9.1 SUMMARY

It is an established fact that development of a country depends upon its natural and human resources. But the optimum use of natural resources for the development is possible only, if first, the human resources are well developed. Whereas in order to develop the human resources, a well-planned programme of education and training of the masses is essential.

In the second half of the twentieth century, the world has gone through a scientific and technological revolution. As a result not only the methods of production have changed tremendously, new techniques in production, new materials and energy generating devices and new machines are being used throughout the world. Thus, education and training of the new generation to enable them to acquire the scientific and technological knowledge and skills has become much more important.

Countries like Japan, Sweden, Norway, Korea, Holland, etc. have developed themselves with the efficiency of human beings, though they have very scarce natural resources as compared to the other countries of the world. On the other hand, there are countries like India, having large natural resources but they have not developed at the expected pace. According to the World Bank report
(2002) percentage of trained workers in the age group of 20-24 in India has been 5.06% whereas it has been 64.11% in Australia, 78% in Canada, 68.57% in France, 75.33% in Germany, 43.68% in Italy, 80.39% in Japan.

Thus, we can easily conclude that as far as the number of technically trained workers is concerned, India is far behind the developed countries of the world.

But contrary to it, the technical education system in India has made a very significant quantitative progress after independence. India possessed only 42 technical institutions at degree level and 53 institutions at diploma level with an annual intake of merely 2950 and 3650 students respectively which have grown to approximately 1511 technical institutions at degree level and 1697 institutions at diploma level in the year 2003 which represents one of the highest average growth rates in the world.

In this context, many eminent economists feel that most of the developing nations have been led to believe that the rapid quantitative expansion of technical and engineering education holds the key to their economic development and as a result these countries have expanded their technical and engineering education at a rate which is extremely difficult to justify either socially or financially in terms of optimal resource allocation and India is one of such countries.
There is no doubt that since independence, India has produced a large number of competent, qualified engineers who have contributed to the success of many Indian companies and industries. Also a large number of our engineering graduates have made an impact in the corporate world internationally. Despite these positive outcomes there are many limitations in the engineering education system of India before as well as after Independence, especially until late eighties most of the institutions were opened in the southern states. But it has happened only after late eighties that engineering colleges in Punjab has started increasing but after that there has been a haphazard mushroom growth of engineering institutions.

Though there are a variety of institutions imparting different types of engineering education in Punjab. Yet most of them are maladjusted and are out of step with the real needs of development of the state. Since the government has declared that it cannot afford to finance the higher and technical education for all, therefore a number of self-financed colleges of engineering and technology have been established in Punjab like other parts of the country. Consequently, the problem of commercialization of education and inequality of opportunity has become more in Punjab. Though there is a mechanism for accreditation (National Board of Accreditation) and an Umbrella Agency, the All India Council for Technical Education (AICTE) setup to monitor and control engineering
education at the national level, yet the quality of engineering education in many institutions is suspect. The participation of the women, SCs, STs, OBCs and other underprivileged classes in engineering education in the country in general and Punjab in specific has also not improved according to the goals.

Further, there are different types of institutions of engineering education in Punjab. Some are managed by central government others by state government, others are private, but aided by state government, whereas others are run by the universities. While there are self-financed institutions also. This variety leads to unequal rates of fees and heterogeneous quality of education in different type of institutions.

Further, Punjab has been fast emerging as a state with a large pool of scientific and technological manpower. The sheer number may boast of significant success in terms of the generation of graduates in various branches of engineering and technological education, but it reveals a shortsighted policy making that produces more unemployed engineers every year. Though the planned development of higher engineering and technology education in Punjab is only fifty years old, it has brought into sharp focus the issues of uneven growth, quality and social coverage of engineering and technology education.

This situation calls for a number of questions to be answered: Has the engineering education system in the country in general and
in Punjab in specific been able to provide the required quantity and quality of engineers for the growth of the Indian economy? Is the engineering education system in Punjab catering to the different societal needs of the state? Has the self-financing engineering education system provided the similar education as provided by the public system? In the context of globalization, is there a need to modify the engineering education system in India? There are no clear-cut answers to these and many more other questions.

This calls for a rethinking as to what is wrong with the current policies and strategies of the state government and the union government and what should be the policy direction for the future. Therefore there has been a need to look into the various aspects of the growth and development of engineering and technology education in India in general and in Punjab in specific. Thus keeping in view this need, the investigator planned to conduct the study entitled:

‘A CRITICAL STUDY OF GROWTH AND DEVELOPMENT OF ENGINEERING EDUCATION IN PUNJAB AFTER INDEPENDENCE’

9.1.1 Objectives of the Study

The present study has been undertaken with the following objectives:

(i) To study the policy perspective in engineering education in India.
(ii) To study the general growth and development of engineering education at the national level after Independence.
(iii) To study the general growth and development of engineering education in Punjab after Independence.
(iv) To study the views and perceptions of teachers, administrators, intellectuals, social activists and beneficiaries with regard to various issues related to growth and development of engineering education in Punjab.
(v) To conduct the case studies of some engineering institutions of Punjab

9.1.2 Operational Definitions:

i. Critical Study: A critical study, critically evaluates the effects of policies and programmes on their targets in terms of the objectives they are meant to achieve. It assesses the extent to which goals are realized and looks at the factors associated with successful and unsuccessful outcomes. The assumption is that by critically analyzing the facts evaluation assists decision-makers to make wise choices among future course of action. Criticism of the consequences of programmes should improve decision-making.

ii. Growth and Development: Growth and development of engineering education in Punjab in the context of the present study connotes the policy perspective, achievements in engineering education, institutional network, sanctioned intake, enrolment, output, regional and social distribution, financing pattern and demand and supply of engineers at the national level as well as in Punjab to be studied through trend analysis alongwith the views and perceptions of the respondents regarding the issues related to engineering
education in Punjab and the case studies of some selected engineering institutions of Punjab.

iii. **Engineering Education**: Engineering Education connotes the education provided to the students in various engineering colleges, universities, IITs, IISCs, NITs and other institutions of the country for Bachelor of Engineering (B.E.), Master of Engineering (M.E.), Bachelor of Technology (B. Tech), Master of Technology (M. Tech) and Doctor of Philosophy (Ph.D) in engineering in the following trades.

a. Aeronautics  
b. Architecture  
c. Civil Engineering  
d. Computer Science Engineering  
e. Chemical Engineering  
f. Electrical Engineering  
g. Electronics & Communication Engineering  
h. Electronics & Instrumentation  
i. Leather Technology  
j. Mechanical Engineering  
k. Information Technology  
l. Textile Engineering  
m. Production Engineering, etc.
9.1.3 Delimitations of the Study

i. The Study has been delimited to the growth and development of engineering education during the period 1947-2004. But the analysis of secondary data has been delimited to the data and material available in the secondary sources. Therefore in those cases where the data beyond 2004 has been available it has also been included in the study.

ii. The analysis of secondary sources of data about the growth and development of engineering education at the national level has been delimited to the data regarding the brief recommendations of various committees, admission procedure for engineering institutions in different states of the country expansion in number of institutions, sanction strength, student intake and outturn, engineering graduates per million population in India, average intake per institute, doctorates degrees awarded in India, international comparisons of growth rates of graduate engineers, engineering doctorates, percentage of engineering Ph.Ds. to Bachelor engineering degrees, growth rates of academic output and growth in faculty of Indian Engineering institutions, social distribution of engineering education, regional distribution of engineering institutions and sanctioned intake per million population, gender participation, financing of engineering education, demand and supply of engineers.

iii. The analysis of secondary sources of data regarding growth and development of engineering education in Punjab has been delimited to the data regarding increase in number of engineering institutions, sanctioned intake, comparison of student intake in Punjab with neighbouring states, output strength ratio of different branches, teacher-student ratio in different disciplines in Punjab, distribution of teachers in highest qualifications at degree level, regional distribution, social distribution, gender participation, financing of engineering education and demand & supply of engineers.

iv. The views and perceptions towards various issues related to growth and development of engineering education of only following groups have been studied:

   a. Administrators
b. Teachers  
c. Students  
d. Intellectuals  
e. Parents  
f. Social Activists  

Administrators include the Vice-Chancellors, Registrars, and Deans of the universities, Registrars, Principles of various colleges of engineering and Heads of various departments of engineering institutions whereas teachers include the faculty members of engineering institutions only. In the sample of intellectuals only the university and college teachers who have been teaching different social science subjects i.e. sociology, political science, economics, education, history and public administration and who have been well aware of the socio-economic conditions of Punjab as well as policy of the government have been included. While social activists include only those persons who have been actively involved in social work and have been related to the field of education in one or the other way. Whereas beneficiaries include the students studying in final year of graduate degree courses of engineering or first or second year of the masters degree courses of engineering and their parents.

v. The views and perceptions of administrators, teachers, students, intellectuals, parents and social activities with regard to various issues related to growth and development of engineering education in Punjab have been studied by following the qualitative approach.

vi. Case studies of following institutions of engineering education of Punjab have been conducted.

a. National Institute of Technology, Jalandhar  
b. Giani Zail Singh College of Engineering & Technology, Bathinda  
c. University College of Engineering, Patiala
d. Yadvindra College of Engineering, Talwandi Sabo

e. Guru Nanak Dev College of Engineering & Technology, Ludhiana

f. Chandigarh Engineering College, Landran

g. Guru Gobind Singh College of Engineering & Technology, Talwandi Sabo

h. Thapar Institute of Engineering & Technology, Patiala

vii. Under the case studies of the eight engineering institutions of Punjab mentioned above, only the study of following aspects of these institutions have been covered:

a. Recognition and Accreditation

b. Procedure for admission

c. Courses available and intake

d. Social distribution of seats

e. Infrastructure

f. Faculty

g. Fee structure

h. Placement

i. Research and development

j. Feedback from the faculty and students

9.1.4 Methodology

In order to conduct the present study the quantitative as well as qualitative approach of descriptive research has been employed in the following manner:

9.1.4.1. Design of the study

To study the growth and development of engineering education at national and Punjab level, critically, the investigator has adopted
different approaches of descriptive research which has resulted in dividing the research work into following four parts:

i. Policy Perspective

ii. Analysis of Secondary Sources

iii. Study of views and perceptions

iv. Case Studies

9.1.4.1.1 Policy Perspective: The policy perspective of engineering education has been studied on the basis of reports of various commissions and committees, five year plans, and other related documents. The government policies related to technical and engineering education viz-a-viz educational needs of the country in general and the state in specific have been reviewed in detail. Needless to mention that the policy perspective in growth and development of engineering education in Punjab has been studied in the broader context of the national policy as well.

9.1.4.1.2 Analysis of Secondary Sources: The trend analysis has been done to study the pattern of growth and development of engineering education at national level and in Punjab which has been based on secondary sources of data. For this purpose various documents of Punjab and Central Government and study reports of various institutions and researchers have been analyzed. The secondary data from all these sources has been pooled up to study the trends of growth and development of engineering education at the national and the state level separately in terms of the following:
a. Expansion in number of institutions  
b. Sanctioned strength  
c. Student intake and outturn  
d. Growth in faculty  
e. Regional and social distribution of engineering education  
f. Financing of engineering education  
g. Demand and supply of engineering graduates

9.1.4.1.3 Study of Views & Perceptions: The views & perceptions to the different issues related to engineering education has been studied by the method of research to be applied as under:

9.1.4.1.3.2 Sampling

To study the views & perceptions, the investigator has used the purposive method of sampling. The representative samples from the different segments of the public have been selected. The administrators, intellectuals, social activists, teachers of various engineering colleges and beneficiaries have constituted the universe of the study. The detailed composition of the sample has been as per given below:

<table>
<thead>
<tr>
<th>Sampling Group</th>
<th>Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Administrators</td>
<td>- 50</td>
</tr>
<tr>
<td>2. Teachers</td>
<td>- 100</td>
</tr>
<tr>
<td>3. Students</td>
<td>- 100</td>
</tr>
<tr>
<td>4. Intellectuals</td>
<td>- 50</td>
</tr>
<tr>
<td>5. Parents</td>
<td>- 100</td>
</tr>
<tr>
<td>6. Social Activists</td>
<td>- 50</td>
</tr>
</tbody>
</table>
9.1.4.1.3.3 Development of Interview Schedules

In order to study the views & perceptions towards the growth and development of engineering education in Punjab, the following interview schedules have been constructed and standardized by the investigator:

i. Interview schedule for administrators
ii. Interview schedule for teachers
iii. Interview schedule for students
iv. Interview schedule for intellectuals
v. Interview schedule for parents
vi. Interview schedule for social activists

9.1.4.1.4 Case Studies: Case studies of eight engineering institutions of Punjab state being run under the different types of managements have been conducted. These case studies have been conducted with the help of a self-constructed ‘Institutional Inventory’ to seek information about the following aspects of the institution:

i. Admission procedure
ii. Recognition and Accreditation of the institutions
iii. Courses available and intake
iv. Social distribution of seats
v. Infrastructure
vi. Faculty
vii. Fee structure
viii. Placement
ix. Research and development
x. Feedback from the faculty and students

Moreover feedback from the students and teachers about the institution in general and about the above aspects of the institution in particular has also been taken.

A rough draft of the ‘Institutional Inventory’ has been constructed after reviewing the related literature on the subject. Then opinions of the experts about the inventory have also been sought after discussing the objectives of the research study with them. After this a preliminary try-out of this inventory has been carried out in two engineering colleges to get feedback regarding the suitability of items in terms of various components, language and content.

The preliminary try-out has helped the investigator to revise, modify and alter the items. All the irrelevant, impractical and ambiguous items have been modified or deleted and new adequate items have been added. Thus the final draft of the inventory along with the questionnaire for feedback has been prepared which has been used to conduct the case studies of the following institutions (the final draft of the institutional inventory and feedback questionnaire has been appended with the thesis in the form of Appendix A):

i. National Institute of Technology, Jalandhar
ii. Giani Zail Singh College of Engineering & Technology, Bathinda
iii. University College of Engineering, Patiala
iv. Yadvindra College of Engineering, Talwandi Sabo
v. Guru Nanak Dev College of Engineering & Technology, Ludhiana
vi. Chandigarh Engineering College, Landran
vii. Guru Gobind Singh College of Engineering & Technology, Talwandi Sabo
viii. Thapar Institute of Engineering & Technology, Patiala

A sample of 25 students and 10 teachers has been taken from each of the institutions to get feedback about the institution.

**9.1.5 Conduct of the Study**

1. To study the policy perspective of engineering education, the reports of various education commissions and committees, five year plans and other policy documents have been collected from various libraries, internet and other sources and have been reviewed.

2. To study the trend analysis, the document analysis of the following has been made:
   a) Economic surveys
   b) Statistical Abstracts of Punjab
   c) Reports of Planning Commission of Government of India
e) I.S.T.E. (Indian Society of Technical Education)’s reports
f) I.I.E. (Indian Institute of Engineers) Reports
g) All India Educational Surveys
h) Annual reports of Government of India
i) National Science Foundation Reports
j) Journals, Magazines and Newspapers
k) Policy documents and reports of various Education Commissions.
l) AICTE Annual Reports
m) CABE Committee Report
n) Reports of Directorate of Technical Education, Punjab
o) Five Year Plan documents of Government of India
p) Various research journals
q) Research reports of various researchers
r) Other reports and data available on the internet.

3. To ascertain the views and perceptions of the respondents the investigator has personally interviewed the various groups of subjects as stated in the sampling.

4. To conduct the case studies of eight institutions of engineering the self-constructed ‘Institutional Inventory’ has been used.
The investigator has personally visited these institutions to seek the detailed information regarding these institutions.

9.1.6 Analysis of Data

1. Various documents and reports on technical and engineering education have been scrutinized to cull out the theoretical and empirical observations with regard to policy perspective and implementation mechanism.

2. The quantitative data regarding increase in number of institutions, faculty strength, students intake and outturn, financing pattern and demand and supply which have been available in various secondary sources have been analysed with the help of statistical tables and drawing of line graphs, bar charts and pie charts, etc.

3. The technique of ‘content analysis’ has been used to study the views and perceptions of different groups of people namely administrators, intellectuals, social activists, teachers of engineering colleges and beneficiaries regarding the various issues related to engineering education in the context of specific socio-economic conditions of the state in particular and the country in general. Further, ‘percentage analysis’ of the views & perceptions given by the respondents has been done and presented in the form of statistical tables and the results have been discussed.
4. The case studies of eight engineering colleges have been done with the help of data collected through self constructed Institutional Inventory. Since the case study is a way of organizing social data for the purpose of viewing social reality. It examines social unit as a whole. The unit may be a person, family, a social group, a social institution or a community. The purpose is to understand the life cycle or an important part of the life cycle of the unit. The case study probes deeply and analyses interactions between the factors that explain present status or the influence, change or growth' (Best and Kahan 2003:249). Therefore the information collected through the Institutional Inventory has been organized in the light of one of the objectives of the present research study regarding the study of procedure for admission, recognition and accreditation of the institutions, intake, infrastructure, courses available, reservation of seats, faculty, fee structure, placement & research & development, etc.

9.2 CONCLUSIONS

On the basis of the study of policy perspective, analysis of secondary data, content analysis of views and perceptions of respondent groups and the case studies of various types of engineering institutions, the following conclusions have been drawn:
9.2.1 Policy Perspective

1. In the pre-independence period, the industrial policy of the British Government was based on the interests of British Capitalist Class and India was treated as a market for exporting raw materials to England and importing many manufactured goods from England to India. Therefore the required industrial development in India could not take place. Such a situation did not encourage any type of development in Indian Engineering Education. However few institutions of engineering and technology were opened in major cities of the country before Independence.

2. After Independence the policy of the government has been oriented towards the development of industrial base of the country. Therefore, it has also been realized by the Indian government that if all the industries have to be run properly there has been a need of a large number of well trained engineers. Thus after independence in order to provide engineering education, a number of public institutions have been opened and trained engineers have been prepared in large quantity to meet the requirement of the new industry.

3. Different five year plans have laid stress on various aspects of technical and engineering education for its further development. During the first two, five years plans a long term planning was done for the development of technical and
engineering education and IITs and Regional Colleges of Engineering were established. The successive five years plans after this have paid attention to industrial development, teaching and research programmes, scholarships and fellowships for talented but poor students, pre-service and in-service training of engineers in industry, training of teachers, checking the mismatch between demand and supply of engineers, development of autonomous colleges and review and monitoring of the engineering education. Moreover the last and eleventh five year plan has also laid stress on the review of status of engineering education, to critically examine the issues of access, quality and relevance, removal of obsolescence and modernization of labs, workshops, libraries, computer facilities, international bench marking and effective transparent accreditation.

4. Taking into consideration the need to grow and develop engineering education after 1947 a number of commissions and committees have been constituted by the government of India for spreading technical and engineering education in the country. On the recommendations of the initial commissions and committees the government has taken the initiative in its own hands and has shared sufficient funds for establishment of engineering institutions. But after seventies private entrepreneurs have also started taking the initiative to
establish engineering institutions. Moreover after the adoption of the neo-liberal policies by the government of India in the earlier nineties the field of professional education in India has been dominated by the private initiative and engineering education has been no exception to it.

5. In the recent years the government has started including the people from private sector in the committees and commissions for policy making for higher and technical education, which has adversely affected the policy against the common man as in case of Ambani Birla report and National Knowledge Commission Report we can easily observe the reflection of interests of the capitalist class.

6. Before as well as after Independence, until nineties most of the engineering institutions were opened in the southern states. But as the development of the country caught speed and a variety of goods were to be manufactured; more and more engineering institutions were opened in other parts of the country also. But it has happened only after the late eighties in Punjab that the number of engineering institutions have started increasing. However after nineties it has caught speed and resulted in the mushroom growth of institutions after the government has adopted the policy of allowing the private initiative in the professional education.
Even the institutes of excellence like IITs, IISC, IISERs, and IIITs have not been evenly distributed over the different states and regions of India.

7. Central as well as Punjab government have slowly reduced general subsidies in engineering education in a phased manner during the recent years through fee revisions in the public institutions. However a system of merit scholarships, educational loans and fee waiver schemes for the financially weaker sections of society have been introduced by the both the central as well as the state government.

9.2.2. Growth and Development of Engineering Education at the National Level

1. There has been a phenomenal growth in the number of engineering institutions in the country after Independence especially since early nineteen eighties. During this period, on an average the number of engineering institutions in India has grown at a faster rate as compared to other countries of the world.

2. Moreover there has been a significant increase in the sanctioned intake, enrolment and outturn of engineering graduates after independence. The increase in number of engineering graduates output has further contributed to the increase in number of post graduate output. The percentage of post graduate engineers output to the graduate engineers
output has been maximum in nineteen eighties which has started decreasing after it and declined by fifty percent upto 2004.

3. Similarly the number of engineering doctorates awarded in India has also increased gradually after Independence and nearly approached one thousand in 2004. However the percentage of doctorates output to graduate engineers output has declined at a very fast rate after 1986 and in 2004 it has approached the earlier rate of 1964.

4. The number of engineers per million population in India is still behind South Korea, Australia, Germany, UK, New Zealand, USA, Japan and China. Whereas the growth rate of output at the bachelors level in India has been highest in the world.

5. The growth rate at the masters and doctoral level has also been significantly high except in the discipline of Civil engineering. Moreover the growth rate in most of the disciplines like Chemical, Computer, Electrical, Electronics and Mechanical engineering, etc. has been tremendous.

6. Although the number of teachers in engineering institutions have increased after independence continuously, yet there has been an acute shortage of faculty in all the institutions. Even IITs, NITs have been facing the faculty crunch severely. The future requirements of faculty in the field of engineering education do not seem to be fulfilled easily.
7. Although there has been a tremendous growth of engineering institutions in most parts of the country yet it has been disproportionate as far as the different regions of the country are concerned. The growth in number of institutions and sanctioned intake has been maximum in the Southern region whereas it has been minimum in the Eastern region.

8. Besides, the representation of underprivileged groups of society in the engineering field has not been satisfactory. In other words the engineering education has contributed in a very limited way to the social mobility in the Indian society.

9. Although the enrolment of female students at graduate level in engineering courses has gone on increasing and it has marked a jump after 1971, yet the gulf between the proportion of men and women has been alarming. It is also important to note that in the institutions of excellence like IITs, the percentage of women engineers has been significantly lower than the national level. On the other hand, though enrolment of female students in post graduate courses in engineering has increased but it has not been proportionate with the growth in the enrolment of female students at the graduate level.

10. Despite the high returns associated with investment in technical education, the level and pattern of financing technical education in the country has been far from satisfactory. Inspite of the fact that the amount of money spent
on technical education has increased 235 times from first plan to tenth five year plan, the allotment to technical education has decreased from 13 percent of the total allotment for education in the first five year plan to 10 percent of the total allotment for education in the tenth five year plans.

11. Moreover, the number of private institutions has continuously increased after independence, especially after the adoption of neo-liberal policies by Government of India after 1991. In the year 2003-04 the percentage of private engineering institutions has risen to 85% leaving behind only 15% of the total engineering institutions in India to be funded by the Central and State Governments.

12. The growth in number of institutions of engineering education has been out of step with the growth of economy and the population. As a result there has been a greater increase in the number of trained engineers than the actual demand. This situation has led to unemployment among the engineers in all the states of the country. But the problem of unemployment of engineering graduates has been most acute in the southern states of Tamil Nadu, Karnataka, Andhra Pradesh and Orissa. Moreover this problem has been more serious in case of Civil, Electrical, Electronics and Mechanical Engineering trades as compared to others.
9.2.3. Growth and Development of Engineering Education in Punjab

1. The growth in number of engineering education institutions in Punjab after independence has been almost linear upto the end of the last century which shows a steady increase. During this period some new branches have also been added to the old ones. But after nineteen ninety, there has been a very fast growth in the number of institutions of engineering education in Punjab and the growth of private institutions have been much more as compared to the public institutions.

2. The intake of students has significantly increased in the electronics, computers and mechanical branches of engineering in Punjab. It is also important to note that the student intake in the engineering institutions of the state have always been more than its neighbouring states like Himachal Pradesh and Haryana.

3. It has also been found that output to sanctioned strength ratio (o/s) for graduate engineers in the state has been comparatively low in the disciplines like computer science, production, IT, electrical and leather technology etc.

4. There has been no institution of excellence like IIT or IIM or IISC established in Punjab till 2008. The only IIT sanctioned for Punjab is IIT, Ropar which has started working at IIT Delhi. The education is being offered in it only in three branches viz.
Computer Science and Engineering, Electrical Engineering and Mechanical Engineering with strength of 40 students in each branch.

5. As far as discipline wise faculty student ratio in the state is concerned, it has not been satisfactory especially in the branches of electronics and communication, information technology and computer science. The survey of qualifications of teachers employed in various institutions has displayed a dismal picture as unqualified faculty has been recruited due to shortage of qualified candidates.

6. The growth of engineering institutions in the different regions of the state has been disproportionate. Malwa region of the state has the largest number of engineering education institutions where as Majha has the least. Moreover, no engineering institution has been established in the districts of Barnala, Mansa, Hoshiarpur and Tarntaran.

7. Besides this, although the total enrollment of female students at graduate level in engineering courses in Punjab has increased over the years after independence, yet it is far behind the attainment of the ideal of ‘gender equality’.

8. The participation of scheduled caste students in engineering education in Punjab, even in the recent years, has not been satisfactory. It is almost negligible except for Electrical, Mechanical, Electronics and Computer Science branches.
9. The expenditure on technical education in the state as the percentage to the total expenditure on education has continuously decreased during the recent years.

10. However unemployment of all types of engineering graduates has been a common phenomena in Punjab. But the problem of unemployment has been more serious in Computer Science engineering, Mechanical Engineering and Electronics and Communication Engineering as compared to the other branches.

9.2.4 Views and Perceptions of the Respondents

1. Although, the study has led us to a mixed response of the respondents to the question that whether the growth and development of engineering education in Punjab has been satisfactory or not. Yet except the administrators, majority of all other groups of respondents i.e. teachers, students, intellectuals and social activists are of the opinion that growth and development of engineering education in Punjab has not been satisfactory. They have declared it dissatisfactory because of the dilution of quality, faculty crunch, over expansion, privatization, commercialization, mismanagement and unplanned and uncontrolled growth of engineering institutions.

2. The present study has also revealed that majority of the respondents including administrators, teachers, stake holders
and the community members are dissatisfied with the role of the central and state government and their agencies have played in the growth and development of engineering education. Many of the respondents have criticized the government’s policy of allowing the private initiative in the field of engineering education. It has been a general perception among most of the respondents that the government has left the field of engineering and other types of professional education open for the rich people to invest and earn large profits.

3. The analysis of opinions of the respondents on the issue of responsiveness of the engineering education system towards the societal needs has also led us to the mixed results. However comfortable majority of the respondents has felt that instead of catering to the needs of society, the private engineering and technology institutions are catering to the needs of the upper classes, industrialists and MNCs (Multi National Companies). In other words the general perception among the majority has been that most of the privately managed institutions do not benefit the ‘common-man’ rather they are oriented to fulfill the needs of the market.

4. The study also leads us to the result that overall majority of the respondents is of the opinion that the private initiative in
the field of engineering education has lead to the dilution of quality, commercialization and increase in unit cost of engineering education.

5. The study further reveals that majority of the community members opine that huge profits for the managements and the misuse of political influence by the people in power have accelerated in the mushroom growth of engineering institutions. It has also been highlighted by the respondents that most of the newly opened self-financed institutions do not fulfill the norms and standards prescribed by AICTE.

6. The analysis of the views and perceptions of the different groups of respondents also reveals that a handsome majority of them recommends to keep in mind the fulfillment of AICTE norms and societal requirements before the opening up of new institutions. However it is also recommended by sizeable potion of the respondents that only the people with higher engineering degrees should be allowed to open new engineering education institutions, who already possess a proper knowledge about engineering and technology education and its aims and objectives in the Indian context.

7. Further, the study reveals about the opinions of the respondents regarding the motivating factors behind the ever increasing popularity of engineering courses among the
students. Various groups of respondents have highlighted that the degree courses in engineering and technology have become most favourite among the stakeholders of higher education in Punjab because of the job market value of these courses, higher social status of engineers in the contemporary society, higher pay packages, opportunities for better quality of life in this profession and the chances to go abroad.

8. The present study also leads us to the result that most of the administrators, parents and teachers perceive that clash of entrance test dates affects the students success therefore they recommend that there must be a single entrance test system throughout the country, for all the institutions of engineering and technology. Moreover, most of the students along with their parents have been satisfied with the trades and institutions in which they have got admitted.

Furthermore an overwhelming majority of the parents prefer public institutions for the education of their wards. Although a good majority of the parents also admit that their wards have got admission on merit basis in the engineering courses, yet there is a sizeable portion of the parents who admit that they had to pay an extra amount of money to get their wards admitted.
9. The study of opinions and perceptions of respondent and teachers has also resulted in finding that they perceive a number of causes behind the low output strength \((o/s)\) ratio in the B.E./B.Tech courses. The major causes of low output strength \((o/s)\) ratio as perceived by the respondents have been the lack of interest/ aptitude of the students in engineering, lack of good infrastructure in institutions, admission through payment seats and lack of qualified and competent faculty. Moreover, they also perceive that lack of awareness, lack of competent faculty, later on change of trade by the students, lack of job opportunities and lesser popularity of the leather technology, electrical and civil engineering trades lead to comparatively low output strength \((o/s)\) ratio in these trades.

10. After the analysis of the views and perceptions of different groups of respondents it has also been found that majority of teachers and parents are of the view that quality of engineering education in Punjab has been upto the mark whereas on the other hand majority of administrators, students, intellectuals and social activists do not agree with them. As far as the dilution of quality of engineering education is concerned the administrators and teachers who closely watch the process of teaching and learning in the institutions, enlist political interference, profit motive, faulty procedures of recognition
and accreditation of institutions, insufficient faculty, as the causes behind the dilution.

Moreover, a good majority of the students reveals that all the supporting services are not provided to them by their respective institution and further more in their opinion engineering graduate who pass out from the various engineering institutions of Punjab do not possess sufficient practical knowledge.

11. The content analysis of views and perceptions of the respondents has also resulted in ascertaining that majority of the respondents perceive that the quality of engineering education in the private engineering institutions has not been up to the mark because these institutions have been opened with the profit motive and they generally lack proper infrastructure, competent faculty and other student support services.

12. The study of view and perceptions of the respondents also reveals that most of the administrators, teachers and intellectuals opine that the role of AICTE in ensuring the quality of engineering education has not been satisfactory.

13. The percentage analysis of the opinions of the respondents has also ascertained that a handsome majority of them
recommend that entrance test should be the sole criteria for admissions to engineering and technology degree courses.

14. The study also reveals that administrators and teachers who are directly related to the process of admissions in the engineering institutions in one way or the other way enlist the causes behind the seats remaining vacant in various engineering institutions of Punjab as lack of manpower planning, inferior quality of education, location of the institutions or lack of welfare schemes.

15. Furthermore, the study leads us to the result that a comfortable majority of the respondent administrators, teachers and intellectuals opine that Indian Institutions can compete with the world level institutions. Also good majority of intellectuals favour the cooperation between Indian and Foreign institutions, whereas a handsome majority of social activists opine that it can be decided only after going through a particular Memorandum of understanding signed between Indian and other countries and conditions of cooperation that whether we should accept it or not.

16. After analyzing the contents of the opinion and perceptions of the respondents it has also been ascertained that a good majority of respondent teachers, intellectuals and social activists opine that the participation of underprivileged classes
in engineering education has not been satisfactory. Whereas a four fifth majority of the administrators opines that gender participation in engineering education has been satisfactory.

17. The analysis of opinions of the respondent administrators, intellectuals and social activists shows that on the one hand an overwhelming majority of administrators do not favour the policy of reservation. Whereas on the other hand a good majority of intellectuals as well as social activists favour the policy of reservations of seats for the underprivileged classes. Moreover, it has also been ascertained as the majority of intellectuals opine that it does not affect the quality. Also, majority of the administrators and teachers are of the view that seats reserved for the underprivileged classes are regularly filled.

18. The study further resulted in ascertaining that the majority of respondents perceive that engineering education in Punjab is accessible only to the elite class. In other words the economic hurdles don't allow the students belonging to lower classes to easily get the engineering education. Moreover majority of the student intellectuals, parents and social activists also opine that equal opportunities for all are not available to get engineering education. It has also been ascertained that significant number of teachers and social activists are of the
opinion that private initiative has helped in expansion of the opportunities for the students to get engineering education.

19. The content analysis of the views and perceptions of the respondents also ascertains, their opinion about the various problems faced by rural students in getting admission to the engineering courses. The problems highlighted by the respondents include incapacity to pay, lack of awareness, lack of cognitive abilities, lack of aptitude for science and maths, language problem, lack of transport facilities and shy attitude of the rural students.

20. The analysis of responses also results in finding the mixed response of the respondents towards the question that whether engineering institutions provide concessions to the needy and deserving students. But on the whole it has been ascertained that majority of the respondents do not agree with the notion that engineering education institutions have been generally provide concessions to the needy and deserving students.

21. Further, majority of the respondents recommend that engineering education should be entirely funded by the government. But it has also been recommended by some of the respondents that fees, contract with industry, philanthropists donations and educational loans are the other alternatives.
22. Furthermore it has also been ascertained that except the majority of administrators, a good majority of all other respondents are of the view that private institutions are charging exorbitant fees.

23. Also, an overwhelming majority of all groups of respondents agree to the notion that capitation fee charged by the engineering institutions is not justified at all. It has also been ascertained that a significant portion of the student respondents admit that they had to pay an extra amount of money to get admission in engineering courses.

24. The study also leads us to the conclusion that there is a complete unanimity among the administrators and respondents teachers about the notion that it is essential for every institution to provide placement services to all the students. Moreover respondents teachers enlist infrastructure, lack of practical experience among the students, poor student performance and improper location of the institution as the hurdles in the way of properly providing placement services to the students.

25. The analysis also indicates that a good majority of the respondents accept that the placement services available in the institutions of engineering and technology in Punjab are neither sufficient not satisfactory.
26. After analyzing the contents of the responses of the students it has also been ascertained that a handsome majority of the respondents agrees with the statement that there is a mismatch between demand and supply of engineers in Punjab. As enlisted by the respondents the causes of the mismatch between demand and supply of engineering graduates in Punjab are inferior quality of education, lack of industries in the state and lack of manpower planning. Moreover it has also been recommended by some of the respondents that the further proliferation of engineering education institutions should be checked and the engineering graduates should also come forward to start self ventures. Moreover majority of the respondents are of the opinion that it is the government which is responsible for the unemployment prevalent in the engineering field. But majority of the administrators and social activists do not oppose the phenomena of brain drain. Whereas the factors responsible for the brain drain, as enlisted by the respondents are better future in the advanced countries, attractive salary, easy placement, clean environment, craze for foreign lands, better status, better treatment abroad, unfavourable policy of the government, exposure and higher study.

27. It has also been indicated by the content analysis of the opinions of the respondents that there is a complete unanimity
among the respondents regarding the notion that there is a significant difference between the conditions of working as an engineer in the public sector and a private undertaking.

28. The content analysis of the views and perceptions of the respondents also leads us to the result that an overwhelming majority of the respondents is in favour of encouraging the agro-based engineering courses in Punjab instead of the traditional ones.

9.2.5 Case Studies of Various Types of Institutions of Engineering and Technology

1. The case studies of eight engineering colleges of Punjab have led us to the conclusion that although there is not much difference between the fee structure of Punjab Government run colleges of engineering and privately managed self-financed colleges of engineering. Yet the students of privately managed self-financed colleges have complained that the security money, development funds, higher rates of hostel fee, transport fee and many more hidden charges are levied by the private colleges which make the education provided by these colleges comparatively more costly.

2. The fee structure of institutions run by Government of India (e.g. NIT, Jalandhar) has been found to be much more reasonable than the institutions run by Government of Punjab
(e.g. Giani Zail Singh College of Engineering and Technology, Bathinda).

3. An uniformity has been found in the tuition fee charged by all the engineering institutions affiliated to Punjab Technical University (PTU) Jalandhār. But the University College of Engineering run by Punjabi University, Patiala has been charging a very high rate of fees among all the institutions studied. Whereas on the other hand subsidized engineering education has also been provided by this university to the rural students in Yadwindra College of Engineering Talwandi Sabo.

4. Although student support services have been provided by all types of institutions, studied by the investigator but it has been found that students in most of the institutions are not fully satisfied by these services.

5. All is not well with the quality of engineering education in Punjab. The quality of engineering education in public as well as private institutions has been suffering due to shortage of competent and qualified faculty, lack of good academic environment, dearth of accommodation for staff, inferior quality of food provided in the hostel, poor staff of students lacking in communication skills and other soft skills.

6. The age of the institutions seems to be directly proportional to the quality of education provided in them. The oldest institutions like Thapar University, Patiala and Guru Nanak
Engineering College, Ludhiana have been rated much higher than the newly established institutions by the stakeholders.

7. The case studies have also enabled the researcher to find that some seats have always remained vacant in most of the institutions of Punjab which has further suggested that before expanding the engineering education in Punjab, no sound manpower planning has been done.

8. Except one or two institutions, all other institutions of engineering and technology are found to be lacking good Research and Development Wings which affects the quality of training of the engineers to a considerable extent.

9. The case studies have also suggested that however most of the engineering institutions in Punjab have enough land and sufficient buildings, infrastructure and laboratories. But most of them have not been found to possess sufficient qualified and competent faculty.

9.3 EDUCATIONAL IMPLICATIONS

The basic purpose behind the present research work has been to study and analyse the pace and pattern of growth and development of engineering education in India in general and in Punjab in specific. After drawing the already stated conclusions of the study, which reflect that all is not well with the engineering education system in the country as well as in the state of Punjab,
the investigator has proposed the following implications of the research study:

1. Although, there has been a tremendous growth and development of engineering education in the country, yet engineering education has neither been well planned nor systematically coordinated. The study shows that the expansion of engineering education has been uneven throughout the country. The southern states have a much higher growth rate as compared to Eastern and Northern regions. Thus it has been suggested that in order to achieve a balanced growth and provide equal opportunities to the students of all the regions and states, further growth in the Southern states should be controlled where as it should be encouraged in the Eastern and Northern states. It has also been found that in some of the states of India, there are institutions of excellence and National institutions of repute like IITs, IISc, NITs, National Laboratories, other Central Institutions and National Universities, but there are other states where there are no such institutions. Thus it has been recommended that new National level/ Central institutions should also be opened in the states where there are no such institutions.

2. The study has also revealed that on the one hand growth rate of engineering graduates and post graduates in the country
has increased at a very faster rate in India in the recent years, whereas on the other hand the number of engineering doctorates as the percentage of engineering graduates has rather decreased. It has created a shortage of doctorate faculty in the engineering institutions. Thus there is an urgent need to create provisions to produce much more number of engineering doctorates than being produced at present in the country.

3. The adoption of neo-liberal policies by the government of India in the last decade of the twentieth century has ushered in an era of self-financing private institutions of engineering and technology. The mushroom growth of ill-equipped, ill-provided and ill-planned self financing engineering education institutions has lead to the deterioration of quality of engineering education. It appears that the purpose of these institutions has not been the imparting of quality training to prepare the prospective engineers, rather they appear to be interested in minting money. Thus the state Governments, AICTE and the concerned universities should put a check on the proliferation of these institutions and should evolve a sound mechanism to regulate them.

4. Due to proliferation of private self-financed institutions of engineering and technology education, the meaning of very concept of quality has also started changing. Quality has been
interpreted to mean ‘Saleability’ or ‘Marketability’. Most importantly, as market forces have predominated and penetrated deep into the system, the engineers who work in the public sector after getting education in private institutions of commercial nature never prove to be dedicated workers of the nation. In such a scenario, government should itself take the responsibility to train, the engineers needed for its public sector in the public institutions.

5. Since the study has shown that there is an acute shortage of the competent and qualified faculty in the engineering education field, therefore AICTE should chalk out a plan to train and educate the required number of teachers for different institutions of engineering and technology in the country.

6. It has also been discovered during the study that there are no R&D (Research and Development) Wings in most of the institutions of engineering and technology education in Punjab. If we really want our engineers to get first hand experience of research, innovation and the process of development of new machines, devices and techniques then AICTE should make it mandatory for all the institutions of engineering and technology throughout the country to start their Research and Development Wings. If it is done, it would also help in boosting the scientific and technological research throughout the country.
7. The present study also shows that, after Independence the participation of the disadvantaged sections of society in the engineering education has not been satisfactory. Thus women, SC’s, ST’s, OBC’s and other economically weaker students should be encouraged to get engineering education by providing more facilities to them in order to achieve the constitutional ideal of ‘Equality of opportunity for all.’

8. Although the allocation for technical education in the union budget has increased over the past years, yet the budget allocated to technical education has not been sufficient to cater to the ever increasing needs of the technical education in the country. Since there has been a dire need of opening up of new national/central/public institutions in different states of the country and a big chunk of the budget is spent on the AICTE and existing IITs, IIMs, IISc, IIITs, NITs, and IISER therefore the budgetary allocation must be increased enough so that new institutions can be established.

9. Moreover, the unit cost of engineering education in the private self-financed institutions has been very high which leads to the exclusion of common Indian students from engineering education. By providing engineering education only to the elite sections of the society these institutions have been contributing in further widening the gap between different social classes. Thus there has been a need to analyse the cost
factors of engineering education with respect to the financing patterns of the different institutions and make these factors reasonable and affordable for the ordinary students.

10. It has also been found through the present study that there is a huge imbalance between demand and supply of engineers in the country. In order to achieve a balance between demand and supply of engineers, two fold efforts should be initiated at the part of the government. Firstly, the unplanned proliferation of private engineering education institutions should be checked and secondly the government should make provisions for smooth and speedy placements of the qualified engineers through its own public placement services. In other words, the manpower planning mechanism in the field of engineering education should be set well in place.

11. It has also been observed that the engineering courses run in the institutions of engineering and technology in Punjab are all similar to the courses run in other parts of the country in general. But Punjab being an industrially backward state has not been able to absorb all the engineers thus trained. Rather Punjab being an agricultural state needs the services of engineers trained in agro-based engineering courses. Therefore, agro-based engineering courses should be introduced in all the institutions of engineering and technology
being run in Punjab after establishing agro-based industries in the state on a large scale.

9.4 SUGGESTIONS FOR FURTHER RESEARCH

Although the present study has enabled us to understand the pattern and pace of growth and development of engineering education in Punjab to a large extent, yet it is suggested that:

1. Replicative studies of the present study should be carried out in other states of the country also in order to reveal the consolidated picture of growth and development of engineering education at the national level.

2. Since it has been clear from the findings of the present study that the growth and development of engineering education has been uneven in various regions and states of the country. Therefore comparative studies of growth and development of engineering education of different regions and states should be carried out and further the causes and consequences of the differences observed in those regions or states should also be studied.

3. After the introduction of private initiative in the field of engineering education, big disparities in the fee structures of private and public institutions of engineering education have been observed. In this context, a comparative study of the financing pattern and cost factors of engineering education in the private and public institutions of engineering and technology should be carried out.

4. The participation of socially deprived sections (Women, SC’s, ST’s and OBC’s, etc.) of society in the higher and technical education has not improved in some of the states of the country as compared to the national statistics. In this regard, there is a scope for research on the causes of poor participation of these sections of society in technical education, especially the people living in the educationally backward regions and states of the country.

5. The present study has shown that there has been an acute shortage of well qualified faculty in the field of engineering and technology education. Thus research is needed to find out the number of estimated qualified teachers required for different
branches of engineering education for the future years so that manpower planning in this field can help to solve the problem of shortage of faculty.

6. Further research on the demand and supply pattern of engineering graduates, post graduates and doctorates should also be conducted in order to find the discipline wise, region wise and state wise trends so that efforts to balance the demand and supply of engineers can be initiated.

7. Institutes of Excellence like IITs, IISCs, NITs, National Laboratories and other National Institutions of science and technology have not been equally distributed among all the regions and states of the country. The impact of such factors on the development of science and engineering education in different regions and states can also be studied.

8. The present study has been confined to the growth and development of engineering education at degree level only. A similar study of growth and development of technical education at the diploma level may also be conducted.

9. The present research work has taken about five years to complete. During this period, even after the collection of data many new changes have taken place in the field of engineering education. Thus a replicative study of views & perceptions of different groups of respondents may also be conducted by including more questions in the interview schedules used in the present study related to the changes occurred in the recent times.

10. In the present study, the views and perceptions of different groups of respondents towards various issues related to growth and development of engineering education have been studied by including only the Administrators, Teachers, Intellectuals, Social Activists, Students and their Parents. A replicative study of the present research study may be conducted by studying the views and perceptions of other sections of society as well.

11. The process of globalization has made a significant impact on our higher and technical education system. Consequently, our institutions are signing up MOU’s with the foreign institutions and universities. Moreover, our students have been going to other countries to get technical education. Further, the problem of brain drain has also been becoming more and more serious. And above all Indian government may think of
opening the education sector under the provisions of GATS (General Agreement on Trade in Services) in future. This situation calls for a detailed study of the impact of globalization on the growth and development of higher & technical education in India and its consequences for the country.

12. Like engineering education, the problems of uneven expansion, diluting quality, unavailability of equality of opportunity and ills of privatization have been affecting other fields of higher education also. Thus studies on growth and development of medical education, teacher education, management education, and higher education in general should also be conducted.