mr. Mahab Halder
Director
Research & Remedy
22, N.S. Road, Calcutta-110 034

8. Mr. S.K. Pain
DGM (HR)
Biecco Lawrie Limited
P-54, Hide Road Extn.,
Calcutta-700 088

9. Mr. P.K. Mukherjee
Director (Tech)
Bharat Bhari Udyog Nigam Ltd.,
26, Raja Santos Road
Calcutta-700 027

10. Dr. S.R. Bhadra Chaudhuri
Professor & HOD (HRD)
Bengal Engineering College
Howrah-711 103

11. Mr. C.K. Bose
ASM
Nutrishell Food Products,
26, C.R. Avenu, 1st Floor
14, N.S. Road, Calcutta-700 034

12. Dr. P.K. Gupta
Secretary General
NAFEN

13. Mr. Rishi Kumar
Cultural Secretary
NAFEN

14. Mr. Amit Mukherjee
Asst. General Manager
NAFEN

*Annexure-VIII*

**Record Note of Discussions of the 4th Brainstorming Session held at the ISRO Headquarters, Bangalore on 24th August, 1998 - Chaired by Dr. K. Kasturirangan, Chairman, ISOR and Secretary DOS, Govt. of India**

The list of participants is enclosed at *Annexure-VIII(A)*

The main points which emerged from the Brainstorming Session are as follows :

1. There is a lack of infrastructure in many of the private Engineering Colleges.
2. There is excessive bureaucracy and procedures which delay even the utilisation of funds.
3. Due to liberalisation, there is an increasing role of MNCs, IT, and in the near future, direct to home transmission, are the emerging areas.
4. Telecommunication, computers and software will be the major areas of development in the next 10 years, calling for massive investments.
5. Inter-phase with the industry is very poor, particularly the R&D component.
6. Instead of short term summer training programmes, there should be at least one year internship for Engineers before they are awarded degrees like for medical doctors.
7. Industry must come forward and adopt at least one lab in each Engineering College.
8. All India competitive exams for selection of teachers for Engineering Colleges like IAS.
9. Code of Ethics and Conduct to be evolved for Engineers, including licensing, as for medical doctors.
10. There should be continuous skill upgradation for Teachers.
11. Networking of resources, first major city-wise between Engineering Colleges and ultimately at the national and international level.
12. Cross-migration from one branch to another branch in the 3rd and 4th year of engineering.
13. Proper teaching softwares to be developed in order to have innovative teaching methodologies.
14. More and more use of tele-conferencing and video conferencing to be adopted.
15. Medium and small scale industry should also come forward and take engineers as trainees for one year internship.
16. Engineers during their education must appear for aptitude test in order to find out their aptitude for a particular branch of engineering.
17. Number of Engineers are under-employed, i.e., they are not doing the engineering job, but other types of jobs in order to gain employment.
18. Industry must be involved while upgrading and revising the curriculum.

19. Industry and Academics must liasion when their Executive go from industry to Academics and Academics to industry for sharing their experiences. This period must be for one year at least.

20. Academics must create special funds for Teachers to give training in new important emerging areas.

21. Interpersonal and behavioural sciences subjects must be introduced in the engineering curriculum.

22. Proper weightage/multiplying factors to be evolved to bring marking of each University/ College to a common level.

*Annexure-VIII(A)*

**List of Invitees to the 4th Brainstorming Session held on 24th August, 1998 at ISRO Hqrs., Bangalore, Chaired by Dr. K.Kasturirangan, Chairman, ISRO, GOI**

1. Mr. K. Audi Seshu
Executive Director
I.T.I. Limited
Corporate Office,
45/1, Magrath Road,
Bangalore-25

2. Mr. C.R. Seetharam
Om Consultants,
9th Cross, 6th Main
P.O. Box -365,
Mahabalewaram
Bangalore-560 003

3. Mr. B. Krishnappa
Principal
M.S. Ramaiah College of Engg.,
M.S.R. Nagar, HMT Layout
Bangalore -560 054

4. Ms. Damini Sampat
Deputy Director
GOI, Deptt. of Space
ISRO Headquarters
New BEL Road
Bangalore-560 094

5. Dr. J. Krishnamurthy
Scientist
GOI, Deptt. of Space
ISRO Headquarters
New BEL Road
Bangalore-560 094

6. Mr. C.V.S. Prakash
Scientist
GOI, Deptt. of Space
ISRO Headquarters
New BEL Road
Bangalore-560 094

7. Mr. K.S. Shetty
General Manager
K.P.C. Limited
82, Shakthi Bhavan
Race Course Road,
Bangalore-560 001

8. The Chief HRD Manager
KPC Limited
82, Shakthi Bhavan
Race Course Road,
Bangalore-560 001

9. Mr. E. K. Kutty
Dy. Director,
GOI, Deptt. of Space
ISRO Headquarters
New BEL Road
Bangalore-560 094

10. Mr. S. Satish
Dy. Director,
GOI, Deptt. of Space
ISRO Headquarters
New BEL Road
Bangalore-560 094

11. Mr. S.Krishnamurthy
Director
GOI, Deptt. of Space
ISRO Headquarters
New BEL Road
Bangalore-560 094

12. Dr. B.N. Bisvanali
Principal
University of Visweshwarya College
of Engineering,
K.R. Circle, Bangalore-560 056

13. Mr. K.R. Sridharamurthy
Scientific Secretary
GOI, Deptt. of Space
ISRO Headquarters
New BEL Road
Bangalore-560 094

14. Dr. P.K. Gupta
Secy. General
NAFEN

15. Mr. Y.P.S. Tomar
Executive, NAFEN

*Annexure -IX*

# List of Engineering Colleges who responded to the Questionnaire (Zone-wise)

| Zone | S.N. | Name of the Institute | Place | State |
|---|---|---|---|---|
| East | 1 | Govt. Engg. College | Nadia | West Bengal |
| | 2 | Bihar College of Engg., | Patna | Bihar |
| | 3 | Bhagalpur College of Engg., | Bhagalpur | Bihar |
| | 4 | Bihar Institute of Technology | Dhanbad | Bihar |
| | 5 | Birla Institute of Technology | Ranchi | Bihar |
| | 6 | Bokaro Institute of Tech., | Bokaro | Bihar |
| | 7 | M.A. College of Engg. & Tech | Patna | Bihar |
| | 8 | Muzaffarpur Inst. Of Tech., | Muzaffarpur | Bihar |
| | 9 | Patna Institute of Technology | Patna | Bihar |
| | 10 | Orissa Engineering College | Bhubaneshwar | Orissa |
| | 11 | Bengal Engg. College | Howrah | West Bengal |
| North | 12 | Regional Engg College | Hamirpur | Haryana |
| | 13 | Zakir Hussain College | Aligarh | U.P. |
| | 14 | G.S. Institute of Tech | Indore | M.P. |
| | 15 | Thapar Instiute of Engg. | Patiala | Punjab |
| | 16 | Punjab Engg. College | Chandigarh | Punjab |
| | 17 | MBM Engg. College | Jodhpur | Rajasthan |
| | 18 | Birla Institue of Tech. | Pilani | Rajasthan |
| | 19 | HKES, SLN Engg. | Raichur | Karnataka |
| | 20 | Guru Nanak Dev Univ. | Amritsar | Punjab |
| | 21 | Delhi College of Engineering | Delhi | New Delhi |
| | 22 | Indian Institute of Technology | Delhi | New Delhi |
| | 23 | B.M.S. Inst. of Technology | Faridabad | Haryana |
| | 24 | C.R. State College of Engg., | Murthal | Haryana |
| | 25 | M.M. Engg. College | Ambala City | Haryana |
| | 26 | SJPML Inst. of Engg. Tech., | Radaur | Haryana |
| | 27 | Vaish College of Engg., | Rohtak | Haryana |
| | 28 | Govt. Engg. College | Jammu Tawi | J&K |
| | 29 | Institute of Engg. & Tech., | Bareilly | U.P. |
| | 30 | M.M.M. Engg. College | Gorakhpur | U.P. |
| | 31 | Univ. of Roorkee | Roorkee | U.P. |
| | 32 | H.B.T.I. | Kanpur | U.P. |
| | 33 | Kamla Nehru Institute of Tech., | Sultanpur | U.P. |
| | 34 | Indian Institute of Technology | Kanpur | U.P. |
| | 35 | Jamia Millia Islamia | Delhi | Delhi |
| | 36 | Netaji Subhas Inst. Of Tech. | Delhi | Delhi |
| South | 37 | K.E. Society | Sangli | Maharashtra |
| | 38 | Crescent Engg. College | Chennai | Tamil Nadu |

| | | | | |
|---|---|---|---|---|
| | 39 | Sri Siddhartha Institute | Tumkur | Karnataka |
| | 40 | KSRM College of Engg. | Cuddapah | A.P. |
| | 41 | Adhiyamaan Engg. | Dharmapuri | Tamil Nadu |
| | 42 | The National Institute | Mysore | Karnataka |
| | 43 | M.S.Ramaiah Institute | Bangalore | Karnataka |
| | 44 | Chaitanya Bharati Inst. | Hyderabad | A.P. |
| | 45 | College of Engineering | Vishakhapatnam | A.P. |
| | 46 | Deccan College of Engg. | Hyderabad | Karnataka |
| | 47 | J.L.N. College of Engg,. | Anant Pur | A.P. |
| | 48 | K.L. College of Engg., | Guntur | A.P. |
| | 49 | Kakatiya Inst. of Tech., | Warangal | A.P. |
| | 50 | M.J.College of Engg., | Hyderabad | A.P. |
| | 51 | R.V.R.&J.C. College of Engg. | Guntur | A.P. |
| | 52 | S.V.H. College of Engg., | Machilipatram | A.P. |
| | 53 | Univ. College of Engg., | Hyderabad | A.P. |
| | 54 | B.L.D.E.A. College of Engg., | Bijapur | Karnataka |
| | 55 | B.V.B. College of Engg., | Vidyanagar | Karnataka |
| | 56 | Bangalore Inst. Of Tech., | Bangalore | Karnataka |
| | 57 | Bapuji Inst. Of Engg.&Tech., | Davanegere | Karnataka |
| | 58 | Basaveswar Engg. College | Bijapur | Karnataka |
| | 59 | Dr. ambedkar Inst. Of Tech., | Bangalore | Karnataka |
| | 60 | D. Sagar College of Engg., | Bangalore | Karnataka |
| | 61 | Ghousia College of Engg., | Bangalore | Karnataka |
| | 62 | K.L.S.G. College of Engg., | Belgaum | Karnataka |
| | 63 | Golden Valley Inst. Of Engg., | Bangalore | Karnataka |
| | 64 | S.K.SJ. Technological Inst. | Bangalore | Karnataka |
| | 65 | Guru Nanak Dev Engg. College | Bidar | Karnataka |
| | 66 | Institute of Technology | Kanada | Karnataka |
| | 67 | Islamia Inst. Of Technology | Bangalore | Karnataka |
| | 68 | J.M.M. Inst. Of Technology | Chitradurga | Karnataka |
| | 69 | K.V.G. College of Engineering | Sullia | Karnataka |
| | 70 | Malnad College of Engineering | Hassan | Karnataka |
| | 71 | Manipal Inst. Of Technology | Manipal | Karnataka |
| | 72 | M.V.J. College of Engineering | Bangalore | Karnataka |
| | 73 | R.V. College of Engineering | Bangalore | Karnataka |
| | 74 | Sidda Ganga Inst. Of Tech., | Tumkur | Karnataka |
| | 75 | S.J. College of Engineering | Mysore | Karnataka |
| | 76 | Visvesvaraya College of Engg., | Bangalore | Karnataka |
| | 77 | College of Engineering | Adoor | Kerala |
| | 78 | Govt. College of Engineering | Kannur | Kerala |
| | 79 | Rajiv Gandhi Inst. Of Tech., | Valoor | Kerala |
| | 80 | School of Engineering | Kochi | Kerala |
| | 81 | S.C.T. College of Engineering | Thiruvananthapuram | Kerala |
| | 82 | T.K.M. College of Engineering | Kolam | Kerala |

| | | | | |
|---|---|---|---|---|
| | 83 | Indian Engineering College | Tirunelveli | Tamil Nadu |
| | 84 | Arunai Engg. College | Sambuvarayar | Tamil Nadu |
| | 85 | Coimbatore Inst. Of Tech | Coimbatore | Tamil Nadu |
| | 86 | Dr. MGR Engg. College | Chennai | Tamil Nadu |
| | 87 | J.J. College of Engg. & Tech. | Truchirapelli Taluk | Tamil Nadu |
| | 88 | K.L.N. College of Engg., | Madurai | Tamil Nadu |
| | 89 | Hindustan College of Engg. | Chennai | Tamil Nadu |
| | 90 | Anjuman Engg. College | Bhatkal | Karnataka |
| | 91 | Rural Engg. College | Dharwad | Karnataka |
| | 92 | National Engg. College, | Kovilapatti | Tamil Nadu |
| | 93 | S.V. College of Engg. | Chennai | Tamil Nadu |
| **West** | 94 | Jawaharlal Nehru Engg. | Aurangabad | Maharashtra |
| | 95 | Kolhapur Institute of Tec | Kolhapur | Maharashtra |
| | 96 | Shivaji Vidya Prasarak | Dhule | Maharashtra |
| | 97 | SDM College of Engg. | Dharwad | Maharashtra |
| | 98 | DKTE Society | Kolhapur | Maharashtra |
| | 99 | College of Engg | Akola | Maharashtra |
| | 100 | K.K. Wagh Edu. Soc. | Nashik | Maharashtra |
| | 101 | M.S.Univ. | Baroda | Gujarat |
| | 102 | Bhilai Inst. Of Technology | Durg | M.P. |
| | 103 | Govt. Engineering College | Bhopal | M.P. |
| | 104 | Govt. Engineering College | Bilaspur | M.P. |
| | 105 | Govt. Engineering College | Jabalpur | M.P. |
| | 106 | Govt. Engineering College | Raipur | M.P. |
| | 107 | Govt. Engineering College | Jagdalpur | M.P. |
| | 108 | Govt. Engineering College | Rewa | M.P. |
| | 109 | Govt. Engineering College | Sagar | M.P. |
| | 110 | Govt. Engineering College | Ujjain | M.P. |
| | 111 | Inst. Of People's Sc. & Tech., | Stana | M.P. |
| | 112 | Madav Inst. Of Tech. & Sc., | Gwalior | M.P. |
| | 113 | A.C.C.R. Institute of Tech., | Mumbai | Maharashtra |
| | 114 | S.S.M. Society's College of Engg., | Pune | Maharashtra |
| | 115 | Amrutvahini College of Engg., | Ahmednagar | Maharashtra |
| | 116 | A.S.S.A. College of Engg., | Nagpur | Maharashtra |
| | 117 | A.B. College of Engineering | Sangli | Maharashtra |
| | 118 | Army Institute of Technology | Pune | Maharashtra |
| | 119 | B.C.Y.R.C's College of Engg., | Nagpur | Maharashtra |
| | 120 | B.V.B.S.P. College of Engg., | Mumbai | Maharashtra |
| | 121 | B.V. College of Engineering | Pune | Maharashtra |
| | 122 | B.V. College of Engineering | Mumbai | Maharashtra |
| | 123 | Dr. D.Y. Patil College of Engg., | Pune | Maharashtra |
| | 124 | D.K.T.E.S. Engg. Institute | Kolhapur | Maharashtra |
| | 125 | Dr. B.S.A. Tech. University | Raigad | Maharashtra |
| | 126 | E.S.K. Inst. Of Tech. & Science | Ramtek | Maharashtra |

| | | | | |
|---|---|---|---|---|
| | 127 | Fr. C.R. College of Engineering | Mumbai | Maharashtra |
| | 128 | M.H. Patil Inst. Of Engg. & Tech | Gondia | Maharashtra |
| | 129 | Govt. College of Engineering | Amravati | Maharashtra |
| | 130 | Govt. College of Engineering | Aurangabad | Maharashtra |
| | 131 | Govt. College of Engineering | Pune | Maharashtra |
| | 132 | Govt. College of Engineering | Karad | Maharashtra |
| | 133 | Marathwada Inst. Of Technology | Aurangabad | Maharashtra |
| | 134 | J.S.B.S. Naik College of Engg., | Pusad | Maharashtra |
| | 135 | K.E. Society College of Engg., | Sangli | Maharashtra |
| | 136 | K.G. College of Engineering | Karjat | Maharashtra |
| | 137 | Priyadarshini College of Engg., | Nagpur | Maharashtra |
| | 138 | L.M.T.J.S.S. College of Engg., | Mumbai | Maharashtra |
| | 139 | Maharashtra Inst. Of Tech., | Pune | Maharashtra |
| | 140 | R.S. Inst. Of Engg. & Technology | Ratnagiri | Maharashtra |
| | 141 | Military Engineering College | Pune | Maharashtra |
| | 142 | Y.R.Chavan College of Engg., | Nagpur | Maharashtra |
| | 143 | Anuradha Engineering College | Chikhli | Maharashtra |
| | 144 | K.E.S. Engg. College | Raigad | Maharashtra |
| | 145 | Pravara Rural College of Engg., | Ahmednagar | Maharashtra |
| | 146 | Shri S.G.M.College of Engg. | Buldana | Maharashtra |
| | 147 | Walchand College of Engg. | Sholapur | Maharashtra |
| | 148 | Victoria Jubilee Tech. Institute | Mumbai | Maharashtra |

***Annexure-XI***

# List of Industries who responded (Sector-wise)

| Sector | S.No | Name of Organisation | Place | State |
|---|---|---|---|---|
| **Automobile** | **1** | Bajaj Auto Ltd. | Aurangabad | Maharashtra |
| | **2** | Daewoo Motors I Ltd, | Noida | U.P. |
| | **3** | Tata Engg. & Locomotives | Mumbai | Maharashtra |
| | **4** | Mahindra & Mahindra Ltd | Mumbai | Maharashtra |
| | **5** | Ind Auto Ltd. | Mumbai | Maharashtra |
| | **6** | BEML | Bangalore | Karnataka |
| | **7** | MUL | Gurgaon | Haryana |
| **Oil, Gas and Petroleum** | **8** | Essar Oil Ltd. | Mumbai | Maharashtra |
| | **9** | BPCL | Mumbai | Maharashtra |
| | **10** | HOC Ltd. | Mumbai | Maharashtra |
| | **11** | Castrol I Ltd. | Mumbai | Maharashtra |
| | **12** | HPCL | Mumbai | Maharashtra |
| | **13** | EIL | New Delhi | New Delhi |
| | **14** | IOC | New Delhi | New Delhi |
| | **15** | ONGC | New Delhi | New Delhi |
| | **16** | OIL | New Delhi | New Delhi |
| **Power** | **17** | Damodar Valley Corp. | Calcutta | West Bengal |
| | **18** | Karnataka Power Corp. | Bangalore | Karnataka |
| | **19** | Reliance India Ltd. | Mumbai | Maharashtra |
| | **20** | BSES | Mumbai | Maharashtra |
| | **21** | NPC Ltd. | Mumbai | Maharashtra |
| | **22** | Maharashtra State Elec. Board | Maharashtra | Maharashtra |
| | **23** | HVPNL | Panchkula | Haryana |
| | **24** | PSEB | Patiala | Panjab |
| | **25** | NTPC | New Delhi | New Delhi |
| | **26** | IREDA | New Delhi | New Delhi |
| | **27** | APSEB | Hyderabad | A.P. |
| | **28** | UPSEB | Lucknow | U.P. |
| **Power** | **29** | MPSEB | Jabalpur | M.P. |
| | **30** | BHEL | New Delhi | New Delhi |
| | **31** | WBSEB | Calcutta | West Bengal |
| **Steel/ Aluminium** | **32** | BALCO | New Delhi | New Delhi |
| | **33** | Rourkela Steel Plant | Rourkela | Orissa |
| | **34** | Bokaro Steel Plant | Bokaro | Bihar |
| | **35** | Heavy Engg. Corp. Ltd. | Ranchi | Bihar |
| | **36** | Durgapur Steel Plant | Durgapur | West Bengal |
| | **37** | HINDALCO | Renukut | U.P. |
| | **38** | Vishakapatnam Steel Plant | Vishakapatnam | Orissa |
| | **39** | INDALCO | New Delhi | New Delhi |
| | **40** | Bhilai Steel Pant | Bhilai | M.P. |
| | **41** | Tata Steel | Jamshedpur | Bihar |
| Railways | **42** | Railways Board | | All India |

***Annexure-X***

# List of Industries who responded (Zone-wise)

| Zone | S.No | Name of Organisation |
|---|---|---|
| East | 1 | Tata Engg. & Locomotives |
| | 2 | Damodar Valley Corp. |
| | 3 | WBSEB |
| | 4 | Rourkela Steel Plant |
| | 5 | Bokaro Steel Plant |
| | 6 | Heavy Engg. Corp. Ltd. |
| | 7 | Durgapur Steel Plant |
| | 8 | Vishakapatnam Steel |
| | 9 | Tata Steel |
| North | 10 | Daewoo Motors I Ltd, |
| | 11 | MUL |
| | 12 | EIL |
| | 13 | IOC |
| | 14 | ONGC |
| | 15 | OIL |
| | 16 | PSEB |
| | 17 | NTPC |
| | 18 | IREDA |
| | 19 | UPSEB |
| | 20 | HVPNL |
| | 21 | BHEL |
| | 22 | BALCO |
| | 23 | HINDALCO |
| | 24 | INDALCO |
| South | 25 | BEML |
| | 26 | Karnataka Power Corp. |
| | 27 | APSEB |
| West | 28 | Bajaj Auto Ltd. |
| | 29 | Mahindra & Mahindra Ltd |
| | 30 | Ind Auto Ltd. |
| | 31 | Essar Oil Ltd. |
| | 32 | BPCL |
| | 33 | HOC Ltd. |
| | 34 | Castrol I Ltd. |
| | 35 | HPCL |
| | 36 | Reliance India Ltd. |
| | 37 | BSES |
| | 38 | NPC Ltd. |
| | 39 | Maharashtra State Elec. Board |
| | 40 | MPSEB |
| | 41 | Bhilai Steel Pant |
| All India | 42 | Railways |