ENGINEERING COLLEGES IN KERALA: AN ANALYTICAL STUDY

SUREKHA P.M.

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DECLARATION

I, **SUREKHA, P.M.,** do here by declare that this thesis, entitled **"ENGINEERING COLLEGES IN KERALA : AN ANALYTICAL STUDY"** is an original work done by me under the supervision of **Dr. M.N. Mohamedunni Alias Musthafa,** Associate Professor, Department of Education, Central University of Kerala for the award of Degree of Doctor of Philosophy in the faculty of Education. I also declare that this thesis or any part of it has not been submitted by me for the award of any other Degree, Diploma, Title or Recognition before.

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Certificate

I, **Dr. M. N. MOHAMEDUNNI ALIAS MUSTHAFA,** do hereby certify that this thesis entitled **ENGINEERING COLLEGES IN KERALA : AN ANALYTICAL STUDY** is a record of bonafide study and research carried out by **SUREKHA. P.M**, under my supervision and guidance and that it has not been previously formed the basis for the award of any other Degree, Diploma, Title or Recognition.

Place: Calicut University **Dr. M.N. MOHAMEDUNNI ALIAS MUSTHAFA**

Date : .04.2018 (*Supervising Teacher*)

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INTRODUCTION

Education is a basic human right and considered as an important key to the national development, being the central agency for shaping the individual and the nation. It is a way of developing personal endowments, building capability levels and overcoming issues and choices for the improvement. Education is very important in the process of acquisition, assimilation and communication of accumulated knowledge, values and skills from one generation to others. In a wider sense, education contributes to the growth and development of society.

As education is a social process, the higher education acts as an instrument of individual, social and economic development of every nation. In addition to education, the growth and development in all the spheres of a country also depends on the technological improvement and on its scientific and technical man power.

Globalization and industrialization led to tremendous changes in the requirements and aspirations of the society across the world. In every walk of life, there have been a lot of technological innovations which are making our life easier. To innovate, adopt and operate these technologies, suitably trained technical man power is essential. So the technical education of the country is entrusted with the responsibility of developing suitable technical manpower with adequate capability to meet the requirements.

Engineering education is one of the main areas in technical education. The World Wide Web gives a very apt definition for the subject as, ‘Engineering is the science, skill and profession of attaining and relating scientific, social, practical and economic knowledge in order to design and build structures, machines, devices, systems, materials and processes’. Engineering as a subject of study is the answer to the societal, technological and economic development of any nation because it cannot be divorced from any aspect of present day human activities.

Engineering education has been configured around creating a sound understanding of the concepts along with problem solving capabilities supported by scientific thinking. According to Sharma (2013) India’s emergence as one of the largest economies of the world largely owes to the impressive growth of science and technology education. Therefore technical education has a crucial role in speeding up growth and development of India.

The formulation and administration of the rules, regulations and laws relating to science and technology in India is done by the Ministry of Science and Technology of Government of India. The ministry includes the following departments among many others:

- The Department of Science and Technology (DST): Established on 3rd May 1971. The main objective of DST is to promote new areas of Science & Technology and it plays the role of a nodal department for organizing, coordinating and promoting Science & Technology activities in the country (www.dst.gov.in).

- Department of Scientific and Industrial Research (DSIR): Responsible for carrying out the activities relating to indigenous technology promotion, development, utilization and transfer (www.dsir.gov.in).

The Government of India appoints various commissions and committees also for looking into the matters of scientific and technical education in the country from time to time. These commissions and committees offer relevant recommendations regarding the quality and expansion of technical education in India. One of the most important decisions taken by the Government about the technical education of India was the establishment of All India Council of Technical Education (AICTE) to supervise the activities of all technical institutions in the country. AICTE was established first in November 1945 as an advisory body and later in 1987, given statutory status by an act of Parliament.

The Act reads as follows:

To provide for an establishment of an All India Council for Technical Education with a view to the proper planning and coordinated development of the technical education system throughout the country, the promotion of qualitative improvement of such education in relation to the planned quantitative growth and the regulation and proper maintenance of norms and standards in the technical education system and for matters connected therewith. (www.aicte-india.org).

The objectives of AICTE are given as follows:

- Promotion of quality in Technical Education
- Planning and Coordinated development of Technical Education system
- Regulations and maintenance of norms and standards.

The notable recommendations of some of the commissions are briefly given below:

The University Commission (1948) under the chairmanship of Dr. S. Radhakrishnan underlined the importance of science and technology. The commission made many recommendations and suggestions for enhancing engineering education in order to meet the growing demands for technically skilled manpower. The report underlined that the existing colleges imparting engineering education are national assets on which the future of engineering education may be built, suggested opening new engineering colleges and arranging of in-service training for teachers at the existing institutes so that they may be able to renew their knowledge off and on.

The Secondary Education Commission (1952) also known as Mudhaliar Commission, recommended to start more technical schools.

According to Thacker Committee (1957), the quality of the staff of engineering colleges must be enhanced through quality improvement programs and short term courses.

Kothari Commission (1964-66) underlined the importance of quality of engineering education in India. The commission laid down a definite procedure for admission in to engineering degree courses. It recommended that the admission to the engineering courses should be based on the merit of candidates in the lower classes and also underlined the importance of assessing the interests, attitude and sharpness of mind of candidates. The commission stressed the importance of reservation for underprivileged sections of the society.

Kothari Commission made an overall view of engineering education and underlined the role of engineering education in industrialization. The report also stressed the importance of expansion of technical and engineering institutions, quality of engineering institutions and equal opportunity for underprivileged and other deprived sections of the society. It also pointed out the need of qualified and competent staffs in engineering education.

To meet the rising demands of the economy in every sphere, National Policy on Education (1986) made much more meaningful suggestions for the growth and development of engineering education in India. The policy recommended that curricula of technical courses will be prepared according to the needs of industry and encouraged professional societies to perform their role in the advancement of technical education.

The 42nd Constitutional Amendment (1976) underlined that technical education is a joint responsibility of the Centre and the State. The review of National Policy on Education during 1990-92 stresses the modernization of technical education and equity content and process of education at all levels.

Presently there are various types of engineering institutions in our country imparting technical education to meets the occupational needs of industrial age. The engineering education of India is passing through a transitional phase. A large number of engineering institutes especially private colleges have occupied the Indian engineering education sector.

Need and Significance of the Study

Engineering education is gaining momentum day by day because of rapid advancement in science and technology. It plays a significant role in producing competent and skilled technological manpower needed for social and economic development of every nation.

Technical education, especially engineering education is very much linked with the society and human being. It has an important role in the development of human resources by creating skilled man power and increase of productivity of industries thereby improving the quality of life in the nation. That is, every product and construction can be said to be attained by the engineering technology. As a profession, engineering addresses both urgent needs and challenges faced by our society and offer a wide range of career opportunities in terms of development.

After independence there had been a phenomenal growth in the number of technical education in India. As a result, the capacity of sanctioned intake also increased. Though this growth was good for the country, the expansion has been an inadequately planned and haphazard one. Up to 1970s, there were only few engineering institutions in each state. From 1996, there had been a remarkable increase in the number of technical institutions in India. The number of technical institutions increased from 448 in 1996-97 to 1058 in 2000-2001. This phenomenal growth in the number of technical education institutes is because of the introduction of private investment in the education sector. The economic reforms initiated by Government of India in 1990s consisted of structural adjustments and policies. These structural adjustments and policies cut down the public expenditure in general and higher education in particular (Rani, 2002). The direct result was that the government reduced its investment shares to higher education from the total allocation of the educational budget of the central and state government. At the same time, the demand for higher education grew rapidly. Though the demand became double, the number of institutions for higher education did not rise accordingly at the time.

On account of the decrease of funds for higher education in the budget, there was severe pressure from the higher education sector to mobilize the resources through non-governmental agencies including private agencies. This became a serious problem and the government had to take up measures for self reliance which can provide more massive investment.

The idea of self financing of higher education came from these difficulties faced by the Government. 'User Pay Principle' is the basis of self financing system of education. The discussion paper on government subsidiaries by the Government of India (1997) provides a revealing insight into the government thinking of higher education as “non merit good”. At the same time students were facing problems to obtain an entry in to the institutions of professional education. To overcome these difficulties government permitted private agencies to start more institutions. These private investments also influenced the dramatic increase of the number of engineering institutions in India. At the time of independence the number of engineering institution was below 50, which increased to 3,384 in 2013-14.

This increase in the number of colleges although increased the availability of seats, actually led to the deterioration of quality of engineering education. Most of these institutions do not even have adequate number of qualified faculties and infrastructure (Subbarao, 2013). Based on the report of National Association of Software and Services Companies (NASSCOM), only 12-20% of graduate engineers passed out of these institutions are employable.

In Kerala, the courses in Engineering have emerged as one of the most preferred option for students after passing out from the secondary school system. The engineering education in Kerala was essentially public funded right from the beginning until 2001, backed by the Government and also with a small number of private engineering colleges.

When the public expenditure on higher education was dropped by the government, the inability of the state to invest further in technical education led to the liberalization of technical education from 2001. During this period, the State started allowing private investments in technical education system in a self financing mode. This led to the increase in the number of technical institutions in Kerala.

Kerala is one of the states having a large numbers of seats for B.Tech courses. According to Mani and Arun (2012), Kerala’s share in the total intake for undergraduate engineering studies accounts for about five percent and the intake in 2008-09 was 5 times the increase of intake in 1990-91. In response to the growing demand for engineering, the number of engineering colleges increased and there has been a tremendous increase in the sanctioned intake capacity and actual intake for engineering in the state as given in Table 1.

Table 1

Growth in the Number of Engineering Colleges, Sanctioned Intake and Actual Intake

Year	Number of Engineering Colleges	Intake	
		Sanctioned	Actual
1991	9	2810	2795
1995	16	4441	3930
1996	17	4699	4657
1997	17	4871	4792
1998	17	5122	4979
1999	24	6668	6126
2000	33	8820	8739
2001	45	11293	11147
2002	74	18280	16143
2003	81	19889	16563
2004	87	23643	16837
2005	91	24256	21857
2006	91	26349	25471
2007	91	28578	27975
2008	94	30069	29635
2011	142	45147	NA

Source: Mani & Arun, www.cds.edu.

A significant increase in the number of engineering colleges occurred in 2002. Thirty one new engineering colleges were endorsed during that year. Almost all these new engineering colleges were in the private sector and they are referred as Self financing colleges. The intake capacity and actual intake also increased, but 2002 onwards the actual intake started becoming considerably less than the sanctioned intake capacity. From 1994 to 2013 the number self financing engineering colleges increased to 150.

The self financing colleges do not receive any grants from the Government but their main income is fees and donations of various kinds charged from the students. The arrival of self financing colleges has been subjected to several virulent debates on the consequences of privatization and quality of education.

In Kerala, this increase in the number of engineering colleges and the increased intake capacity raised lots of quality issues. Non availability of qualified and competent teaching staffs, lack of infrastructure facilities, financial problems, lack of close linkage between industries and engineering institutions, lack of employability of graduate engineers are the major issues prevailing in the engineering education system.

The many issues raised by academicians, experts and general public made the authorities sit up and view them seriously. The expert committee of High Court of Kerala observed the lack of qualified faculty and infrastructure in a large number of colleges. The analysis of results from 84 engineering colleges by the Directorate of Technical Education (2012) revealed that the average pass percentage was below 50% in 51 colleges in three consecutive years (2009, 2010, 2011). (Source: www. dtekerala. gov.in/downloads/ resana12.pdf)

Considering many such issues, the High Court on June 28th, 2012 ordered the All India Council of Technical Education (AICTE) to consider revoking affiliations given to self financing engineering colleges that lack infrastructure facilities and had a low pass percentage (below 40%). The Court also directed the state not to grand new Non Objection Certificate (NOC) for new colleges. (http:// decanchronicle. com/channels/cities /kochi/ shut-lowerprforming-engineering-colleges-hc-955).

Another major issue is that thousands of seats in engineering colleges are laying vacant in many colleges. To overcome this issue, Government decided to relax eligibility criteria for entrance examination. This again had long reaching impacts in the engineering education sector. Those who were unable to secure good marks in the higher secondary level itself, on gaining admission into the high level engineering courses had to struggle themselves to cope up with the difficulty of the different subjects taught. This straight away led to the low pass percentages. A good percentage of students are choosing these types of technical courses on parental pressure, without taking in to consideration their aptitude and attitude towards the stream of study. Also the condition that is prevailing in Kerala is that anyone, irrespective of the marks secured in the plus two level, can gain admission in to any of the self financing colleges if they are willing to pay the fees and donation.

The faculty shortage also directly affects the quality of engineering education. More than the shortage in the number of the teachers, the matter that is inadvertently affecting the teaching - learning process is the dearth of qualified and competent teachers. Along with the number of intake capacity, the number of graduates pass out of the colleges also increased which in turn flooded the job market. Just like any student with low marks can gain admission to B.Tech courses, anyone with a mere B. Tech degree also can become a teacher in an engineering college.

Even with the stringent guidelines of AICTE, irrespective of not having enough faculty, infrastructure, financial resources etc many private self financing colleges are getting sanction for more courses and seats. Adequate facilities with respect to classrooms, laboratories and equipments are not being offered by those college managements which are concerned only on profit. Students are not getting enough training during their study in these colleges. The direct result of all these short comings is low pass percentage.

Many reports on technical education pointed out that the graduates from many colleges are not employable, which means that they are not competent or skilled enough to perform well in actual job situations. The question arises from this fact is the suitability of the curriculum. With more and more new technologies and innovations coming up, the policy makers and educationists need to ask themselves many questions: is the present curriculum worthy of producing qualified and competent manpower? Are the students able to acquire and develop the competencies envisaged for the courses? Are the teachers competent enough to transact the curriculum as it was envisioned?

For the improvement of the quality of education there is a need of well qualified teachers, good infrastructure facilities, well framed curriculum, better modes of transaction etc. The quality of an educational institution depends on the availabilities and utilization of infrastructure facilities, human resources, curriculum planning, organization, transaction and evaluations. Any limitation on any of the above no doubt will adversely affect the total quality of the system. For improvement of the system a critical analysis of the existing portfolio is a must. There arises a need for the research inquisitiveness to reveal the real handicaps exist in the engineering education system in Kerala. It is the prime responsibility of the researchers in education to come up with concrete solutions to eradicate any malignancies if exist in the system. This demands an in depth study. With this intention in mind the researcher attempted an analytical study on the engineering colleges in Kerala.

Statement of the Problem

This study is an attempt to analyse the profile of engineering colleges in Kerala in general and the infrastructure facilities, human resources, curriculum and financial resource availability of engineering colleges and also to explore the problems prevailing in the engineering colleges in detail. An in depth analysis of the engineering colleges during the study period 2013 to 2016 relating to the objectives of engineering education and in terms of the above mentioned areas has been attempted. Hence the present study is entitled as '**ENGINEERING COLLEGES IN KERALA: AN ANALYTICAL STUDY**'.

Definition of Key Terms

Engineering Colleges

The word "Engineering" is derived from the word "Ingenerate" which means to create or design. Oxford English Dictionary defined Engineering as "the application of science to design, build and use of machines etc". Engineering is involved in the development providing infrastructure, goods and services for industry and society. As a profession it is directed towards applying and advancing skills and competencies that are bases on body of unique knowledge in mathematics, science and technology integrated with business and management, which is acquired through learning and professional growth in an engineering discipline (Mishra, 2010). Engineering colleges are the educational institutions which impart engineering education.

In the present study engineering colleges operationally refers to the colleges in which Bachelor of Technology (B.Tech) and Master of Technology (M.Tech) courses are being offered.

Analytical Study

According to Good (1963) 'Analytical Study is the purposeful mental activity involving breaking down a problem into its elements of logical parts'.

In this study, analytical study operationally defined as analysis of the facilities, performance and problems of engineering colleges in detail. The study is also analytical in the sense that the facts or information obtained have been analysed to make a critical evaluation with a view to making suggestions for the general improvement of the overall situation of engineering colleges in Kerala. The process of operation involved in this aspect is analysing the different aspects of engineering education exist, available or conducted in the engineering colleges under study and evolving the derivatives.

Objectives of the Study

1. To study the general profile of engineering colleges in Kerala in terms of growth and details of courses, accreditation, intake capacity, enrolment, vacant seats, pass percentage and placement.
2. To investigate the availability of the physical facilities in the selected engineering colleges in Kerala.
3. To examine the availability of the human resources of selected engineering colleges in Kerala.
4. To study the planning, organisation and transaction of the curriculum of engineering courses.
5. To examine the financial resources of selected engineering colleges in Kerala.
6. To study the responses of principals regarding the planning and organisation and mode of transaction of the curriculum for the engineering courses followed in their institutions.
7. To analyse the responses of teachers regarding the planning, organisation, curriculum transaction and evaluation for the engineering courses followed in their institutions.

8. To analyse the responses of students regarding the facilities, curricular and co-curricular activities in their engineering colleges
9. To study the responses of B.Tech graduates regarding facilities and curriculum of engineering colleges in Kerala.
10. To analyse the parental responses regarding facilities and limitations of engineering colleges
11. To locate the deficiencies in the engineering education in Kerala, if any and suggest remedies.

Analysis of these objectives leads to the evolution of the shortcomings exist and possible solutions to overcome.

Methodology

Design of the Study

The study followed mixed method. That is, it used both qualitative and quantitative approach in combination. The investigator adopted multiple lines of approach for studying the same problem. The study was carried out in two phases.

Phase I. In the phase one document analysis was done to analyse the current scenario (2013 to 2016) of engineering colleges in Kerala.

Phase II. In the second phase, facilities and problems of selected engineering colleges were analysed.

Sample Used for the Study

The study was aimed to analyse the engineering colleges of Kerala in detail. In 2013, there were 159 engineering colleges in Kerala: Nine engineering colleges under direct control of the State Government, three colleges aided by the Government, 141 colleges under private management (self financing mode), one NIT (National institute of Technology) under Central Government, two colleges under Agricultural University, one under Cochin University of Science and Technology, one Indian institute of Science and Technology College and one deemed college (Amrita School of Engineering).

The investigator collected data from relevant sources and from five groups from whom authentic and apt information could be obtained. The groups were; principals, faculty members and students of engineering colleges, graduates in engineering and parents of engineering students. This forms the target population of the study. From this population data were collected from 30 principals, 184 faculty members, 440 engineering students and 50 engineering graduates. The sample of principals, faculties and students were selected using stratified random sampling technique giving due representation to different strata based on type of institutions. Sample of graduates and parents were selected using simple random technique. In addition to this, the investigator collected data from academicians, experts and activists associated with the field.

Tools and Technique

For the study, the following research tools were employed for gathering data.

1. Questionnaire on Engineering Colleges to Principals (Musthafa & Surekha, 2014)
2. Questionnaire on Engineering Colleges to Faculty Members (Musthafa & Surekha, 2014)
3. Questionnaire on Engineering Colleges to Students (Musthafa & Surekha, 2014)
4. Questionnaire on Engineering Colleges to Engineering Graduates (Musthafa & Surekha, 2014)
5. Questionnaire on Engineering Colleges to Parents of Engineering Students (Musthafa & Surekha, 2014)

Unstructured Interview was also used as supplementary tool for collecting data from experts, social/media activists and stakeholders.

Statistical Technique Used

In order to find answers to the objectives, "Estimation of Percentage" was the statistical technique used for the study.

Scope of the Study

The technological innovations play an important role in sustaining economic prosperity, security and social well being of the nation. Therefore engineering education has an important role in the development of every nation. Engineering colleges are entrusted with the responsibility of producing competent and skilful engineers to meet the requirements of society.

To produce quality technical man power, engineering colleges must have quality faculty, curriculum, infrastructure, finance etc. This study analyses the facilities, with respect to infrastructure, human resources, financial resources and curriculum and also extended to explore the deficiencies existed in the engineering colleges. Since valid tools were used to collect data giving due representation to each categories and data collection was carried out in a methodological manner, it is expected that the study gives a clear picture of engineering colleges in Kerala and will help in the improvement of the standards of engineering colleges in Kerala. The investigator hoped that the findings of the study help students, faculties, administrators and authorities to tide over the prevailing issues in the engineering education system of Kerala.

Delimitation of the Study

1. The study was delimited to the engineering colleges exist during the study.
2. The profile of engineering colleges were taken interms of growth and details of courses, accreditation, intake capacity, enrolment, vacant seats, pass percent and placement.
3. For profile analysis investigator selected 158 engineering colleges only (except for growth of engineering colleges). The 155 engineering colleges affiliated to Kerala Technological University and the 3 engineering colleges each under Kerala University, University of Calicut and M.G.

University only were considered due to the unavailability of affiliation details of the rest of the colleges in the documents.

4. For the survey part the student sample was limited to B.Tech courses, no consideration was given to the specific branches of the B.Tech course.
5. Different categories of engineering colleges are there in Kerala. The study was limited to three categories of engineering colleges, viz. 9 colleges under direct control of the State Government, 3 Aided by the Government and 146 Self-financing types.
6. For the survey part, the Government owned self financing and private self financing colleges are not categorised. Both were jointly considered as self financing engineering colleges.
7. The study was delimited to the districts: Kasaragod, Kozhikode, Malappuram, Thrissur, Palakkad, Eranakulam and Trivandrum.

Organization of the Report

The report of the study is presented in the following way.

Chapter 1

This chapter of the report contains a brief introduction, need and significance of the study, statement of the problem, definition of key terms, objectives, methodology in brief, scope of the study, delimitation of the study and organization of the report.

Chapter 2

It gives the conceptual evolution of the concept of the study.

Chapter 3

This chapter contains the review of related studies on engineering education.

Chapter 4

This chapter contains the methodology of the study and is discussed under two phases: methodology used to study the general profile of engineering colleges is discussed in phase 1 and phase 2 deals with the methods used to study the facilities and issues of sampled engineering colleges. This covers the discussion of the documents used for the study, tools employed for the collection of data, selection of sample, procedure of data collection, scoring and consolidation of data and statistical technique used for analysis.

Chapter 5

Details of analysis along with conclusion are presented in the chapter.

Chapter 6

The last chapter includes a brief summary of the study, major findings, analytical derivatives, educational implications of the study and suggestions for further research.

Chapter II

CONCEPTUAL FRAMEWORK OF THE STUDY

- *Evolution and Historical Development of Engineering Education*
- *History of Engineering Education in India*
- *Types of Engineering Colleges in Kerala*
- *B.Tech Degree Courses in Kerala*
- *Admission Process - Entrance Examination*
- *Curriculum of Engineering Education*
- *Directorate of Technical Education, Kerala*
- *APJ Abdul Kalam Technological University*

CONCEPTUAL FRAMEWORK OF THE STUDY

In this chapter the conceptual evolution and historical development of engineering education are presented.

Evolution and Historical Development of Engineering Education

Engineering education is comparatively a new area in the field of education. According to Bhattacharya and Maitra (2016) it is a special form of education and training developed to meet the needs of an industrial age by academic education with skill training. It is the activity of teaching knowledge, skills and principles for the professional practice of engineering.

Unlike other types of professional education, engineering education has not had a long history. Even though the engineering profession can be traced back to the earliest time, there were no available records of history about formal engineering education until 1700. The first record available about technical education was at Russia in 1701. The Moscow School of Mathematics and Navigation was the first Russian educational institution in 1701 established to produce sailors, engineers, cartographers and bombardiers to support Russian military (https://en.wikipedia. org/wiki/Engineering_ education).

Another record available about the engineering education was from France in 1747, when a French engineer Jean Rodolphe Perronet started world's first engineering school: Ecole des Ponts et Chaussess (www. britanica.com/biography/Jean-Perronet). Thus French were considered as the leaders in engineering in the 17th and 18th century and also pioneers of engineering education in the world (Kumar and Singh, 2009).

During the Renaissance period, the faculty of Engineering was considered as a part of the faculty of 'Arts'. The period of Industrial Revolution (1750-1850) changed the attitude of the society towards engineering and the people started considering the discipline as 'Science'. During this period Civil, Mechanical and Electrical Engineering have been introduced. During the same period, James watt invented 'Steam engine' (1780) which led the human capacity to generate and handle large amounts of energy for the development. Transformation from human labour and hand tools to large and complicated machineries and the change in transportation from bullock cart and like other ways to railroads and steamship also occurred in the same time (Kumar and Singh, 2009).

The Engineers evolved from two different streams: one stream belonged to artisans and craftsmen from the lowest strata of the less specialised section of the society of the last century. The other stream, from the modern class who had understanding about sciences and had acquired the practice of organised and disciplined thinking. To uplift the capabilities of the less privileged class in handling the new types of machines, School for General Education of Craftsmen and Artisans was established by John Anderson at Glasgow about 1790. Another such school was founded in

London in 1823 by Dr. Brikbech. The Anderson University later became the famous Royal Technical College, Glasgow.

According to Raynolds (1992) different types of Engineering institutions were established in United States of America (USA) at the history of engineering education. The first type appeared in USA Military academy style, the first one among these being the West Point Academy founded in 1802. The polytechnic type Schools of Engineering were the next type. The first school in this category was Gardines of Maine established in 1823, but this did not live long. In 1824, Resslers Polytechnic Institute at Troy in New York was established and it is the oldest surviving technical institute in USA. The Polytechnic College of Pennsylvania started in 1853 offered the first regular curricula and granted the first degree certificate in Mining Engineering and Mechanical Engineering (Grayson, 1980). The University of Virginia started in 1833, awarded the Bachelor of Degree (BA) with Engineering elective. Columbia University was the pioneer in offering Mechanical, Machines and Civil Engineering as part of the 'scientific and literary courses' of study which led to the B.S Degree in 1830 (Issapour & Sheppard, 2015)

The Morrill Act 1862, which allowed the establishment of colleges from the proceeds of federal land sales, gave a tremendous boost to the engineering education in the USA. The number of colleges offering engineering grown from a few (about 4 by some estimate) to one hundred by the turn of the century (Baker, 1900; McGivern, 1960). Starting from 1880, tremendous changes happened in engineering education in USA. One of the important changes was the inclusion of more Science and Mathematics in the engineering curriculum (Marcus, 2005).

In Germany about 1825, the Polytechnic School at Karlsruhe was founded from two older institutions; it was the first of this category in that country. In 1833, the curriculum of that school was changed to call attention to a "high scientific discipline" and the school became basically professional. Germany built up a chain of technological institutes after the Franco-Prussian, which provided for the teaching of all grades of men from craftsmen to researchers and this was mainly accountable for the great industrial and technical superiority of Germany which was noticed through the First World War. The great Technische Hochschule at Charlottenburg, Berlin was founded in 1879 as part of the University, but was later separated from the university for the sake of administrative ease (Universities Quarterly, 1948; Jeba & John, 2009).

The accomplishment of this institution led to the foundation of the Imperial College of Science and Technology in London in 1907. By the terms of its charter, the college stands alone in being specially charged to develop postgraduate studies for their application to industries. It can be concluded that after 1871, technical schools were developed rapidly in Europe and United States to serve the needs of the growing industries that burst into activity at that time (Kumar & Sigh, 2009).

The inclusion of more science in engineering education was realised by the publication of *Report on Evaluation of Engineering education* in 1955.

This report is also known as Grinter Report which stimulated the growth of Graduate Engineering education. *The Presidents Science Advisory Committee* (PSAC) report 1962 entitled *Meeting Man power needs in Science and Technology* recommended to accelerate graduate training in engineering to overcome the severe shortage of engineers and scientists at that time. While retaining the importance of Bachelors Degree in Engineering, the Goals study report of the period 1963-68 entitled *Goals of Engineering Education* recommended considering the significance of Masters Degree also (National Research Council Staff, Engineering Graduate Education and Research, 1985).

The 19^{th} century witnessed the birth of many new branches of engineering in addition to the classical Mechanical and Civil Engineering. Since then, the Engineering education is persistently developing and changing at a fast rate.

History of Engineering Education in India

Technical education is mainly designed for the supply of technically trained man power for industry and economic development of every nation through application of science and technology. The growth of colleges of engineering in America and Europe, providing aspirants with good technical education and special proficiency in Mathematics prompted the rulers of India to establish similar type of technical schools in India. During the colonisation of Britain in India, the rulers of Britain wanted to know about the topography and resources of India through Physical survey. For achieving that the traders of Britain established a survey school at Madras in 1794 to train the Indian workforce in modern land survey and to assist British surveyors in their land survey process. It can be said that though the foundation of technical education was laid almost at the same time that was founded in Europe, the growth of technical education in India was stunted till India become independent (Sen, 1989).

In the year 1802, a School of Surveying was established in the northern region of India at Saharanapur. This school later became the Roorkee College in 1847 and then Thomson College of Engineering in 1854 at Roorkee and in 1949 the status of this college was further enhanced and this became the first Technical University in India (Maitra, 2017). In 2001, the Roorkee Technical University has been given the status of Indian Institute of Technology (IIT).

In 1825, there were indications of technical schools existed in Calcutta and Bombay. These schools were attached to the ordinance factories and other engineering establishments for training artisans and artificers. The need for introduction of occupational education was highlighted in Wood's Despatch 1854 (Sen, 1989). The Roorkee Engineering College was the first engineering college in India and it was established more or less at the time of Wood's Despatch. The main aim of this institute at that time was to train Civil Engineers for the development of Upper Ganga Canal.

The first Industrial School was established at Guindy, Madras in 1842. And then in 1854, a school for training of overseers was established at Poona.

In pursuance/continuation of British Government policy in India and also on the recommendations of Wood's Despatch, three more engineering colleges were established, one each in Bengal (Calcutta College of Engineering), Bombay (Poona college of Engineering) and Madras (Guindy College of Engineering) in 1956 and 1958 respectively. All the three colleges provided almost same pattern of training and later were upgraded to Degree level colleges in Civil Engineering (Sen, 1989; Chopra & Sharma, 2009).

The Calcutta College of Engineering was opened at the Writers Building in November 1856: then the name was changed to Bengal Engineering College in 1857 and this college was affiliated to Calcutta University. In 1865, the college was merged with the Presidency College. Later in 1880, it was detached from Presidency College and occupied the properties and buildings of Bishop's college.

The Poona College of Engineering affiliated to the Bombay University was the only engineering college in Western Presidency. In Madras Presidency the industrial school attached to the Gun Carriage Factory became finally the Guindy College of Engineering affiliated to Madras University. Up to 1880, these three colleges had licentiate course in Civil Engineering.

After 1880 there were a felt need for training in Mechanical and Electrical engineering, but at that time the three engineering colleges were offering only apprenticeship classes in these subjects. The Victoria Jubilee Technical Institute was started in 1887 at Bombay to give training in Mechanical, Electrical and Textile Engineering. In the year 1915, the Indian

Institute of Technology (IIT), Bangalore started Electrical Engineering classes under Dr. Alfred Hey. From the starting itself, the institute began to give certificates and associateships on the subject and the latter being regarded as equivalent to the Engineering degree.

In 1902, at Bengal the leaders of Swadeshi Movement organised a National Council of Education. Many institutions were started under the organisation but only one institute - College of Engineering and Technology at Jadavpur had survived. In 1902 it started Diploma courses in Mechanical Engineering and in 1921, Chemical Engineering.

The Calcutta University Commission debated the pros and cons for the introduction of graduate level courses in Mechanical and Electrical Engineering in Indian engineering colleges. The reasons cited, from the recommendations of the Indian Industrial Commission [1915, under the Chairmanship of Sir Thomas (Holland)] against the introduction of Electrical Engineering courses is given in quotation from the report:

"We have not specifically referred to the training of electrical engineers, because electrical manufactures have not yet been started in India, and there is only scope for the employment of men to do simple repair work, to take charge of the running of electrical machinery, and to manage and control hydro-electric and steam-operated stations. The men required for these three classes of work will be provided by the foregoing proposals for the training of the various grades required in Mechanical Engineering. They will have to acquire in addition, special experience in electrical matters, but, till this branch of engineering is developed on the constructional side, and the manufacture of electrical machinery taken in hand, the managers of electrical undertakings must train their own men, making such use as they can of the special facilities offered for instruction at the engineering colleges and the Indian Institute of Science" (MHRD).

MHRD also reported in the Overview of Technical Education in India that the credit of starting degree class in Mechanical Engineering, Electrical Engineering and Metallurgy belongs to University of Banaras in 1917. After fifteen years, Bengal Engineering College at Sibpur started Mechanical Engineering in 1931, Electrical Engineering in 1935 and Metallurgy courses in 1939. Almost at the same time these courses were also started in Guindy and Poona College of Engineering.

After Independence a large number of engineering colleges were started in India because of the realisation that India has to become a great industrial country. To achieve this, large number of technically competent manpower is required.

Development of Engineering Colleges after Independence

In the year 1947 there were only 44 Engineering Colleges and 43 Polytechnics (including Pharmacy and Architecture Institutions) in India. Due to the efforts and initiatives taken during successive Five Year Plans and particularly due to policy changes of Government of India in the eighties to allow participation of Private and Voluntary Organizations in the setting up of Technical Institutions on self-financing basis, there occurred an uncontrolled growth in the number of Technical Education institutes.

The Sarkar Committee (1945) appointed by the AICTE recommended the establishment of Higher Technical Institutes based on the Massachusetts Institute of Technology (MIT) in India i.e. IITs in order to meet post-war needs of engineers of higher level (Awale, 1996). Based on these recommendations, in 1950, the first IIT was established at Kharagpur. At the time of establishment it was named as Eastern Higher Technical Institute, which was later changed to Indian Institute of Technology in 1951. Six IITs were established in different regions of the India and were declared as Institutes of National Importance by an act of Parliament in 1961; amended in 1966. Those six IITs were established at Bombay (1958), Kanpur (1959), Madras (1960), Delhi (1963), Gowhathi (1999) and Roorkee (2000) (AICTE Hand Book, 2015).

The Planning Commission of India appointed the Engineering Planning Committee (EPC) in 1955 for the overall assessment of the demand and supply position in respect of technical manpower. During the second five year plan period (1956-61), a large number of industrial projects were to be completed. To fulfill the demand of engineering personnel for industrial sector, Indian government decided to start seventeen Regional Engineering Colleges (RECs) in India (Jai Krishna Committee Report, 1974). In the year 2002, MHRD decided to upgrade all the RECs to National Institutes of Technology (NIT). Government also decided to start three new NITs at the same time. The National Institute of Technology Act 2007 passed by the Government of India provided the NITs with complete autonomy in their functioning. As per this Act, all individual NITs are functioning as an Autonomous Technical University and draft their own curriculum and functioning policy (http://Wikipedia.org/wiki/National_ institutes _technology). These NITs are located at 31 different places of India.

The dearth of engineering personnel to meet the needs of industrial and other service sectors was noticed by the authorities at the end of the 5^{th} five year plan. To overcome this difficulty there was a pressure to expand the number of engineering institutes in India. The State Government also decided to start engineering colleges under State Government and Government Aided sector. Besides these some of the states decided to permit private agencies to start engineering colleges in India. The increase of private engineering colleges was significant after 1991 (Rao, 1997).

There has been a tremendous increase in the number of engineering institutes from 110 in 1960 and to 337 in 1990. In the year 2000 the number of engineering institutes was 776. From 2000 onwards, a quantum jump was visible in both the number of engineering institutes and their intake. In 2005, the number of engineering institutes increased to 1346 and further to 3384 in 2013. The intake per institute also increased from 336 in 2005 to 483 in 2013. The total student intake also increased from 3700 in 1950 to 16,34,596 in 2013 (AICTE Hand book 2015; Sharma, 2017).

To fulfill the technical man power needs of India, the Ministry of Human Resource Development (MHRD) in the year 2008 decided to start eight new IITs in different states of India under XI five year plan (www.iitm.ac.in) and those were at Gandhinagar, Jodhpur, Hyderabad, Indore, Patna, Bhubaneswar, Ropar, and Mandi.

Structure of Indian Technical Education System

The structure of technical education in India consists of several sub-systems such as the Central and State Government, Universities, All India Council of Technical Education (AICTE), Professional bodies such as Council of Architecture and the management committees of individual institutions. The umbrella agency, AICTE was constituted by the Indian government in 1948 as an advisory body in all matters relating to technical education. In 1988, AICTE was awarded statutory authority for planning, formulation and maintenance of norms and standards, accreditation and ensuring the coordinated development of technical and management education. The Directorate of Technical Education, the state Universities to which colleges are affiliated and Board of Technical Education are the state government level agencies which deal with technical education. The vast technical education of India comprises of 17 IITs, 20 NITs, state technical universities and a large number of engineering colleges spread across the country.

The Indian Engineering education has a pyramidal structure. Few elite institutions are at the peak of the pyramid. The global excellence in teaching, research and consultancy in the field of engineering are the emphasis of these institutions. In India, Indian Institute of Technologies (IITs) and National Institute of Technologies (NITs) are the elite institutions imparting Engineering Education in India. Only through these elite institutions sufficient number of professionals cannot be produced. The Indian service sectors and industries primarily depend on the graduates of engineering coming from the second and third level institutions: engineering colleges under State Government and Universities of India.

Commissions and Committees on Technical Higher Education in India

The Government appointed different committees and commissions to review the education system of India at different points of time. Commissions are meant to give directions for improvement. After independence there had been several commissions on Technical education appointed by the government for the improvement of technical education in India. The few important ones are discussed here separately.

Sarkar Committee (1945-1949).

Based on the recommendations of the Central Advisory Board of Education (CABE), the Government of India appointed a committee in 1945 to survey the entire question of Indian Technical Education and to make significant recommendations with respect to the Post-War Reconstruction Plan. The chairman of the committee was late Sri. Nalini Ranjan Sarkar. The committee submitted an interim report in 1946. According to the Committee the existing facilities of Higher Technical Education are inadequate, both in quantity and quality. The major recommendations of the committee are as follows.

- Four Higher Technical Institutions should be set up in North, South, East and West zones of India. These institutions should be in the pattern of Massachusetts Institute of Technology, USA.
- To ensure the proper planning of buildings, equipments and courses of the study, principals and heads for the main departments should be appointed for these four institutes and an experienced architect be secured at a sufficient early stage.

S.S. Bhatnagar Committee (1947).

In 1947, the Government appointed a scientific manpower committee called 'S S Bhatnagar Committee' under the chairmanship of Dr. Santi Swarup Bhatnagar. The committee assessed the requirements of scientists, technologists, engineers and doctors to meet the needs of economic and industrial development of India after independence. The committee estimated the ratio between the demand and supply of technical manpower and suggested it to be at 4:1. This was the first systematic assessment of the scientific manpower needs of India (Saha & Ghosh, 2012).

Radhakrishnan Commission (1948-1949).

The commission is also known as University Education Commission, constituted under the chairmanship of Dr. S. Radhakrishnan. The main recommendations of the commission regarding the technical education are,

- More vocational education institutions should be started to reduce the burden of the Universities.
- The curriculum of the 1st year for every engineering discipline should be the same.
- New technological institutes should be started.
- Such institutes should give importance to practical training for engineering students at the concerned industrial centres.
- Provision for higher education and research should be made in the field of engineering.

Mudaliar Commission (1952).

The Secondary Education Commission, under the chairmanship of Dr. A Lakshmanaswamy Mudaliar was constituted in 1952. The commission suggested establishing more technical schools for the improvement of technical education system (Banarjee and Muley, 2008).

Thacker Committee (1959-1961).

Under the chairmanship of Professor M.S. Thacker, in 1959 a committee was formed to study comprehensively the post graduate engineering education and research in India. The report of the committee was submitted in 1961.

The major recommendations were as follows:

- Scholarships should be given to post graduate students to attract candidates of high merit.

- The research and post graduate programmes should be concentrated in a limited number of institutions as there is limited number of qualified faculties.
- To promote the growth of technology, relationship should be developed between academic institutions and industries.
- More employment opportunities should be created for P.G. students.
- Research scholars and PG students should be encouraged to undertake part time teaching.
- Research oriented or design oriented project work should be given importance.
- Masters degree must be the minimum qualification for Ph.D.

Kothari Commission (1964).

The Kothari Commission otherwise known as National Education Commission, formed by the Government of India in 1964. Under the chairmanship of Dr. S. Kothari, the commission submitted its report in 1966. The report submitted had the following recommendations.

- Training in ITIs and Technical Schools must be production oriented.
- Meritorious B.Sc. Degree students should be encouraged to study some branches of engineering such as Electronics and Instrumentation.
- Provisions for practical training to students from the third year with the help of industry should be made in engineering courses.
- Research oriented project works should be included in the curriculum.
- Revise curriculum.

- To attract highly qualified engineering personnel for teaching and research, good salary should be offered.

L.S. Chandrakant Committee (1971).

Under the chairmanship of L.S. Chandrakanth, this committee was constituted to look in to the matter of the postgraduate education and research programmes.

The major recommendations of the committee were:

- The curriculum of PG should be revised.
- The emphasis on laboratory and project work should be increased.
- PG diploma courses should be organized for industry.
- Institutions must be given freedom to start new courses.

Kelker Committee 1976.

The Kelker Committee was constituted in 1976 to evaluate the fulfillment of aims and objectives of Technical Teachers Training Institutes (TTIs) and to suggest further roles of the TTIs in the scheme of Technical education in general and for the purpose of teacher training in particular.

The recommendations of the committee were as follows.

- Introduce modular training programme and short term training programme.
- In modular training of 12 weeks duration, include training in Pedagogy and Industrial training.

- To bring attitude change, special appreciation courses should be arranged for senior personnel.

Nayudamma Committee (1978-1980).

It was a Review Committee on Post Graduate Education and Research in Engineering Technology. The Committee found that the one year PG diploma programmes in engineering were not successful, and forwarded some important recommendations (Saha & Ghosh, 2012).

Major Recommendations of the review were:

- The P.G. programmes should be of 2 years duration.
- Should ensure selection of meritorious and motivated students by All India Graduate Aptitude Test in Engineering (GATE).
- Ensure Industry participation in the course of study.
- Part time PG. programmes should be introduced in the industry relevant area.
- AICTE should be made a statutory body through an act of parliament.
- Ph.D. should be the essential qualification for post graduate teaching.

National Policy on Education (1986).

The main recommendations of NPE with respect to technical education were,

- Technical Manpower Information System should be developed.
- From school stage onwards, programmes on computer literacy should be organised on a wider scale.

- The curricula of technical and management courses should be prepared according to the needs of industry.
- Encourage professional societies to perform their role in the advancement of technical and management education.
- The AICTE will be responsible for planning, formulation and maintenance of norms and standards for technical and management institutions. It will be also responsible for accreditation, monitoring and evaluation, funding of priority areas, maintaining uniformity of certification and accords and ensuring the co-ordinated and integrated development of technical and management education.

Based on these recommendations, the AICTE became a statutory body through an act of parliament in 1987.

Nayudamma Committee (1986).

To review the functioning of IITs of India, the Government constituted a Review committee under Dr. Y Nayudamma. The main recommendations were:

- The student strength of UG and PG courses should be maintained at 1:1 ratio.
- B.Tech level programmes in the IITs should aim at greater flexibilities and ensure a science based engineering curriculum.
- The UG and PG programmes should be periodically reviewed to update and modify the courses to match the needs of the country and the development in science and technology.

- Departments should have more flexibility in academics.
- Should have more strict and objective assessment of all faculties. For highly merited people should be given special status and additional 'perks'.

P. Ram Rao Committee (1995-1999).

The PG Review Committee headed by P. Ram Rao submitted its report in 1999. The committee recommended urgent measures to revitalise post graduate education, doctoral programmes and faculty development in Engineering and Technology education. The recommendations were:

- Duration of PG programme to be increased to 21 months.
- Scholarship of PG students should be increased and reviewed periodically.
- To attract motivated and meritorious scholars, attractive fellowship and contingency grant should be given.
- National Doctoral Programme should be started.
- The number of Ph.Ds in Engineering & Technology should be increased to meet the faculty requirement.

Mashelkar Committee (1996-1998).

Based on the recommendation of the Mashelkar Committee, the 17 Regional Engineering Colleges have been converted to National Institute of Technology. This change shifted the control of these institutes from state to centre.

U.R. Rao Committee (2002-2003).

The review committee was set up by Ministry of Human Resource Development in 2002 to review the functioning of AICTE and define its role.

The notable recommendations of the Committee were:

- To control the number of institutions and intake of students, those institutions that do not have enough faculty or infrastructure must be ruthlessly stopped.
- Ph.D holders in engineering should be recruited for the faculty positions.
- Right salary should be paid to staffs.
- For poor students, fees should be reduced.
- Further expansion of UG level technical institutions should not be allowed and approval for new institutions should be stopped for at least for 5 years because UG students' intake exceeds the national average of 350/million population.
- Utilise qualified retired faculties to reduce the faculty shortage.
- Institution and industry linkage should be significant.

P. Ram Rao Committee (2002-2004).

To review the working of Indian Institute of Technology, Government of India appointed a review committee under the chairmanship of Dr. Rama Rao. Some of the recommendations were,

- Retirement age can be extended from 62 to 65 years for selected highly qualified faculties.

- IITs should create a separate Human Resource Unit to check the faculty recruitment and their retention.
- Efficient screening procedure should be conducted for selection of students in research.

Knowledge Commission Report on Technical Education 2005-2008.

On 13 June, 2005, Dr. Manmohan Singh, the then Prime Minister of India constituted the National Knowledge Commission (NKC). Some of the initiatives proposed by NKC are,

- Professionals from industry and research laboratories should be invited to participate in the teaching process in the technical institutions. Institutions should create adjunct positions for them.
- Students who have teaching competency should be indentified at their undergraduate level itself and motivated to take teaching as career.
- Start four year UG programmes in Science along with engineering programme to reduce the gap between Science and Technology.
- To meet the increasing demand, public - private partnership should be encouraged to start more institutes of excellence.
- Increasing the number of faculties by relaxing the criteria of appointing only Ph.Ds for undergraduate teaching.

Dr. Anil Kakodkar Committee (2010-2011).

The Committee was appointed by MHRD to suggest a roadmap for strengthening the financial administrative and academic autonomy of the IITs. The major recommendations were,

1. Increase the number of Ph.Ds to 10,000 by 2020-25 from about 20 IITs.
2. The curriculum should need greater flexibilities to provide greater choices to students.
3. Produce at least 1,00,000 quality engineering graduates/year through the central government institutions of technology.

These commissions and committees made valuable suggestions for the improvement of engineering education in India. Many of the recommendations are still to be followed by many institutions/ bodies.

Development of engineering education in Kerala.

As per records, the first engineering college in Kerala is the College of Engineering, Trivandrum commonly known as CET. The CET started in 3rd July 1939 by Sree Chithira Thirunal Balarama Varma, the Maharaja of Travancore. At the time of establishment it was under Travancore University with a British man named Major T.H Mathewman as its first principal. It offered degree and diploma courses in Mechanical, Electrical and Civil branches, and the initial intake capacity was 21 students in each of these branches.

After the independence of India, a few more institutes were established in various districts of the state. The second oldest engineering college in the Kerala established after independence is the Government Engineering College, Thrissur (GECT). This was the first one to be established after the formation of Kerala State. The foundation stone of the college was laid by the late Pandit Jawarharlal Nehru, the first Prime Minister of India, on 26 April 1958. At the time of its establishment, the college has three undergraduate programs in Civil, Mechanical and Electrical Engineering.

The first engineering college comes under the category of Government Aided Engineering College in Kerala was the Thangal Kunju Musaliar College of Engineering commonly known as TKM College of Engineering, founded in 1958. The college is located at Karikode, 6 k.m. from the city of Kollam in southern Kerala. The college was founded by the TKM Educational Trust, an organization established by Thangal Kunju Musaliar. The college started with 120 students and offering courses in Mechanical Engineering, Civil Engineering and Electrical Engineering under University of Kerala.

NSS College of Engineering, Palakkad is the fourth engineering educational institution established in Kerala and the second engineering college started in the Government Aided category of engineering colleges. It was founded in the year 1960 by Nair Service Society during the second five year plan with the assistance of Central and State Government under Grant-in-Aid scheme. At the time of beginning, the college had offered three degree courses in Engineering - Civil, Mechanical and Electrical & Electronics engineering.

The pioneer engineering education institute in the central region of Kerala is the Mar Athanasius College of Engineering, Kothamangalam established in the year 1961. It is the third and last Government Aided Engineering college in Kerala managed by Mar Athanasius College

Association. The college was started with the intake of 120 students in three branches of engineering: Civil, Mechanical and Electrical Engineering.

In the year 1961, one of the elite institutions in Kerala - the National Institute of Technology, Calicut formerly known as Regional Engineering College, Calicut was established to impart high standard technical education. It is considered as one of the institutes of National importance by the National Institute of Technology Act 2007 passed by the Parliament. Until 1963 it was affiliated to Kerala University after that it came under University of Calicut. The college was started with an intake of 125 students.

After 25 years of gap, the third government engineering college started in Kannur in 1986-Government Engineering College, Kannur affiliated to University of Calicut.

From the establishment of the first institute in 1939 till 1990s, engineering education in Kerala was funded by the government. Most of the institutes were owned and administered by the State; there were three aided institutions as well. After 1990, six Government Engineering colleges also were started. In 1991 Rajiv Gandhi institute of Technology, Kottayam was established. In 1999, four engineering colleges started in four districts of Kerala: Trivandrum, Kozhikode, Palakkad and Wayanad and lastly in 2000, Government Engineering College, Idukki was started.

The demand for qualified engineers started shooting up due to the results of the economic liberalisation policies. By the late 1990s such changes started getting reflected on the education and employment scenario of Kerala as well. However, the intake capacity of government technical education institutions was not sufficient to meet this ever increasing demand for engineering graduates. Consequently, liberalization of technical education in Kerala became an inevitable move. The liberalisation of technical education from 2001 or so, dramatically increased the number of engineering colleges in Kerala (Mani & Arun, 2012).

In 1989 the Government Model Engineering College, Cochin was started. It is the first Self Financing Engineering college under the Government department, Institute of Human Resource Development (IHRD). At first it was affiliated to Cochin University of Science and Technology. Other 21 Institutions were also started under the support of govt. agencies such as Institute of Human Resource Development (IHRD), Co-operative Academy of Professional Education (CAPE), Lal Bahadur Shasthri Centre of Science and Technology and Kerala State Road Transport Corporation (KSRTC).

The first Private Self-financing Engineering College in Kerala is the MES College of Engineering, Kuttippuram in Malappuram district. It was established in 1994 with an intake of 60 students in each branch of engineering - Computer science & Engineering, Electronics & Communication Engineering, Applied Electronics & Engineering and Mechanical Engineering. The MES College of Engineering was established as an institution with minority status and managed by Muslim Educational Society.

More private players came to the picture from late 1990s in the system of engineering education in Kerala. As a result, institutions that offer B.Tech and M.Tech courses grew by leaps and bounds. The number of engineering colleges in Kerala during 1991 was 9, with an intake capacity of about 2,800 students. By the beginning of 2000 it is increased to 33, with an intake capacity of closer to 9,000 students. According to the KEAM (Kerala Engineering Agriculture Medical Entrance Examination) 2013 prospectus published by the Commissioner of Entrance Examination (CEE), today there are more than 150 engineering institutes with approximately 51,000 plus sanctioned seats in various streams. The districts with most number of colleges (more than 20) are Thiruvananthapuram and Ernakulam. Wayanad, is the district with least number of engineering institutes in Kerala, only one.

Types of Engineering Colleges in Kerala

There are a number of institutions in Kerala which can be divided into 5 broad categories as given below based on their mode of administration and funding.

1. Central Government
2. State Government
3. Government Aided
4. Government controlled Self-financing
5. Private Self-financing

Some of these categories can be subdivided based on the governing body that administers the institutions. Let us look at each of these categories in detail.

Central Government Engineering colleges.

Kerala has only one institute that comes under the administration of the Central Government. It is the National Institute of Technology (NIT) located at Calicut. It was formerly known as REC (Regional Engineering College). Admission to B.Tech courses in NIT is conducted through the National level Joint Entrance Examination Main (JEE Main). Students are selected to M.Tech courses based on their GATE qualification/scores.

State Government Engineering colleges.

The State Government engineering colleges are administered by the Directorate of Technical Education (DTE) of Kerala Government. The College of Engineering, Trivandrum (CET) is the oldest (established in 1939) in this category, while the Govt. Engineering College Mananthavady, Wayanad is the youngest (established in 2000). As of now there are nine such institutions with the capacity to enroll about 3,000 students every year for undergraduate courses.

Aided Engineering colleges.

An Aided educational institution is a private one, but is recognized and financially aided by the Government. There are three Government aided engineering colleges in Kerala with an annual intake capacity of about 1,500 students per year for B.Tech courses. These are located at Ernakulam, Palakkad and Kollam districts.

Self-financing Engineering colleges under the control of Government.

Apart from the Government and Aided ones, there are a number of self-financing colleges that offer B.Tech and M.Tech courses. However, not all of them are under private management. Some of them are under the control of Government agencies or organizations. These agencies are:

a. Institute of Human Resource Development (IHRD)
b. Co-operative Academy of Professional Education (CAPE)
c. Kerala, Calicut and Mahatma Gandhi Universities
d. Cochin University of Science and Technology (CUSAT)
e. Kerala State Road Transport Corporation (KSRTC)
f. Centre for Continuing Education Kerala (CCEK)
g. Lal Bahadur Sastri Centre for Science and Technology (LBS)
h. Kerala Agricultural University (KAU)

The seat allotment and fee structure followed by the institutions under this category are different from the others. Admission to undergraduate courses is based on the ranks candidates obtained in Kerala Engineering Agriculture Medical (KEAM) Entrance examination.

Institute of Human Resource Development (IHRD).

Nine institutions are there under the aegis of Institute of Human Resource Development (IHRD). The intake capacity is approximately 765 students every year under various B.Tech courses in these institutions. All of them are affiliated to Cochin University of Science and Technology

(CUSAT), and the courses they offer are recognized by All India Council of Technical Education (AICTE).

Co-operative Academy of Professional Education (CAPE).

There are 8 engineering colleges under the aegis of Co-operative Academy of Professional Education (CAPE), which is an autonomous society formed under the Govt. of Kerala. All colleges are affiliated to CUSAT and recognized by AICTE. The intake capacity is about 1,000 students every year in different undergraduate courses.

State Universities.

Three engineering colleges are established and managed by three universities of Kerala. University of Kerala, University of Calicut and Mahatma Gandhi (MG) University run Engineering institutes which are affiliated to them.

Cochin University of Science and Technology (CUSAT).

Under Cochin University of Science and Technology (CUSAT) three engineering colleges offer different courses in B. Tech and M. Tech courses. School of Engineering inside the main campus in Kochi, and a University campus in Kuttanad, both of which offer B.Tech and M.Tech courses. Another self financing institute of CUSAT is the Kunjali Marakkar School of Marine Engineering in Kochi offering B.Tech course in Marine Engineering. CUSAT conducts a common engineering test for the selection of students for admission in these institutions.

Kerala State Road Transport Corporation (KSRTC).

Under KSRTC, Sree Chitra Thirunal College of Engineering in Trivandrum offers courses in engineering. It has a governing body chaired by the Transport Minister of the State.

Center for Continuing Education Kerala (CCEK).

Center for Continuing Education Kerala (CCEK) is an autonomous body formed by the Govt. of Kerala. The College of Engineering in Munnar administered by CCEK offers both B.Tech and M.Tech courses, and is affiliated to CUSAT.

Lal Bahadur Sastri Centre for Science and Technology (LBS).

Lal Bahadur Sastri Centre for Science and Technology, is an undertaking of Kerala Government. It is headquartered in Thiruvananthapuram. Currently there are two self-financing institutes under LBS. They are Lal Bahadur Shastri College of Engineering, Kasaragod and LBS Institute of Technology for Women, Poojappura (Thiruvananthapuram). The LBS Engineering College, Kasaragod is affiliated to Kannur University and the LBS Institute of Technology for Women is affiliated to Kerala University.

From 2014 onwards all these engineering colleges are affiliated under Kerala Technological University (KTU) except three engineering college undertaken by the State universities of Kerala.

Private Self-Financing Engineering colleges.

These are owned and run by private managements. They can be divided into two broad categories based on the associations that represent them.

Kerala Catholic Engineering College Managements' Association (KCECMA).

12 Engineering institutions are run by the Kerala Catholic Engineering College Managements' Association (KCECMA) in different parts of the state. Those who apply to these institutes should qualify the Kerala Engineering Agriculture and Medical (KEAM) Entrance Examination. Rajagiri School of Engineering Technology is one of the most notable institutions of KCECMA.

Kerala Self Financing Engineering College Managements' Association (KSFECMA).

According to the latest records, there are more than 180 private self-financing engineering colleges in Kerala. They belong to different managements, but an association named Kerala Self Financing Engineering College Managements' Association (KSFECMA) was formed in 2001 to represent all these private self financing colleges. Students are admitted in such institutes both on merit and on management quota. 50 % of the seats are filled from the list of the Commissioner for Entrance Examination on merit and reservation. The remaining 50% seats in engineering are filled by respective managements. Out of this 50% management quota seat 35% is filled by management and 15% is allotted to NRI students. The fees charged by these private institutes are higher compared to others.

Other institutions.

In addition to the above mentioned ones, there are a number of other institutes that offer engineering courses in various streams. Details of such institutions are presented here:

Kerala Agricultural University (KAU).

There are two institutes under the governance and affiliation of Kerala Agricultural University. They are the College of Dairy Science And Technology in Mannuthy, Thrissur and Kelappaji College of Agricultural Engineering and Technology in Malappuram.

B.Tech and M.Tech courses in the departments of CUSAT.

Apart from the self-financing B.Tech courses CUSAT offers other B.Tech and M.Tech courses. These courses are offered by the departments located inside the main campus. Selection is through CUSAT CAT examination.

Indian Institute of Space Science and Technology (IIST).

It is the deemed university for engineering courses in Kerala sponsored by Indian Space Research Organisation (ISRO). It offers B.Tech courses in Aerospace Engineering, Avionics, and Physical Sciences. In addition to these, M.Tech courses, Ph.D. and Post-doctoral facilities are also offered by IIST. Admission to IIST is only through Joint Entrance Examination (JEE).

Amrita School of Engineering.

Amrita Vishwa Vidyapeetham is a multi-disciplinary research university accredited by NAAC. It offers B.Tech programmes at the Amritapuri Campus located in Kollam. The university conducts its own entrance examination for admission.

B.Tech Degree Courses in Kerala

The technical institutions across the state offer various undergraduate courses in different branches of engineering. The most popular B. Tech courses in Kerala are Mechanical Engineering (ME), Electrical and Electronics Engineering (EE), Civil Engineering (CE), Electronics and Communication Engineering (EC), Information Technology Engineering (IT), Applied Electronics and Instrumentation Engineering (AE), Chemical Engineering (CH), Computer Science and Engineering (CS) and Electronics and Instrumentation Engineering (EI).

Apart from these popular courses, undergraduate courses are also offered in other streams such as Aeronautical Engineering (AO), Production Engineering (PE), Industrial Engineering (IE), Mechanical (Automobile) Engineering (MA), Instrumentation and Control Engineering (IC) and Bio-technology (BT).

Few institutions offer some of the rare B.Tech courses: Metallurgy (Amal Jyothi College of Engineering, Kottayam), Safety and Fire (School of Engineering, CUSAT, Kochi), Instrumentation Technology and Naval Architecture and Ship Building (CUSAT Main Campus,Kochi), Food Technology (T.K.M Institute of Technology, Ezhukone ,Kollam), Polymer Engineering (University College of Engineering, Thodupuzha, Idukki), Printing Technology (Calicut University Institute of Engineering and Technology, Malappuram), Food Engineering (Kelappaji College of Agricultural Engineering and Technology, Tavanur, Malappuram), Dairy Science and Technology (College of Dairy Science and Technology, Mannuthy, Thrissur) and Biomedical Engineering (Model Engineering College, Thrikakkara, Ernakulam and T.K.M Institute of Technology, Ezhukone, Kollam)

All India Council for Technical Education (AICTE) and Engineering System

In order to facilitate development and assure quality of technical and engineering education in India and to regulate it, the Government of India constituted an advisory body AICTE in November, 1945 as an apex organization. It made certain rules and regulations to control the institutions so that the standards of engineering education may remain intact. AICTE is vested with statutory authority for planning, formulation and maintenance of norms and standards, assuring quality through accreditation, giving financial support in priority areas, monitoring and evaluation, maintaining uniformity of certification and awards and ensuring coordinated and integrated development and management of technical education in country (Palit, 1998) (www.aicte-India.org).

This body was given statutory status by an act of parliament in 1987. This act made the body more powerful enabling it to control, regulate and standardize all the institutions related to technical, engineering and management. The institutions setup under its guidance are of three types: Government Institutions, Government Aided Institutions and Private Institutions. The rules and regulations made by the AICTE are applicable to all the institutions though in practice it is found that many institutions do not follow them properly thereby making the education substandard. The AICTE is responsible for the approval of all engineering institutions and it monitors the growth of technical education in relation to planned qualitative and quantitative growth and proper maintenance of norms and standards. There are seven statutory regional committees for assisting the AICTE in planning and development of technical education, monitoring and periodic evaluation of approved institutions of the region (Education and National Development Report of the Education Commission, 1970). AICTE constituted National Board of Accreditation (NBA) to accredit and evaluate the institutions according to the norms and standards fixed by this body.

AICTE handbook 2013 states that admission authority/body/ institution shall not permit admissions of students to a technical program which is not approved by the Council. The requirement and eligibility for seeking approval of the council for new technical institutes are mentioned in the guidelines as below.

- A Society registered under the Registration of Societies Act 1860 through the Chairman or Secretary of society or a Trust registered under the Charitable Trusts Act 1950 or any other relevant Acts through the Chairman or Secretary of the trust or a company established under Section 25 of Companies Act 1956 or Central or State Government / UT Administration or by a Society or a Trust registered by them.
- Land requirement for UG programs is 2.5 acres in other than rural places and 10 acres in rural area. For Diploma, 1.5 and 5 acres respectively and for PG 2.5 and 10 acres other than rural and rural respectively. It shall be in one piece and cover hostel area too.
- Building plan of the Institution shall be prepared by an Architect registered with Council of Architecture and approved by the Competent Authority as chosen by concerned State Government / UT.

- Instructional area and Administrative area requirements shall be as per given in the hand book.
- Amenities area requirements as per that given in the handbook.
- Circulation area of 25% of sum of Instructional, Administrative and Amenities area is desired for covering common walkways, staircases, entrance lobby and other similar areas.
- Central Library with Reading Room area requirement shall be based on hand book as per Appendix 4.2.1 and Computer Centre program wise area requirement shall be as per Appendix 4.2.1
- Total minimum funds required: 100 Lakhs as proof of operational expenses.
- New Technical Institutes offering Engineering & Technology program shall necessarily opt for courses from group 'C' of courses (Applied Electronics & Instrumentation Chemical Engineering / Technology Civil Engineering / Technology, Construction Engineering Computer Science, Computer Science and Engineering, Computer Science & Information Technology, Computer Technology Electrical Engineering or Electrical & Electronics Engineering Electronics and Communication Engineering Information Technology Instrumentation and Control Engineering Mechanical Engineering Production Engineering)
- The head of the "Technical Institute" shall be named as "Principal" having qualifications satisfying existing norms as defined for Principal in a program of the Technical Institute.
- Requirement of Computers, Software, Internet and Printers, Requirement of Laboratory equipments and Experiments, Requirement

of books and Library facilities for each Program , Requirement of E-Journals shall be as given in the AICTE hand book

- Requirement of essential and desired requirements shall be as given in the handbook. In the hand book marked as essential need to be made available at the time of the Expert committee visit.
- The hand book gave the faculty student ratio for UG courses in engineering technology as 1:15, for PG it is 1:12
- Based on the order No. 37-3/Legal/2012 dated 25.05.2012 (www.aicte-india.org>Bureau-Administration-Rules & Regulations) in all AICTE approved technical institutions in order to guarantee transparency by Technical Institutions imparting technical education, in admissions and with principal objectives of preventing unfair practices and to provide a mechanism to students for redressal of their grievances, AICTE has notified regulation for establishment of mechanism for Grievance Redressal Committee and Ombudsman. In the case of non-compliance of above regulations, shall be called for disciplinary action against any willfully contravenes or continually fail to comply with the provision of above regulation.

For the purpose of applying for Grant of Extension of Approval to existing Technical Institution, the Institution should submit an application for Extension of Approval online in the AICTE Web-Portal www.aicte-india.org

Grant of approvals is based on self disclosure of required facilities and infrastructure availability as submitted online in the AICTE Web Portal.

National Board of Accreditation (NBA)

The usefulness of NBA lies with the concern of developing quality education in the globalized world. Further, it is a process of quality assurance. NBA was constituted by the AICTE, as an Autonomous Body, under section 10(4) of the AICTE Act, 1987 in order to evaluate institutes or function of various programs on the basis of guidelines issued by the body from time to time. The institutes can apply only for accreditation, it's programs are approved by the AICTE and it must have completed at least two batches of students. NBA and AICTE in a way play a positive role to facilitate technical and engineering education throughout India. The accreditation process is very careful and has several inputs such as quality of teaching, level of research, faculty expertise, evaluation of teachers and standard of infrastructure and resources available at the institutions (http:// www. nbaind .org/).

National Technical Manpower Information System (NTMIS)

In order to guarantee planned growth of technical education, the AICTE has introduced a scheme 'National Technical Manpower Information System'(NTMIS) to create a database, to monitor demand and supply of engineering manpower and to make sure deliberate improvement of engineering education. The council has also launched an Early Faculty Induction Program to attract bright engineering students towards the teaching profession while providing them best training (http://www.nitk.ac.in/facility/ national-technical-manpower-information-system).

Admission Process - Entrance Examination

Joint Entrance Examination (JEE).

National Institute of Technology (NITC) and Indian Institute of Space Science and Technology (IIST) admits students to their B.Tech courses through the national level Joint Entrance Examination popularly known as JEE. Students who seek admission in NITC should qualify JEE (main). Those who wish to join the undergraduate courses offered by IIST should qualify JEE (Main), and further JEE (Advance).

Kerala Engineering Agriculture and Medical Entrance (KEAM).

Admission to various engineering institutions in Kerala is done through three main entrance tests namely, KEAM, JEE and CUSAT CAT. Kerala Engineering Agriculture and Medical Entrance (KEAM) is a state-level entrance test. Admission to the B.Tech courses in all Government, Aided and Self-financing engineering colleges in Kerala is done through this test. The Commissioner of Entrance Examination (CEE) conducts annually the test in the month of April. Admissions are made on the basis of the marks applicants got in the CEE KEAM entrance examination.

Common Admission Test of CUSAT (CUSAT CAT).

CEE KEAM is not applicable to the B.Tech programmes conducted by CUSAT. Those who wish to join the B.Tech courses in CUSAT will have to qualify CUSAT CAT entrance examination. It is usually conducted in the month of May every year.

Allotment and Reservation of Seats

Govt. of Kerala has prescribed different kinds of seat reservation policies for the Government, Aided and Self-financing institutes of the state.

At the time of admission to engineering college, Government publishes orders. Based on these orders colleges admit students.

In government engineering institutes, 100% admission to B. Tech courses is based only on merit. The admission process is done by the Commissioner of Entrance Examination through Centralized Admission Process (CAP). A fixed percentage of seats are reserved for SC/ST/ and backward classes. In case of Government Aided Colleges, admission is also based on merit in the entrance examination.

The seats in the self-financing engineering colleges controlled by the Government departments are divided into three categories - 50% seats are Government merit, 35% are management and 15% NRI quota. As for Private self-financing colleges, 50% of the total seats are reserved for students under Government merit. The rest of the seats will be filled by the management observing govt. regulations on the matter. NRI students will be allotted seats as per the stipulated guidelines i.e 15%. The admission to seats under government merit will be done observing the reservation policies meant for socially and economically backward classes, SC and ST.

Curriculum of Engineering Education

The education of an engineer extends over a wide range of knowledge; from pure science, and especially what is known as engineering science, to technology. The major portion of the field is covered by the following branches: aeronautical, agricultural, chemical, civil, electrical, industrial, mechanical, metallurgical, mining, geological, and nuclear engineering. There is a great variety and a good deal of specialization in the above branches. A Civil

Engineer may aim at Highway Engineering, Structural Engineering or some other branch, and his/her education will be influenced to some extent by his/her choice. Similarly a Mechanical Engineer may aim at Automatic, Machine-tools, Aeronautical or general Production Engineering; and an Electrical Engineer at heavy current work such as power supply, at light current work such as telephone communications or at work in the field of electronics.

Modern engineering demands a sound training in General Science, particularly in Physics, Mathematics and Chemistry. For certain industries a basic knowledge of Biology is also essential. The relative importance of the fundamental sciences depends on the branch of engineering for example, an Electronics Engineer who wishes to specialize in Communication or Electronics needs an extensive knowledge of Physics and Mathematics, where as for an Agricultural Engineer, training in Chemistry and the Biological Sciences is more important.

Views on engineering education in later half of the 20th century emphasized the need for broadening of the curriculum and for an understanding by engineers of the social implications of their work. It was recognized that (especially in management posts) the ability to deal skillfully with problems of human relations was sometimes as important as technical knowledge.

Directorate of Technical Education, Kerala

In 1954 AICTE made a recommendation for appointing a separate unit of technical education in each state. Based on the recommendation, the Government of Travancore- Cochin created a post of special officer for technical education. In 1957 the Government of Kerala created Board of Technical Education and a separate Department of Technical Education in the state as per the Order ED(F)2-3891/57/EHD dated 4th September, 1957. Based on the same order the state government created a post of Director of Technical Education and appointed Sri. K.C.Chako as the first Director of Technical Education.

The Engineering College, Trivandrum was brought under the department on 1.12.1958. Now under Directorate of Technical Education, there are 12 Engineering Colleges, 49 Polytechnic Colleges, 3 Colleges of Fine Arts, 39 Technical High Schools, 17 Government Commercial Institutes, 42 tailoring and garment making Training Centres and 4 Vocational Training Centres. The two Regional Directorates of this department are functioning at Kozhikode and Kothamangalam. The Department has a Curriculum Development and a Supervisory Development Centre functioning at Kalamassery. Also an Industry Institute Interaction Cell is functioning at the Directorate.

APJ Abdul Kalam Technological University

APJ Abdul Kalam Technological University is a state Government University and has come in to existence on 21st May 2014, envisaging to bring all the engineering colleges in Kerala under one umbrella. Initially the name of APJ Abdul Kalam Technological University was Kerala Technological University (KTU). The aim of KTU is to give leadership to the technology related policy formulations, engineering planning for the state. It also emphasizes to improve the academic standards of Graduates, Post graduates and

Research programs in Engineering Science and Technology. KTU manages and regulates the academic standards of all colleges affiliated to the University. The main thrust areas are Research, Development and Innovations.

Conclusion

This chapter discussed the evolution of engineering colleges in Kerala. The chapter also discussed the historical development of engineering education across the globe, pre independent India and post independent India and observations of various commissions and committees on the different aspects of engineering education. Attempt was also made to give a synoptic framework of the engineering education in Kerala. The number of engineering colleges in Kerala was very low until 1990, only 9 and all were managed directly by the Government. At present the State can boast of having more than 180 engineering colleges, both in the Government managed sector and privately managed sector catering to the technological needs of Kerala. With the conceptual frame work depicted in this chapter the investigator tried to locate the research studies conducted in the related areas of research which is described in Chapter 3 and investigator formulated a methodology adequate to accomplish the fixed objectives for the study.

Chapter II

CONCEPTUAL FRAMEWORK OF THE STUDY

- *Evolution and Historical Development of Engineering Education*
- *History of Engineering Education in India*
- *Types of Engineering Colleges in Kerala*
- *B.Tech Degree Courses in Kerala*
- *Admission Process - Entrance Examination*
- *Curriculum of Engineering Education*
- *Directorate of Technical Education, Kerala*
- *APJ Abdul Kalam Technological University*

CONCEPTUAL FRAMEWORK OF THE STUDY

In this chapter the conceptual evolution and historical development of engineering education are presented.

Evolution and Historical Development of Engineering Education

Engineering education is comparatively a new area in the field of education. According to Bhattacharya and Maitra (2016) it is a special form of education and training developed to meet the needs of an industrial age by academic education with skill training. It is the activity of teaching knowledge, skills and principles for the professional practice of engineering.

Unlike other types of professional education, engineering education has not had a long history. Even though the engineering profession can be traced back to the earliest time, there were no available records of history about formal engineering education until 1700. The first record available about technical education was at Russia in 1701. The Moscow School of Mathematics and Navigation was the first Russian educational institution in 1701 established to produce sailors, engineers, cartographers and bombardiers to support Russian military (https://en.wikipedia. org/wiki/Engineering_ education).

Another record available about the engineering education was from France in 1747, when a French engineer Jean Rodolphe Perronet started world's first engineering school: Ecole des Ponts et Chaussess (www. britanica.com/biography/Jean-Perronet). Thus French were considered as the leaders in engineering in the 17th and 18th century and also pioneers of engineering education in the world (Kumar and Singh, 2009).

During the Renaissance period, the faculty of Engineering was considered as a part of the faculty of 'Arts'. The period of Industrial Revolution (1750-1850) changed the attitude of the society towards engineering and the people started considering the discipline as 'Science'. During this period Civil, Mechanical and Electrical Engineering have been introduced. During the same period, James watt invented 'Steam engine' (1780) which led the human capacity to generate and handle large amounts of energy for the development. Transformation from human labour and hand tools to large and complicated machineries and the change in transportation from bullock cart and like other ways to railroads and steamship also occurred in the same time (Kumar and Singh, 2009).

The Engineers evolved from two different streams: one stream belonged to artisans and craftsmen from the lowest strata of the less specialised section of the society of the last century. The other stream, from the modern class who had understanding about sciences and had acquired the practice of organised and disciplined thinking. To uplift the capabilities of the less privileged class in handling the new types of machines, School for General Education of Craftsmen and Artisans was established by John Anderson at Glasgow about 1790. Another such school was founded in

London in 1823 by Dr. Brikbech. The Anderson University later became the famous Royal Technical College, Glasgow.

According to Raynolds (1992) different types of Engineering institutions were established in United States of America (USA) at the history of engineering education. The first type appeared in USA Military academy style, the first one among these being the West Point Academy founded in 1802. The polytechnic type Schools of Engineering were the next type. The first school in this category was Gardines of Maine established in 1823, but this did not live long. In 1824, Resslers Polytechnic Institute at Troy in New York was established and it is the oldest surviving technical institute in USA. The Polytechnic College of Pennsylvania started in 1853 offered the first regular curricula and granted the first degree certificate in Mining Engineering and Mechanical Engineering (Grayson, 1980). The University of Virginia started in 1833, awarded the Bachelor of Degree (BA) with Engineering elective. Columbia University was the pioneer in offering Mechanical, Machines and Civil Engineering as part of the 'scientific and literary courses' of study which led to the B.S Degree in 1830 (Issapour & Sheppard, 2015)

The Morrill Act 1862, which allowed the establishment of colleges from the proceeds of federal land sales, gave a tremendous boost to the engineering education in the USA. The number of colleges offering engineering grown from a few (about 4 by some estimate) to one hundred by the turn of the century (Baker, 1900; McGivern, 1960). Starting from 1880, tremendous changes happened in engineering education in USA. One of the important changes was the inclusion of more Science and Mathematics in the engineering curriculum (Marcus, 2005).

In Germany about 1825, the Polytechnic School at Karlsruhe was founded from two older institutions; it was the first of this category in that country. In 1833, the curriculum of that school was changed to call attention to a "high scientific discipline" and the school became basically professional. Germany built up a chain of technological institutes after the Franco-Prussian, which provided for the teaching of all grades of men from craftsmen to researchers and this was mainly accountable for the great industrial and technical superiority of Germany which was noticed through the First World War. The great Technische Hochschule at Charlottenburg, Berlin was founded in 1879 as part of the University, but was later separated from the university for the sake of administrative ease (Universities Quarterly, 1948; Jeba & John, 2009).

The accomplishment of this institution led to the foundation of the Imperial College of Science and Technology in London in 1907. By the terms of its charter, the college stands alone in being specially charged to develop postgraduate studies for their application to industries. It can be concluded that after 1871, technical schools were developed rapidly in Europe and United States to serve the needs of the growing industries that burst into activity at that time (Kumar & Sigh, 2009).

The inclusion of more science in engineering education was realised by the publication of *Report on Evaluation of Engineering education* in 1955.

This report is also known as Grinter Report which stimulated the growth of Graduate Engineering education. *The Presidents Science Advisory Committee* (PSAC) report 1962 entitled *Meeting Man power needs in Science and Technology* recommended to accelerate graduate training in engineering to overcome the severe shortage of engineers and scientists at that time. While retaining the importance of Bachelors Degree in Engineering, the Goals study report of the period 1963-68 entitled *Goals of Engineering Education* recommended considering the significance of Masters Degree also (National Research Council Staff, Engineering Graduate Education and Research, 1985).

The 19th century witnessed the birth of many new branches of engineering in addition to the classical Mechanical and Civil Engineering. Since then, the Engineering education is persistently developing and changing at a fast rate.

History of Engineering Education in India

Technical education is mainly designed for the supply of technically trained man power for industry and economic development of every nation through application of science and technology. The growth of colleges of engineering in America and Europe, providing aspirants with good technical education and special proficiency in Mathematics prompted the rulers of India to establish similar type of technical schools in India. During the colonisation of Britain in India, the rulers of Britain wanted to know about the topography and resources of India through Physical survey. For achieving that the traders of Britain established a survey school at Madras in 1794 to train the Indian workforce in modern land survey and to assist British surveyors in their land survey process. It can be said that though the foundation of technical education was laid almost at the same time that was founded in Europe, the growth of technical education in India was stunted till India become independent (Sen, 1989).

In the year 1802, a School of Surveying was established in the northern region of India at Saharanapur. This school later became the Roorkee College in 1847 and then Thomson College of Engineering in 1854 at Roorkee and in 1949 the status of this college was further enhanced and this became the first Technical University in India (Maitra, 2017). In 2001, the Roorkee Technical University has been given the status of Indian Institute of Technology (IIT).

In 1825, there were indications of technical schools existed in Calcutta and Bombay. These schools were attached to the ordinance factories and other engineering establishments for training artisans and artificers. The need for introduction of occupational education was highlighted in Wood's Despatch 1854 (Sen, 1989). The Roorkee Engineering College was the first engineering college in India and it was established more or less at the time of Wood's Despatch. The main aim of this institute at that time was to train Civil Engineers for the development of Upper Ganga Canal.

The first Industrial School was established at Guindy, Madras in 1842. And then in 1854, a school for training of overseers was established at Poona.

In pursuance/continuation of British Government policy in India and also on the recommendations of Wood's Despatch, three more engineering colleges were established, one each in Bengal (Calcutta College of Engineering), Bombay (Poona college of Engineering) and Madras (Guindy College of Engineering) in 1956 and 1958 respectively. All the three colleges provided almost same pattern of training and later were upgraded to Degree level colleges in Civil Engineering (Sen, 1989; Chopra & Sharma, 2009).

The Calcutta College of Engineering was opened at the Writers Building in November 1856: then the name was changed to Bengal Engineering College in 1857 and this college was affiliated to Calcutta University. In 1865, the college was merged with the Presidency College. Later in 1880, it was detached from Presidency College and occupied the properties and buildings of Bishop's college.

The Poona College of Engineering affiliated to the Bombay University was the only engineering college in Western Presidency. In Madras Presidency the industrial school attached to the Gun Carriage Factory became finally the Guindy College of Engineering affiliated to Madras University. Up to 1880, these three colleges had licentiate course in Civil Engineering.

After 1880 there were a felt need for training in Mechanical and Electrical engineering, but at that time the three engineering colleges were offering only apprenticeship classes in these subjects. The Victoria Jubilee Technical Institute was started in 1887 at Bombay to give training in Mechanical, Electrical and Textile Engineering. In the year 1915, the Indian

Institute of Technology (IIT), Bangalore started Electrical Engineering classes under Dr. Alfred Hey. From the starting itself, the institute began to give certificates and associateships on the subject and the latter being regarded as equivalent to the Engineering degree.

In 1902, at Bengal the leaders of Swadeshi Movement organised a National Council of Education. Many institutions were started under the organisation but only one institute - College of Engineering and Technology at Jadavpur had survived. In 1902 it started Diploma courses in Mechanical Engineering and in 1921, Chemical Engineering.

The Calcutta University Commission debated the pros and cons for the introduction of graduate level courses in Mechanical and Electrical Engineering in Indian engineering colleges. The reasons cited, from the recommendations of the Indian Industrial Commission [1915, under the Chairmanship of Sir Thomas (Holland)] against the introduction of Electrical Engineering courses is given in quotation from the report:

"We have not specifically referred to the training of electrical engineers, because electrical manufactures have not yet been started in India, and there is only scope for the employment of men to do simple repair work, to take charge of the running of electrical machinery, and to manage and control hydro-electric and steam-operated stations. The men required for these three classes of work will be provided by the foregoing proposals for the training of the various grades required in Mechanical Engineering. They will have to acquire in addition, special experience in electrical matters, but, till this branch of engineering is developed on the constructional side, and the manufacture of electrical machinery taken in hand, the managers of electrical undertakings must train their own men, making such use as they can of the special facilities offered for instruction at the engineering colleges and the Indian Institute of Science" (MHRD).

MHRD also reported in the Overview of Technical Education in India that the credit of starting degree class in Mechanical Engineering, Electrical Engineering and Metallurgy belongs to University of Banaras in 1917. After fifteen years, Bengal Engineering College at Sibpur started Mechanical Engineering in 1931, Electrical Engineering in 1935 and Metallurgy courses in 1939. Almost at the same time these courses were also started in Guindy and Poona College of Engineering.

After Independence a large number of engineering colleges were started in India because of the realisation that India has to become a great industrial country. To achieve this, large number of technically competent manpower is required.

Development of Engineering Colleges after Independence

In the year 1947 there were only 44 Engineering Colleges and 43 Polytechnics (including Pharmacy and Architecture Institutions) in India. Due to the efforts and initiatives taken during successive Five Year Plans and particularly due to policy changes of Government of India in the eighties to allow participation of Private and Voluntary Organizations in the setting up of Technical Institutions on self-financing basis, there occurred an uncontrolled growth in the number of Technical Education institutes.

The Sarkar Committee (1945) appointed by the AICTE recommended the establishment of Higher Technical Institutes based on the Massachusetts Institute of Technology (MIT) in India i.e. IITs in order to meet post-war needs of engineers of higher level (Awale, 1996). Based on these recommendations, in 1950, the first IIT was established at Kharagpur. At the time of establishment it was named as Eastern Higher Technical Institute, which was later changed to Indian Institute of Technology in 1951. Six IITs were established in different regions of the India and were declared as Institutes of National Importance by an act of Parliament in 1961; amended in 1966. Those six IITs were established at Bombay (1958), Kanpur (1959), Madras (1960), Delhi (1963), Gowhathi (1999) and Roorkee (2000) (AICTE Hand Book, 2015).

The Planning Commission of India appointed the Engineering Planning Committee (EPC) in 1955 for the overall assessment of the demand and supply position in respect of technical manpower. During the second five year plan period (1956-61), a large number of industrial projects were to be completed. To fulfill the demand of engineering personnel for industrial sector, Indian government decided to start seventeen Regional Engineering Colleges (RECs) in India (Jai Krishna Committee Report, 1974). In the year 2002, MHRD decided to upgrade all the RECs to National Institutes of Technology (NIT). Government also decided to start three new NITs at the same time. The National Institute of Technology Act 2007 passed by the Government of India provided the NITs with complete autonomy in their functioning. As per this Act, all individual NITs are functioning as an Autonomous Technical University and draft their own curriculum and functioning policy (http://Wikipedia.org/wiki/National_ institutes _technology). These NITs are located at 31 different places of India.

The dearth of engineering personnel to meet the needs of industrial and other service sectors was noticed by the authorities at the end of the 5th five year plan. To overcome this difficulty there was a pressure to expand the number of engineering institutes in India. The State Government also decided to start engineering colleges under State Government and Government Aided sector. Besides these some of the states decided to permit private agencies to start engineering colleges in India. The increase of private engineering colleges was significant after 1991 (Rao, 1997).

There has been a tremendous increase in the number of engineering institutes from 110 in 1960 and to 337 in 1990. In the year 2000 the number of engineering institutes was 776. From 2000 onwards, a quantum jump was visible in both the number of engineering institutes and their intake. In 2005, the number of engineering institutes increased to 1346 and further to 3384 in 2013. The intake per institute also increased from 336 in 2005 to 483 in 2013. The total student intake also increased from 3700 in 1950 to 16,34,596 in 2013 (AICTE Hand book 2015; Sharma, 2017).

To fulfill the technical man power needs of India, the Ministry of Human Resource Development (MHRD) in the year 2008 decided to start eight new IITs in different states of India under XI five year plan (www.iitm.ac.in) and those were at Gandhinagar, Jodhpur, Hyderabad, Indore, Patna, Bhubaneswar, Ropar, and Mandi.

Structure of Indian Technical Education System

The structure of technical education in India consists of several sub-systems such as the Central and State Government, Universities, All India Council of Technical Education (AICTE), Professional bodies such as Council of Architecture and the management committees of individual institutions. The umbrella agency, AICTE was constituted by the Indian government in 1948 as an advisory body in all matters relating to technical education. In 1988, AICTE was awarded statutory authority for planning, formulation and maintenance of norms and standards, accreditation and ensuring the coordinated development of technical and management education. The Directorate of Technical Education, the state Universities to which colleges are affiliated and Board of Technical Education are the state government level agencies which deal with technical education. The vast technical education of India comprises of 17 IITs, 20 NITs, state technical universities and a large number of engineering colleges spread across the country.

The Indian Engineering education has a pyramidal structure. Few elite institutions are at the peak of the pyramid. The global excellence in teaching, research and consultancy in the field of engineering are the emphasis of these institutions. In India, Indian Institute of Technologies (IITs) and National Institute of Technologies (NITs) are the elite institutions imparting Engineering Education in India. Only through these elite institutions sufficient number of professionals cannot be produced. The Indian service sectors and industries primarily depend on the graduates of engineering coming from the second and third level institutions: engineering colleges under State Government and Universities of India.

Commissions and Committees on Technical Higher Education in India

The Government appointed different committees and commissions to review the education system of India at different points of time. Commissions are meant to give directions for improvement. After independence there had been several commissions on Technical education appointed by the government for the improvement of technical education in India. The few important ones are discussed here separately.

Sarkar Committee (1945-1949).

Based on the recommendations of the Central Advisory Board of Education (CABE), the Government of India appointed a committee in 1945 to survey the entire question of Indian Technical Education and to make significant recommendations with respect to the Post-War Reconstruction Plan. The chairman of the committee was late Sri. Nalini Ranjan Sarkar. The committee submitted an interim report in 1946. According to the Committee the existing facilities of Higher Technical Education are inadequate, both in quantity and quality. The major recommendations of the committee are as follows.

- Four Higher Technical Institutions should be set up in North, South, East and West zones of India. These institutions should be in the pattern of Massachusetts Institute of Technology, USA.
- To ensure the proper planning of buildings, equipments and courses of the study, principals and heads for the main departments should be appointed for these four institutes and an experienced architect be secured at a sufficient early stage.

S.S. Bhatnagar Committee (1947).

In 1947, the Government appointed a scientific manpower committee called 'S S Bhatnagar Committee' under the chairmanship of Dr. Santi Swarup Bhatnagar. The committee assessed the requirements of scientists, technologists, engineers and doctors to meet the needs of economic and industrial development of India after independence. The committee estimated the ratio between the demand and supply of technical manpower and suggested it to be at 4:1. This was the first systematic assessment of the scientific manpower needs of India (Saha & Ghosh, 2012).

Radhakrishnan Commission (1948-1949).

The commission is also known as University Education Commission, constituted under the chairmanship of Dr. S. Radhakrishnan. The main recommendations of the commission regarding the technical education are,

- More vocational education institutions should be started to reduce the burden of the Universities.
- The curriculum of the 1st year for every engineering discipline should be the same.
- New technological institutes should be started.
- Such institutes should give importance to practical training for engineering students at the concerned industrial centres.
- Provision for higher education and research should be made in the field of engineering.

Mudaliar Commission (1952).

The Secondary Education Commission, under the chairmanship of Dr. A Lakshmanaswamy Mudaliar was constituted in 1952. The commission suggested establishing more technical schools for the improvement of technical education system (Banarjee and Muley, 2008).

Thacker Committee (1959-1961).

Under the chairmanship of Professor M.S. Thacker, in 1959 a committee was formed to study comprehensively the post graduate engineering education and research in India. The report of the committee was submitted in 1961.

The major recommendations were as follows:

- Scholarships should be given to post graduate students to attract candidates of high merit.

- The research and post graduate programmes should be concentrated in a limited number of institutions as there is limited number of qualified faculties.
- To promote the growth of technology, relationship should be developed between academic institutions and industries.
- More employment opportunities should be created for P.G. students.
- Research scholars and PG students should be encouraged to undertake part time teaching.
- Research oriented or design oriented project work should be given importance.
- Masters degree must be the minimum qualification for Ph.D.

Kothari Commission (1964).

The Kothari Commission otherwise known as National Education Commission, formed by the Government of India in 1964. Under the chairmanship of Dr. S. Kothari, the commission submitted its report in 1966. The report submitted had the following recommendations.

- Training in ITIs and Technical Schools must be production oriented.
- Meritorious B.Sc. Degree students should be encouraged to study some branches of engineering such as Electronics and Instrumentation.
- Provisions for practical training to students from the third year with the help of industry should be made in engineering courses.
- Research oriented project works should be included in the curriculum.
- Revise curriculum.

- To attract highly qualified engineering personnel for teaching and research, good salary should be offered.

L.S. Chandrakant Committee (1971).

Under the chairmanship of L.S. Chandrakanth, this committee was constituted to look in to the matter of the postgraduate education and research programmes.

The major recommendations of the committee were:

- The curriculum of PG should be revised.
- The emphasis on laboratory and project work should be increased.
- PG diploma courses should be organized for industry.
- Institutions must be given freedom to start new courses.

Kelker Committee 1976.

The Kelker Committee was constituted in 1976 to evaluate the fulfillment of aims and objectives of Technical Teachers Training Institutes (TTIs) and to suggest further roles of the TTIs in the scheme of Technical education in general and for the purpose of teacher training in particular.

The recommendations of the committee were as follows.

- Introduce modular training programme and short term training programme.
- In modular training of 12 weeks duration, include training in Pedagogy and Industrial training.

- To bring attitude change, special appreciation courses should be arranged for senior personnel.

Nayudamma Committee (1978-1980).

It was a Review Committee on Post Graduate Education and Research in Engineering Technology. The Committee found that the one year PG diploma programmes in engineering were not successful, and forwarded some important recommendations (Saha & Ghosh, 2012).

Major Recommendations of the review were:

- The P.G. programmes should be of 2 years duration.
- Should ensure selection of meritorious and motivated students by All India Graduate Aptitude Test in Engineering (GATE).
- Ensure Industry participation in the course of study.
- Part time PG. programmes should be introduced in the industry relevant area.
- AICTE should be made a statutory body through an act of parliament.
- Ph.D. should be the essential qualification for post graduate teaching.

National Policy on Education (1986).

The main recommendations of NPE with respect to technical education were,

- Technical Manpower Information System should be developed.
- From school stage onwards, programmes on computer literacy should be organised on a wider scale.

- The curricula of technical and management courses should be prepared according to the needs of industry.
- Encourage professional societies to perform their role in the advancement of technical and management education.
- The AICTE will be responsible for planning, formulation and maintenance of norms and standards for technical and management institutions. It will be also responsible for accreditation, monitoring and evaluation, funding of priority areas, maintaining uniformity of certification and accords and ensuring the co-ordinated and integrated development of technical and management education.

Based on these recommendations, the AICTE became a statutory body through an act of parliament in 1987.

Nayudamma Committee (1986).

To review the functioning of IITs of India, the Government constituted a Review committee under Dr. Y Nayudamma. The main recommendations were:

- The student strength of UG and PG courses should be maintained at 1:1 ratio.
- B.Tech level programmes in the IITs should aim at greater flexibilities and ensure a science based engineering curriculum**.**
- The UG and PG programmes should be periodically reviewed to update and modify the courses to match the needs of the country and the development in science and technology.

- Departments should have more flexibility in academics.
- Should have more strict and objective assessment of all faculties. For highly merited people should be given special status and additional 'perks'.

P. Ram Rao Committee (1995-1999).

The PG Review Committee headed by P. Ram Rao submitted its report in 1999. The committee recommended urgent measures to revitalise post graduate education, doctoral programmes and faculty development in Engineering and Technology education. The recommendations were:

- Duration of PG programme to be increased to 21 months.
- Scholarship of PG students should be increased and reviewed periodically.
- To attract motivated and meritorious scholars, attractive fellowship and contingency grant should be given.
- National Doctoral Programme should be started.
- The number of Ph.Ds in Engineering & Technology should be increased to meet the faculty requirement.

Mashelkar Committee (1996-1998).

Based on the recommendation of the Mashelkar Committee, the 17 Regional Engineering Colleges have been converted to National Institute of Technology. This change shifted the control of these institutes from state to centre.

U.R. Rao Committee (2002-2003).

The review committee was set up by Ministry of Human Resource Development in 2002 to review the functioning of AICTE and define its role.

The notable recommendations of the Committee were:

- To control the number of institutions and intake of students, those institutions that do not have enough faculty or infrastructure must be ruthlessly stopped.
- Ph.D holders in engineering should be recruited for the faculty positions.
- Right salary should be paid to staffs.
- For poor students, fees should be reduced.
- Further expansion of UG level technical institutions should not be allowed and approval for new institutions should be stopped for at least for 5 years because UG students' intake exceeds the national average of 350/million population.
- Utilise qualified retired faculties to reduce the faculty shortage.
- Institution and industry linkage should be significant.

P. Ram Rao Committee (2002-2004).

To review the working of Indian Institute of Technology, Government of India appointed a review committee under the chairmanship of Dr. Rama Rao. Some of the recommendations were,

- Retirement age can be extended from 62 to 65 years for selected highly qualified faculties.

- IITs should create a separate Human Resource Unit to check the faculty recruitment and their retention.
- Efficient screening procedure should be conducted for selection of students in research.

Knowledge Commission Report on Technical Education 2005-2008.

On 13 June, 2005, Dr. Manmohan Singh, the then Prime Minister of India constituted the National Knowledge Commission (NKC). Some of the initiatives proposed by NKC are,

- Professionals from industry and research laboratories should be invited to participate in the teaching process in the technical institutions. Institutions should create adjunct positions for them.
- Students who have teaching competency should be indentified at their undergraduate level itself and motivated to take teaching as career.
- Start four year UG programmes in Science along with engineering programme to reduce the gap between Science and Technology.
- To meet the increasing demand, public - private partnership should be encouraged to start more institutes of excellence.
- Increasing the number of faculties by relaxing the criteria of appointing only Ph.Ds for undergraduate teaching.

Dr. Anil Kakodkar Committee (2010-2011).

The Committee was appointed by MHRD to suggest a roadmap for strengthening the financial administrative and academic autonomy of the IITs. The major recommendations were,

1. Increase the number of Ph.Ds to 10,000 by 2020-25 from about 20 IITs.
2. The curriculum should need greater flexibilities to provide greater choices to students.
3. Produce at least 1,00,000 quality engineering graduates/year through the central government institutions of technology.

These commissions and committees made valuable suggestions for the improvement of engineering education in India. Many of the recommendations are still to be followed by many institutions/ bodies.

Development of engineering education in Kerala.

As per records, the first engineering college in Kerala is the College of Engineering, Trivandrum commonly known as CET. The CET started in 3rd July 1939 by Sree Chithira Thirunal Balarama Varma, the Maharaja of Travancore. At the time of establishment it was under Travancore University with a British man named Major T.H Mathewman as its first principal. It offered degree and diploma courses in Mechanical, Electrical and Civil branches, and the initial intake capacity was 21 students in each of these branches.

After the independence of India, a few more institutes were established in various districts of the state. The second oldest engineering college in the Kerala established after independence is the Government Engineering College, Thrissur (GECT). This was the first one to be established after the formation of Kerala State. The foundation stone of the college was laid by the late Pandit Jawarharlal Nehru, the first Prime Minister of India, on 26 April 1958. At the time of its establishment, the college has three undergraduate programs in Civil, Mechanical and Electrical Engineering.

The first engineering college comes under the category of Government Aided Engineering College in Kerala was the Thangal Kunju Musaliar College of Engineering commonly known as TKM College of Engineering, founded in 1958. The college is located at Karikode, 6 k.m. from the city of Kollam in southern Kerala. The college was founded by the TKM Educational Trust, an organization established by Thangal Kunju Musaliar. The college started with 120 students and offering courses in Mechanical Engineering, Civil Engineering and Electrical Engineering under University of Kerala.

NSS College of Engineering, Palakkad is the fourth engineering educational institution established in Kerala and the second engineering college started in the Government Aided category of engineering colleges. It was founded in the year 1960 by Nair Service Society during the second five year plan with the assistance of Central and State Government under Grant-in-Aid scheme. At the time of beginning, the college had offered three degree courses in Engineering - Civil, Mechanical and Electrical & Electronics engineering.

The pioneer engineering education institute in the central region of Kerala is the Mar Athanasius College of Engineering, Kothamangalam established in the year 1961. It is the third and last Government Aided Engineering college in Kerala managed by Mar Athanasius College

Association. The college was started with the intake of 120 students in three branches of engineering: Civil, Mechanical and Electrical Engineering.

In the year 1961, one of the elite institutions in Kerala - the National Institute of Technology, Calicut formerly known as Regional Engineering College, Calicut was established to impart high standard technical education. It is considered as one of the institutes of National importance by the National Institute of Technology Act 2007 passed by the Parliament. Until 1963 it was affiliated to Kerala University after that it came under University of Calicut. The college was started with an intake of 125 students.

After 25 years of gap, the third government engineering college started in Kannur in 1986-Government Engineering College, Kannur affiliated to University of Calicut.

From the establishment of the first institute in 1939 till 1990s, engineering education in Kerala was funded by the government. Most of the institutes were owned and administered by the State; there were three aided institutions as well. After 1990, six Government Engineering colleges also were started. In 1991 Rajiv Gandhi institute of Technology, Kottayam was established. In 1999, four engineering colleges started in four districts of Kerala: Trivandrum, Kozhikode, Palakkad and Wayanad and lastly in 2000, Government Engineering College, Idukki was started.

The demand for qualified engineers started shooting up due to the results of the economic liberalisation policies. By the late 1990s such changes started getting reflected on the education and employment scenario of Kerala as well. However, the intake capacity of government technical education institutions was not sufficient to meet this ever increasing demand for engineering graduates. Consequently, liberalization of technical education in Kerala became an inevitable move. The liberalisation of technical education from 2001 or so, dramatically increased the number of engineering colleges in Kerala (Mani & Arun, 2012).

In 1989 the Government Model Engineering College, Cochin was started. It is the first Self Financing Engineering college under the Government department, Institute of Human Resource Development (IHRD). At first it was affiliated to Cochin University of Science and Technology. Other 21 Institutions were also started under the support of govt. agencies such as Institute of Human Resource Development (IHRD), Co-operative Academy of Professional Education (CAPE), Lal Bahadur Shasthri Centre of Science and Technology and Kerala State Road Transport Corporation (KSRTC).

The first Private Self-financing Engineering College in Kerala is the MES College of Engineering, Kuttippuram in Malappuram district. It was established in 1994 with an intake of 60 students in each branch of engineering - Computer science & Engineering, Electronics & Communication Engineering, Applied Electronics & Engineering and Mechanical Engineering. The MES College of Engineering was established as an institution with minority status and managed by Muslim Educational Society.

More private players came to the picture from late 1990s in the system of engineering education in Kerala. As a result, institutions that offer B.Tech and M.Tech courses grew by leaps and bounds. The number of engineering colleges in Kerala during 1991 was 9, with an intake capacity of about 2,800 students. By the beginning of 2000 it is increased to 33, with an intake capacity of closer to 9,000 students. According to the KEAM (Kerala Engineering Agriculture Medical Entrance Examination) 2013 prospectus published by the Commissioner of Entrance Examination (CEE), today there are more than 150 engineering institutes with approximately 51,000 plus sanctioned seats in various streams. The districts with most number of colleges (more than 20) are Thiruvananthapuram and Ernakulam. Wayanad, is the district with least number of engineering institutes in Kerala, only one.

Types of Engineering Colleges in Kerala

There are a number of institutions in Kerala which can be divided into 5 broad categories as given below based on their mode of administration and funding.

1. Central Government
2. State Government
3. Government Aided
4. Government controlled Self-financing
5. Private Self-financing

Some of these categories can be subdivided based on the governing body that administers the institutions. Let us look at each of these categories in detail.

Central Government Engineering colleges.

Kerala has only one institute that comes under the administration of the Central Government. It is the National Institute of Technology (NIT) located at Calicut. It was formerly known as REC (Regional Engineering College). Admission to B.Tech courses in NIT is conducted through the National level Joint Entrance Examination Main (JEE Main). Students are selected to M.Tech courses based on their GATE qualification/scores.

State Government Engineering colleges.

The State Government engineering colleges are administered by the Directorate of Technical Education (DTE) of Kerala Government. The College of Engineering, Trivandrum (CET) is the oldest (established in 1939) in this category, while the Govt. Engineering College Mananthavady, Wayanad is the youngest (established in 2000). As of now there are nine such institutions with the capacity to enroll about 3,000 students every year for undergraduate courses.

Aided Engineering colleges.

An Aided educational institution is a private one, but is recognized and financially aided by the Government. There are three Government aided engineering colleges in Kerala with an annual intake capacity of about 1,500 students per year for B.Tech courses. These are located at Ernakulam, Palakkad and Kollam districts.

Self-financing Engineering colleges under the control of Government.

Apart from the Government and Aided ones, there are a number of self-financing colleges that offer B.Tech and M.Tech courses. However, not all of them are under private management. Some of them are under the control of Government agencies or organizations. These agencies are:

a. Institute of Human Resource Development (IHRD)
b. Co-operative Academy of Professional Education (CAPE)
c. Kerala, Calicut and Mahatma Gandhi Universities
d. Cochin University of Science and Technology (CUSAT)
e. Kerala State Road Transport Corporation (KSRTC)
f. Centre for Continuing Education Kerala (CCEK)
g. Lal Bahadur Sastri Centre for Science and Technology (LBS)
h. Kerala Agricultural University (KAU)

The seat allotment and fee structure followed by the institutions under this category are different from the others. Admission to undergraduate courses is based on the ranks candidates obtained in Kerala Engineering Agriculture Medical (KEAM) Entrance examination.

Institute of Human Resource Development (IHRD).

Nine institutions are there under the aegis of Institute of Human Resource Development (IHRD). The intake capacity is approximately 765 students every year under various B.Tech courses in these institutions. All of them are affiliated to Cochin University of Science and Technology

(CUSAT), and the courses they offer are recognized by All India Council of Technical Education (AICTE).

Co-operative Academy of Professional Education (CAPE).

There are 8 engineering colleges under the aegis of Co-operative Academy of Professional Education (CAPE), which is an autonomous society formed under the Govt. of Kerala. All colleges are affiliated to CUSAT and recognized by AICTE. The intake capacity is about 1,000 students every year in different undergraduate courses.

State Universities.

Three engineering colleges are established and managed by three universities of Kerala. University of Kerala, University of Calicut and Mahatma Gandhi (MG) University run Engineering institutes which are affiliated to them.

Cochin University of Science and Technology (CUSAT).

Under Cochin University of Science and Technology (CUSAT) three engineering colleges offer different courses in B. Tech and M. Tech courses. School of Engineering inside the main campus in Kochi, and a University campus in Kuttanad, both of which offer B.Tech and M.Tech courses. Another self financing institute of CUSAT is the Kunjali Marakkar School of Marine Engineering in Kochi offering B.Tech course in Marine Engineering. CUSAT conducts a common engineering test for the selection of students for admission in these institutions.

Kerala State Road Transport Corporation (KSRTC).

Under KSRTC, Sree Chitra Thirunal College of Engineering in Trivandrum offers courses in engineering. It has a governing body chaired by the Transport Minister of the State.

Center for Continuing Education Kerala (CCEK).

Center for Continuing Education Kerala (CCEK) is an autonomous body formed by the Govt. of Kerala. The College of Engineering in Munnar administered by CCEK offers both B.Tech and M.Tech courses, and is affiliated to CUSAT.

Lal Bahadur Sastri Centre for Science and Technology (LBS).

Lal Bahadur Sastri Centre for Science and Technology, is an undertaking of Kerala Government. It is headquartered in Thiruvananthapuram. Currently there are two self-financing institutes under LBS. They are Lal Bahadur Shastri College of Engineering, Kasaragod and LBS Institute of Technology for Women, Poojappura (Thiruvananthapuram). The LBS Engineering College, Kasaragod is affiliated to Kannur University and the LBS Institute of Technology for Women is affiliated to Kerala University.

From 2014 onwards all these engineering colleges are affiliated under Kerala Technological University (KTU) except three engineering college undertaken by the State universities of Kerala.

Private Self-Financing Engineering colleges.

These are owned and run by private managements. They can be divided into two broad categories based on the associations that represent them.

Kerala Catholic Engineering College Managements' Association (KCECMA).

12 Engineering institutions are run by the Kerala Catholic Engineering College Managements' Association (KCECMA) in different parts of the state. Those who apply to these institutes should qualify the Kerala Engineering Agriculture and Medical (KEAM) Entrance Examination. Rajagiri School of Engineering Technology is one of the most notable institutions of KCECMA.

Kerala Self Financing Engineering College Managements' Association (KSFECMA).

According to the latest records, there are more than 180 private self-financing engineering colleges in Kerala. They belong to different managements, but an association named Kerala Self Financing Engineering College Managements' Association (KSFECMA) was formed in 2001 to represent all these private self financing colleges. Students are admitted in such institutes both on merit and on management quota. 50 % of the seats are filled from the list of the Commissioner for Entrance Examination on merit and reservation. The remaining 50% seats in engineering are filled by respective managements. Out of this 50% management quota seat 35% is filled by management and 15% is allotted to NRI students. The fees charged by these private institutes are higher compared to others.

Other institutions.

In addition to the above mentioned ones, there are a number of other institutes that offer engineering courses in various streams. Details of such institutions are presented here:

Kerala Agricultural University (KAU).

There are two institutes under the governance and affiliation of Kerala Agricultural University. They are the College of Dairy Science And Technology in Mannuthy, Thrissur and Kelappaji College of Agricultural Engineering and Technology in Malappuram.

B.Tech and M.Tech courses in the departments of CUSAT.

Apart from the self-financing B.Tech courses CUSAT offers other B.Tech and M.Tech courses. These courses are offered by the departments located inside the main campus. Selection is through CUSAT CAT examination.

Indian Institute of Space Science and Technology (IIST).

It is the deemed university for engineering courses in Kerala sponsored by Indian Space Research Organisation (ISRO). It offers B.Tech courses in Aerospace Engineering, Avionics, and Physical Sciences. In addition to these, M.Tech courses, Ph.D. and Post-doctoral facilities are also offered by IIST. Admission to IIST is only through Joint Entrance Examination (JEE).

Amrita School of Engineering.

Amrita Vishwa Vidyapeetham is a multi-disciplinary research university accredited by NAAC. It offers B.Tech programmes at the Amritapuri Campus located in Kollam. The university conducts its own entrance examination for admission.

B.Tech Degree Courses in Kerala

The technical institutions across the state offer various undergraduate courses in different branches of engineering. The most popular B. Tech courses in Kerala are Mechanical Engineering (ME), Electrical and Electronics Engineering (EE), Civil Engineering (CE), Electronics and Communication Engineering (EC), Information Technology Engineering (IT), Applied Electronics and Instrumentation Engineering (AE), Chemical Engineering (CH), Computer Science and Engineering (CS) and Electronics and Instrumentation Engineering (EI).

Apart from these popular courses, undergraduate courses are also offered in other streams such as Aeronautical Engineering (AO), Production Engineering (PE), Industrial Engineering (IE), Mechanical (Automobile) Engineering (MA), Instrumentation and Control Engineering (IC) and Bio-technology (BT).

Few institutions offer some of the rare B.Tech courses: Metallurgy (Amal Jyothi College of Engineering, Kottayam), Safety and Fire (School of Engineering, CUSAT, Kochi), Instrumentation Technology and Naval Architecture and Ship Building (CUSAT Main Campus,Kochi), Food Technology (T.K.M Institute of Technology, Ezhukone ,Kollam), Polymer Engineering (University College of Engineering, Thodupuzha, Idukki), Printing Technology (Calicut University Institute of Engineering and Technology, Malappuram), Food Engineering (Kelappaji College of Agricultural Engineering and Technology, Tavanur, Malappuram), Dairy Science and Technology (College of Dairy Science and Technology, Mannuthy, Thrissur) and Biomedical Engineering (Model Engineering College, Thrikakkara, Ernakulam and T.K.M Institute of Technology, Ezhukone, Kollam)

All India Council for Technical Education (AICTE) and Engineering System

In order to facilitate development and assure quality of technical and engineering education in India and to regulate it, the Government of India constituted an advisory body AICTE in November, 1945 as an apex organization. It made certain rules and regulations to control the institutions so that the standards of engineering education may remain intact. AICTE is vested with statutory authority for planning, formulation and maintenance of norms and standards, assuring quality through accreditation, giving financial support in priority areas, monitoring and evaluation, maintaining uniformity of certification and awards and ensuring coordinated and integrated development and management of technical education in country (Palit, 1998) (www.aicte-India.org).

This body was given statutory status by an act of parliament in 1987. This act made the body more powerful enabling it to control, regulate and standardize all the institutions related to technical, engineering and management. The institutions setup under its guidance are of three types: Government Institutions, Government Aided Institutions and Private Institutions. The rules and regulations made by the AICTE are applicable to all the institutions though in practice it is found that many institutions do not follow them properly thereby making the education substandard. The AICTE is responsible for the approval of all engineering institutions and it monitors the growth of technical education in relation to planned qualitative and quantitative growth and proper maintenance of norms and standards. There are seven statutory regional committees for assisting the AICTE in planning and development of technical education, monitoring and periodic evaluation of approved institutions of the region (Education and National Development Report of the Education Commission, 1970). AICTE constituted National Board of Accreditation (NBA) to accredit and evaluate the institutions according to the norms and standards fixed by this body.

AICTE handbook 2013 states that admission authority/body/ institution shall not permit admissions of students to a technical program which is not approved by the Council. The requirement and eligibility for seeking approval of the council for new technical institutes are mentioned in the guidelines as below.

- A Society registered under the Registration of Societies Act 1860 through the Chairman or Secretary of society or a Trust registered under the Charitable Trusts Act 1950 or any other relevant Acts through the Chairman or Secretary of the trust or a company established under Section 25 of Companies Act 1956 or Central or State Government / UT Administration or by a Society or a Trust registered by them.
- Land requirement for UG programs is 2.5 acres in other than rural places and 10 acres in rural area. For Diploma, 1.5 and 5 acres respectively and for PG 2.5 and 10 acres other than rural and rural respectively. It shall be in one piece and cover hostel area too.
- Building plan of the Institution shall be prepared by an Architect registered with Council of Architecture and approved by the Competent Authority as chosen by concerned State Government / UT.

- Instructional area and Administrative area requirements shall be as per given in the hand book.
- Amenities area requirements as per that given in the handbook.
- Circulation area of 25% of sum of Instructional, Administrative and Amenities area is desired for covering common walkways, staircases, entrance lobby and other similar areas.
- Central Library with Reading Room area requirement shall be based on hand book as per Appendix 4.2.1 and Computer Centre program wise area requirement shall be as per Appendix 4.2.1
- Total minimum funds required: 100 Lakhs as proof of operational expenses.
- New Technical Institutes offering Engineering & Technology program shall necessarily opt for courses from group ‘C’ of courses (Applied Electronics & Instrumentation Chemical Engineering / Technology Civil Engineering / Technology, Construction Engineering Computer Science, Computer Science and Engineering, Computer Science & Information Technology, Computer Technology Electrical Engineering or Electrical & Electronics Engineering Electronics and Communication Engineering Information Technology Instrumentation and Control Engineering Mechanical Engineering Production Engineering)
- The head of the “Technical Institute” shall be named as “Principal” having qualifications satisfying existing norms as defined for Principal in a program of the Technical Institute.
- Requirement of Computers, Software, Internet and Printers, Requirement of Laboratory equipments and Experiments, Requirement

of books and Library facilities for each Program , Requirement of E-Journals shall be as given in the AICTE hand book

- Requirement of essential and desired requirements shall be as given in the handbook. In the hand book marked as essential need to be made available at the time of the Expert committee visit.
- The hand book gave the faculty student ratio for UG courses in engineering technology as 1:15, for PG it is 1:12
- Based on the order No. 37-3/Legal/2012 dated 25.05.2012 (www.aicte-india.org>Bureau-Administration-Rules & Regulations) in all AICTE approved technical institutions in order to guarantee transparency by Technical Institutions imparting technical education, in admissions and with principal objectives of preventing unfair practices and to provide a mechanism to students for redressal of their grievances, AICTE has notified regulation for establishment of mechanism for Grievance Redressal Committee and Ombudsman. In the case of non-compliance of above regulations, shall be called for disciplinary action against any willfully contravenes or continually fail to comply with the provision of above regulation.

For the purpose of applying for Grant of Extension of Approval to existing Technical Institution, the Institution should submit an application for Extension of Approval online in the AICTE Web-Portal www.aicte-india.org

Grant of approvals is based on self disclosure of required facilities and infrastructure availability as submitted online in the AICTE Web Portal.

National Board of Accreditation (NBA)

The usefulness of NBA lies with the concern of developing quality education in the globalized world. Further, it is a process of quality assurance. NBA was constituted by the AICTE, as an Autonomous Body, under section 10(4) of the AICTE Act, 1987 in order to evaluate institutes or function of various programs on the basis of guidelines issued by the body from time to time. The institutes can apply only for accreditation, it's programs are approved by the AICTE and it must have completed at least two batches of students. NBA and AICTE in a way play a positive role to facilitate technical and engineering education throughout India. The accreditation process is very careful and has several inputs such as quality of teaching, level of research, faculty expertise, evaluation of teachers and standard of infrastructure and resources available at the institutions (http:// www. nbaind .org/).

National Technical Manpower Information System (NTMIS)

In order to guarantee planned growth of technical education, the AICTE has introduced a scheme 'National Technical Manpower Information System'(NTMIS) to create a database, to monitor demand and supply of engineering manpower and to make sure deliberate improvement of engineering education. The council has also launched an Early Faculty Induction Program to attract bright engineering students towards the teaching profession while providing them best training (http://www.nitk.ac.in/facility/national-technical-manpower-information-system).

Admission Process - Entrance Examination

Joint Entrance Examination (JEE).

National Institute of Technology (NITC) and Indian Institute of Space Science and Technology (IIST) admits students to their B.Tech courses through the national level Joint Entrance Examination popularly known as JEE. Students who seek admission in NITC should qualify JEE (main). Those who wish to join the undergraduate courses offered by IIST should qualify JEE (Main), and further JEE (Advance).

Kerala Engineering Agriculture and Medical Entrance (KEAM).

Admission to various engineering institutions in Kerala is done through three main entrance tests namely, KEAM, JEE and CUSAT CAT. Kerala Engineering Agriculture and Medical Entrance (KEAM) is a state-level entrance test. Admission to the B.Tech courses in all Government, Aided and Self-financing engineering colleges in Kerala is done through this test. The Commissioner of Entrance Examination (CEE) conducts annually the test in the month of April. Admissions are made on the basis of the marks applicants got in the CEE KEAM entrance examination.

Common Admission Test of CUSAT (CUSAT CAT).

CEE KEAM is not applicable to the B.Tech programmes conducted by CUSAT. Those who wish to join the B.Tech courses in CUSAT will have to qualify CUSAT CAT entrance examination. It is usually conducted in the month of May every year.

Allotment and Reservation of Seats

Govt. of Kerala has prescribed different kinds of seat reservation policies for the Government, Aided and Self-financing institutes of the state.

At the time of admission to engineering college, Government publishes orders. Based on these orders colleges admit students.

In government engineering institutes, 100% admission to B. Tech courses is based only on merit. The admission process is done by the Commissioner of Entrance Examination through Centralized Admission Process (CAP). A fixed percentage of seats are reserved for SC/ST/ and backward classes. In case of Government Aided Colleges, admission is also based on merit in the entrance examination.

The seats in the self-financing engineering colleges controlled by the Government departments are divided into three categories - 50% seats are Government merit, 35% are management and 15% NRI quota. As for Private self-financing colleges, 50% of the total seats are reserved for students under Government merit. The rest of the seats will be filled by the management observing govt. regulations on the matter. NRI students will be allotted seats as per the stipulated guidelines i.e 15%. The admission to seats under government merit will be done observing the reservation policies meant for socially and economically backward classes, SC and ST.

Curriculum of Engineering Education

The education of an engineer extends over a wide range of knowledge; from pure science, and especially what is known as engineering science, to technology. The major portion of the field is covered by the following branches: aeronautical, agricultural, chemical, civil, electrical, industrial, mechanical, metallurgical, mining, geological, and nuclear engineering. There is a great variety and a good deal of specialization in the above branches. A Civil

Engineer may aim at Highway Engineering, Structural Engineering or some other branch, and his/her education will be influenced to some extent by his/her choice. Similarly a Mechanical Engineer may aim at Automatic, Machine-tools, Aeronautical or general Production Engineering; and an Electrical Engineer at heavy current work such as power supply, at light current work such as telephone communications or at work in the field of electronics.

Modern engineering demands a sound training in General Science, particularly in Physics, Mathematics and Chemistry. For certain industries a basic knowledge of Biology is also essential. The relative importance of the fundamental sciences depends on the branch of engineering for example, an Electronics Engineer who wishes to specialize in Communication or Electronics needs an extensive knowledge of Physics and Mathematics, where as for an Agricultural Engineer, training in Chemistry and the Biological Sciences is more important.

Views on engineering education in later half of the 20th century emphasized the need for broadening of the curriculum and for an understanding by engineers of the social implications of their work. It was recognized that (especially in management posts) the ability to deal skillfully with problems of human relations was sometimes as important as technical knowledge.

Directorate of Technical Education, Kerala

In 1954 AICTE made a recommendation for appointing a separate unit of technical education in each state. Based on the recommendation, the Government of Travancore- Cochin created a post of special officer for technical education. In 1957 the Government of Kerala created Board of Technical Education and a separate Department of Technical Education in the state as per the Order ED(F)2-3891/57/EHD dated 4th September, 1957. Based on the same order the state government created a post of Director of Technical Education and appointed Sri. K.C.Chako as the first Director of Technical Education.

The Engineering College, Trivandrum was brought under the department on 1.12.1958. Now under Directorate of Technical Education, there are 12 Engineering Colleges, 49 Polytechnic Colleges, 3 Colleges of Fine Arts, 39 Technical High Schools, 17 Government Commercial Institutes, 42 tailoring and garment making Training Centres and 4 Vocational Training Centres. The two Regional Directorates of this department are functioning at Kozhikode and Kothamangalam. The Department has a Curriculum Development and a Supervisory Development Centre functioning at Kalamassery. Also an Industry Institute Interaction Cell is functioning at the Directorate.

APJ Abdul Kalam Technological University

APJ Abdul Kalam Technological University is a state Government University and has come in to existence on 21st May 2014, envisaging to bring all the engineering colleges in Kerala under one umbrella. Initially the name of APJ Abdul Kalam Technological University was Kerala Technological University (KTU). The aim of KTU is to give leadership to the technology related policy formulations, engineering planning for the state. It also emphasizes to improve the academic standards of Graduates, Post graduates and

Research programs in Engineering Science and Technology. KTU manages and regulates the academic standards of all colleges affiliated to the University. The main thrust areas are Research, Development and Innovations.

Conclusion

This chapter discussed the evolution of engineering colleges in Kerala. The chapter also discussed the historical development of engineering education across the globe, pre independent India and post independent India and observations of various commissions and committees on the different aspects of engineering education. Attempt was also made to give a synoptic framework of the engineering education in Kerala. The number of engineering colleges in Kerala was very low until 1990, only 9 and all were managed directly by the Government. At present the State can boast of having more than 180 engineering colleges, both in the Government managed sector and privately managed sector catering to the technological needs of Kerala. With the conceptual frame work depicted in this chapter the investigator tried to locate the research studies conducted in the related areas of research which is described in Chapter 3 and investigator formulated a methodology adequate to accomplish the fixed objectives for the study.

Chapter III

REVIEW OF RELATED LITERATURE

- *Literature Related to the International Context*
- *Literature Related to Indian Context*
- *Literature Related to Kerala Context*

REVIEW OF RELATED LITERATURE

Every piece of enduring research needs to be associated with the work already done, to attain an overall relevance and purpose. Thus the review of literature grows to be a link between the study proposed and the studies already done. Review of literature involves evaluating reports of research works as well as opinions of different authors related to actual research work proposed to be undertaken.

Since survey of related literature helped us to show whether evidence already available solves problems adequately without further investigation and thus may also suggest the method of research appropriates. It provides a strong theoretical back ground of the study and help the researcher to conduct the research in a fruitful and meaningful manner.

The reviews provided in this chapter are drawn from previous studies generally on technical education and particularly on engineering education. Research literature related to engineering education has been identified and presented under three headings:

1. Literature Related to the International Context
2. Literature Related to Indian Context
3. Literature Related to Kerala Context

Literature Related to the International Context

To improve the retention and graduation rates of engineering students, many interventions have been proposed by several experts. One such intervention is to use study groups for entry level engineering students. These study groups provide a structured environment and a sense of community feeling to students. Luciana, John & Cindy (2018) investigated the impact of such study groups on probability of retention and graduation of engineering students studying for the first year Mathematics course. In the study, students who participated in the mathematics study groups were compared to students of similar academic preparation who did not participated in such groups. The study found that, student participation in study groups is significantly associated with the higher odds of being retained in engineering studies throughout the first 3 years of college.

Mosly (2017) studied the significance of entrepreneurship education in engineering programmes. The study was performed at the college of Engineering-Rabigh Branch of King Abdulaiziz University in Saudi Arabia. Majority i.e. 90% of the participants agreed that the introductory course on entrepreneurship provided them with sufficient knowledge and skills required to establish their future business and it also changed students' mindset and increased their entrepreneurial awareness. The study revealed the importance of entrepreneurship education in engineering students.

Boles and Whelan (2017) explored the factors which influence students’ success in engineering education using a critical review and investigation of the literature combined with findings of case studies conducted at three Australian Universities using focus group discussion. This investigation found that there are many complex factors hindering students' success in engineering. The quality of students' academic interaction, curriculum design & organization, assessment & feedback and learning environment were the factors identified by the study which influence the students' success. The result of focus group discussion revealed that 'with in class environment' and 'on campus social environment' are very important. The study also found that enthusiastic, helpful, organized and approachable faculties are another significant factor which influences the success of students. Connection with industry and practical experiences were the other helpful factors identified by the study.

Chua, Chuatoco, Dela Peña, Jimenez and Co (2017) conducted a study to establish whether participation in extracurricular activities has an influence to the employability of the Industrial Engineering graduates of the University of Santo Tomas, Manila, Philippines. The study established that participation in extracurricular activities have no direct influence to the employability of the graduates. The further analysis also revealed that the soft skills possessed by the graduates who did not participate in any extracurricular activities during their collegiate years have an effect on their employability.

Aguila, De Castro, Dotong and Laguador (2016) conducted a study to determine the present employment status, competencies learned in college and work – related values of the Computer Engineering Graduates of one

Private Higher Education Institution in the Philippines, that contributed to their job placement. The study found that the average employment rating of BS Computer Engineering graduates from 2013 to 2015 is 84.6 percent. The students opined that the most useful competencies that they learned from the college are skills in information technology, problem solving and communication. The students also considered that the work related values that contributed to job placement are perseverance, love for God and hard work. Some of the recommendation of the study are

- The authority may seek the advice of the alumni regarding the latest software application being utilized by the industries to incorporate in the curriculum.
- The university may strengthen its job placement programs and send communications regarding job opportunities for unemployed graduates.
- Enhance the communication skills of the students through intensified instruction of giving enough classroom exercises and activities designed to boost their confidence in both writing and oral communications.

Using the latest Australian national census data, Palmer & Campbell(2016) analysed the form of the professional engineering workforce and the occupational outcomes for graduates of undergraduate engineering programs in Australia. The data showed that the Australian professional engineering workforce is comprised of people with a wide range of educational qualifications, and, even immediately post-graduation, many Australian engineering graduates pursue non-engineering occupations. This study presents important findings for those designing undergraduate engineering curricula that seek to equip students for the best employment outcomes, given the nature of the professional engineering work environment, and the short and long term occupations that engineering graduates actually pursue in Australia.

Myers (2016) for her doctoral work undertook evaluation of admission practices in USA as potential barriers to create equitable access to under graduate engineering education. The author suggested that the engineering colleges need to take bold admission steps such as becoming test score optional, and alternatively relying much more heavily on students' four-year high school academic track records. Changes in admission policies and practices related to engineering colleges' use of standardized test scores could significantly change who gains access to undergraduate engineering, thereby attaining racial and ethnic parity.

Esa, Padi and Hassan (2015) conducted a case study in Malaysian Polytechnics to identify the level of implementation of employability skills by engineering lecturer at the Polytechnic during the process of teaching and learning and the level of employability skills mastered by students as well as the differences that exist. The study found that the level of employability skills implemented by lecturers and mastered by students at the high level and no difference between the level of employability skills implemented by lecturers and mastered by students during the process of teaching and learning.

Meyer and Marx (2014) explored the experiences of four undergraduates who chose to leave engineering and provides insight into their reasons for leaving. For identifying institutional and individual factors that contributed to their decisions to leave, students who recently left engineering were interviewed. Poor performance, feeling unprepared for demands of the engineering program, difficulty fitting into engineering etc are the individual factor contributed to the attrition of students. The study also found that institutional factors also contributed to attrition of students in Engineering.

The efficiency of engineering curriculum in the context of sustainable development and development of social responsibility through elaboration of pedagogical guidelines was analysed by Abrens and Zascerinska (2012) for three consecutive years with 85 student engineers during the Baltic Summer School programme. They have found that the engineering students' social experience and attitude towards environment were positive and the engineering curriculum influences the student engineer learning outcomes. Students' needs were a criterion of efficiency of engineering curriculum in the context of sustainable development.

Ariadurai and Manohanthan (2008) examined opinion of the faculties on the instructional strategies used to teach engineering courses at distance mode in Sri Lanka. The sample comprised of 11 faculty members teaching at Open University of Sri Lanka (OSUL's) using instructional strategy - blended education instruction. The study found that majority of the faculties were not satisfied on the time available and taken for the study, availability and variety of the materials, independent learning skills and performance of the students. Many useful suggestions were offered by the faculty members to overcome these difficulties such as training to be given for self study, change of teaching learning process from teacher centered to learner centered, screening students on their ability to do engineering courses etc.

A study conducted by Brunhaver, Korte, Barle and Sheppard (2011) examined the disjuncture between engineering education and practices. Qualitative interviews were used to collect views of engineering students and new working engineers. The study found that engineering education system does not produce effective and quality graduates with professional skills, organizational knowledge and skills and focuses only on the technical side. Engineers learn these skills only after entering into the workforce. Though the student is exposed to professional skills such as commercial and team work in the educational process, these were not the true representation of actual skills needed for the job.

Mishra (2010) while studying about engineering curricula in the global scenario and the challenges for India, opined that despite the many sporadic curricula reforms, most Indian engineering institutions are falling behind with respect to facing challenges of the 21st century. He observed that this is due to administrative set up, over centralised academic power and rigid regulations that hinder innovative academic practices and student learning. Mishra suggested decentralisation and overhauling of technical education system which will include curricula reforms to improve students' higher level learning.

Ghadban (2007) studied the situation of engineering education in Palestine. The study presents data on the gradual progress of engineering education from 1980 to 1999. The study focused on analysing the aspects such as faculty members, curricula and syllabus, admission policies and students, specialization and sponsorship, buildings and equipments, funding and linkage to society and institutional organizations. The result showed a relative stagnation in the number of faculty compared to the increase in the number of students (the ratio of student : faculty were much lower than the required standards and international criteria), and decline in scientific research. In the case of course and curricula, no serious attempt was seen made to integrate global accomplishment in the field of engineering. It was also noted from the study that students in Palestine join colleges of engineering without being fully aware of the nature of the subjects, the talents required or nature of the profession they will engage. The result regarding the material capacities, buildings and equipments showed an obvious shortage of college buildings.

Prados, Peterson & Lattuca (2005) analysed the impact of Engineering Criteria (EC) 2000 on the quality of engineering education. According to the authors, accreditation has provided quality control for engineering education in the United States for more than 70 years. Despite the fact, by the year 1980s, the accreditation criteria had become increasingly prescriptive, inhibiting development of innovative programs to reflect changing needs of practice. To overcome the issue, ABET (Accreditation Board for Engineering and Technology) and its stakeholders developed revised criteria, which emphasize learning outcomes, assessment, and continuous improvement rather than detailed curricular specifications. To assess the effectiveness of the new criteria, ABET has commissioned a multiyear examination of the impact of EC2000 on U.S. engineering education and found that the revised ABRT EC2000 supports continuous improvement of the accreditation process and positively influences the quality engineering education.

Literature Related to Indian Context

Sankaran and Mohanty (2018) conducted a study to explore the teaching and learning methods currently being practiced by engineering college faculty members and to review the perceptions of the engineering teachers on the teaching-learning methods that would benefit the engineering students. The study was conducted among faculty members of various engineering colleges affiliated to Technical University of Odisha. The study found that the faculty members are not much aware of how problem-based and project-based teaching and learning approaches can benefit their students in the classrooms. The results also revealed that project-based method, group discussion, problem-based method, brainstorming, case study method and role playing are not very popular teaching-learning methods among the faculty members. The majority of faculties responded that they do not practice these methods frequently in their classes. The old chalk and talk method was the most common teaching-learning method that was extensively used by the participants. According to the response of faculties chalk and talk and audio-visual methods are most useful for engineering students.

Maitra (2017) observed that some of the private engineering colleges have started winding up their courses because of lack of demand and decline in the number of students joining the engineering courses. According to the author, 2000 onwards there had been a quantum jump in both the number of engineering institutes and intakes.

Chaudhary (2016) examined the growth of engineering education in the post economic reform period using secondary data published by Ministry of Human Resource Development, All India Council of Technical Education and University Grants Commission. The study found that, there had been a massive expansion in engineering education with respect to the number of institutions and enrolment in engineering. The study also revealed that the massive increase in the enrolment did not coincide with the access to the engineering courses in the case of women and disadvantaged sections of the Indian society such as scheduled castes and scheduled tribes. Another thing revealed by the study was that the public expenditure on engineering education not increased on par with the enrolment rate.

Shukla and Garg (2016) conducted a study to find out the skills of engineering graduates required by the industry. For that a questionnaire was developed on the basis of discussion with industry executives and literature review. Analysis of the 67 responses of industry executives revealed that problem solving skill, designing solutions and ability to conduct investigations of complex problems were the three most important skills valued by the industry personnel and they do not value ethics, synergy between engineering and society, environment and sustainability.

Mohanty and Dash (2016) opined that engineering education in India faces significant challenges as it requires meeting the demands of technical profession and emerging job market and discussed about the preparation of professional engineering educators in India. According to them, nowadays e-learners and online consumers are increasing, so today's educators have to update their digital expertise. The paper stressed that technical faculty should need to learn the innovative approaches to teaching and learning, which consecutively will entail effective professional development for both new and experienced faculties of engineering. To accommodate these changes, they suggested redesigning of curricula and pedagogy and making the pre-service teacher preparation programme mandatory part of technical higher education.

According to Sharma (2015) technical education must reengineer their vision and mission to carryout multinational activities. To withstand the challenges of globalization, all technical institutions must have autonomy for academic, administrative and financial matters. In addition they should encourage partnership with industries, support research consultancy and continuing education in technical institutes. Sharma also stressed that developing linkage and partnership with international agencies is a must for internationalization.

The relevance of technical communication for engineering students in Indian context was discussed by Chetia (2015). He stressed that engineering profession highly depends on communication skills. Engineers must be able to communicate their ideas and design clearly and successfully to their subordinates, co-workers, supervisors and clients. It also pointed out the role of English in technical communication.

Kale and Sapali (2014) observed that only ten percent of aspirants get admission in Government and Aided institutions and remaining ninety percent have to seek admission in Private self-financing engineering colleges. He observed that it was to meet the increasing demand of engineers from various industrial sectors and the low number of available seats in government institutions, a quantitative growth of self financing institutions took place and by this the annual intake capacity increased from four hundred to five hundred students per college. This sudden growth of the number of colleges/ seats resulted in the trend of vacant seats in private engineering institutes. According to this paper only a few students were employable from the pass outs of these private institutions.

Potti, *et al.* (2014) conducted a study to identify the unique practices followed in a few high performing self financing engineering colleges in India. The study first identified some quality indicators through literature review on high performance organizations. The sample was 15 top ranked self financing engineering colleges that were listed out by the magazine Outlook. Structural interviews and discussions with various core groups of stakeholders of these colleges were used to identify the unique practices followed with respect to the quality indicators. Unique practices identified by the study were listed under six headings. The study factors connected with these unique practices with respect to quality indicators are given below.

→ *Organizational governance*: decentralization, faculty involvement, monetary incentives for faculty members, performance appraisal of faculties, skill up-gradation for staff, employers feedback, admission criteria and Alumni involvement.

→ *Members of the faculty*: efficiency of faculty, commitment of faculty and publications.

→ *Students*: transport facility, examination and system.

→ *Facilities*: number of messes, medical facility, hostel facility, availability of learning materials.

→ *Teaching and learning*: number of instructional days, academic research for higher qualification, helping academically weaker students and quizzes conducted on regular basis.

→ *Process:* training of students for placement, entrepreneurial development, consultancy, industrial visits, patents, sponsored research projects, etc. listed in the study.

Gambhir, Grover and Wadhwa (2014) conducted a study to identify the parameters affecting quality in engineering education from the views of stakeholders and also attempted to develop Education Quality Index. Students and parents viewed that Brand name, Cost of Education, Infrastructural Facilities, Students' Academic Results, Placement Records and Faculty Effectiveness are the important factors influencing quality. Employers are more concerned about the reputation of institution, quality of students (knowledge, performance in examination, personality traits of students) and research orientation of the college. The study also analysed the imbalance in engineering education based up on the data from AICTE for the academic year 2011-12. The result showed that more than 90% of intake capacity opens only for ten B.Tech programs and there was a total disorder in the nomenclatures of the courses. The study also found that there is a huge imbalance in terms of number of seats per ten thousand population across States and Union territories and Districts.

Singh and Singh (2014) discussed about the evolution of private engineering education in India. The paper also tried to elaborate the challenges and opportunities of the private engineering education in India. The passing of the Private Universities' (Establishment and Regulation) Bill in 1995 in the Parliament gave boost to opening of many private engineering colleges in India. The paper states that the mushroomed growth of private engineering colleges in India continued with almost every state having at least one private funded engineering college. The authors opined that the main aim of these private institutions is to earn profit and in order to earn profit they are ready to compromise with quality of students, quality of faculties, quality of inputs, administration and stipulated infrastructure. This will result in the low quality output in the form of engineering graduates and this is also projected in the stifled growth of our country's economy.

Students' attrition and retention in engineering colleges of South India was analysed by Hussain and Khader (2014). The study found that, in engineering institutions students are moving from engineering courses to non engineering courses due to lack of interest in engineering courses offered, lack of English knowledge in students and fear about the engineering mathematics. The study also revealed that the move from engineering to a non-engineering discipline does not guarantee a success in the new discipline that is, those students transferring to general studies, are not succeeding in their new major.

Gosavi (2013) explored the present scenario and seat vacancy trend of engineering institutions in India. The primary data was analysed to investigate the reasons for large number of vacant seats in engineering colleges of India. The uncontrolled growth of engineering institutions, primarily due to the participation of private sector was the main reason for the vacant seats, other reasons identified were the poor quality of some of the colleges, poor result, poor placement and lack of monitoring by apex bodies like AICTE/DTE or Universities in ensuring quality. The study also discussed that large number of vacant seats in self financing colleges is threatening the financial viability of these institutions and suggested salient points for eradication of unfair practices in the engineering institutions such as following 100% norms for infrastructure, appointing qualified and experienced faculty, providing facilities like adequate salary and allowances to faculty as per norms, ensuring facilities to students through close monitoring etc. The author also suggested that if the above mentioned actions are not undertaken, the authorities should take decision to close those institutes which do not provide adequate facilities.

Kumar (2013) conducted a study to investigate the impact of managerial policies and rewards or incentives on the motivation of teachers of engineering colleges. The study found that incentives extend the motivation whereas the poor administrative policies diminish the motivation of the teachers. A large number of the teachers are not happy with the managerial policies of their management which is responsible for their low level of motivation and most of them are not motivated and satisfied with their present salary.

Sreejith (2013) observed that quality of the teachers, quality of curriculum and syllabus and problems in the conduct of practical examinations are the main issues in engineering education. The colleges and universities that sacrifice academic standard for immediate tuition gain was another important issue prevailing in technical education.

According to Pandi, Jeyathilagar & Kubendran (2013), the mushrooming of engineering institutions in Tamilnadu has resulted in an enormous number of technical graduates. They have opined that quality technical education is necessary for the survival of the institutions and the delivery of quality engineers will boost the ability to face competition and improve quality in every sphere of business.

Ravichandran, Kumar and Venkatesan (2012) empirically measured the service quality level using the new industry specific scale called HEDPERF (Higher Education Performance Measurement Scale) among engineering colleges of Tiruchirappalli. The study revealed that standardized syllabus & structure, quality programmes, student feedback for progressive measures, empathetic administrative staff to solve students' problems and fair treatment were the dominant variables which can strongly predict the overall service quality.

Jindal and Aggarwal (2011) conducted a study to explore factors for effective delivery of engineering programs in private and public institutes and to analyze those factors to effective teaching. A total of 80 students from engineering institute participated in the study. The data was collected through a questionnaire-cum-interview method from the selected respondents. The analysis has been made on the basis of factor analysis technique. The result indicated that to make teaching effective, use of latest determinant and teaching evaluation are necessary. Student feedback is the most important factor to make teaching effective as per the opinions of students from private institutions. Public college students were of the opinion that timely declaration of the result is most important to make teaching effective.

Sayeda, Rajendran and Lokachari (2010) conducted a study to explore adoption of quality management practices in engineering educational institutions (EEIs) in India from management's perspective. The study was descriptive in nature. A closed ended questionnaire with nominal and interval scale was used to collect data. The study highlighted 27 critical factors or dimensions of quality management. These dimensions were used to analyse the relationship between Institutional Performance and Total Quality

Management (TQM). The study found a positive and significant relation between TQM dimensions and institutional performance. The study identified two critical factors as the key enablers of quality management: healthy innovative practices and feeder institution partnership.

A comparative analysis of the engineering education programs in India under different management styles was done by Viswanadhan (2009). The comparison was based on the score allotted by the National Board of Accreditation, India. Accreditation scores of programmes that have undergone NBA Accreditation during the period 2000-2003 have been collected for the study. The study found that the performance of autonomous colleges were superior to government/aided/self financing colleges.

Kumar and Singh (2009) studied the growth and development of Engineering Education in Punjab after independence. The study followed both qualitative and quantitative approaches. Policy perspectives of engineering education were studied on the basis of the report of various commissions and committees related to technical educations, five year plans and other related documents. The secondary data from all the sources had been pooled to study the trends of growth and development of engineering education at National and State levels separately. To know the view and perception about engineering education, they have collected data from primary sources (administrators, teachers, students, parents, intellectuals and social activists) through interview, and in the last phase case studies of eight engineering colleges of Punjab state. Some of the major findings of the study are:

- The expansion of engineering education has been uneven throughout the country.
- The growth rate of graduates and post graduates in engineering has increased at a faster rate but the percentage of doctorate out-put has decreased in India.
- There is an acute shortage of competent and qualified faculties in the engineering education field.
- There is a huge imbalance between demand and supply of engineers in India.
- No R & D (Research and Development) wings in most of the engineering institutions of Punjab.
- Participation of disadvantaged sections of society (Women, SC's, ST's, OBCs and other economically backward students) in engineering education is not satisfactory.
- The budget allocated to technical education has not been sufficient to cater the needs.
- The unit cost of engineering education in the private self financed institutions is very high.
- The mushrooming of the self financing engineering education institutions leads to the deterioration of quality of engineering education in the State.

Viswanadhan (2008) explored the status of engineering programmes in India by analysing the NBA reports for the period 2000-2005. The paper assesses the performance of engineering colleges in terms of total scores obtained by the under graduate engineering programmes in the NBA accreditation process during the period. The trend identified from the study is that most of the programmes applied for the accreditation process are getting accredited through the revised accreditation process only.

The author has opined that the reason for this phenomenon might be due to the following factors.

- The programmes satisfying the minimum requirements are only applying for accreditation.
- There is a tendency in the NBA expert teams to give accreditation status to all the applied programmes.

From the qualitative analysis it was observed that programmes forwarded for accreditation were good in major physical resources and their managements were committed in achieving their intended goals. The major weaknesses identified by the process were inadequate supporting processes and faculty members.

Kumar (2008) observed that most of the private engineering institutions are not having qualified and competent faculty because they do not provide enough salary. Many of the qualified engineers prefer to serve private companies because they are paid much more than these private institutions in the form of salary and other remuneration.

Shetty (2006) observed that reservation policy of the Government had no negative effect on the quality of engineering education. He also stressed the importance of giving chance to the deprived to display their talents. He underlined that quality of faculty must be the focal point of engineering education.

Dhawan (2004) conducted a study to depict the seat vacancy of engineering colleges. The study found that 2000 seats are vacant in engineering colleges especially in Haryana.

Praveen (2003) discussed that since 1980, there is a real boom in the growth and development of engineering education in India. The increase is not only in the number of institutions but also with the corresponding increase in the intake capacity and out turn rate. At the same time there is significant new courses have also been started. He also observed that the employment opportunities of engineers vary from state to state.

According to Hariharan (2003), the deterioration of the standard of engineering education was primarily due to the shortage of financial input to the system. To improve the quality, the Central and State Government should take the responsibility of financing the system. The engineering institutions and management also have to take steps to release funds by their own way.

According to Srivastav (2003), there is a shortage of faculties in engineering colleges. According to him India will need about one lakh teachers for degree level institutions by 2006. The intake capacity is expanded at a very fast rate but rate of supply of teachers has been extremely slow. According to the study, 75% of Ph.D. holders are working in all the elite institutions like IITs., Technical Universities, 17 Regional Engineering Colleges etc. The study found that many of the faculties of engineering colleges are fresh graduates, very few are post graduates. These teachers are not paid as per the AICTE norms and are appointed on contract basis. There are no qualified paper setters and examiners and in his opinion, the scenario delays publication of result by the universities. All these problems ultimately lead to the poor quality of engineering education.

According to the views of Sharma (2001), engineering education faces many problems such as low quality, lack of practical experience, no interaction with industry, old and defective curriculum, problems related with medium, research, administration & control and unemployment.

Studies Related to the Kerala Context

Dhanya and Kinslin (2016) conducted a study to assess the current status of perceived work life balance among engineering college teachers in Kerala. Sample consisted of 318 engineering faculty belongs Junior level, Middle level and Senior level. From the result, it was found that level of work life balance varies in government, aided and private engineering colleges. The study also found that work family spill over, work family conflict and work family facilitations were moderately perceived by the faculties of engineering colleges in all the three categories and also no significant variation between male and female faculty. The study also proven that support from the organizations of employees can reduce work family conflict.

Jestine and Sornam (2016) analysed the awareness and availabilities of e-resources in engineering college libraries in Kerala. A well structured questionnaire was distributed among 66 librarians of engineering colleges in Kerala. The result showed that awareness of librarian about various e-resource packages was extremely good and availability was also good but membership in consortia, subscription and infrastructure with respect to e-resource were not up to the mark.

Rahman and Unnikrishnan (2015) have discussed the issues and challenges faced by the technical education sector in Kerala and its future prospects. The authors observed that intake capacity of technical institutes increased and at the same time many seats in technical education institutes in Kerala are vacant.

Paulachan and Gopal (2014) conducted a study to measure the impact of organizational culture and performance on social acceptability of private self financing engineering colleges in Kerala and Karnataka. Questionnaires, interview schedule and direct personal interviews were the tools used for the study. Students, faculties and head of the institute comprised of the sample. The study found that self financing colleges of Karnataka show better organizational culture and better organizational performance. The study also found that organizational culture has high positive correlation with organizational performance and social acceptability. The study found that Kerala stands lower to Karnataka.

Sandhya, Chand and Rajesh (2016) conducted a study to analyse the employee retention rate in self financing engineering colleges of Kerala. The data were collected through an online survey among members of faculty holding different ranks in self financing engineering colleges of Kerala. A structured questionnaire was used for data collection. The analysis found that salary is an important factor determining the employee turnover ratio. Gross salary, total year of experience, work location and service in the current institution have significant relationship with employee's retention.

The electronic information behaviour of engineering faculty members of Kerala was explored by Pradeep and Francis (2014). A structured questionnaire was distributed to collect data from government engineering college faculties. The study found that the faculty member use electronic information mainly for updating knowledge and for preparing teaching materials. The faculty members needed e-journals, e-books, social networking, online tutorials etc for the purpose. The study also found that all the engineering faculties have skill for internet use but only a few percentage of faculties have skill for programming. From the study it was also revealed that faculty members possessed sufficient skills for using social networking sources and other internet facilities.

Rajasenan (2014) conducted a study on Gender Bias and Caste Exclusion in Engineering Admission in Kerala. According to the author, the major problems of the engineering entrance examination is the exclusion of certain sections of the society in social, economic, regional and gender dimensions. The study focused on two aspects of exclusion based on engineering entrance examination; gender centred as well as caste-linked. Data were collected from the Nodal Centre of Kerala functioning at Cochin University of Science and Technology under the National Technical Manpower Information System and also estimated from the Centralized Allotment Process. Rajasenan concluded that social status in society coupled with economic affordability to quality education seemed to have significant influence in the performance of students in the Kerala engineering entrance examinations. The study also revealed that there is wide gender disparity with respect to performance in the high ranking levels irrespective of social groups.

Pillai, *et al.* (2013) analysed the opinions of teachers about the essential quality characteristics of a good engineering college teacher. Opinions were collected through survey conducted among the teachers of the engineering colleges in Kerala who belongs to different disciplines to rate the importance of different attributes about the characteristics of engineering college faculties. The relative importance of the characteristics in the teaching learning process found out in the study in a structured way using the multivariate decision making technique Analytical Hierarchy Process. The result showed that attitude, skill and knowledge were the indispensable domain of an engineering college teacher. Subjects knowledge and communication skills were found be the most important attributes. The study also proposed that accountability to the teaching profession, management ability and responsibility to the society are less important for teachers with inappropriate attitude.

Kumar, Prasanth and Sundaram (2013) studied campus placements in Kerala with respect to engineering colleges. Primary data was collected from engineering college students using questionnaires. The secondary data was collected from government record, official records other than government record, textbooks, journals and internet portals. The authors argue that fundamental skills acquired by the students at the school level and the extracurricular activities such as technical events, arts, sports and games at later stages of their education have an overall impact in shaping the career and overall personality development of students. The study revealed that there is significant relation between occupation of guardian and students level of interest in campus placements. It is also inferred by the study that there is an association between the percentages of mark obtained by the students with number of placement drives. Another important factor identified from the study was the medium of instruction by the teachers. It has an impact on students' ability in expressing their ideas in campus selection process.

Prasanth, Kumar and Sundaram (2013) conducted an empirical study to find out the impact of age group, educational qualification, experience, extend of participation of faculty members and impact of career development programmes on the quality of teaching. Data comprised of primary and secondary data. Primary data collected from 110 faculty members of engineering colleges using schedule. Secondary data collected from various government records, web portal of department of technical education, other official records, journals and textbook. The result of the study revealed that majority of the faculty of engineering colleges belongs to thirty five years and their basic qualification was B.Tech. The study found that the most popular career development tool utilized by faculty members in the field of engineering is attending seminars but there was reluctance from the part of faculty members of engineering colleges in participating career development programmes. The authors suggested that all stakeholders of engineering education must introspect and try to prevent the quality erosion in all respects.

Kumar and Khadir (2013) conducted a study to evaluate the level of teaching effectiveness attributes and to find out the attribute that most contributes to teaching effectiveness of self financing engineering college teachers of Kerala. The study found that there is a lack of team effort, teaching efficiency, class room behavior and commitment to the profession. All the teaching attributes and teaching effectiveness of teachers were medium in self financing engineering colleges.

The authors suggested the following measures to improve the performance of teachers and thereby increase the quality of education and students.

- The teachers in each department should coordinate their academic activities for enhancing the performance of the overall institute.
- The management should conduct interdepartmental competitions annually for the teachers that help to improve their team effort and coordination.

- Teachers should be provided mandatory and sufficient training to use appropriate pedagogy in the class room and thereby enhance their classroom behavior.
- All the teachers must update their knowledge by working on research papers or participating in conferences and workshops which in turn will make them competitive and enhance teaching efficiency.
- Teachers should give students multiple informal opportunities to give feedback throughout the semester, thus practicing their feedback skills.
- Include education stakeholders in decisions regarding teaching effectiveness
- Teachers need to be assured that ratings are a formative method of evaluation and that assistance to improve their teaching will be made available to them.

Mani and Arun (2012) conducted a study to analyse whether the increase in enrolment in engineering has resulted in the actual supply of engineers. According to authors there has been significant increase in the engineering degree programmes and enrolment rate in Kerala. The study found that actual outturn rate have been steadily declining and especially since 2004. This decline was observed both at aggregate level, across different branches and across different colleges. The study concluded that liberalisation policies has not brought in the expected benefits, that is many students who gain admission to engineering colleges do not have the basic talents, which can be built only by improving school education. The authors suggested that long-term public investment in schools and in higher education is the only solution to the question of capable students and shortage of quality teachers. They have also pointed out that managements of the institutions are forcing governments to change policies so that they get more prey to fill their vacant seats. Demand for reducing the minimum qualification is an example. These institutions only care about intake and fees obtained and not their output.

Jose and Mani (2011) conducted a study on industry requirements for competence of engineering graduates. The study adopted cluster sampling with engineering students, students selected on campus interview and employed category. The study found that there exists a skill gap at varying lengths between industry needs and the competencies of the engineering graduates. Engineering graduate belongs to different categories do not differ in their competence and emotional intelligence. They proposed that the academic institutions should act as the binding force to fix the skill gap and the level should be initiated from the School Schedule and this can be done through finishing school programs.

Archana and Kabir (2010) studied web presence of the engineering colleges in libraries of Kerala. This study conducted to analyse the presence and presentation of libraries of engineering colleges in their respective websites. A set of criteria were developed by the investigators for the analysis of the websites. On the basis of the result, library websites were ranked. The study revealed that majority of the websites of engineering colleges in Kerala has least representation of their respective libraries. Another important observation of the study was that even the highest scoring libraries satisfy only half of the criteria listed for analysis.

Azeez and Bavakutty (2007) conducted a study to develop library consortium for engineering colleges in Kerala and also analysed the status of engineering college libraries in respect of availability of resources, their financial position automation and application of information technology, provision of electronics resources etc. Data was collected from chief librarians and users of library. Some of the useful findings of the study are:

- 21.42% engineering college libraries in Kerala were research level institutions.
- Students of government engineering college libraries are making use of their libraries more when compared to aided and self financing colleges.
- Large majority of librarians opined that library resources were properly utilized by the users' community.
- A good number of engineering college libraries in Kerala does not have enough budget to meet their requirements.
- Majority of the libraries of engineering colleges in Kerala have fully classified, catalogued their collection.
- Majority of users are satisfied with library services.
- Majority of users of all categories of engineering colleges in Kerala are not satisfied with the provision of interlibrary loan, internet and speed of internet and also on the electronics resources availability.

- Lack of trained professional staff is considered as one of the major barriers in formation of a consortium of engineering college libraries in Kerala.

Sivasanakaran, Ravindran and Babu (2004) from the Integrated Rural Technology Centre (IRTC) conducted a project for Centre for Developmental Studies (CDS) to ascertain the failure rates and wastage among the students of engineering in Kerala, to identify the reasons for failure, including systemic defects and to suggest remedial actions. They have observed that students with very low score in the entrance test get admission to engineering colleges because of the peculiarities of entrance test and the phenomenal increase in the number of engineering colleges. Also that a high number of students fails to clear their early semester examinations, even then they study all the semesters without passing any subjects. So the weaker students have dozens of back-papers.

The study identified that the majority of incompletes were admitted in Quota seats and also were admitted late in to the first year classes. The study warns that admitting students with very low ranks in entrance examination and low marks in mathematics could result in an unacceptable high level of wastage. They recommended the following points to remedy the situation.

- Enforcing the 'Year out' rule before admission to every odd semester
- Stipulation of a cutoff score for qualifying and entrance examinations which should be enforced for all types of communities' and other quota (management, payment etc) reservation students.

Conclusion

The intensive review of literature reveals that there are few studies related with engineering education. Here only the most relevant studies on the topic under study are documented. The common points raised by many of the researchers include the following:

- There has been an unusual expansion in the number of technical institutions especially engineering institutions in India due to the introduction of private sector in the field of technical education.
- Due to this type of unscientific expansion, the quality of technical education became low.
- A lot of seats are being kept vacant in the engineering college managed by the private sector.
- Shortage of qualified and experienced teaching force is another problem pertaining to technical education.
- The low percentage of pass outs, low employability of graduates, low number of placements are some of the problems faced by the students.

During the review the researcher did not come across any significant studies on engineering colleges in general nor any attempts to assess the availability of infrastructure, human resources, financial resources and planning, organization & transaction of curriculum of engineering colleges in Kerala. All these factors call for an in depth study on engineering colleges in general and facilities and problems of engineering colleges in specific.

Chapter IV

METHODOLOGY

- *Design of the Study*
- *Sample Used for the Study*
- *Tools and Technique used for the Study*
- *Procedure Adopted for Data Collection*
- *Scoring and Consolidation of Data*
- *Statistical Technique Used*

METHODOLOGY

The methodology is the detailed description of procedures or techniques adopted for a research study. The purpose of the present study is to analyse various aspects of the Engineering colleges in Kerala. The details of design of the study, tools and techniques, data collection procedure, scoring and consolidation of data and statistical techniques used are described under different sub headings in this chapter.

Design of the Study

Design of the study refers to plan and structure of investigation used to obtain answers to research questions. The investigator tried to collect pertinent data on engineering colleges in Kerala from different sources. For an accurate evaluation and analysis of engineering colleges in Kerala only one type data was not adequate. Creswell (2006) stressed that the use of qualitative and quantitative approaches in combination provides a better understanding of research problem than either approach alone.

According to Patton (1990) qualitative method consists of three kinds of data collection:

- In-depth open ended interviews
- direct observation and
- written document.

The data from interviews consist of direct quotations from people about their experiences, opinions, feelings and knowledge. The data from observations consist of detailed description of people's activities, actions and full range of interpersonal interactions and organisational process that are part of observable human experiences. Document analysis in qualitative inquiry yields excerpts, quotations, or entire passages from organisational, clinical or programme records; memoranda and correspondence; official publications and reports; personal dairies; and open ended written responses to questionnaires and surveys.

According to Patton (2002), qualitative researchers approach their data with a unique case orientation. That is, each case is unique and must be treated accordingly. Patton also described *context sensitivity* of qualitative data analysis as it cannot be completely detached from the theme of qualitative data. The reason that the data collected through the qualitative method are so powerful that they are sensitive to the historical, social and temporal context in which the qualitative data were collected. Because something occurs in one setting such as in a class room at a particular time and at a particular school does not mean that similar occurrence should be expected in another place or even in the same settings at another time.

Best and Khan cited Patton to describe the interpretation of the qualitative data analysis as, "interpretation involves explaining the findings, answering "why" questions, attaching significance to particular results and putting patterns in to an analytic frame work. It is tempting to rush into the creative work of interpreting the data before doing the detailed, hard work of putting together coherent answers to major descriptive questions. But description comes first. The discipline and rigor of qualitative analysis depend on presenting solid descriptive data in such a way that others reading the results can understand and draw their own interpretations".

According to Best and Khan a single survey will often contains items that provide for qualitative responses and also questions those results in quantitative data. The study is an attempt to analyse the engineering colleges in Kerala. The questionnaire prepared for this study has both quantitative and qualitative questions. In addition to this questionnaire, document analysis and unstructured interview were also used. Through the interview the experiences, knowledge and opinions about the engineering colleges were collected and analysed. For document analysis official publications and reports, news paper reports and open ended written responses to questionnaires were used. In the quantitative part, the closed type responses to the questionnaires were analysed. As this study follows both qualitative and quantitative approaches, it comes under mixed method research.

For making the study in-depth, data is to be collected through multiple approaches. This enables the cross checking of the data which in turn enhances the reliability and minimises the subjectivity. So for the better understanding of the research problem the investigation demands a mixed approach. In mixed method research the researcher deliberately combines or integrates qualitative and quantitative approaches as component of the research (Ponce and Pagán-Maldonado 2015). According to Creswell the mixed method research focuses on collecting, analysing and mixing both qualitative and quantitative data in a study or series of studies.

The study was carried out in two phases and so the report of the study is presented in two phases.

Phase I

The aim of the phase 1 is to analyse the current scenario of engineering colleges in Kerala. This phase describes, infers and interprets the existing conditions of engineering colleges in Kerala. The study principally concerned with the conditions of the colleges during the years from 2013 to 2016, although past and present events and their influences were also taken in to consideration as they related to conditions originally intended for the study. The methodology adopted for this phase was document analysis.

The following documents were analysed by the investigator as the sources:

- Economic Review Reports of Government of Kerala
- Documents from the website of Kerala Technological University (Result analysis of B.Tech 2015-16)
- Documents from the website of All India Council of Technical Education (AICTE) (Statistical reports of intake, enrolment, passed and placed students of engineering and technology courses of Kerala)
- Websites of Kerala Entrance Commission
- News paper reports about the engineering colleges in Kerala

The following aspects of the engineering colleges in Kerala were analysed from the above mentioned documents:

- growth in the number of colleges
- courses offered
- details of accreditation of courses
- intake capacity and enrolment from 2013 to 2016
- vacant seats
- number of vacant seats during the academic years from 2013 to 2016
- percentage of pass for the academic year 2016 - 17
- details of placement

Phase 2

The facilities and problems of engineering colleges in Kerala were analysed in this phase. The investigator selected the engineering colleges in Kerala for the study and appropriate representation was given to each category of population in selecting the sample. Data was collected from principals, faculties, students, parents of engineering students and engineering graduates using questionnaire.

In the concluding phase, analytical derivatives of the existing conditions of engineering colleges in Kerala were done. The conditions were examined with respect to the stipulations laid down by the AICTE as detailed in their hand book. The responses of academicians, activists, policy makers and other personalities related with engineering education in

Kerala collected through unstructured interviews were also considered to arrive at conclusions.

Sample Used for the Study

The selection of sample is a prerequisite for the success of any study. The sample selected should exhibit all the properties of the population it represents. The population of the present study was the engineering colleges in Kerala.

There were a total of 159 engineering colleges in Kerala in 2013, when the study was undertaken, as listed below:

- 9 colleges under the direct control of State Government
- 3 colleges under the Aided sector
- 141 colleges under Self Financing scheme (25 Government sponsored + 116 Private management)
- 1 National Institute of Technology (NIT) under Central Government
- 2 colleges under Kerala Agricultural University
- 1 college under Cochin University of Science and Technology
- 1 Indian Institute of Space Science and Technology college
- 1 Amrita School of Engineering

This is further elaborated in the Table 2

Table 2

Engineering Colleges in Kerala under Different Managements

Sl. No.	Engineering colleges			Total No.
1.	Fully owned by Government			9
2.	Government Aided			3
3.	Under Kerala Agriculture University (KAU)			2
4.	Government sponsored self financing colleges under:			25
	a.	Institute of Human Resources Development (IHRD)	9	
	b.	Kerala State Road Transport Corporation (KSRTC)	1	
	c.	Co-operative Academy of Professional Education (CAPE)	9	
	d.	Centre for Continuing Education Kerala (CCEK)	1	
	e.	Lal Bahadhur Sasthri Centre for Science & Technology (LBS)	2	
5.	State University			
	a.	University of Kerala	1	
	b.	University of Calicut	1	
	c.	Mahatma Gandhi (MG) University	1	
6.	Private self financing colleges under:			116
	a.	Kerala Catholic Engineering College Managements' Association (KCECMA)	12	
	b.	Kerala Self Financing Engineering College Managements' Association (KSFECMA)	104	
7.	Cochin University of Science and Technology (CUSAT)			1
8.	National Institute of Technology (NIT) Central Government			1
10.	Indian Institute of Space Science and Technology			1
11.	Amrita School of Engineering			1
	Total			159

In 2014, the State Government established a separate governing body to bring all the engineering colleges in Kerala (except those under State Universities) under one umbrella: APJ Abdul Kalam Technological University of Kerala. Initially it was named as Kerala Technological University and was established on May 21, 2014. The University at the time of its establishment had 9 Government engineering colleges, 3 Government Aided engineering colleges and 146 Self financing engineering colleges affiliated to it.

Sample Selected for the Study

Studying the entire population is not practicable because the population is distributed throughout the state and data collection will be tedious in terms of time and effort. It was then decided to use a representative sample from the population. The investigator made all attempts to ensure the representation of engineering colleges run by the three main agencies while selecting sample (Government, Aided and Self financing). The districts selected for the collection of data were Malappuram, Kozhikode, Kasaragod, Thrissur, Palakkad, Eranakulam, Kollam and Trivandrum.

Technique of Sampling

As the population consisted of a large number of colleges belonging to different strata with respect to type of management, the investigator adopted stratified random sampling technique for collecting data from principals, faculty members and students. In the case of B. Tech graduates and parents of engineering students, the investigator adopted simple random sampling technique. The sample comprises the following categories

1. Principals of engineering colleges in Kerala

2. Faculties of engineering colleges in Kerala

3. Students of engineering colleges in Kerala

4. Graduates of engineering colleges in Kerala

5. Parents of engineering students of Kerala

The sample representation is given in the Table 3

Table 3

Distribution of Samples

Samples	Government	Aided	Self financing	Total
Principals	4	1	25	30
Faculties	43	22	119	184
Students	80	60	300	440
Graduates		50		
Parents		50		

Tools and Technique used for the Study

The following tools were used for the collection data for the present investigation

1. Questionnaire on Engineering Colleges to Principals (Musthafa & Surekha, 2014)
2. Questionnaire on Engineering Colleges to Faculty Members (Musthafa & Surekha, 2014)
3. Questionnaire on Engineering Colleges to Students (Musthafa & Surekha, 2014)
4. Questionnaire on Engineering Colleges to B.Tech Graduates (Musthafa & Surekha, 2014)

5. Questionnaire on Engineering Colleges to Parents of Engineering Students (Musthafa & Surekha, 2014)
6. Unstructured Interview was also used as supplementary tool for collecting data from experts social/media activists and stakeholders.

Before preparing the tool, the investigator studied available documents related to the present study and discussions were made with experts in the field of engineering education. For the preparation of tools, the investigator followed the AICTE Approval Process Handbook 2013, Manual for accreditation of undergraduate engineering programmes of National Board of Accreditation (NBA), Directorate of Technical Education Hand Book; Kerala State, The article: The Skills, Attributes and Qualities of an Engineer from, "Encouraging Lifelong Learning by means of a Web-based Personal and Professional Development Tool", by Maddocks AP, Dickens JG, Crawford AR (2002).

The AICTE hand book had given a detailed description of facilities required for running an engineering college. Many other sources like news paper and other media reports, magazines and periodicals were also perused for the preparation of tools.

1. Questionnaire on Engineering Colleges to Principals

The investigator developed the questionnaire for collecting the responses of Principals of engineering colleges regarding the facilities and performance of engineering colleges. Open ended questions were also included for reporting their suggestions for improvement of conditions of engineering colleges in Kerala.

Questions/ Statements regarding the following aspects were included in this questionnaire.

1. General information
2. Managing agency
3. Infrastructure facilities
4. Human resources
5. Availability of financial resources
6. Planning and organisation of the curriculum
7. Transaction of the curriculum
8. Examination and certification
9. Suggestions for improvement

Number of items, nature of items and response patterns followed for each item of the above aspects are described below. These areas are presented in the tool in different sections and subsections.

General information.

A total of five items were given to get the general information like name of engineering college, district in which the institute is situated, year of establishment, whether the college is recognised or not and type of management.

Section A - Infrastructure and Instructional Facilities .

The aim of this section is to get an overall picture about the physical and infrastructure facilities of engineering colleges in detail. A total of 35 main questions under which sub questions also were prepared for this section. The investigator made use of the AICTE handbook for framing items regarding the infrastructure facilities like class rooms, laboratories, workshop, seminar hall, drawing hall, computers, library, hostels, student resting rooms, physical exercise rooms, canteen etc. available at the colleges. The hand book gives detailed description of minimum requirement to start an engineering institution in India. The hand book also details essential and desirable requirements for running a college. Essential facilities are stand alone language laboratory, potable water supply, electric supply, sewage disposal, fax, telephone, website, barrier free built environment, fire and safety & other safety measures, general notice board, first aid medical counselling facility and grievance redressal committee. The desirable requirements are back up electric supply, public announcement system, post /ATM /bank facility, CCTV, insurance for students, display of courses in front of the college, staff quarters etc. Items are both yes/ no type and open ended.

Class room.

The first two items were prepared to collect the data regarding class room facilities of engineering colleges. The first one was yes or no type and constructed to know about the availability of class rooms and the second one was an open ended question intended to collect views regarding the limitation of class room facilities available in the engineering colleges.

Laboratory.

Three items of yes/no type were prepared for collecting information regarding availability of adequate number of laboratories, adequacy of equipments and satisfaction on laboratory facilities of engineering colleges. Fourth one was free response type for reporting the limitations of the laboratory facilities.

Workshop.

Three questions of yes/no type were prepared to know about workshop facilities of engineering colleges like the availability of workshop, adequacy of equipments in the workshop, additional workshop if any and satisfaction on the availability of workshop facilities. The fourth item was constructed to know about the views and limitations of workshop facilities of the engineering colleges.

Seminar hall & Drawing hall.

A total of four items were included to get information regarding seminar hall and drawing hall facilities of engineering colleges. Two items were of yes or no type and the other two were free response types.

Computer.

To collect details regarding the availability of computers at engineering colleges, 9 items were included. Eight items were yes or no type and the ninth item was free response type. Items were constructed to check the availability of departmental computer room, central computing facility, adequacy of number of computers, internet and wi-fi, printers including colour printer, central photocopying in computer room, and satisfaction on computer facilities of engineering colleges. The open ended question was to know about the limitations regarding computer availability of engineering colleges.

Miscellaneous.

A total of 8 items were presented to get information on Student resting room facility, Physical exercise facility, Student hostels, Canteen facility and Rooms for faculties.

Library.

To get information regarding the availability of library facility, 18 items were included. The first 10 items were yes or no type given to collect information about the availability of Central library, Department library, e-journals, multimedia PCs, computerised indexing, reading room seating, reprographic facility, document scanning, document printing and NPTEL facility in the library. Apart from the two columns for marking yes/No, one more column was given to write the limitations of library facilities of the engineering colleges in Kerala.

Four items dealt with the number of books, number of reference books, number of national journals and number of international journals. Two items were included to collect information regarding the number of cards given to the students and faculty members.

Essential requirements.

AICTE has stipulated some essential requirements for running an Engineering institution. Based on AICTE handbook 2013, all engineering colleges should make available the listed essential requirements. The Language Laboratory is used for language tutorials. These are attended by students who voluntarily opt for Remedial English classes. Lessons and exercises are recorded on a weekly basis so that the students are exposed to a variety of listening and speaking drills. This especially benefits students who are deficient in English and also aims at confidence-building for interviews and competitive examinations. The Language Laboratory sessions also include word games, quizzes, extemporary speaking, debates, skits etc. These sessions are complemented by online learning sessions which take place in the Multi - Purpose Computer Lab. This Lab shall have 25 Computers for every 1000 students).

Potable Water supply and outlets for drinking water at strategic locations, Electric Supply, Sewage Disposal, Telephone and FAX, Institution web site, Barrier Free Built Environment (Barrier Free Built Environment for disabled and elderly persons including availability of specially designed toilets for ladies and gents separately), Safety provisions including fire and other calamities, General Insurance provided for assets against fire, burglary and other calamities, General Notice Board and Departmental Notice Boards, First aid, Medical and Counselling Facilities etc are the essential requirements that should be available in the Engineering colleges. Fourteen yes or no type items were included in the tool to get information regarding essential requirements of engineering colleges.

Desirable requirements.

To seek information regarding desirable requirements seven yes or no type items were included. An open ended item was constructed to collect information about any other limitations regarding infrastructure facilities.

Section B - Human resources' availability

One of the objectives of the study is to examine the availability of human resources at engineering colleges. So the items in this section were constructed to obtain information regarding the availability of faculties, technical staffs, librarians and non teaching staffs in each college.

Section C - Financial Resources.

Items of this section were constructed to get information about the availability of financial resources for engineering colleges. Six items were constructed under this section, each with a specific purpose. Items were constructed to collect information about the agency rendering financial assistance to engineering colleges for its smooth functioning, details regarding the amount spent during the last academic year and proposed for the current academic year on various items and financial problems that affect the functioning of engineering colleges

Section D - Parent Teacher Association (PTA) , College union and Alumni association

Items of this section were constructed to seek information regarding the Parent Teacher Association (PTA), College Union and Alumni

Associations of engineering colleges. A total of 9 items were given under this section.

Section E- Planning, organisation and transaction of the curriculum.

Planning and organisation of the curriculum.

In this section the investigator prepared a total of 3 items, for getting information on the authority that does the planning, organisation and designing of the curriculum, the participation of principals and faculties of engineering colleges in curriculum planning and the effectiveness of curriculum in preparing the student for the job market.

Admission procedure.

Three items were prepared to get information about admission procedure of engineering colleges. First item was free response type regarding the minimum qualification details for admission and the second was to know about aptitude test. The last item was to know about the limitations of admission process.

Curriculum transaction.

Working days and hours of instruction.

In this section the investigator prepared six items. The first 4 items were free response type and included to get information about the total number of working days, working days taken to complete all admission, number of teaching days and practical hours. The fifth item was constructed to collect response about the adequacy of working days to complete all the curricular and co curricular activities and it was yes or no type. The sixth item was an open ended question to get views about the adequacy of working days and hours of instruction in engineering colleges.

Internship.

Internship is an important activity in engineering education. It gives a good practical exposure to students. Four items were prepared to collect data about internship such as the time allotted for internship, the evaluation of students during internship and the purpose of internship.

Co curricular and extracurricular activities.

Two items of this section were constructed to know about co-curricular activities of engineering colleges. The first item was to list out the co curricular activities of engineering colleges. The second one was to know about the organisers of co curricular activities in the college.

Performance /Examination / Pass of students.

Regarding examination and certification the investigator constructed 9 items. 5 items of free response type were given to know about the agency responsible for conducting internal, external and practical examinations. Two items were regarding the reappearance of failed candidates and the chances for reappearance. Eighth and Ninth items were included to know about diagnostic test for identifying backward students and remedial measures. The last item was constructed to check the validity of the certificate: four options are given as government sector, private sector, national level and international level.

Section F.

One of the objectives of the study was to locate deficiencies in engineering education if any and to suggest remedial measures. In this section two open ended items were included. The first item constructed to seek the opinion of principals regarding the engineering colleges in Kerala. The second item was to give suggestions to improve engineering education in Kerala. These two items seeks a general view of engineering colleges in Kerala. Adequate space was given in the tool for answering.

Scoring.

The frequency of the responses of the structured form was tabulated directly. In the case of open ended items the responses were pooled and categorised. Then the frequency of the responses was tabulated for each item.

Validity and reliability of the questionnaire.

During the process of construction of the tool itself content validity and face validity were ensured. This tool is constructed by referring to the guidelines of AICTE hand book and other materials mentioned above. The questionnaire covered all the important aspects of the engineering colleges that the investigator could locate. Validity of the tool was established with proper selection of the items according to the objectives of the study. So the investigator believes that the questionnaire is valid enough to yield the required data. For establishing content validity the investigators consulted with experts in the field of study. The experts were academicians and faculties of engineering colleges. The experts agreed that the items in the questionnaire were suitable to check the objectives of the study.

A tool is said to have face validity when it appears to measure what the author had in mind, what he thought he was measuring (Garrett, 2005). The investigator tried to phrase the items in the questionnaire in the least ambiguous way and the meanings of all unfamiliar terms were clearly defined so that the principals were able to respond to the items without misunderstanding. Thus the tool posses face validity.

The reliability of the questionnaire was established by checking the collected data through multiple sources. Hence cross checking of the data is done inorder to increase the authenticity and integrity of the data which make the research more reliable. The tool is presented as Appendix A.

2. Questionnaire on Engineering Colleges to Faculty members

One of the objectives of the study was to analyse the responses of faculties of engineering colleges regarding the planning, organisation and transaction of curriculum of engineering courses followed in their colleges. For this purpose the investigator with the help of supervising teacher prepared the above tool.

Before preparing the tool, the investigator made a thorough review of handbooks and articles regarding engineering education and conducted discussions with experts in the field of engineering to get an in-depth knowledge of different scenarios pertaining to the field of study. To know about the facilities of engineering colleges, the dimensions covered in the first questionnaire was included.

General information.

The first part of the questionnaire was intended to get general information of faculties of engineering colleges. The items were given to collect name of the faculty, designation, age, sex, year of experience, name of the college, type of management, district, email/phone number, GATE score and in-service training programme undergone, if any.

Section A.

This section intended to collect data regarding the curricular competencies envisaged in the present curriculum of engineering courses. For that, the investigator pooled out all the competencies needed for engineering profession by thorough reading and discussion with the experts. The section contains a total of 22 items.

The last item was an open ended question. This section consisted of three columns. In the first column the competencies were listed. The second column was to know whether the curriculum is able to develop the competencies envisaged. Here the respondent has to tick mark in the relevant options as Poor, Average and High.

In the third column the respondent has to write briefly the activities /teaching learning strategies given to facilitate the corresponding activities. The investigator could include all the major competencies needed for engineering profession. The competencies included in the tool are Knowledge Integration, Develop Ability to work in team, Develop Sensitivity towards environmental, sustainable and global issues, Develop sensitivity towards moral and ethical issues, Develop 'Readiness for lifelong' learning, Develop entrepreneurship, Develop ability to assist others, Develop ability to apply knowledge, Develop Designing Skills, Developing problem solving skills, Develop Technical competencies, Develop decision making skills, Develop analytical skills, Develop Research skills, Develop Experimentation skill, Develop communication skill, Develop project planning, management skill, Develop presentation skill and Develop mentoring skill.

Evaluation.

To know about the evaluation process in engineering colleges the items were arranged in three columns: in the first column activities were listed as written examination, practical examination, viva voce, seminar, assignment, group project and others. The second column was to know about the internal and external evaluation of the listed activities. The respondents tick mark on the relevant column. The third column was intended to get information about occasion of evaluation of the activities: the options given are, during the instruction, at the end of the class, at the end of the term and at the end of the semester.

Working days and hour of instruction, Club activities and internship.

Two items were prepared to collect information about working days and hour of instruction. To collect information about students' club activities of engineering colleges two items were included. The last item constructed to collect the views of faculties about internship programme.

Section B.

Items in this section were constructed to collect data regarding the facilities and performance of engineering colleges in detail. To collect details of infrastructure facilities of engineering colleges, 18 items were constructed regarding class room, laboratory, workshop, drawing hall, seminar hall, computer, library, student resting room, student hostel, physical exercise facility, canteen facility and faculty room. Nine items were open ended and others were yes or no type. Thirteen items regarding essential requirements and 7 items regarding desirable requirements were also included and these were yes or no type.

To get information about the views of engineering college faculties about financial resources, two items were prepared. One was open ended and the other was yes or no type. Regarding the human resources availability two items were included: one to check the satisfaction of faculties on human resource availability and the other was to write reason for dissatisfaction. About the activities of PTA and Alumni associations, six items were constructed: three for each. One from each was open ended.

Section C.

Two open ended items were included in the section. One to know about the opinion of faculties on engineering colleges in Kerala and the second, for giving suggestions for improvement of the system.

Scoring.

The frequencies of the responses of the structured items were tabulated directly. In the case of open ended items the similar responses were pooled and categorised. Then the percentages of the responses were tabulated for each item.

Validity and reliability of the questionnaire.

During the process of construction of the tool itself content validity and face validity were ensured. This tool was constructed by referring to the guidelines of AICTE hand book and other documents mentioned above. The questionnaire covered all the important aspects of the engineering colleges that the investigator could locate. Validity of the tool was established with the proper selection of the items according to the objectives of the study. So the investigator believes that the questionnaire is valid enough to yield to the required data. For establishing face validity the investigators consulted with experts in the field of study. The experts included were academicians and faculties of engineering colleges. The experts agreed that the items in the questionnaire are valid enough to check the objectives of the study.

The investigator tried to phrase the items in the questionnaire in the least ambiguous way and the meanings of all unfamiliar terms were clearly defined. The reliability of the questionnaire was established by checking the collected data through multiple sources. Hence cross checking of the data is done inorder to increase the authenticity and integrity of the data which make the research more reliable. The tool is presented as Appendix B.

3. Questionnaire on Engineering Colleges to Students

One of the objectives of the study was to analyse the responses of students regarding the facilities, curricular and co curricular activities of their engineering colleges. For this purpose the investigator with the help of supervising teacher prepared the tool for collecting data from engineering college students. For getting a thorough understanding about the curricular and co curricular activities the investigator referred the books mentioned earlier. Students are the actual stakeholders of any educational system and this tool has the provision to obtain the views of students on the facilities of engineering colleges in detail.

A total of 93 items regarding general information of the engineering student, type of management of the college, infrastructure facilities available, human resources available, parent teacher association, alumni association, college union curricular and co-curricular activities were included in the questionnaire.

The tool was constructed under three sections.

Section A.

The items regarding name of student, age, gender, name of college, type of management, course of study were included in general information area. To seek information regarding infrastructure facilities items regarding class room facilities, laboratory facilities, workshop facilities, drawing hall, seminar hall, central computing facility, library, canteen, facility for physical exercise, essential requirement and desirable requirement were included next.

Seven questions were prepared to collect data about the human resources at the colleges - Principal, Faculties, Technical staffs and Non-teaching staffs. Nine items were included to gain knowledge about the functioning of Parent Teacher Association (PTA), College Union and Alumni Association. The items were both yes/ no type and open ended. Provision was given to express the satisfaction of students on the above facilities available in their college and also to note down the reasons of dissatisfaction, if any.

Section B.

The aim of this section was to collect the views of students regarding curricular and co-curricular activities of engineering colleges. Regarding co-curricular activities 11 items were prepared. Items were in both structured and open ended forms. Items to know about the major co curricular activities of the colleges, organisers of co curricular activities, participation in these activities, details regarding the club activities were included. To get data about curricular activities items about working days, effectiveness of curriculum, problems related with instructional medium, teaching methods adopted, internship related and examination were constructed. Total 30 items were prepared from this area.

Engineering is a professional course. For the development of engineering skill and competency in addition to practical experiences, internship is very effective. Now the present curriculum of engineering is giving importance to entrepreneurial skill development also in students. In AICTE guidelines for establishing a technical institution, the importance of linkage with industry is stressed because this linkage has a vital role in students' wholesome growth as well as for the contribution of institution to society.

In the questionnaire 6 items were included to collect data about internship. Among this, four were structured and the rest, yes/no type. One was prepared to know about the duration of the practice and was free response type and the other item was prepared to seek opinion of students regarding the internship they have received.

Section C.

Students are the actual beneficiaries in all the teaching learning process. Curricular transaction is effective only when the system adopts suitable teaching learning strategies in class rooms. Here also the investigator realises the significance of innovative process for effective curricular transaction. This section was constructed to know about the responses of students of engineering regarding the process of curricular transaction in connection with teaching learning strategies adopted in their colleges. The investigator listed out 28 teaching learning strategies to know about the occurrence of these strategies in engineering colleges from students. Investigator hoped that almost all the curricular and co curricular activities were covered by these activities and further hopes that if the colleges conduct these activities in systematic and scientific way, it will facilitate the development of skills and competencies in students needed for the engineering profession.

All teaching learning activities were listed in the left column. In the right column three responses were given as always, sometimes and never. The respondent has to read these activities and mark their responses in the relevant column using tick mark on the activities that were adopted by the faculties in their college.

The last two items were to get the opinion of engineering college students on engineering colleges in Kerala and for getting their suggestions for improvement of the system.

Scoring.

For the yes or no type items the responses and the frequencies were tabulated. In the case of unstructured open ended items the responses are pooled and categorised and then the frequencies were tabulated.

Validity and reliability of the questionnaire.

The questionnaire on engineering colleges to students was prepared by considering authentic books and guidelines and by discussion with experts in the field of engineering. Therefore the investigator hopes that this tool is valid to yield adequate data. The reliability and authenticity of the tool was assured by cross checking the data provided by the students with heads and faculties of the institutions. The tool is presented as Appendix C.

4. Questionnaire on Engineering Colleges to Engineering Graduates

One of the objectives of the investigation was to study the responses of B.Tech graduates regarding facilities and curriculum of engineering colleges in Kerala. The opinion of graduates who are the pass outs from engineering colleges are crucial in the evaluation of facilities they used in their colleges during their study and also to evaluate the teaching learning process and the competencies they had achieved during their study. The responses made by the graduates helped to understand the problems/issues if any exists in the system. Also it helped to cross check the views of principals, faculties, and students of engineering colleges. This will increase the objectivity of the study.

Before preparing the tool the investigator made discussions with the experts in the field of engineering education. For getting theoretical background, the investigator referred the books and materials mentioned earlier. The tool has three sections.

Section A

The section A of the tool was to know about the general information about the graduates, name of the institution from which they have studied their B.Tech course, present occupation and name of the B.Tech programme.

The section also has items regarding infrastructure facilities, human resource availabilities, performance of faculties and instructional medium. Both yes or no type and open ended items were included. Total 13 main questions and 5 sub questions were there in this section.

Section B

The aim of this section was to collect data about the curriculum and competencies envisaged by the curriculum. The investigator after discussion with experts in the field of engineering listed out a total of 18 competencies which are needed for a skilful and competent engineer.

The investigator adopted following strategy for arranging the items. Three columns were given in this section. In the first column the competencies were arranged. The respondent has to rate these competencies as Poor, Average and High given in the second column. The third column was free response type: here the respondents have to write their responses about the teaching learning strategies adopted by their teachers/colleges to achieve these competencies. Provision was also given to the respondent to add competencies they noticed or achieved which were not listed in the tool. In this section one item was constructed to check the satisfaction on the competencies envisaged by the present curriculum and space was given to write the reason for dissatisfaction. Four items were constructed to collect the views of graduates on the general aspects of the curriculum.

Section C.

This section is to seek the view of graduates about the engineering colleges in Kerala and to suggest remedial measures to improve the standard of engineering colleges in Kerala. Two items were constructed and were open ended.

Scoring.

For the yes or no type items the responses and the frequencies were tabulated. In case of unstructured open ended items the responses were pooled and categorised then the frequencies were tabulated.

Validity and reliability of the questionnaire.

The questionnaire on engineering colleges for graduates was prepared by referring authentic documents and guidelines and by discussion with experts in the field of engineering. Therefore the investigator hopes that this tool is valid to yield adequate data. The reliability of tool was assured by cross checking the data with different samples under investigation. The tool is presented as the Appendix D.

5. Questionnaire on Engineering Colleges to Parents of Engineering Students

This questionnaire was constructed to analyse the parental responses regarding facilities and limitations of engineering colleges. In general, parents exhibit interest in their children's study and are very keen to know about the facilities of institution where their child study. So the investigator decided to collect data from parents of engineering students about the facilities and problems of engineering colleges. Thirty items were included in the tool. The items regarding general information as name of the parent, qualification, occupation, college in which their daughter/son studied and type of management of the college are included in the first section.

Items regarding infrastructure, computers, library, hostel, college union, parent teacher association, administration, human resources availability, curricular and co curricular activities and other problems of colleges were also included. Adequate space was given in the tool to write opinions and suggestions in brief. The tool was developed in both Malayalam and English languages.

Scoring.

For the structured items, responses and frequencies were tabulated. In the case of unstructured open ended items, the responses were pooled and categorised then the frequencies were tabulated.

Validity and reliability of the questionnaire.

The questionnaire on engineering colleges for parents was prepared by considering authentic books and guidelines and by discussion with experts in the field of engineering. Therefore the investigator hopes that this tool is valid to yield adequate data. The reliability of the tool was assured by cross checking the data with different samples under investigation. The tool is presented as Appendix E.

6. Unstructured Interview Schedule

Interviews were conducted with academicians, experts, social/media activists and stakeholders who are closely related with engineering education for collecting their views about problems of engineering colleges in Kerala. The academicians included Deans of engineering colleges, principals and head of the departments of engineering colleges. Those persons who are actively involved in the social activities related to the field of education were considered as social/media activists. The stakeholders included ongoing students and B.Tech graduates. The interview had a framework of dimensions to be explored with respect to the issues related to engineering colleges in Kerala. The schedule consisted of eleven main items. Interview was unstructured and open allowing freedom to all the responses regarding engineering colleges. The framework adopted for interview is presented as Appendix G

Procedure Adopted for Data Collection

After fixing the sample for the study, the investigator approached principals of engineering colleges. Most of them (especially Self financing colleges) claimed that everything in the college was well and no investigation of this type is needed. They were reluctant to give permission to collect data from their colleges. After convincing the importance of research study of this type and with the assurance of confidentiality of their responses, they were ready to co-operate.

After getting permission from the concerned authorities, the questionnaires were given to principals, faculties and students of engineering colleges. The investigator has given proper instructions and time to fill the questionnaire. Majority of the faculties were not ready to fill the tool on the same day hence the investigator visited an institution several times to collect data. In the case of data from students, only two colleges gave the permission to collect it on the same day, others were not ready to give permission to do it in the class time. In that case the investigator distributed the tool and gave instructions clearly to fill it. The class leaders and some other students voluntarily helped the investigator to collect data from students.

To collect data from graduates, the investigator collected details of them from the respective engineering colleges. The graduates were located in different parts of the country and abroad so it was very difficult to collect data. So the investigator decided to purposefully select the graduates from the details available. The availability and feasibility were the yard sticks used. Heterogeneous groups were located after contacting them over phone, the investigator visited their workplaces like companies, organisations, banks etc.

To collect data from parents of engineering students randomly selected the parents and the tool was given to them through the students.

The unstructured interviews were conducted with 6 experts, 10 faculties, 4 social/media activists, 10 ongoing students and 10 graduates. The responses of the interview were used for further analysis.

The investigator distributed 35 questionnaires to principals, 250 to faculties, 500 to students, 100 to graduates and 100 to parents, but numbers of returned questionnaires were 30 from principals, 184 from faculties, 440 from students, 50 from graduates and 50 from parents. Almost ten months were taken for data collection process.

Scoring and Consolidation of Data

The questionnaire contained items of both structured and unstructured types. For the structured items, the frequencies of the type of responses were found out and then tabulated. For the unstructured items, similar responses were pooled and categorised, then the frequencies of each category of responses were found out and tabulated. Data collected through interview were pooled, similar responses were analysed commonly and dissimilar one separately and were used for further analysis.

Statistical Technique Used

In order to find answers to the objectives framed, percentage analysis was used wherever needed.

Percentage score of each option of each item

$$\textbf{P (option)} = \frac{\text{Number of resonses obtained for each option of the item}}{\text{Total number of responses obtained for that item}} \text{x}100$$

The result obtained through the percentage analysis interpreted qualitatively. The result obtained is presented in the chapter V

Chapter V

ANALYSIS AND INTERPRETATION OF DATA

- ***Phase 1:*** *Profile of Engineering Colleges in Kerala*
- ***Phase 2:*** *The Facilities Available at Engineering Colleges*

ANALYSIS AND INTERPRETATIONS

The present study is mainly intended to analyse the facilities, performance and problems of engineering colleges in Kerala. This chapter deals with analysis and interpretation of the data based on the objectives framed for the study as listed in the Chapter 1. The following description gives the objective wise analysis and results of the study.

Quantitative and Qualitative analysis of the Data

The data was collected from different sources through multiple lines of approach as given below.

1. Documents pertaining to the study
2. Responses of principals of engineering colleges
3. Responses of faculty members of engineering colleges
4. Responses of students of engineering colleges
5. Responses of engineering graduates
6. Responses of parents of engineering students

In addition to these, data obtained through unstructured interviews of stakeholders and experts in the field of engineering education was also used for the analysis. The analysis of the data obtained through various sources and samples was done in line with the objectives of the study and is given as four parts as detailed below:

In the first part, a general profile of all the colleges offering under graduate level engineering education is presented.

The second part consists of the description of the analysis of phase two of the study. Here the facilities available at engineering colleges, from the responses of sample selected for the study, are analysed in detail.

In the concluding part, a comprehensive discussion is given on the basis of the reported data and attempt is made to identify the different aspects and problems pertaining to the engineering colleges in Kerala.

Phase 1: Profile of Engineering Colleges in Kerala

To study the general profile of engineering colleges in Kerala, the researcher analysed secondary data available in websites of All India Council of Technical Education (AICTE) and Entrance Commission of Kerala, documents from Directorate of Technical Education, Kerala Technological University, Review reports of Government of Kerala, News paper reports etc. The compiled data gives a reflection on the following aspects with respect to the Engineering education in Kerala, such as the growth in,

- number of engineering colleges,
- number of B. Tech courses offered by engineering colleges,
- intake capacity of engineering colleges with respect to B. Tech courses from 2013 to 2016,
- intake capacity of different branches of B.Tech ,
- intake capacity and enrolment for all engineering and technology courses from 2013 to 2016,
- percentage of enrolment of girl students in B.Tech and M.Tech from 2013 to 2016,

- branch wise intake capacity & enrolment of the five branches having high intake capacity,
- vacant seats in engineering colleges for 2013 to 2016.
- pass percentage of five courses having highest intake capacity,
- pass percentage of engineering colleges for the last academic year 2016-17 and
- details of placement from 2013 to 2016.

Growth in Number of Engineering Colleges in Kerala

The first engineering college in Kerala was established in the year 1939, the second and third in 1958, the fourth and fifth in 1960 and ’61 respectively. The sixth one was the Regional Engineering College (Now called NIT) established in 1961, and after 25 long years in 1986, another college at Kannur was started. The first self-financing engineering college under Government sector - Government Model Engineering College, Cochin was started in 1989. One more college under Kerala Agricultural University also started offering B.Tech courses in the years 1985. So, until 1991, there were only 9 colleges offering under graduate engineering education in Kerala. Table 4 gives the category wise distribution of engineering colleges in Kerala, as was given in the Kerala Economic Review published by Kerala Planning Board.

Table 4

Distribution of Engineering Colleges in Kerala: Category Wise

Year	Government	Aided	Self-financing	Total
Until 1991	5	3	1	9
1991	6	3	1	10
1992-1996	6	3	5	14
1996 - 1998	6	3	6	15
1999 - 2001	9	3	21	45
2002 - 2008	9	3	83	94
2011	9	3	131	142
2012	9	3	131	142
2013	9	3	141	152
2014	9	3	152	164
2015	9	3	152	164
2016	9	3	171	183

Source: Kerala Economic Review (various issues), State Planning Board, Govt. of Kerala

Analysis of the data presented in table 4 revealed that the total number of engineering colleges in Kerala, though gradually increased from 1992, showed a jump in the year 2011. From 94, the number of colleges increased to 142. As of now, (2016), there are 183 engineering colleges in Kerala. It can also be seen that the increase was only in the number of self-financing colleges and the number of Government and Aided engineering colleges remain the same for the years mentioned.

The total number of colleges comes under various managements: State Government, Central Government, Universities, Private agencies etc. Apart from these colleges, six more colleges also are there in Kerala offering engineering and technology courses.

- One National Institute of Technology (NIT) under Central Govt.
- Two colleges under Kerala Agricultural University
- One under Cochin University of Science and Technology
- One Indian Institute of Space Science and Technology
- One Amrita School of Engineering (Deemed University)

Out of 183 colleges under State Government departments, only 155 colleges were awarded affiliation to Kerala Technological University at the time of its establishment. Three colleges are still affiliated to University of Calicut, University of Kerala and Mahatma Gandhi University respectively.

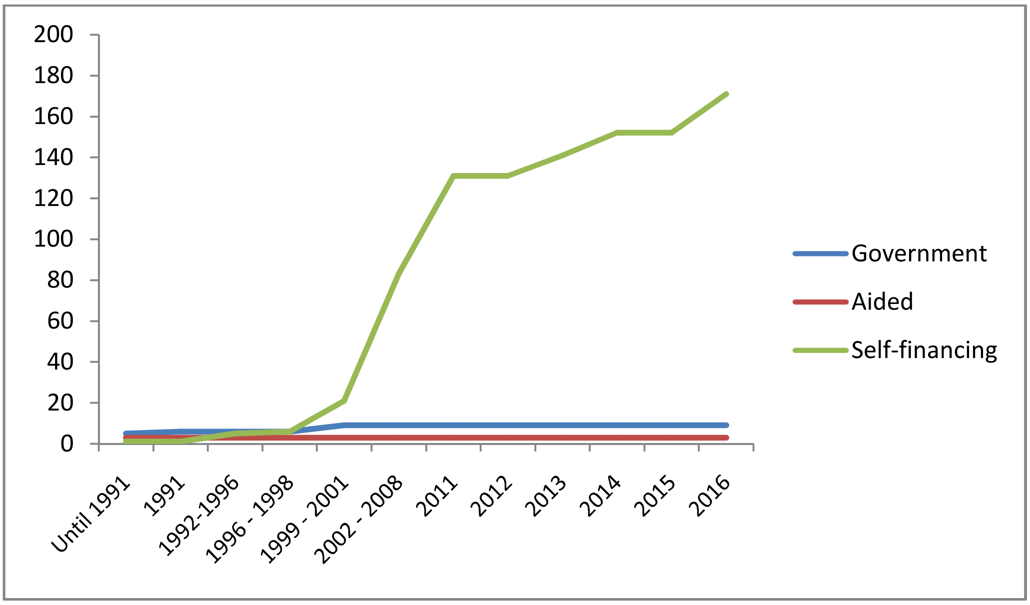

Figure 1. Graphical representation of the growth of different category of engineering colleges in Kerala from 1991-2016.

The percentage of Government engineering colleges in Kerala is 4.91% but in the case of Aided engineering colleges, the percentage of distribution is 1.64% only. The majority, 93.44% engineering colleges, belongs to Self-financing category which can again be divided to two: 13.66% Government Self-financing and 79.78% Private Self-financing. The graphical representation is given in the following figure.

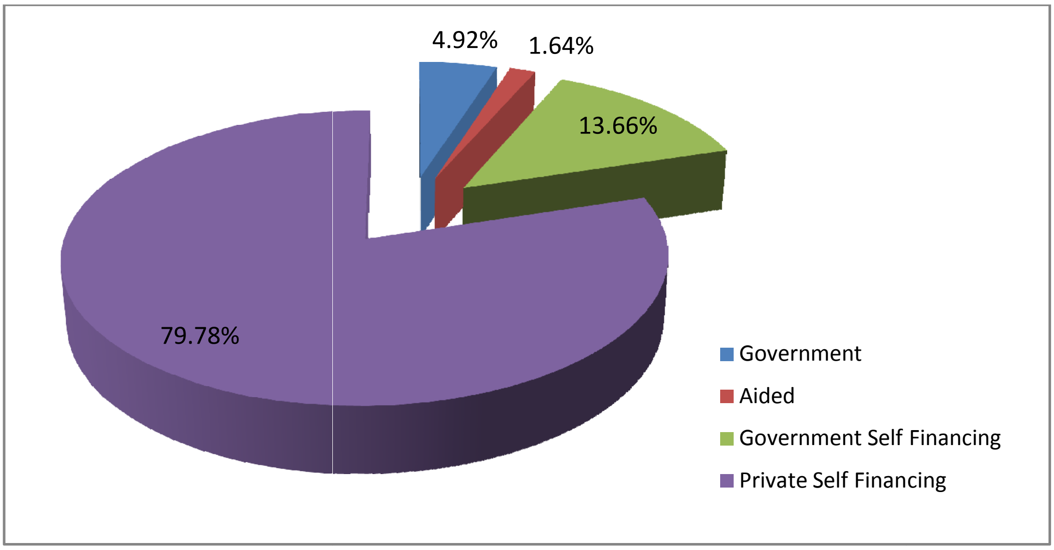

Figure 2. Graphical representation of the distribution of different category of engineering colleges in Kerala (2016)

From the data, it is clear that the percentage of government and aided colleges is very low when compared to the number of self-financing engineering colleges. It can also be deduced that though the number of engineering colleges is increasing year by year, the increase is only in the self-financing sector.

Accreditation Details of B. Tech Courses of Engineering Colleges in Kerala

National Board of Accreditation (NBA) is the agency for accrediting engineering institutes or engineering programmes in India. The NBA accreditation programme is the official performance assessment mechanism of engineering colleges and it has definite standards and criteria by which the strengths and weakness of individual programmes in an engineering college can be judged. Through its quality assurance and improvement process, the various programmes in an approved institution are critically evaluated by the NBA to authenticate that the institution or the programme maintain the norms and standards prescribed by the regulations from time to time. The accreditation is a sort of recognition that a programme or institute execute definite standard.

The purpose of the accreditation is to promote and recognise excellence in technical education. This external verification of quality of both under graduate and post graduate level programme of colleges and universities in a large extent benefited the stakeholders: institutions, students, faculties and society as it gives a promise or confidence for assuring quality.

The data collected on B.Tech courses at the 158 engineering colleges affiliated under KTU is given in the table below.

Table 5

Engineering Colleges having Accredited B.Tech Courses: Category wise

Sl. No.	Type of Management	Total No. of colleges	Colleges having accredited courses	Percentage
1	Government	9	4	44.44
2	Aided	3	3	100
3	Govt Self-financing	25	5	20
4	Private Self-financing	121	15	12
	Total	158	27	17.08

When all the engineering colleges are considered, only 17.08% are having accredited courses. All the Aided engineering colleges have accredited courses in B. Tech, but only about half of the Government colleges have accredited courses (44.44%). 20% Government managed self-financing colleges have accredited B. Tech courses while 12% of private self-financing engineering colleges have accredited courses.

A comprehensive picture of total number of under graduate courses and accredited/ non-accredited courses in the aforementioned colleges having some accredited courses are presented in Table 6.

Table 6

Details of Accreditation of B. Tech Courses in Engineering Colleges of Kerala

Sl No:	Type of management	No.	Total number of undergraduate courses	Number of accredited courses	Number of courses not accredited
1	Govt	1	9	7	2
		2	8	8	0
		3	6	5	1
		4	5	5	0
2	Aided	1	8	7	1
		2	7	3	4
		3	9	4	5
3	Government owned Self-financing	1	5	5	0
		2	7	4	3
		3	5	2	3
		4	4	3	1
		5	4	2	2
4	Self-financing (SF)	1	9	2	7
		2	8	6	2
		3	7	5	2
		4	6	4	2
		5	6	5	1
		6	6	3	3
		7	6	2	4
		8	5	2	3
	7 Self-financing colleges			All courses	

Source: Website of Entrance Commission Kerala (https://cee.kerala.gov.in/main.php)

From the table, it can be seen that out of the 4 Government engineering colleges having accredited undergraduate programmes, two colleges have all the courses accredited. The other two colleges have to get accreditation for 3 courses in total: 2 out of 9 and 1 out of 6 respectively.

Out of 25 Government owned self-financing colleges, only 5 colleges have accredited courses (20%). All the courses of one college were accredited. In the rest 4 colleges, one has 2 accredited courses out of 4, another has 4 out of 7, the third one has 2 out of 5 and the fourth has 3 courses out of 4 were accredited.

Only twelve percentage (15 out of 121) of private self-financing engineering colleges are having accredited B. Tech courses. Out of this, all the courses available at 7 engineering colleges are accredited. In the rest 8 engineering colleges only a few courses out of the total courses offered i.e., 2 out of 9, 6 out of 8, 5 out of 7, 4 out of 6, 5 out of 6, 3 out of 6, 2 out of 6 and 2 out of 5 are accredited.

Discussion

The accreditation process encourages the quality improvement initiative of every institution. It helps to create a sound and challenging academic environment in the colleges and contribute to the social and economic development of the country by producing high quality technical man power. So the stability of the quality of engineering programmes is a must to produce high quality man power in engineering. When analysing the accreditation details it showed that the percentage of colleges having accredited courses in different branches of engineering is only 17.08%. Of these, the major contributing engineering colleges belong to Aided and Government category.

Majority of the Government sponsored self-financing and Private self-financing colleges are not offering even one accredited course. The result gives a clear indication of weakness in the performance and lack of quality of engineering programmes in Kerala.

Number of Courses Offered by Engineering Colleges in Kerala

A total of 29 courses are available for students in the engineering colleges of Kerala. The table presents the data with respect to the number of courses offered in colleges belonging to different categories.

Table 7

Number of B. Tech Courses in Engineering Colleges of Kerala

No. of courses in a College	Government		Aided		Govt self-financing		Private self-financing		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
2					1	4	1	0.82	2	1.27
3					6	24	4	3.31	10	6.33
4	1	11.11			5	20	14	11.57	20	12.66
5	4	44.44			7	28	66	54.55	77	48.73
6	2	22.22	1	33.33	6	24	26	21.49	35	22.15
7			1	33.33			5	4.13	6	3.8
8	1	11.11	1	33.33			3	2.48	5	3.16
9	1	11.11					2	1.65	3	1.9

Source: website of Entrance Commission Kerala (https://cee.kerala.gov.in/main.php)

From the table it can be seen that the four Government engineering colleges are offering 9, 8, 6 & 5 courses each while the three Aided colleges are offering 8, 7 & 6 courses each. In the case of 25 Government self-financing colleges, 6 colleges are offering the highest number of 6 courses each. Seven colleges are offering 5 courses, five are offering 4 courses, 6 are offering 3 courses and only one college is offering the lowest number of 2 courses.

In the Private self-financing sector, 7-9 courses are offered by only 10 colleges. Majority, i.e., 66 colleges are offering 5 courses and 26 are offering 6 courses each. 19 colleges among the lot are having only 4, 3 & 2 courses in each.

It can also be seen from the table that about half of the engineering colleges in Kerala (48%) offer five undergraduate engineering courses each. 22.15% engineering colleges in total offer 6 engineering courses at undergraduate level. Only 1.9% of engineering colleges are offering 9 engineering courses in B. Tech. 1.27% engineering colleges are offering the lowest number of 2 courses.

Discussion

With respect to the number of undergraduate courses offered by engineering colleges under different managements, the data indicated that majority of engineering colleges are offering five undergraduate courses. Most of the colleges were started with the maximum number of courses allowed.

Intake Capacity of Engineering Colleges

As per the AICTE norms, at the time of starting, a college can opt for 5 courses or 5 divisions of a single course with 60 seats each, but the final number of seats for a particular course/ division opted by the colleges is usually based on the facilities of that college and the demand for the course/s. Also if the colleges were unable to fill allotted seats in 5 consecutive years, the AICTE will reduce the number of seats, 30 numbers at a time. The intake capacity of engineering colleges belonging to the three categories in Kerala are summarised in the table given below.

Table 8

Intake Capacity of Engineering Colleges: Category wise

Intake capacity	Government		Aided		Government Self-financing		Private Self-financing		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
100-200	-	-	-	-	5	20	6	4.96	11	6.96
201-300	3	33.33	-	-	7	28	51	42.15	61	38.61
301-400	4	44.44	-	-	9	36	22	18.18	35	22.15
401-500	-	-	-	-	3	12	20	16.53	23	14.56
501-600	-	-	1	33.33	1	4	15	12.4	17	10.76
601-700	1	11.11	-	-	-	-	4	3.31	5	3.16
> 700	1	11.11	2	66.67	-	-	3	2.48	6	3.8

Source: Website of Entrance Commission Kerala (https://cee.kerala.gov.in/main.php)

Discussion

Considering all the 155 colleges affiliated to KTU and the three University colleges, only 11 colleges, both in Government managed and privately managed sector, are having a low number of seats in different branches for the B.Tech course, between 100 and 200. 38.61 % colleges are allotted 201 to 300 seats, i.e. a total of 61 colleges from all categories out of the total 158. In 22 (22.15%) colleges the intake capacity is 301-400. 14.56 % and

10.76% colleges are having the intake capacity of 500-600 and 601 - 700 respectively. Only 6 colleges are being allotted the highest number of seats, having above 700.

The result indicated that the allotment of seats is not the same for all colleges. A good number of seats are available at few Government and Aided colleges where the fees are nominal. A good percentage of engineering colleges have the intake capacity between 200-300.

Intake Capacity of Engineering Colleges offering both B.Tech. and M. Tech Courses

As per the Kerala Economic Reviews, the intake capacity of engineering colleges offering UG and PG programs was 52803 in 2013. It gradually increased to 53,434 seats in 2014, to 58,237 in 2015 and to 60,376 in 2016.

The percentage of increase for intake was 14.34% from 2013 to 2016. The graphical representation of the data is given as Figure 3.

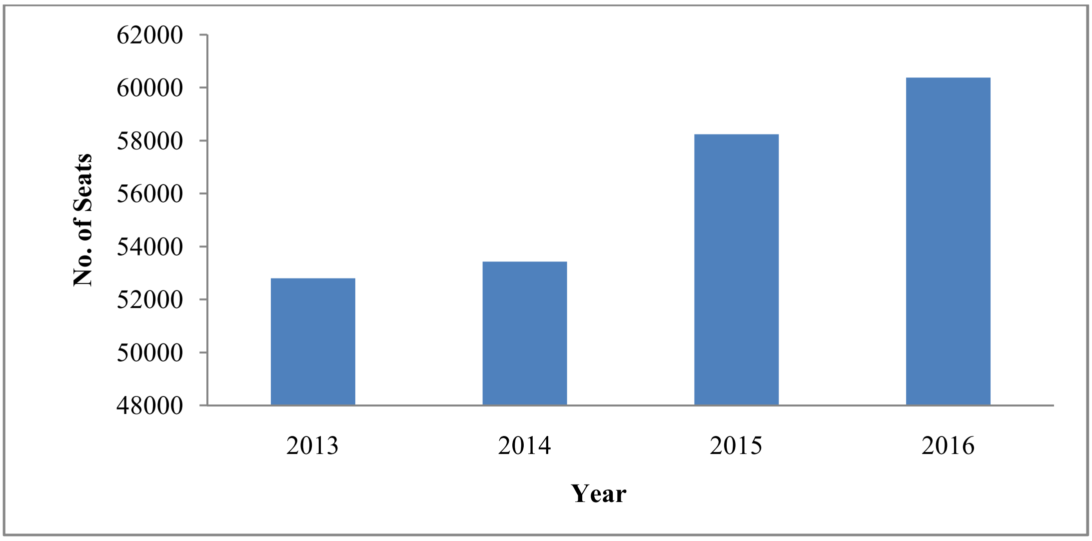

Figure 3. The graphical representation of year wise total intake capacity of engineering colleges offering B.Tech and M.Tech courses

The total intake capacity can further be divided to that of colleges belonging to different categories so that to understand the category in which the actual increase/ allotment of seats have taken place. The data collected are given in the Table 9

Table 9

Category wise Total Intake Capacity of Engineering Colleges

Year	Government		Aided		Self-financing		Total
2013	3178	6.22%	1613	3.05%	48011	90.93%	52802
2014	3113	5.82%	1640	3.07%	48681	91.10%	53434
2015	3343	5.74%	1700	2.92%	53194	91.34%	58237
2016	3283	5.44%	1850	3.06%	55243	91.50%	60376

As per the data given in the Kerala Economic Review report, though the total intake capacity increased from the year 2013 to 2016, that increase is mainly in the Aided and Self-financing colleges. Government colleges started with an intake capacity of 3178, but it has been reduced to 3113 in the following year. Year 2015 saw an increase in the number, which was again reduced from 3343 to 3283 in 2016. The increase in the number of available seats with respect to the Self-financing colleges is on par with that of Aided colleges: 7,232 seats to 237 seats i.e. 15% and 14.7 % respectively. Majority (above 90%) of the total allotted seats are with self-financing sector.

Discussion

The result about the intake capacity of engineering colleges revealed that every year, more seats are being allotted to colleges. The percentage of increase is high in Self-financing category of engineering colleges and it was very less in Government/Aided engineering colleges, making the engineering education a costly affair. The low number of seats available in the Government and Aided sectors where low fee structure forced the students to take up admission in the self-financing sector.

Intake capacity of Different Branches of B. Tech Courses

In Kerala, a total of 29 branches are being offered in the B.Tech Engineering programme. The sanctioned number of seats in these branches are given in the Table 10.

Table 10

Intake capacity of Different Branches of B. Tech Courses

Sl. No.	Name of the Course	Sanctioned Intake
1.	Electronics & Communication Engineering	10,497
2.	Computer Science And Engineering	8,298
3.	Mechanical Engineering	7,487
4.	Electrical And Electronics Engineering	7,378
5.	Civil Engineering	6,707
6.	Information Technology	2,703
7.	Applied Electronics And Instrumentation	1,440
8.	Architecture	1240
9.	Automobile Engineering	420
10.	Electronics And Instrumentation Engineering	246
11.	Biomedical Engineering	240
12.	Production Engineering	240
13.	Aeronautical Engineering	180
14.	Chemical Engineering	180

Sl. No.	Name of the Course	Sanctioned Intake
15.	Biotechnical And Biomedical Engineering	180
16.	Diary Science and Technology	180
17.	Printing Technology	150
18.	Instrumentation And Control Engineering	120
19.	Information Science Engineering	120
20.	Biotechnology	120
21.	Safety And Fire Engineering	90
22.	Polymer Engineering	60
23.	Textile Technology	60
24.	Marine Engineering	60
25.	Food Technology	60
26.	Agricultural Engineering	49
27.	Instrumentation Technology	40
28.	Ship Building	40
29.	Industrial Engineering	32

Source : (https://cee.kerala.gov.in/main.php)

The highest number of seats is available with the branch-Electronics and Communication Engineering and the lowest number of seats is for Industrial Engineering programme.

Intake Capacity and Enrolment

Though there are many sanctioned seats at different levels / branches of technology education, the enrolment of students may not always be 100%.

In Kerala there are three different levels for Engineering and Technology courses: Diploma, Undergraduate and Postgraduate. Here the researcher compared the intake capacity and enrolment of engineering and technology courses at all the three levels in Kerala, the results of which are given in Table 11

Table 11

Intake Capacity and Enrolment for all Engineering and Technology Courses

Sl. No.	Year	Intake capacity	Enrolment	Percentage of Enrolment
1	2013-14	98117	70805	78.16%
2	2014-15	108136	71790	66.39%
3	2015-16	108059	68321	63.23%
4	2016-17	108527	63569	58.60%

Source: www.aicte.org

Table 11 shows that for all levels (UG, PG, Diploma) in Engineering and Technology, the sanctioned intake capacity was increased from 98117 in the year 2013 to 108527 in the year 2016. There was a slight decrease in the intake in 2015 when compared with 2014.

Analysing the enrolment of students from 2013 to 2016, it can be seen that, the number of students got admitted in various courses decreased from 70,805 to 63,567. This indicates that the intake /enrolment rate in engineering courses is decreasing year by year. The graphical representation of intake capacity and enrolment in all engineering Technology courses is given in the Figure 4.

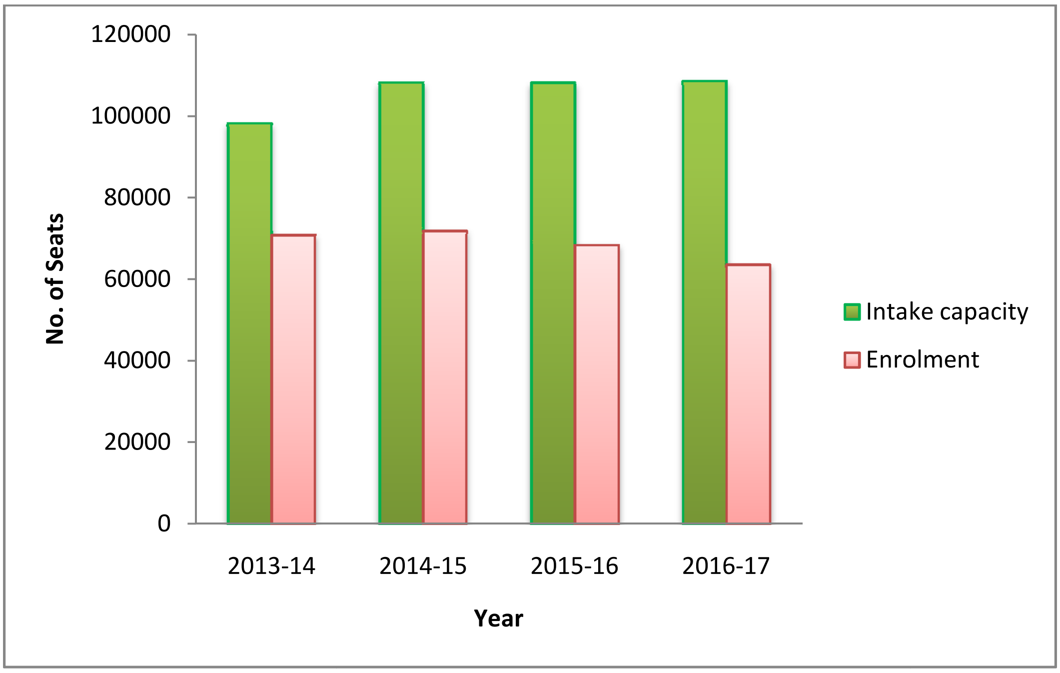

Figure 4. Intake capacity and enrolment for all engineering and technology courses

Discussion

The findings reveal that there is a big difference in the sanctioned intake and actual enrolment in all the Engineering and Technology courses. The intake capacity has been increasing year by year, but the enrolment rate is showing a negative trend. The majority of the sanctioned seats are vacant in Engineering Technology courses in Kerala. This shows that the appeal of the once preferred engineering education is diminishing year by year.

Enrolment of Girl Students in Engineering Colleges of Kerala

In a state where the number of females is more than that of the males, their presence in the B.Tech and M.Tech programme is examined as part of the study. The values are presented here.

Table 12

Enrolment of Girl Students in B. Tech and M.Tech Courses

Sl.No.	Year	B. Tech	M. Tech
1	2013	39.65%	46.74%
2	2014	38.74%	48.94%
3	2015	36.86%	55.86%
4	2016	36.42%	61.19%

Source: Economic Review reports, Kerala planning board, Government of Kerala.

Analysis of the data reveals that the enrolment of girl students in undergraduate courses of engineering decreased from 39.65% to 36.42% from 2013 to 2016. At the same time, the enrolment rate with respect to the M.Tech courses increased considerably from 46.74 to 61.19.

The low rates can be attributed to the general belief that the technology courses are mostly the boys' forte. Then again the values with respect to post graduate course present another picture. Most boys prefer jobs than higher studies, but girls who have secured good marks opt for higher studies.

Intake capacity, enrolment and vacant seats of courses having highest number of sanctioned seats

The five engineering and technology programmes which have highest sanctioned seats are Electronics & Communication Engineering (EC), Computer Science (CS), Mechanical Engineering (ME), Civil Engineering (Civil) & Electrical & Electronics Engineering (EEE). The intake and enrolment rates of these five courses for all levels (UG, PG and Diploma) are given in Table 13

Table 13

Intake Capacity, Enrolment and Percentage of Vacant Seats of Five Branches of Engineering and Technology

Year/ Branch		EC	CS	ME	Civil	EEE
	Intake	21,892	18550	17125	12989	11832
13-14	Enrolment	15,386	14452	12509	10972	8113
	Vacant seats	29.71%	22.09%	26.95%	15.52%	31.43%
	Intake	22911	19766	19920	15138	13059
14-15	Enrolment	13790	15715	12172	12013	7833
	Vacant seats	39.81%	20.49%	38.89%	20.64%	40.01%
	Intake	22308	20167	20094	15130	13024
15-16	Enrolment	11376	15786	12147	11701	7473
	Vacant seats	49.00%	21.72%	39.54%	22.66%	42.62%
	Intake	21881	19993	20799	15652	13120
16-17	Enrolment	10224	13881	12402	10493	6672
	Vacant seats	53.27%	30.57%	40.37%	32.96%	49.15%

It can be seen from the table that, in the case of the branch Electronics and Communication Engineering, the enrolment rates have been decreasing year by year. From 29.7% vacant seats in the academic year 2013 - 14, the percentage of vacant seats increased to 53% in the year 2016-17. In the Computer Science branch, the percentages of vacant seats are 22.09, 20.49, 21.72 & 30.57 in the respective years. Here also the enrolment rates are becoming lower. In the Mechanical Engineering branch also, the enrolment rates are decreasing, the percentage of vacant seats increasing from 26.95 to 40.37. The Civil and EEE branches also are exhibiting similar trends.

Looking at the total picture, a leading daily reported that in the gap of 4 years, the number of vacant seats in the B.Tech programme increased two fold. From 8,481 vacant seats in the year 2013, the number increased to 12,181 in 2014, 16,528 in 2015 and 17,333 in 2016. This is represented in the graph given below.

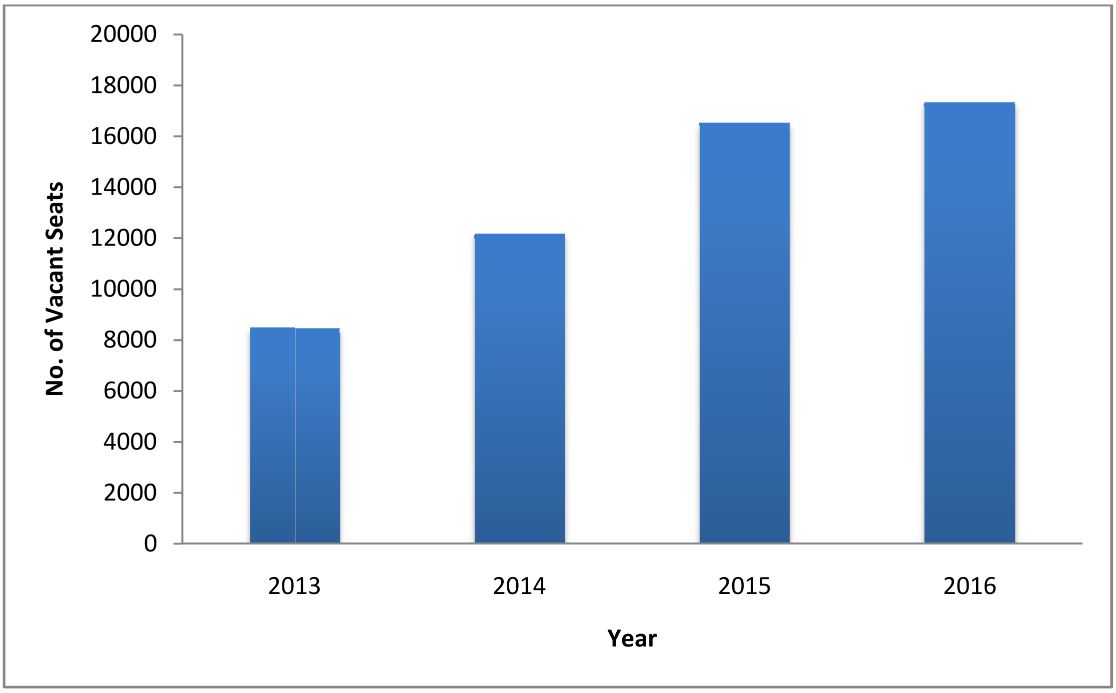

Figure 5. Number of vacant seats for B.Tech Programme in the year 2013-2016

The details of vacant seats in different categories of colleges after the third allotment process of the year 2017 are given in the table below.

Table 14

Vacant Seats in Different Categories of Colleges

Type of Management	Vacant seats	Total sanctioned seats	Vacant seat in %
Government & Aided	291	5046	5.77%
Govt owned & University self-financing colleges	2800	7554	37.07%
Private self-financing colleges	15869	23612	67.21%

Discussion

From the results it is clear that except Electronics and Communication Engineering branch, all the other four branches had an increase in intake capacity from 2013-14 to 2016-17. At the same time, a negative trend is visible in the enrolment rates. On considering all the B.Tech courses also, the same trend can be seen.

In Government and Aided colleges, the number of vacant seats is very low and again there are chances that even these seats also will be filled up by the end of the admission procedure. The highest number of vacant seats is with the Self-financing colleges.

It has been reported in the news papers that most of these vacant seats in the Self-financing colleges are of Government quota as the stipulations with respect to the marks to be secured in both the Plus Two level education and Entrance examinations are strict. In 61 branches at different colleges, no candidate has taken Government quota seats in the year 2017.

It can be deduced that irrespective of the lower rate of enrolment, the authorities are allotting more colleges / seats. Also can be deduced that the students prefer Government and Aided colleges than that of Self-financing colleges. This may be due to the low fee structure and stability/ facilities/ quality of the colleges. Considering the case of vacant seats in Government quota at the self-financing colleges, the logical conclusion that can be drawn is that the managements are filling up their seats without any regard to the marks/ entrance ranks of students. Otherwise the low fee Government seats would have been filled up.

Pass percentage and enrolment rate

When the enrolment rates of the five Engineering and Technology courses having the highest number of sanctioned seats are compared with the pass percentage of students, an alarming trend can be visible from the data. The details are given in the table below.

Table 15

Year wise Pass Percentage based on Enrolment Rates for Five Branches of Engineering and Technology

Branches	2013-14	2014-15	2015-16	2016-17
Electronics & Communication Engineering	53.91%	61.36%	38.55%	37.96%
Computer science	51.63%	58.03%	28.56%	29.07%
Mechanical Engineering	33.73%	33.41%	19.36%	20.48%
Civil engineering	28.55%	47.37%	19.62%	14.93%
Electrical &Electronics Engineering	50.87%	50.87%	25.57%	24.81%

The data collected reveal that the pass percentage for all the five courses has been decreasing from 2013 to 2016. Though three out of five branches had a pass percentage above 50 at 2013, by 2016 all the values dropped down to below 38. The academic year 2014 -15 has had a better performance from the previous year in three branches, but after that the values have come down drastically. The lowest pass percentage is with the Civil Engineering branch, a mere 14.93% students pass out from the colleges.

Discussion

This decrease is an indication of low quality engineering education and pointing towards issues of the present system of engineering education in Kerala. It can also be attributed to the low level of students' performance too. Those who with low marks in the higher secondary level, also are managed to secure admission in Private self-financing colleges if not in Government and Aided colleges. Those come under the compulsion of parents without any real aptitude for the course most of the times are unable to cope up with the heavy syllabus, hence the low pass percentage.

Analysis of Pass percentage of engineering colleges for the year 2015-16

The result of students is one of the indicators of academic performance. The high values of pass percentages can be termed both as an indicator of the aptitude of students for the particular course as well as the quality of teaching in the colleges. In the year 2012, the result analysis of 84 engineering colleges by the Directorate of Technical Education shows that 60% of engineering colleges have an average pass percentage of 50% for the academic year 2009-2011. The researcher has considered the result of 2015-16 academic year of 152 engineering colleges, published in the website of KTU for further analysis.

Table 16

Total Pass Percentage of Engineering Colleges in Kerala for 2015-16

Pass percentage	Government	Aided	Self-financing	Total (%)
Above 90%	2		1	1.97
80-90%	4	3	7	9.21
70-80%			10	6.58
60-70%	3		20	15.13
50-60%			18	11.84
40-50%			15	9.86
30-40%			28	18.42
20-30%			23	15.31
10-20%			15	9.87
< 10%			3	1.97

Source: Website of KTU

It can be seen from the values that all the Government Engineering colleges are having very good performance in terms of pass percentages. All the three Aided colleges also are having very good pass percentages, between 80 and 100%.

Though the number of Self-financing colleges is more, they are having very low values with respect to success of students in academics. Only 38 colleges are having pass percentages above 60. Majority of the colleges - a huge 72.34% are showing very low pass percentages.

Discussion

One of the very important indicator of the quality and standard of any educational institute is the students' performance in the evaluations. Here analysing the result from the above table it reveals that majority (55.26%) of the engineering colleges have below 50% pass. The performance of Government and aided engineering colleges are found to be far more superior to the self-financing category colleges. The majority of self-financing colleges (59%) performance in respect to the examination result was very poor. It can be seen as an indication of both the low academic standards of the students as well as the poor quality of teaching.

Placement of students

The data collected was analysed to check the percentage of students getting placements once they pass out of the colleges. The table presents the year wise percentage of placed students passed out from the aforementioned five branches of study.

Table 17

Year wise Percentage of Placed Students based on the Pass Rate of Five Branches of Engineering and Technology

Branches	2013-14	2014-15	2015-16
Electronics & Communication Engineering	45.77%	50.26%	99.45%
Computer Science	49.93%	50.62%	97.52%
Mechanical Engineering	41.50%	45.27%	79.42%
Civil Engineering	39.94%	23.06%	62.50%
Electrical & Electronics Engineering	46.23%	42.08%	85.09%

Source: Kerala Economic Review (Various Issues), State Planning Board, Govt. of Kerala.

The data reveal that the rate of placement increased from 2013 to 2015. The placement rate was low in civil engineering when compared to other branches. In the year 2015-16 the rate of placement was comparatively high to the other years. This trend can be attributed to the low pass percentages for the year 2015-16.

Discussion

The percentage obtained is based on the pass rate; this pass rate influences the percentage of placement. For the years mentioned the pass percentage was decreased. This decrease influences the percentage rate of placement. The less the number of successful students, the more will be the job opportunities and less competition for the existing post hence the high placement rate.

Conclusion of Profile Analysis

From analysing the profile of the colleges from the secondary data, it is revealed that there has been a rapid increase in the number of engineering colleges in Kerala for the last few years along with the intake capacity. The major share of this increase is the increase of institutions belongs to the self-financing sector. Though the intake is more, there is a negative trend in the enrolment rate of students. In addition to this, thousands of engineering seats have remained vacant over the years and majority of these vacant seats are in private self-financing engineering colleges.

One of the performance indicators of engineering education is the NBA accreditation of engineering programmes. The accreditation status of courses of engineering colleges was not satisfactory. In most of the engineering colleges the accreditation is not completed and very few colleges have accredited courses. Another indicator of performance of any educational system is the examination result of its students. The performance with respect to the result analysis is also not satisfactory as the majority of engineering colleges from the Self-financing sector have below 50% pass.

Compared to the self-financing colleges, the performance of both the Aided and Government engineering colleges is very superior. Admitting students with low marks both in entrance examinations and higher secondary examination in self-financing colleges overtaking the stringent stipulations of entrance commission might be one of the reasons for the low pass percentages in various engineering disciplines and this finally leads to the weak performance of engineering colleges too. The quality issue of engineering colleges arises from these problems:

- Sanctioning of large number of colleges without considering the demand for such courses.
- Non-adherence of Entrance examination marks / achievement in Plus Two for admission to the management seats.
- High intake capacity.
- Low pass percentage and poor placement facility.
- Large number of vacant seats in engineering colleges in Kerala.

Phase 2: The Facilities Available at Engineering Colleges

The phase 2 of the study was undertaken to analyse the facilities available at engineering colleges in detail. During this phase, the investigator tried also to uncover the problems of engineering colleges in Kerala from the responses of sample selected for the study. The responses of principals, faculties and students of engineering colleges were analysed separately for each category. The responses of graduates in engineering and parents of ongoing engineering students were also analysed. This section presents the percentage analysis and interpretation of each component separately for principals, faculties, students, graduates and parents.

As for the sample selected for the study, the break up is given below:

Table 18

Sample of the Study - Break up

Type of management / Sample	Government	Aided	Self-financing	Total
Principals	4	1	25	30
Faculties	43	22	119	184
Students	80	60	300	440
Graduates		50		
Parents		50		

Infrastructure and Instructional Facilities

One of the objectives of the study was to find out the infrastructure and instructional facilities of engineering colleges in Kerala. For that the investigator analysed the data obtained from the responses of Principals, Faculty members, Students, Graduates, Parents of students of engineering colleges in Kerala.

Classroom.

The most important aspect of infrastructural and instructional facility is the class room. Based on the stipulations on starting a new engineering college having undergraduate courses given in the hand book of All India Council of Technical Education (AICTE), the number of class rooms required is equal to the number of divisions, i.e. 4 classes are required for 4 divisions with carpet area 66 sq.m/room for the first year. Then the number of classes should increase in the progressive years.

Responses of principals on class room facilities.

The responses of principals from Government, Aided and Self-financing colleges on availability and facilities of class rooms in their respective colleges were collected and analysed.

All the principals from all three sectors stated that their colleges have adequate number of class rooms. Two of the Government college principals, the Aided college principal and the majority of the Self-financing college principals (88%) reported that they were satisfied with the facilities of the class rooms. The other two Government college principals and the rest of the Self-financing college principals were not satisfied. The reasons cited for the same are as given below:

- Not enough space to accommodate all the students of that class as the intake capacity is growing year by year.

- Old class rooms and old buildings, not modernised up to the needs of the courses.
- Not enough spare land for further expansion of buildings

Responses of faculties on class room facilities.

The responses of the faculties with respect to the facilities of class rooms are presented in the Table 19.

Table 19

Percentage of Category wise Responses of Faculties on Classroom Facilities of Engineering Colleges

Particulars	Percentage of responses					
	Government		Aided		Self-financing	
	Yes	No	Yes	No	Yes	No
Response on satisfaction in the facilities of class rooms	74.42	25.58	68.18	31.82	89.92	10.08

The values reveal that 25.58% of Government, 31.82% of Aided and 10.08% of Self-financing engineering college faculties are not satisfied on class room facilities available in their colleges.

According to those government engineering college faculties who are not satisfied on the class room facilities, the rooms are not built according to the needs of the courses, disproportionate expansion of facilities with respect to the increased intake of students, insufficient space in old buildings, rooms/ buildings being not suitable for such technical courses, inadequate facilities in class rooms and poor construction of rooms.

The 31.82% of the aided engineering college faculties pointed out that though new buildings are being constructed to accommodate the increased number of students, the structure of the rooms is old. The teachers of self-financing colleges did not express any reason for their dissatisfaction on class room facilities.

Responses of students on class room facilities.

Students were asked about the classrooms in general - the numbers, overall conditions of the classrooms, their views on various facilities etc. The responses of the students are presented in the Table 20.

Table 20

Percentage of Category wise Responses of Students on Classroom Facilities of Engineering Colleges

Particulars	Percentage of responses					
	Government		Aided		Self-financing	
	Yes	No	Yes	No	Yes	No
Whether having adequate number of class rooms	90	10	70	30	94.74	5.26
Response on satisfaction in the facilities of class rooms	80	20	41.38	58.62	69	31

From the responses of the students, it can be understood that majority of the colleges have adequate number of classrooms. Only 10% Government, 30% Aided and 5.26% Self-financing college students responded that the number of class rooms is inadequate in their colleges, but the reasons cited by those who were not satisfied with the facilities are different in each category.

20% of government engineering college students were unsatisfied, most among them responded that the rooms are not spacious enough and the rest did not respond.

58.62% of students of Aided colleges are not satisfied on class room facility, majority of them wrote the reason that the number of students was high but the class room space was less. Few pointed out that there is not enough ventilation in class rooms, some others responded that fans and furniture were not good, old and damaged. In summer season, they found it very uncomfortable sitting in the class rooms.

31% Self-financing college students reacted that they were not satisfied on the class room facilities of their colleges, the main reasons being the low ventilation and bad seating arrangements in the rooms.

Discussion

From the above responses regarding the class room facilities in the colleges, all principals from the three categories of colleges reported that their colleges are having adequate number of classrooms. Only half of the principals of Government colleges are satisfied with the facilities, while all from the Aided sector reported satisfaction. Again, majority of principals from Self-financing colleges are satisfied on class room facilities available in their colleges.

In the case of faculties, the unsatisfied faculties were high in aided category than government and self-financing engineering colleges. Analysis of the result obtained from the students revealed that satisfaction level was less in aided college students than self-financing and Government engineering college students.

From the responses of the actual stake holders i.e. the students, it can be deduced that class room facilities of aided colleges were inferior to the government and self-financing colleges even though all are having enough number of rooms.

It is evident that all the Government and Aided engineering colleges were constructed years back considering the then intake of students. With the new stipulations along with the increased number both in students and courses, the facilities they have had become insufficient. Also most of the Government colleges suffered from lack of spare land. In the case of Self-financing colleges, the problem of land is not much of a concern as they have started the colleges only in the recent times and tried to adhere to the stipulations with regard to class rooms.

Other instructional facilities.

Based on AICTE norms for engineering colleges offering UG courses, the following facilities are required.

- Laboratory: minimum number of rooms required for laboratory is 10/ course with a carpet area 66 sq.m/ room.
- Work shop : one room with 200 sq.m/room carpet area is essential.
- Additional lab and workshop are required for colleges having category X courses: Mechanical, Production, Civil, Electrical, Chemical, Textile, Marine, Aeronautical and allied courses of each.

- The laboratories must have equipments as appropriate for experiments as stated / suitable for the requirements of the affiliating University / suitable to the curriculum. It is desired that number of experiment set ups be so arranged that maximum four students shall work on one set.
- One Drawing hall and one Seminar hall/course with a carpet area of 132 sq.m/room each
- Departmental computer room & Central Computing Facility for students. The area requirement for computer room is 75 sq.m. The minimum number of computers required is 20. The student - computers ratio recommended for UG course is 1:4 and for PG 1:2. Every college should set up 3 legal system software, 20 application software, 10% colour printers with respect to the number of computers.
- Central library with reading room & Departmental library facility. The minimum carpet area required is 400 sq.m/room. There should be reading room seating arrangement for 15% of students or maximum 150 capacity. Minimum 100 titles, 500 volumes, subscription of e-journals and national journals (6 national journals per course/ branch), digital library, reprographic facility, document scanning and document printing facility and NPTEL facilities are essential. Hard copy international journal is a desirable thing.

Laboratories and workshops- responses of principals.

The responses of principals from Government, Aided and Self-financing colleges on availability and facilities of instructional facilities in their respective colleges were collected and analysed.

All the principals from all three sectors stated that their colleges have adequate number of laboratories for all branches of courses. The selected Government college principals and the Aided college principal responded that with the enough number of laboratories and workshops, there are enough equipment/ machinery/ apparatus/furniture at both places. They have expressed satisfaction in the facilities offered by different labs and workshops at their colleges. The principals also reported that they have additional workshops too.

In the case of Self-financing colleges, though majority of the principals responded that their colleges have enough number of equipments in laboratories and are satisfied with the facilities (84%), some have expressed that equipments and the facilities are not enough for the courses and students. In the case of the number of workshops, additional workshops and equipments in the workshops also, some principals reported dissatisfaction. One principal stated that the number of workshops is inadequate and two of them said that though there are enough numbers, the equipments are not enough for all the activities. 12% self-financing college principals give the reason for dissatisfaction as building of the workshop is not good. One of the principals from a self-financing category responded that the workshop roof is done with asbestos sheet and it is very difficult to carry out classes in hot season and it is not good for students also. In 5 colleges, there is no additional workshop as they do not offer 'X' category courses. Majority are satisfied on the workshop facilities too.

The values are consolidated and presented in the Table 21.

Table 21

Category wise Responses of Principals on Laboratories and Workshops

Parameters	Frequency of responses					
	Government		Aided		Self-financing	
	Yes	No	Yes	No	Yes	No
Adequate number of Laboratories	4	-	1	-	25	-
Enough equipments in Laboratories	4	-	1	-	21	4
Lab facility is satisfactory	4	-	1	-	21	4
Adequate number of workshops	4	-	1	-	24	1
Enough equipments in workshops	4	-	1	-	23	2
Additional workshop	4	-	1	-	20	5
Satisfied on workshop facilities	4	-	1	-	21	4

Laboratories and workshops- responses of faculties.

The faculties were asked about the facilities offered in laboratories and workshops. Their responses are consolidated and presented in the Table 22.

Table 22

Percentage of Category wise Responses of Faculties on Laboratory and Workshop Facilities

Particulars	Percentage of responses					
	Government		Aided		Self-financing	
	Yes	No	Yes	No	Yes	No
Satisfied on Lab facilities	76.74	23.26	50	50	92.46	7.56
Satisfied on Workshop facilities	100	0	100	0	84.03	15.97

Analysis of the data revealed that nearly one fourth of the faculties at Government colleges and half of those from Aided colleges are not satisfied on laboratory facilities of their colleges. Only few of the faculties from the Self-financing engineering college expressed dissatisfaction about the facilities of labs.

About 72% of the unsatisfied faculty members of Government engineering colleges responded that some equipments are old, damaged and not useful and 81.82% of unsatisfied faculties belonging to Aided category also given the reason as laboratory equipments and facilities being not good. Those from the self-financing category have given the reason for dissatisfaction as the facilities and equipments in the laboratories being inadequate to meet the needs of the students. A few (5.04%) of self-financing college faculties responded that the accessibility of laboratory facilities to students is a problem in their colleges.

Majority of the faculties were satisfied on the workshop availability of the engineering colleges in Kerala. Only a small proportion (15.97%) of self-financing category faculties was not satisfied on workshop facilities availability. The reason pointed out by them was that some equipments and machineries were not working properly and proper maintenance is not being done regularly.

Laboratories and workshops- responses of students.

Students were enquired about the number of equipments and facilities at laboratories and workshops. Their responses are given in the Table 23.

Table 23

Percentage of Category wise Responses of Students on Laboratory and Workshop Facilities

Particulars	Percentage of responses					
	Government		Aided		Self-financing	
	Yes	No	Yes	No	Yes	No
Adequate number of Laboratory	94.74	5.26	85	15	60	40
Enough equipments in Lab	65	35	79.31	20.69	56.86	43.14
Lab facility is satisfactory	60	40	65	35	45	55
Adequate number of workshop	90	10	58.62	41.38	56.86	43.14
Enough equipments in workshop	80	20	55	45	53.33	46.67
Is there additional workshop	100		90	10	50.98	47.06 1.96*

* omitted

From the table it is clear that majority: 94.74% government, 85% aided and 60% self-financing of sampled students, responded that they have adequate number of laboratories in their colleges. Only 65% Government engineering college students, 79% Aided college students and 57 % Self-financing college students responded that there were enough equipments in the laboratories. Many of them expressed that there are not enough equipments in the laboratory. A good number of students from all three sectors expressed that they are not satisfied on the facilities in the laboratories. The percentage of satisfaction level is least in self-financing category. Only the self-financing category students have given reason for dissatisfaction that they were not permitted to freely use their lab facilities all the time they need. There were some restriction from faculties and technical staff.

It can also be seen from the values that majority of the students from Government colleges reported that there are enough number of workshops in their colleges and are satisfied with the number of equipments available there. About half of the students from Aided and Self-financing colleges reported that their colleges do not have adequate number of workshops or equipments. All sample of Government and 90% from Aided colleges reported that their colleges do have additional workshop. Some self-financing college students were not even aware about the presence of an additional workshop at their colleges and (1.96%) omitted the item.

Discussion

Engineering is a skill based profession. Hence laboratory work and workshop is very significant. So any deficiencies in these experiences negatively affect the complete development of engineering competencies and skills in students. From the responses of principals it is clear that in some of the self-financing category of engineering colleges have problems regarding laboratory and workshop facilities.

The results of faculties' responses regarding laboratory facility revealed that the majority of aided faculties were not satisfied on the facilities available in their colleges. Regarding workshop facility self-financing faculties were least satisfied than the other two.

The analysis of the result obtained from the responses of students revealed that there were limitations regarding laboratory and workshop facilities in engineering colleges in Kerala. The self-financing students expressed more limitations than the aided and Government engineering colleges. Majority of them responded that though they have the facilities, the restrictions on accessibility of these facilities are negatively affecting the development of skills.

Drawing hall, seminar hall, computer facilities and common facilities- responses of principals.

The responses of principals on the availability and facilities of Drawing Hall, Seminar Hall, Computers and other Common amenities are consolidated and presented in the table below.

Table 24

Category wise Responses of Principals on Drawing Hall, Seminar Hall, Computer Facilities and Common Facilities

Parameters	Frequency of responses					
	Government		Aided		Self-financing	
	Yes	No	Yes	No	Yes	No
Adequate number of drawing halls	4	0	1	0	25	0
Response on satisfaction in the facilities of drawing halls	3	1	1	0	25	0
Whether having adequate number of seminar hall	4	0	1	0	25	0
Response on satisfaction in the facilities of seminar hall	4	0	1	0	25	0
Computer Facilities						
Availability of Departmental computer rooms	4	0	1	0	25	0
Central computing facility	4	0	1	0	25	0

Table 24 contd...

Parameters	Frequency of responses					
	Government		Aided		Self-financing	
	Yes	No	Yes	No	Yes	No
Adequate No. of computers	4	0	1	0	21	4
Internet	4	0	1	0	25	0
Printers	4	0	1	0	23	2
Colour printer	4	0	1	0	24	1
Wi-Fi	4	0	1	0	24	1
Central photocopying in computer room	4	0	1	0	20	5
Satisfaction	4	0	1	0	21	4
Students' Resting room / Common room	4	0	1	0	25	0
Satisfaction on the above	4	0	1	0	21	4
Physical exercise facilities	4	0	1	0	25	0
Satisfaction on the above	3	1	1	0	20	5
Hostel facility	4	0	1	0	25	0
Satisfaction on the above	4	0	1	0	18	7
Auditorium	4	0	1	0	23	2
Cafeteria/ Canteen	4	0	1	0	25	0

The selected Government college principals and the Aided college principal reported that their colleges have all the stipulated facilities as listed in the table, though in the case of drawing hall facilities and the facilities for physical exercise for students, one Government college principal expressed dissatisfaction.

About the Self-financing college principals, though majority of them expressed satisfaction in the number and facilities of all the above mentioned parameters, in the case of adequate number of computers, printing &

photocopying facilities and Wi-Fi they reported inadequacy. Though all the colleges are having Students' Resting room / Common room, Auditorium, Physical exercise facilities and Hostel facilities, a few of the principals are not satisfied.

Drawing hall, seminar hall and computer facilities-responses of faculties.

The faculties were mainly asked about the facilities at both the drawing hall and the seminar hall. They were also asked about the computer facilities - central computing facility and the departmental facilities. Their consolidated responses are given in the Table 25.

Table 25

Percentage of Category wise Responses of Faculties on Drawing Hall, Seminar Hall and Computer Facilities

Parameters	Percentage of Responses					
	Government		Aided		Self-financing	
	Yes	No	Yes	No	Yes	No
Adequate number of drawing halls/Seminar Hall	100	0	100	0	100	0
Response on satisfaction in the facilities of drawing halls	93.02	6.98	100	0	94.12	5.88
Response on satisfaction in the facilities of seminar hall	90	10	90	10	65	35
Response on satisfaction on the computer facilities	97.67	2.33	72.73	27.27	52.10	47.90

All the colleges are having drawing halls and seminar halls, as reported by the faculties and all/ majority are satisfied on the facilities too. A very low percentage of the Government and Self-financing college faculties are not very satisfied with the facilities of the drawing hall, the reasons being damaged tables and other furniture in the hall. Here again majority of the Government and Aided college faculties are satisfied with the facilities of the seminar hall, but a sizeable proportion of self-financing college teachers were not satisfied on the facilities.

The satisfaction regarding the computing facilities is highest with Government college faculties, not so much with the other two categories. Those who were not satisfied with the facilities they expressed the reasons for their dissatisfactions as,

- no adequate number of working computers
- poor seating arrangement in the computer rooms
- low seating capacity
- no proper Wi-Fi facility

Drawing hall, seminar hall and computer facilities- responses of students.

The students were mainly asked about various facilities they were being provided with and their feelings towards the same. The data are presented in the Table 26.

Table 26

Percentage of Category wise Responses of Students on Computer and Other Common Facilities

Parameters	Percentage of Responses					
	Government		Aided		Self-financing	
	Yes	No	Yes	No	Yes	No
Adequate number of drawing/seminar halls	100	0	100	0	85	15
Response on satisfaction in the facilities of drawing halls	70	30	60	40	65	35
Response on satisfaction in the facilities of seminar hall	90	10	90	10	65	35
<u>Computer Facilities</u>						
Availability of Departmental computer rooms	100		100		94.74	5.26
Central computing facility	100		100		100	
Adequate No. of computers	85	15	65	35	45	55
Internet	94.74	5.26	100		92.16	7.84
Printers	65	35	62.07	34.48	62.75	31.37
Colour printer	30	70	51.73	48.28	19.61	80.39
Wi-Fi	100		37.93	62.07	50.98	47.06
Central photocopying in computer room	70	30	79.31	20.69	56.86	43.14
Satisfaction on the above	85	15	41.38	58.62	33.33	66.67
<u>Other Common Facilities</u>						
Students' Resting room / Common room availability	90	10	100	0	65	35
Satisfaction in the above (well furnished)	50	50	20	40 40*	26.67	70 3.33*
Toilets attached	60	40	23.33	33.33 43.33*	28.33	65 6.67*
Separate room for boys and girls	75	25	43.33	53.33 3.33*	30	66.67 3.33*
Availability of Hostels	100		100		91.67	8.33
Hostel residents	80	20	73.33	26.67	53.33	46.67
Well furnished hostel rooms	50	50	40	33.33 26.67*	23.33	46.67 30*
Satisfaction on the above	50	50	43.33	56.67	20	80

* omitted

From the table it is clear that all sampled students from Government and aided and majority from the self-financing categories responded that they have adequate drawing hall and seminar hall facility. Majority agreed that they are satisfied on the availability. Dissatisfied students from all categories gave similar reasons : not enough tables, damaged and old furniture, not big enough to accommodate all students etc.

All reported that they have departmental and central computing facility in their colleges except 5.26% of students from self-financing category with respect to departmental computer facility. Most of the Government college students said that there is adequate number of computers, along with other facilities like Internet, Printers, Colour Printers, Wi-Fi, Central photocopying in computer room and expressed satisfaction too on the availability and utilisation. On the other hand, on an average, about half of the students from the other two categories of colleges pointed out the inadequacy of these facilities. Their satisfaction levels also are not very high.

Five percentage of government students not responded to the item regarding internet facility. 3.45% aided and 5.88% self-financing college students not responded to the items about printers. 3.45% aided students omitted the item about the colour printer. 1.96% self-financing students omitted the item about wifi facility.

The unsatisfied students from the Govt category responded that the latest version of software are not supported by the computers in the departments labs, some pointed out that developed version of computers are available only in central computing facility centre, not in the departmental labs where they would have been more comfortable.

A good number of Aided students opined that there is less number of computers. 17.24% of aided category students opined that furniture in the computer room was not good. 17.24% expressed that the working of all computers are not satisfactory as most of the computers are old generation computers, most of the time so many computers hang and do not work properly.

Regarding the furniture and other facilities of computer rooms, 58.82% of unsatisfied students of self-financing responded that computer room is not well furnished, 30% of them pointed out that there is no proper seating in computer room and no air conditioning (21%) in the computer room. Many issues are pointed out by the students, such as,

- the student - computer ratio is not adequate.
- the capacity of computer room is inadequate to accommodate all students from same class.
- unsatisfactory back up/ UPS,.
- damaged and old computers
- the software do not work properly and antivirus is not uploaded.
- weak internet connection/no internet connection, low speed, network problem, no adequate Wi-Fi.
- printers are less in number, printers are not working properly, only one computer is connected to printer.

- staff does not allow to print copies.
- no educated staff to maintain it.
- unwanted rules from management.

From the table it is clear that majority of engineering colleges have adequate student resting room facility, but 10% government and 35% Self-financing college students responded that no adequate rest room facility is available. Most of the students from the three categories of colleges responded that they are not satisfied on the resting room facility available in their colleges. The deficiencies pointed out by them are as follows:

- The rooms are not well furnished
- No separate rooms for boys, only girls' rooms are there
- No attached toilets

As much as 40% aided and 3.3% Self-financing students omitted the item about furniture availability of student resting rooms and 43.33% aided and 6.67% self-financing college students omitted the item about the availability of lavatory in the resting room. It may be because of that, most of them are hostellers and they do not have to use the common resting rooms/ toilets.

Majority of the unsatisfied Aided college students raised an issue regarding common room facility, that it is not clean and not much good as a rest room, 58.33 percent among them pointed out the limitation of small rooms, facilities are not sufficient and meant only for ladies.

Considering the hostel facilities provided by the colleges, it can be seen from the values that all the Government and the Aided colleges are providing adequate hostel facilities. It seems that he Self-financing colleges are unable to provide hostel for all students.

About as many as half of the residents of Government and Aided college hostels reported that the rooms are not well furnished and have bad infrastructure and no study halls, only rooms. Less ventilation in hostel rooms, poor mess facility, unsatisfactory cleaning and inadequate water supply, no freedom and rude behaviour of matrons/ wardens are some of the other complaints.

Discussion

It is clear from the responses of students that all there was higher sense of dissatisfaction among the students. Damaged furniture, improper ventilation, inadequate size of rooms etc are some of the reasons pointed out by the students regarding drawing hall and seminar halls. Both places are important for the functioning of a technical institution. Still the authorities neglect these necessities.

Analysis of the data about the computer facilities of engineering colleges revealed that the satisfaction level is low with self-financing college students when compared to the other two category of students. The responses of principals and faculties were somehow contradictory. The unsatisfied students raised so many issues regarding computer facility. They are the actual stakeholders; they feel more problems regarding the facilities. The issues raised by the students were not simple as it is the era of technology and computers and it has a very significant role in education especially in all disciplines of engineering. So any deficiencies regarding this will also negatively contribute to the education of Kerala.

Based on AICTE regulation, all engineering colleges should have common room for girls and boys. Analysis of the above data indicate that majority of students were not satisfied on common room facility of their college. In many of the colleges common room is not available for boys. Inadequacy of the existing facilities is pointed out by all the category of students. There is some contradiction with the responses of faculties and principals with that of students, majority of principals and faculties were satisfied on the availability of common room facilities.

Many students are coming from distant places and a place to live in peace for better studies is as important as good colleges. Provision of good and clean places of stay is essential for a good college. It should be conducive to good learning.

Library facilities- Responses of principals.

The responses of Principals about the library facilities offered by their respective colleges are collected and given in the Table 27.

Table 27

Category Wise Responses of Principals Regarding Library Facility

Particulars	Frequency of Responses					
	Government		Aided		Self-financing	
	Yes	No	Yes	No	Yes	No
Central Library	1	0	1	0	25	0
Departmental library	1	0	1	0	24	1
E- journals	1	0	1	0	24	1
Multimedia PCs	1	0	1	0	19	6
Computerised indexing	1	0	1	0	25	0
Reading room seating	3	1	1	0	25	0
Reprographic facility	1	0	1	0	24	1
Document scanning	1	0	1	0	24	1
Document printing	1	0	1	0	24	1
NPTEL	1	0	1	0	17	8
Satisfaction	3	1	1	0	20	5

Except in the case of reading room seating and overall satisfaction with respect to library facilities in one Government college, all Government and Aided college principals claimed that they have Central Library, Departmental library, E- journals, adequate number of Multimedia PCs, Computerised indexing, Reprographic facility, Document scanning & printing facility and NPTEL. 24% self-financing college principals responded that availability of multimedia PCs are not satisfactory and 32% reported that no NPTEL facility is available in their colleges. 4% reported that no departmental library, e- journals, photocopying facility, document scanning and document printing facility in their library.

The number of books and journals available in the libraries as reported by the principals are given below.

Table 28

Number of Books Available in the Engineering College Libraries- Principals' Responses

Number	Government	Aided	Self-financing
Total Books			
50000 and above	2	1	
40000-50000	1		
30000-40000	1		2
20000-30000			8
Below 20000			2
Number of Reference Books			
5000 and above	3	1	
4000-5000	1		1
3000-4000			
2000-3000			8
1000-2000			3
Below 1000			
Number of National Journals			
150-200	2	1	1
100-150	2		9
50-100			1
Below 50			1
Number of International Journals			
50 and above	2	1	
40-50	2		2
30-40			7
20-30			3
10-20			
Below 10			

All Government college principals claimed that their colleges are having more than 30,000 books in their libraries. In the Aided college also, there are more than 50,000 books. The Self-financing colleges are having comparatively lower number of books, majority having number of books between 20,000 to 30,000. Both the Government and Aided colleges are having a good number of reference books too when compared to that of Self-financing colleges. Only 12 principals from self-financing colleges were ready to respond to the items regarding the number of books and reference books. Almost all colleges are having both national and international journals in their libraries in the range of 50 - 100 and 20 - 30 respectively.

Number of Library cards given to faculty members and students

Regarding the number of library cards given to the faculty members, all the Government and Aided Engineering college principals responded that generally 5 cards are given to each faculty, except in 6 engineering colleges where 7 cards are given. In the case of students, 5 cards are given by government colleges. The aided colleges responded that 2 library cards are given to each student. 20 self-financing college principals responded that 5 cards are given to students, 4 responded that they are providing 4 cards to students and 1 responded that 6 cards are given to students.

Library facility-responses of faculties.

Percentage score obtained for the faculty members regarding their response to library facility is presented in Table 29.

Table 29

Percentage of Category wise Responses of Faculties on Library Facility

Particulars	Percentage of responses					
	Government		Aided		Self-financing	
	Yes	No	Yes	No	Yes	No
Satisfied on Library facilities	69.77	30.23	63.64	36.36	48.74	51.26

The values indicate that a fair number of faculties, especially from Self-financing colleges are not very satisfied with the facilities of the library. The main reasons pointed out by them are,

- Not spacious enough to accommodate all
- Small reading rooms
- Scarcity of books for general reading
- Shortage of subject based books

Some of the faculties from Self-financing Engineering college faculties stated that they don't have department library in the college (19.61%) and no materials for general reading (43.14%).

Library facility-responses of Students

Students were mainly asked about whether the books available are adequate for their requirements and facilities for scanning, photocopying etc. Their responses are summarised in the Table 30.

Table 30

Percentage of Category wise Responses of Engineering College Students on Availability of Library Facility

Facilities of Library	Percentage of responses					
	Government		Aided		Self-financing	
	Yes	No	Yes	No	Yes	No
Adequate books available	60	40	63.33	36.67	35	65
Adequate journals available	80	20	70	30	43.33	56.67
Document Scanning	65	35	63.33	30 6.67*	35	61.76 3.33*
Document printing	30	70	73.33	13.33 13.33*	35	60 5*
Photocopying facilities						
NPTEL (National Programme on Technology Enhanced Learning)	60	40	36.67	33.33 30*	21.66	46.67 31.67*
Satisfaction	55	45	63.33	36.67	43.33	56.67

* omitted/ not aware

From the values it is clear about more than half of the students from self-financing colleges (56%) and less than half of the aided (36%) and government category (45%) are not very satisfied on the availability and functioning of library offered to them by their colleges. The reasons cited by them are similar in nature:

- no adequate books available
- not enough journals
- no document scanning facility

- no document printing facility
- not aware of NPTEL facility
- no NPTEL facility in their colleges
- poor reference system
- syllabus prescribed books are limited in number
- books for reference are not available to all
- small reading room
- no online books and journals
- shortage of reference books
- poor reading room seating

Some of the students omitted and responded don't know on few items regarding library facilities. 6.67% of aided students and 3.33% self-financing students omitted the item regarding document scanning facility. 13.33% aided and 5% self-financing students responded that they don't know whether document printing is available in their library or not and 30% aided and 31.67% self-financing students responded to the item about NPTEL facility as don't know.

It is alarming to note that 31.67% of self-financing and 30% aided sampled students responded that they don't know whether NPTEL facility is available in their institute or not. It can also be deduced from the comparison that the self-financing colleges are not providing enough library facilities to students.

Responses of Students on the Number of Library Cards Given

In the case of Government category, sampled students responded that they had 2 / 5 library cards and these were not enough. In aided colleges also, two cards are given to a student generally. Students from some colleges (13.33%) expressed that library cards are not issued, but they can take 2 books using ID cards. The number of library cards given to students of self-financing colleges was different. The sampled students responded that they have as many as 7. 35% of students opined that in a semester 6 subjects are there, so at least 6 cards are what they need.

Discussion

The results indicate that there were some limitations regarding library facilities of engineering colleges. The issues were raised more by the self-financing students. It was also noted that few students responded 'Don't know' to the item regarding the facilities like NPTEL, document printing and document scanning. It may be because of their lack of awareness on the facilities they have. When cross checking the responses with the data of principals and faculties with students there were dissimilarities. Majority of the principals and faculties claimed that engineering colleges have satisfactory library facilities.

Essential requirements.

Based on AICTE handbook 2013, all engineering colleges should provide the essential requirements. Institutions not maintaining essential requirements shall be liable to suspension of approval for supernumerary seats, if any for one academic year or no admission status in one / more courses for one academic year. The requirements are,

1. Stand alone language laboratory
2. Potable water supply
3. Electric supply
4. Sewage disposal
5. Fax
6. Telephone
7. Website
8. Barrier free built environment (for physically challenged)
9. Fire and safety & other safety measures
10. General notice board
11. First aid medical counselling facility
12. Grievance redressal committee

Responses of principals and faculties on essential requirements.

The responses of the principals from all three category colleges are summarised and given in the Table 31.

Table 31

Percentage of Category wise Responses of Principals on the Availability of Essential Requirements of Engineering Colleges

Particulars	Frequency of responses					
	Government		Aided		Self-financing	
	Yes	No	Yes	No	Yes	No
Stand alone language laboratory	4	0	1	0	24	1
Potable water supply	4	0	1	0	25	0
Electric supply	4	0	1	0	25	0
Sewage disposal	4	0	1	0	24	1
Fax	4	0	1	0	25	0
Telephone	4	0	1	0	25	0
Website	4	0	1	0	25	0
Barrier free built environment	4	0	1	0	24	1
Fire and safety& other safety measures	4	0	1	0	25	0
General notice board	4	0	1	0	25	0
First aid medical counselling facility	4	0	1	0	25	0
Grievance redressal committee	4	0	1	0	25	0
Antiragging cell	4	0	1	0	25	0

All the principals responded that their colleges have all the listed essential requirement except in the case of one (4%) self-financing engineering college where there is no Language laboratory, no sewage disposal plant and no barrier free built environment.

All the faculties of Government and aided category responded that their colleges posses all the essential requirement listed in the table. All faculties of self-financing category also responded that college have the essential requirement except in three cases. That is, 15.97% faculties responded that no stand alone language laboratories, 20.17% responded that no barrier free built environment in the college. 10% of them point out the limitation as no first aid medical facilities.

Responses of students on essential requirements.

The responses of students were a bit different from that of their teachers.

Table 32

Percentage of Category wise Responses of Students on the Availability of Essential Requirements of Engineering Colleges

Particulars	Percentage of Responses								
	Government			Aided			Self-financing		
	Yes	No	Omitted	Yes	No	Omitted	Yes	No	Omitted
Stand alone language laboratory	65	35		36.67	63.33		15.33	80	4.67
Potable water supply	95	5		91	10		94.67	5.33	
Electric supply	100			100			100		
Sewage disposal	60	38.75	1.25	73.33	25	1.67	76	23.33	0.67
Telephone	100			100			100		
Website	100			100			81.67	11.67	6.66

Table 32 contd...

Particulars	Percentage of Responses								
	Government			Aided			Self-financing		
	Yes	No	Omitted	Yes	No	Omitted	Yes	No	Omitted
Barrier free built environment	77.5	22.5		61.67	30	8.33	67.67	27.33	5
Fire and safety& other safety measures	80	20		61.67	26.67	11.67	58.33	36.67	5
General notice board	100			93.33	3.33	3.33	89.33	9	1.67
First aid medical counselling facility	25	65	10	68.33	31.67		66.33	33	3.33
Grievance redressal committee	80	20	6.25	73.33	25	167	26.67	64	9.33
Antiragging cell	100			100			100		

About 35% of the Government college students and majority of Self-financing and aided college students reported that they do not have the help of a standalone language laboratory. Majority from all three category colleges reported on availability and expressed satisfaction too on potable water supply, electric supply, telephone, website, General notice board and Grievance redressal committee.

Twenty two percentage government, 30% aided and 27.33% self-financing engineering students responded that no barrier free built environment in their college. 8.33% aided and 5% self-financing students omitted the item. 20% government 26.67% aided and 36.67% self-financing engineering students responded that no fire and safety measures in their college. 11.67% aided and 5% self-financing students responded to the item as don't know. 65% government, 31.67% aided and 33% self-financing engineering students responded that their colleges have no first aid and medical facility in their colleges. 10% government and 3.33% self-financing responded that they don't know about first aid facilities. Majority, 64% of Self-financing college students responded that no grievance reddressel committee in their colleges.

Discussion

Analysis of the above responses revealed that many of the essential requirements are available in the engineering colleges, but in some colleges some of the essential requirements are not available. Based on the AICTE norms all colleges should set up these essential requirements. The majority of government students expressed the limitations regarding first aid medical and counselling facilities. Majority of aided engineering college students responded that no stand alone language laboratories in their colleges. In the case of self-financing engineering college majority of students responded that stand alone language laboratories and grievance reddressal committees were not available in their colleges.

Desirable requirements.

The desirable requirements for an engineering college as per the AICTE regulations are back up electric supply, public announcement system, post /ATM /bank facility, CCTV, insurance for students, display of courses in front of the college, staff quarters etc.

Responses of principals on essential requirements.

Table 33

Responses of Engineering College Principals on the Availability of Desirable Requirements

Item	Frequency of Responses					
	Government		Aided		Self-financing	
	Yes	No	Yes	No	Yes	No
Back up electric supply	4		1		25	
Public announcement system	4		1		25	
Post /ATM /bank facility	4		1		18	7
CCTV	4		1		25	
Insurance for students		4		1	1	24
Display of courses in front of the college	4		1		25	
Staff quarters	4		1		5	20

All Government and Aided category of engineering colleges have adequate desirable requirements specified in the AICTE handbook as per the responses of the faculties and principals, except insurance coverage for students. In the case of self-financing engineering colleges, 28% principals responded that there is no post and ATM/ bank facility in the college. 96% self-financing college Principals responded that there is no insurance for students and 80% of self-financing college principals responded that no staff quarters are available in their college.

From the analysis it was clear that the Government and Aided Engineering colleges are having all the facilities. All those colleges were established years ago, hence had amble time/ resources to make arrangements. On the other hand, most of the self-financing colleges were established not so long ago, and mostly in remote places. Post/Bank/ATM facilities will hopefully be established in such places soon.

Physical exercise facilities.

Responses of Principals on Physical exercise facilities.

Majority of the principals responded that there are adequate physical exercise facilities in their colleges, but one of the government engineering college principal was not satisfied on it as there is no space for outdoor games.

Responses of Faculties on Physical exercise facilities.

Table 34

Percentage of Category wise Responses of Engineering College Students on the Physical Exercise Facilities

Particulars	Percentage of responses					
	Government		Aided		Self-financing	
	Yes	No	Yes	No	Yes	No
Satisfied on Facility for physical exercise	67.44	32.56	100	0	89.08	10.92

32.56% government engineering college faculties were not satisfied on physical exercise facilities. The main reason pointed out by them was the shortage of space for outdoor games. All the Aided engineering college faculties were satisfied with the physical exercise facilities of their colleges. 10.92% self-financing college faculties were not satisfied on the physical exercise facilities and that expressed the reason as space availability for physical exercise is not enough.

Responses of Students on Physical exercise facilities.

The responses of the students on the physical excise facilities are presented in the Table 35.

Table 35

Percentage of Category Wise Responses of Engineering College Students on the Physical Exercise Facilities

Particulars	Percentage of responses					
	Government		Aided		Self-financing	
	Yes	No	Yes	No	Yes	No
Outdoor Game facility	80	20	100		36.67	63.33
Indoor game Facility	25	75	79.67	10 10.33*	33.33	63.33 3.33*
Satisfaction	60	40	80	20	28.33	71.67

* Omitted

From the table it is clear that majority of the sampled students from Government (60%) and Aided (80%) colleges are satisfied on the availability of facilities for physical exercises. 71.67% of self-financing college students responded that they are not satisfied on the facilities. 20% sampled students of government engineering colleges responded that they have no adequate outdoor game facility and 75 % responded that in their college, no adequate indoor game facility. 10% of the government category student opined that there is no enough tables for indoor games activity in their college. 20% of unsatisfied ones said that the play ground is very small and have only one basket ball court. 13% of Aided category student said that the room for indoor activity was not well built and not safe. Other issues pointed out by the students were,

- No separate courts for different types of games
- Not enough grounds
- No gymnasiums
- No facility for indoor games
- Not enough safety measures
- Timings not suitable, halls /facilities not available after college time.

Discussion: Analysing the above data it is noted that the facilities for physical exercise were not satisfactory in self-financing colleges when compared to the Government and aided engineering colleges.

Limitations regarding infrastructure facilities-responses of principals and faculties.

When asked about whether they are having any other limitations with respect to the infra structural facilities of the college, the Government college Principal pointed out that the college faces space constraints for further expansion. Some similar points pointed out by all respondents are as follows:

- principal's room was not attached to the office room
- no separate cabins for head of the departments

- faculty room available in the college was not satisfactory
- no separate cabins for all the faculties
- the auditorium was not satisfactory

Faculties also pointed out similar issues such as,

- the total land area available was not adequate
- no spare land available for further extension
- no separate cabins for faculties, only common room for all the faculties

17.65% faculties responded that the college has most of the facilities but it was not properly utilised/ made available.

Responses of graduates and parents about infrastructure facilities.

Majority of (80%) graduates responded that they were satisfied on infrastructure facilities while they were studying and 20% of them remarked that they were not satisfied on the infrastructure facilities available in the engineering colleges of Kerala. The dissatisfied graduates did not expressed the reason for dissatisfaction.

The parents were asked about the general aspects of infrastructure facilities available in the colleges: Classrooms, availability of computers, library facilities and hostel facilities. Their responses are given in the Table 36.

Table 36

Percentage Responses of Parents of Engineering Students on Infrastructure Facilities of Engineering Colleges

Item	Yes %	No %
Satisfaction on Infrastructure availability (Classrooms, Furniture, Computers, Hostels, Library)	46	54

46% of parents of engineering students were satisfied on the infrastructure facilities of engineering colleges of their child while 54 % parents were not satisfied on infrastructure facilities of engineering college. Most of them were not satisfied on the hostel facilities provided by the colleges such as,

- not enough hostel facility for girls: there were almost 1000 students but hostel accommodation is only for 150. The problem is mostly pointed out by the parents of students of Government colleges.
- small hostel rooms: 3 or more students have to share one room, difficult at the time of examinations.
- mess hall and kitchen are not clean
- no satisfactory toilet facilities.

44% parents expressed that their children often complain about lack of computer facilities and printers. Regarding library, 18% parents opined that not enough books prescribed in the syllabus are there in the library. 13% raised the problems of conveyance facility particularly for colleges in remote areas. The day scholars are suffering most regarding this lack of conveyance facilities. 9%

parents were dissatisfied on the canteen facility available in engineering colleges.

Human Resource: Availability and Performance

Human resources are the people who make up the work force of an organisation. Here it means the principals, faculties, and other staffs (technical and non - technical) of engineering colleges. One of the objectives of the study is to analyse the human resource availability and their performance at engineering colleges.

Responses of principals regarding human resources availability and performance.

The principals were asked about whether their colleges are having adequate faculties, in each branch, technical and non-technical staff and their satisfaction on the working of the resource personnel. The responses are compiled and given in the table 37.

Table 37

Category wise Responses of Engineering College Principals on Human Resource Availability

Particulars	Frequency of responses					
	Government		Aided		Self-financing	
	Yes	No	Yes	No	Yes	No
Adequate number of faculties (each branch) available	3	1	1	0	25	0
Satisfied with the working of faculties	4	0	1	0	20	5
Adequate number of Technical Staff available	4	0	1	0	24	1
Satisfied on manner of working of Technical staff	4	0	1	0	25	0
Adequate number of non teaching staff available	4	0	1	0	24	1
Satisfied with manner of working of non Teaching staff	4	0	1	0	25	0
Satisfied on human resource availability	3	1	1	0	19	6

Selected Aided and self-financing college principals responded that there is adequate number of faculties at their respective colleges. Two of the Government Engineering principals pointed out that they don’t have adequate number of faculties. Majority are satisfied on the working of faculties except 20% of self-financing engineering college principals. The reason they have specified is that most of the faculties are having only minimum qualification and least experience. They have further remarked that the fresh faculties are treating the job as a stop gap and on getting better positions they leave the job without completing the academic year which is detrimental to the smooth teaching - learning process.

Regarding the adequacy of technical staffs, majority of the principals claimed that they have adequate number of technical and non-technical staffs. 4% of self-financing engineering college principals expressed the inadequacy of technical staffs in their colleges. All the principals were satisfied on the working of technical staffs of engineering colleges.

Even with adequate number of human resources, one government and 24% self-financing engineering college principals responded that they were not satisfied on human resource availability of their engineering colleges. The Government engineering college principal expressed the reasons for dissatisfaction as that some of the faculties are guest faculties in their college. Even though they are having permanent faculties, on retirement or transfer, the positions most of the time are not getting filled up. Then they will have to opt for guest faculties. 20% self-financing college principals opined that most of the faculties only have minimum qualification and they are just pass outs from college and 8% expressed that on getting better jobs they go for it without completing an academic year, and are not committed to teaching.

Responses of faculties regarding human resources availability and performance.

The faculties were asked whether they are satisfied on the availability of faculties/technical staff/non-technical staff for the branches/ courses at their colleges. Their responses are given in the Table 38.

Table 38

Percentage of Category wise Responses of Faculties on Human Resource Availability

Item	Percentage of responses					
	Government		Aided		Self-financing	
	Yes	No	Yes	No	Yes	No
Satisfied on human resource availability	83.72	16.27	68.18	31.82	76.47	23.53

The values indicate that the majority of faculties were satisfied on the availability of human resources at their colleges. 16.28% Government, 31.81% Aided and 23.53% Self-financing engineering college faculties were not satisfied on human resource availability of engineering colleges.

A good percentage (71.43%) of unsatisfied faculties of government engineering colleges expressed their reason for dissatisfaction as the appointment of guest faculties on vacant positions of permanent employees on long leave. Guest faculties mostly are not committed to teaching and leave the job as and when then get better or new jobs. Half of them opined that though the government is sanctioning new courses, new posts are not being sanctioned based on the requirement. This leads to shortage of faculties. Guest faculties are taking the classes for M.Tech courses too. A few (16.27%) government faculties expressed that due to the shortage of clerical staffs they are forced to do clerical works related with the students.

Among the Aided faculties, 28.57% responded that some faculties are not committed to their duty. After some years of teaching they may go to abroad and their position is always vacant in the college or it may take up by guest faculties. Some (14.29%) of the Aided faculties also opined that student intake capacity increased but post sanctioning and appointment is not based on the intake of students, so teacher pupil ratio is not satisfactory.

A good portion of (35.71%) unsatisfied Self-financing college faculties opined that there is scarcity of qualified and experienced teachers in their engineering colleges. 28.57% expressed the limitation that most of the faculties are just M.Tech graduates with 2 or 3 years experience. The faculties expressed that they need experienced faculties or Professors to help them in academic matters. Guidance from senior and experienced faculties is a must. A few (28.57%) of them opined that there were unavailability of skilled full time faculties in self-financing colleges. Majority of (71.43%) self-financing faculties opined that in their colleges, faculties were appointed on temporary basis or contract basis so the permanency of faculties in the institution is a problem. 53.57% opined that job security of teachers in the case of salary, contract etc. create problems. They expressed that salary is very low compared to other engineering jobs. So they are always looking for better jobs and better salary.

Responses of students regarding human resources' availability and performance.

Students are the recipients of the efforts of the human resources of the colleges and their opinions and suggestions are the most valuable. Students were asked about the efforts / working of their principal, teachers, technical and non technical staff at their colleges. Their responses are tabulated as given below.

Table 39

Percentage of Category wise Responses of Engineering Students on Human Resources Availability

Item	Percentage of responses					
	Government		Aided		Self-financing	
	Yes	No	Yes	No	Yes	No
Satisfied on manner of working of Principal	90	10	90	10	73.67	26.33
Adequate number of faculties available	70	30	80	20	55	45
Satisfied with the working of faculties	70	30	73.33	26.67	31.67	68.33
Adequate number of Technical Staff available	77.5	22.5	83.33	16.67	67	33
Satisfied on manner of working of Technical staff	85	15	81.67	18.33	73.67	26.33
Satisfied with manner of working of non teaching staff	65	35	73.33	26.67	60	40

The table shows that majority of the engineering students (90% government, 90% aided and 73.67% self-financing) were satisfied; while 20% government, 10 % aided and 26.33% self-financing engineering students were not satisfied on the manner of working of principals. Some of the unsatisfied students of Self-financing college pointed out that principals are behaving in an autocratic manner, not considering students preferences, do everything without the consent of students and parents.

Majority of engineering college students responded that adequate number of faculties is there in their respective engineering colleges. The limitation regarding the number of faculties is high in self-financing colleges when compared to Government and Aided. Majority of government and aided students were satisfied on the working of faculties but the level of satisfaction was less in the self-financing category.

The unsatisfied students from the Government engineering colleges expressed many reasons for dissatisfaction as: subjective and egoistic faculties, no reinforcements are provided to students on their good work if they are naughty or not liked by the faculty, blaming without considering situation etc. Some faculties are not committed in taking classes, some faculties are guest faculties who do not stick around most of the times for the full academic year.

Aided engineering students (26.67%) also forwarded similar reasons for their dissatisfaction: guest faculties, unpleasant teachers etc.

A good percentage of (55%) self-financing engineering students gave their reasons as: classes are just syllabus oriented, faculties do not have any concern for student capacity, there were negative criticism from faculties, fresh graduates as teachers without any teaching experience. A few (14%) responded that majority of the faculties are trainees and guests, mostly not available for a complete academic year, so no one completes the syllabus. Also they lack teaching skills, experience, qualification not as per the qualification guidelines of AICTE and number of teachers are also less in their colleges.

Majority of Government, aided and self-financing engineering students responded that there were adequate number of technical staff and non teaching staff and satisfied on their working. But the satisfaction level is low in self-financing. The 40% unsatisfied students of self-financing given the reason as the over control and over rule of non-teaching staff, they were very intrusive, cooks up stories about students, some of them were very unfair to students.

Responses of graduates regarding human resources availability.

A good majority (64%) of graduates passed out from the colleges expressed satisfaction on the performance of faculties while 36% were not satisfied on the performance of faculties. Those from the self-financing colleges responded that their faculties did not have actual experiences to transfer the learning. In the case of non teaching staff also, the majority of graduates (96%) were satisfied. 68% of graduates were satisfied on the administrative system of the engineering colleges.

Responses of parents regarding human resource availability.

The majority of parents (82%) were satisfied on the working of principals of engineering colleges while 18 percentage of parents were not satisfied. 48% of the parents opined that there are limitations on the availability of faculties as there are scarcity of permanent faculty and faculty shortage in self-financing colleges. 48% of parents were not satisfied on the working of non teaching staff. 47% of parents responded that teachers do not inform students' academic matters in a timely manner. 53% parents responded that they do not discuss their child's academic matters with faculties.

Discussion

The main problem many of the colleges are facing is the shortage of permanent and experienced faculties. Faculty - Student ratio is poor in many colleges, mostly so with respect to Self-financing colleges. While the problem of Government and Aided colleges related to the permanent positions, the Self-financing colleges are unhappy about the performances of the guest faculties. The permanent faculties are concerned about the low qualifications of their fellow guest faculties and the guest faculties in turn are very much unsatisfied about the insecurities with respect to salary and permanency of the job. Whichever the type of college they are studying, students are concerned with the qualifications, experience, behaviour etc of their teachers.

Parent Teacher Association (PTA), College Union and Alumni Association

Parent - Teacher associations are as the name suggests associations which look into the matters of students and teachers with the aid of the parents of students. The associations are supposed to be a joint effort of the parents and teachers solve and discuss the various issues related to the students' life at colleges. The investigator tried to analyse the responses of the people concerned regarding the working of the association.

College union is a student organisation comprises of a group of representatives of students, the main objective of which is to work for the general welfare of the student community. Some colleges have sectional associations also in each department. The term generally is for one year. Usually a college union organises and conducts sports, arts and other cultural, educational and recreational activities.

Alumni association is an association of former students and these often raises funds for their institutions. Many members provide assistance and service to their juniors too.

Responses of Principals on PTA.

The responses of principals on PTA is presented in the Table 40.

Table 40

Category wise Responses of Principals on the PTA

Particulars	Frequency of Responses					
	Government		Aided		Self-financing	
	Yes	No	Yes	No	Yes	No
Active PTA available	4	0	1	0	25	0
Satisfaction	4	0	1	0	19	6

All the principals responded that PTA was there in their colleges, and except those from Self-financing colleges expressed satisfaction too regarding the working of the PTA. Only 76% of the self-financing engineering college principals opined that they were satisfied on the activities of PTA of their colleges. The rest remarked that the attendance of the parents in the meetings is not satisfactory. Two of them responded that the attitude of parents towards the college is not good. The government engineering college principal responded that PTA is very active at the college and always ready to help institute in any matter including financial help.

Responses of Faculties on PTA.

Similar responses were obtained from the faculties too regarding the working of PTA. Though most of the faculties from Government college expressed satisfaction, 28.5% responded that attendance of parents in the PTA meeting is not satisfactory. About half (45.45%) of the Aided faculties responded that they are not satisfied on the PTA either because parents are not interested in academic matters of colleges or students and 80.67% Self-financing faculties responded that PTA not active. The attendance of parents is not satisfactory.

Responses of Students on PTA.

The responses of the students were similar to what their teachers said. About 40.67 % self-financing students opined that they were not satisfied on the activities of PTA and most of them are of the opinion that the PTA not functioning properly. 33.33% of self-financing students responded that not much meetings are arranged for PTA, only once, at the time of admission. 28.57% self-financing students opined that PTA is not involved in the improvement of college facilities and 4 percentage of self-financing students opined that PTA doesn't have any power to engage in college activities.

Majority of government and aided students responded that PTA was active in their colleges.

Responses of Parents on PTA.

Among the parents 64% responded that PTA was active in the engineering colleges while 36% parents of engineering students opined that PTA was not active. They expressed that the PTA is only for name sake. 14% of them responded that there was only one PTA meeting for an academic year.

Discussion

The percentage analysis regarding the PTA revealed that all the engineering colleges have PTA, but the satisfaction level on the activity of the PTA was different for each category. The satisfaction level is low in the case of self-financing when comparing the responses of principals of the other two. The faculties and principals pointed out the limitation regarding the activity of PTA is regarding the attendance of parents in the PTA meetings. When analysing the responses of student and parents, they pointed out that there were not so much meetings in the college, only once at the time of admission. The satisfaction level on the activities of PTA was less in self-financing students than other two. A combined effort of Teachers and parents is needed for the students' overall development.

Responses of Principals on College Union.

The responses of principals are summarised and presented in the Table 41.

Table 41

Category wise Responses of Engineering College Principals on the College Union

Particulars	Frequency of responses					
	Government		Aided		Self-financing	
	Yes	No	Yes	No	Yes	No
Presence of College Union	4	0	1	0	15	10
Satisfaction	4	0	1	0	16	9

All government and aided college principals responded that college union is active in their engineering colleges but 40% of the self-financing principals, reported that there is no such union. The 36% principals were not satisfied on the activities of union and 20% of them reacted that union is fully political. 30% of them opined that the strike and other problems of union affect the number of working days of colleges and political parties' influence with the union creates lots of issues in colleges.

Response of Students on College Union.

The responses of the students on college union are summarized in the Table 42.

Table 42

Percentage of Category wise Responses of Students on College Union

Particulars	Percentage of responses					
	Government		Aided		Self-financing	
	Yes	No	Yes	No	Yes	No
College Union available	100	0	96.67	3.33	58.67	41.33
Satisfied on the activity of college union	85	15	83.33	16.67	41.33	58.67

Majority of Government and aided engineering college students were satisfied on the availability and activities of their college union. 41.33% self-financing college students responded that there is no college union in their colleges and 50% of self-financing college students were not satisfied on the activities of students union of their colleges. The students of Aided (13.33%) colleges expressed their reason for dissatisfaction that the union do not organise many activities they were supposed to conduct. 41.33% of the self-financing colleges students responded that their college do not allow election/ union because of restrictions from management. Other issues they pointed out included partiality of union towards their respective party members, inactivity of the elected union, no room for office of college union, loss of working days extreme politics/related strikes etc.

Discussion

From the data regarding the college union, it is inferred that in some self-financing engineering colleges formation of college union is not allowed. Majority of principals are satisfied on the activities of the college union. The satisfaction level is less in self-financing category when compared to the other two. Some self-financing engineering college principals opined that the political party of Kerala influences the activities of college union and it creates problems. In Self-financing students also, the satisfaction level towards the union is less when compared to the others.

Alumni Associations

Responses of principals, faculties and students on alumni association are presented below.

Responses of Principals on Alumni associations.

Table 43

Category Wise Responses of Principals on Alumni Association

Particulars	Frequency of responses					
	Government		Aided		Self-financing	
	Yes	No	Yes	No	Yes	No
Alumni association available	4	0	1	0	23	2
Satisfaction	4	0	1	0	20	5

The analysis of the data regarding the alumni association revealed that all the government and aided and majority (92%) of self-financing colleges have alumni associations while 8% self-financing principals responded that no alumni association in the college. Majority of the principals were satisfied on the activities of alumni association while 20% of self-financing principals were not satisfied on the activities saying that it is not very active at their colleges.

Responses of faculties and students on alumni association

32.56% Government, 9% Aided and 49.57% Self-financing engineering college faculties were not satisfied on activities of alumni. A percentage of 36.13% of faculties responded that alumni have not done anything for college.

13.17% Government, 10% Aided and 34.66% Self-financing engineering college students responded that alumni association is not active in their college.

Discussion

Analyses of the data about the alumni association revealed that majority of engineering colleges have alumni association. The satisfaction level is less self-financing category. In few engineering colleges alumni association is inactive. There are a lot of things to do for an alumni association in a college. Alumni can help in the development of the infrastructure, giving financial assistance and help in the academic matters of engineering colleges. A good alumni is an indication good standard of every educational institution.

Admission Procedure

Admission to the B. Tech courses in Kerala is based on the marks the candidates score in entrance examination (Kerala Engineering and Medical Entrance Examination - KEAM) and the marks obtained for Physics , Chemistry and Mathematics in Plus two or equivalent examinations in the ratio 50:50. The marks in Computer Science/ Biotechnology/ Biology will be considered for admission for the candidates who have not studied Chemistry in higher secondary. The minimum marks required for admission are 50% marks in Mathematics and 50% aggregate for Physics, Chemistry and Mathematics. For admission in Management Quota of Private Self-financing engineering colleges, candidates have to secure 45% marks in Mathematics and 45% marks aggregate in Physics, Chemistry and Mathematics. The agency implementing and monitoring selection process is Commissioner of Entrance Examination. The allotment is based on the marks, options made by the student for colleges & branches and reservation rules. Apart from this entrance test, candidates seeking admission to B.Tech in Architecture are required to undertake an aptitude test called NATA (National Aptitude Test in Architecture) which measures the aptitude of applicant for the specific field of study.

Limitations regarding admission procedure.

The principals were asked about the limitations of the present admission procedures to various engineering courses in Kerala. More than half of the principals from all categories of colleges (56.67%) responded that no aptitude test is conducted for admission in to engineering colleges to check the aptitude of students for engineering. The selection of students is made only on the basis of entrance examination which is more like a screening test. As many as 66.67% of the engineering college principals opined that minimum eligibility for admission to the course is only minimum +2 (45%) marks with as low as 10 marks in entrance examination. This leads to the enrolment of students with low quality /capacity.

More than half of (52%) the Self-financing engineering college principals complained that admission to NRI quota seats is usually not filled to the capacity always and are not transferred to general category. The principals also expressed their feeling that majority of students have no interest in Engineering and there are no measures to check the interest of the students.

Discussion

Many of the principals opined that no correct aptitude test is conducted for selection. The entrance examination do not measure the correct aptitude of the students, measures only the basic knowledge in the subjects Mathematics, Physics and Chemistry. Without correct aptitude and interest towards engineering, it will be difficult for the students to master the subject and become a competent and skillful engineer. It is also noted that the minimum score required for admission is 10 in entrance examination and aggregate 45% marks in higher secondary examination, which is far below for any engineering subject. The low quality or capacity of students may read to the low pass percentage of colleges.

Planning, Organisation and Transaction of the Curriculum

One of the objectives of the study is to examine the planning, organisation and transaction of the curriculum of engineering colleges in Kerala. The gathered data from the principals, faculties and students were analysed to get a clear picture of planning, organisation and transaction of the curriculum of engineering courses followed in the engineering colleges of Kerala.

Responses of principals on participation in Planning and organisation of the curriculum.

Cluster (normally a group of 10 colleges) meetings were conducted by State Universities for principals and faculties involved in the planning and organisation of the curriculum until 2014. No such meetings were conducted by KTU after its establishment until now.

The principals reported (56.66%) that they have attended only those cluster / region wise meetings conducted by the State Universities, and so far haven't participated in any of the meetings of KTU for curriculum planning and organisation.

Curriculum.

Curriculum of engineering is the total learning experiences given in the engineering colleges to develop a student to be a competent engineer. The principals, faculties and students were asked about the effectiveness of curriculum in preparing the students for the new job market.

Responses of principals and faculties about curriculum.

Majority of the principals and faculties (84%) remarked that the present curriculum is not effective in preparing the students for the new job market. They have also remarked that the curriculum is not at par with the international standards of engineering education. Another matter pointed out by many are there are no external examinations for laboratory experiments.

Responses of students about present curriculum.

Students were asked about the different aspects about the present curriculum. Responses of them are consolidated and presented in the Table 44.

Table 44

Percentage of Category wise Responses of Students on Curriculum of Engineering Courses

Particulars	Percentage of responses					
	Government		Aided		Self-financing	
	Yes	No	Yes	No	Yes	No
<u>The present curriculum:</u>						
• permits individual difference	60	40	58.62	41.38	66.67	33.33
• inculcate social concern	35	65	36.67	63.33	43.33	56.67
• providing training for future life	70	30	73.33	26.67	80	20
• is over burden	20	80	60	40	61.67	38.33
• is exam oriented	55	45	63.33	36.66	66.67	33.33
• is work oriented	40	60	55	45	65	35
• considers importance of environmental education	55	45	60	40	80	20
• promotes creativity	46.25	53.75	51.67	48.33	50.67	49.33
• enhances motivational level	43.75	56.25	35	65	36.67	63.33
• life oriented	50	50	55	45	46.67	53.33
• contemporary / relevant	50	50	63.33	36.67	46.67	53.33

Analysis of the data revealed that a good percentage (58 - 66) of students from all categories of college responded that curriculum permits individual difference, and many more believes that it provides training for future life. At the same time, an average of forty six percent opined that it is not work oriented either. The Government college students are more of this view, they also do not think that the curriculum is over burden to them. While majority think so, sixty percentage of students from both aided and self-financing colleges think that it is an over burden to them.

Nearly half of the students from all the colleges expressed that the curriculum does not promote creativity and a similar number opined that it is life oriented. While majority of the Self-financing college students see the curriculum as the one which considers the importance of environmental education, only about fifty five to sixty percentage of students from the other two categories think so.

50% government, 36.67% aided and 53.33% self-financing students responded that curriculum is not very relevant.

Discussion

All the engineering colleges in Kerala from the year 2015, follow the curriculum prepared by the APJ Abdul Kalam Technological University. Before that colleges followed the curriculum prepared by the concerned universities under which they were affiliated. Regarding the role of faculties in curriculum planning and organisation no one participated in the new curriculum development under KTU. Also some principals were not satisfied on the present curriculum because it is not effective for new job market and not at par with the international standards. Majority of them raised another issue that the practical examination is only internal in the new curriculum. Majority of students responded that curriculum is exam oriented in nature, does not inculcate social value in students and not enhance motivational level. They do believe that it provides training for future life. It is to be noted that while majority of the Government college students opined that the curriculum/syllabus is not very troublesome for them, only 60 - 61 percentage from the other categories said so. This may be because of the high academic capability of the high entrance ranked students.

Curricular competencies.

Competence is the combination of observable and measurable knowledge, skills, abilities and personal attributes that contribute to better performance. Competencies included in the curriculum of engineering courses were analysed.

Responses of faculties on curricular competencies.

All faculties from all three categories of colleges were asked to rate the capacity of the curriculum in developing the competencies envisaged. Information obtained from the faculties were analysed to examine the curricular competencies envisaged in the curriculum of B.Tech courses in engineering colleges of Kerala. The values are consolidated and presented in the Table below.

Table 45

Percentage of Responses of Engineering College Faculties on Curricular Competencies Envisaged in the Engineering Curriculum

Sl No	Competencies	Percentage of responses		
		High	Average	Poor
1.	Knowledge Integration	66.30	24.46	9.24
2.	Develop Ability to work in team	11.41	60.32	28.26
3.	Develop Sensitivity towards environmental, sustainable and global issues	24.24	52.72	22.87
4.	Develop sensitivity towards moral and ethical issues	10.89	34.24	54.89
5.	Develop 'Readiness for lifelong' learning	22.87	24.24	52.72
6.	Develop entrepreneurship	57.07	34.78	8.15
7.	Develop ability to assist others	26.63	48.91	24.46
8.	Develop ability to apply knowledge	56.52	32.24	9.24
9.	Develop Designing Skills	60.87	27.17	11.96
10.	Developing problem solving skills	76.09	11.96	11.95
11.	Develop Technical competencies	61.95	26.09	11.96
12.	Develop decision making skills	29.89	45.78	35.32
13.	Develop analytical skills	23.37	27.17	49.46
14.	Develop Research skills	14.67	28.26	57.07
15.	Develop Experimentation skill	76.63	22.83	-
16.	Develop communication skill	18.49	43.48	38.04
17.	Develop project planning, management skill	52.17	47.83	-
18.	Develop presentation skill	40.76	46.74	12.5
19.	Develop mentoring skill	33.69	35.33	30.98

More than half of the faculties (>52 - 76%) responded that the capacity of the curriculum to bring forth knowledge Integration and development of Designing Skills, Problem solving skills, Technical competencies, Experimentation skill, Entrepreneurship, Application of knowledge, Project planning & management skills is high.

According to the majority of them (43 - 60%), the capacity of the curriculum in developing the competencies: Ability to work in team, Development of sensitivity towards environmental, sustainable & global issues, Ability to assist others, Decision making skills, Communication skill, Presentation skill and Mentoring skill is average.

Majority (49 - 57%) have rated poor for the capacity of curriculum to develop Sensitivity towards moral and ethical issues, Readiness for lifelong' learning, Analytical skills and Research skills.

Graduates' responses on curricular competencies.

The main products of engineering colleges are the pass outs (graduates) from the colleges. They are the ones who can say about what they have really got from their college during their study. So they have the capacity to analyse the curriculum and the competencies envisaged in it. The percentage of responses of graduates were analysed to know about the competencies envisaged in the curriculum of engineering courses. The result was summarised in the Table 46.

Table 46

Percentage of Responses of Engineering Graduates on Curricular Competencies Envisaged in the Engineering Curriculum

Sl no	Competencies	Percentage of responses		
		High	Average	Poor
1.	Knowledge Integration	54	40	6
2.	Develop Ability to work in team	14	60	26
3.	Develop Sensitivity towards environmental, sustainable and global issues	8	38	54
4.	Develop sensitivity towards moral and ethical issues	14	26	60
5.	Develop 'Readiness for lifelong' learning	10	26	54
6.	Develop entrepreneurship	12	54	24
7.	Develop ability to assist others	30	40	30
8.	Develop ability to apply knowledge	22	24	54
9.	Develop Designing Skills	52	38	10
10.	Develop Problem solving skills	44	40	6
11.	Develop Technical competencies	48	34	18
12.	Develop Decision making skills	32	46	22
13.	Develop Analytical skills	34	48	18
14.	Develop Research skills	18	40	42
15.	Develop Experimentation skill	48	32	20
16.	Develop Communication skill	32	42	26
17.	Develop Project planning, management skill	36	40	24
18.	Develop Presentation skill	26	34	40
19.	Develop Mentoring skill	32	30	38

As per the students' observations, the capacity of the curriculum to develop Knowledge Integration (54%), Designing Skills (52%), Technical competencies (48%), Experimentation skill (48%) and problem solving skills (44%) is high.

A good percentage of graduates responded that (60%) the capacity of the curriculum to develop in the students the ability to work in team, entrepreneurship development (54%), ability to assist others (40%), decision making skills (46%), analytical skills (48%) , communication skill (42%), project planning & management skill (40%) is average.

Majority of graduates rated poor for the ability of the curriculum to develop sensitivity towards moral and ethical issues (60%), ability to apply knowledge, Sensitivity towards environmental, sustainable and global issues and 'Readiness for lifelong' learning (54%), Research skills (42%), presentation skill (40%) and mentoring skill (38%) .

Discussion

Both the faculties and the graduates expressed that the curriculum is successful in developing the following competencies in students:

- knowledge integration
- designing skill
- problem solving skill
- technical competencies and
- experimentation skills

While the faculties thought that Sensitivity towards moral and ethical issues, Readiness for lifelong' learning, Analytical skills and Research skills are least developed through the present curriculum, students added ability to apply knowledge, Sensitivity towards environmental, sustainable and global issues, presentation skill and mentoring skill too.

All the competencies are important equally; at the same time the analysis revealed that some are high, some average and some poor.

Curriculum transaction.

Analysis of the curriculum transaction of engineering college is one of the objectives of the study. The data collected to accomplish the above objective were analysed and presented under the following headings.

Working days and hour of instruction.

The B.Tech regulations 2016 of KTU suggest 180 working days for an academic year, including 144 instructional days (72 days/semester), examination days and semester break. Principals were enquired about the working days of engineering colleges. The responses are tabulated in the Table 47

Table 47

Frequency of Working Days for Engineering Colleges- Responses of Principals

Sl No	Classes	Government	Aided	Self-financing
1.	176-180	3	1	8
2.	171-175	1		10
3.	166-170			2
4.	161-165			3
5.	156-160			1
6.	150-155			1

It is revealed from the responses of the principals that only 12 engineering colleges are have had working days as per the KTU guidelines. Considering the total number of instructional days needed for an academic year, days for admission procedure, examination days and end semester break, the other colleges have fewer working days. This will take up the instructional days of the colleges.

When asked about the teaching hours, 19 principals responded that at their colleges, they have an average of 24 hours per week. Three principals responded that it is 20 hours per week. Regarding the practical hours given, twenty principals responded that it was 6 hours per week while two principals responded that they have 3 hours per week for practical classes.

Regarding the limitations of working days and hours of instruction, three Self-financing college principals opined that because of strike and other activities (political) of students, some teaching days are wasted. One government, one aided and six self-financing engineering college principals responded that for achieving professional expertise and skill development, practical work is very important for the students but the time allotted for the same is very less and not satisfactory. Others did not respond to the question.

Responses of faculties on number of working days.

Faculties were enquired about the working days of engineering colleges. The responses are tabulated in the Table 48.

Table 48

Percentage of Category wise Responses of Faculties on the Working Days

Particulars	Government		Aided		Self-financing	
	Yes	No	Yes	No	Yes	No
Working days are enough to complete all the activities	25.58	74.42	31.81	68.18	10.08	89.92

The majority of the faculties (74.42% Government, 68.18% aided and 89.92% self-financing) responded that number of working days are not enough to complete all activities of a semester.

Responses of Students on working days.

More than half of the student sample (53.75% government, 63.33% aided and 56.67% Self-financing) remarked that they are not getting enough working days to complete all the curricular and co-curricular activities of a semester. They pointed out the limitations regarding working days as, duration of semesters are always too short, though semesters are supposed to be for 6 months, they normally gets academic days from January to March only, April and May being time for summer holidays.

Discussion

Majority of faculties and students opined that the working days were not enough to complete all the teaching learning activities of a semester. The importance of lab work is often neglected. Engineering is a skill based course. The laboratory activities are very significant in engineering course. If the working days are not enough, it negatively affects the development of all the competencies and skills in the students.

Teaching learning strategies.

For the effective transaction of curriculum, activities or teaching learning strategies used in the class room are very important. Analysis of the curriculum transaction of engineering colleges in Kerala was an objective of the study. The responses of faculties and students were analysed to have an understanding about it.

Responses of faculties on teaching learning strategies.

In order to know about teaching learning strategies used in the engineering colleges for the effective transaction of curriculum, responses were collected from faculties. The responses are given below.

Analysis of the data obtained from faculties revealed that faculties always use the teaching learning strategy *Lecturing* along with practicals /experimentation / workshop activities to attain the objectives of curriculum. Majority of the faculties responded that they have also make use of Seminar, Assignment, Project, Technical presentations and Group activities for transaction of curriculum.

Responses of students on teaching learning strategies.

The students were asked about the teaching learning strategies their teachers use in the classrooms for the transaction of curriculum. They were also asked to express their satisfaction on the methods adopted by the teachers.

Responses of government students on teaching learning strategies.

Consolidated data obtained from the government engineering college students is presented in Table 49.

Table 49

Percentage of the Responses of Government Engineering Students on Teaching Learning Strategies

Sl No	Teaching learning activity	Always	Sometimes	Never
1.	Lecturing	92.5	7.5	-
2.	Laboratory experiments	66.25	17.5	16.25
3.	Assignment	63.75	32.5	3.75
4.	Workshop	53.75	25	21.25
5.	Technology integrated teaching	37.5	43.75	18.75
6.	Experimental learning	35	43.75	21.25
7.	Technical presentation	32.5	56.25	11.25
8.	Problem based learning	31.25	60	8.75
9.	Seminar	31.25	65	3.75
10.	Industrial training	31.25	57.5	11.25
11.	Individual project	28.78	52.5	18.75
12.	Tutorial	26.25	50	23.75
13.	Discussion	25	63.75	11.25
14.	Group project	21.25	52.5	26.25
15.	Group activity	17.5	68.75	17.5
16.	Literature survey	17.5	31.25	51.25
17.	Industrial visit	16.25	75	8.75
18.	Demonstration	15	51.25	33.15
19.	Model making	15	42.5	42.5

Sl No	Teaching learning activity	Always	Sometimes	Never
20.	Online study	12.5	3.75	50
21.	Debate	10	40	50
22.	Brain storming	10	40	50
23.	Quiz	10	3.75	52.5
24.	Real time videos	7.5	63.75	28.75
25.	Open courses	5	42.5	52.5
26.	Peer guidance	5	63.75	43.75
27.	Career guidance	3.15	40	22.5
28.	NPTEL video lectures	-	51.25	48.75

Majority of the government engineering college students responded that lecturing, laboratory experiments, assignment and workshop activities are the teaching learning strategies the teachers mostly use in engineering colleges for curricular transaction. A good percentage of students responded that the teachers also make use of technology integrated teaching, experimental learning, problem based learning, group activities, group projects, individual projects, discussions, industrial visits, industrial training, seminar, NPTEL, real time videos, technical presentations, tutorials, peer guidance and career guidance in engineering colleges for transacting curriculum. Approximately, half of the respondents remarked that brain storming, quiz, literature survey and open courses were never used for curricular transaction.

Responses of aided students on teaching learning strategies.

Consolidated data obtained from the students is presented in the Table 50.

Table 50

Percentage of the Responses of Aided Students on Teaching Learning Strategies

Sl No	Teaching learning activity	Always	Sometime	Never
1.	Assignment	66.67	23.33	10
2.	Lecturing	63.33	36.67	-
3.	Seminar	46.67	50	3.33
4.	Problem based learning	45	38.33	16.66
5.	Group project	43.33	56.67	-
6.	Laboratory experiments	41.67	41.67	16.67
7.	Technology integrated teaching	40	21.67	38.33
8.	Discussion	35	53.33	11.67
9.	Demonstration	35	33.33	31.67
10.	Tutorial	33.33	61.67	5
11.	Workshop	31.67	50	18.33
12.	Model making	31.67	26.67	41.67
13.	Technical presentation	31.67	56.67	11.67
14.	Industrial visit	30	61.67	8.33
15.	Group activity	28.33	46.67	21.65
16.	Industrial training	28.33	45	26.67
17.	Quiz	28.33	30	36.67
18.	Individual project	26.67	51.67	21.67
19.	Brain storming	25	31.67	43.33
20.	Peer guidance	25	50	15
21.	Experimental learning	16.67	66.67	16.66
22.	Debate	16.67	31.67	46.67
23.	Literature survey	16.67	25	50
24.	Open courses	16.67	50	33.33
25.	Career guidance	16.67	46.67	20
26.	Online study	15	45	35
27.	NPTEL video lectures	13.33	40	46.67
28.	Real time videos	8.33	51.67	40

The responses of aided college students are somewhat different from their counterparts in the Government colleges. While 92 percentage of students there remarked that lecturing is done always, the aided college students responded that the syllabus is transacted mostly through lecturing and assignments. According to them, the teachers are also making use of problem based learning, technology integrated learning and laboratory experiments always.

A good percentage of students responded that experimental learning, problem based learning, group activities, group projects and individual projects, discussions, industrial visits and industrial training, seminar, workshop, real time videos, technical presentations, tutorials, peer guidance and career guidance are sometimes used in engineering colleges.

As per the opinions of the aided students, debate, discussion, brainstorming, model making, NPTEL, quiz and literature survey are the least used strategies.

Responses of self-financing college students on teaching learning strategies.

Consolidated responses of self-financing students on teaching learning strategies are presented in the Table 51.

Table 51

Percentage of the Responses of Self-financing College Students on Teaching Learning Strategies

Sl No	Teaching learning activity	Always	Sometime	Never
1.	Lecturing	73.46	26.54	-
2.	Assignment	70.38	24.61	5
3.	Laboratory experiments	55.38	21.92	22.69
4.	Discussion	37.69	39.23	23.07
5.	Seminar	34.61	50	15.38
6.	Group project	32.31	50.77	16.92
7.	Workshop	30.76	59.62	9.61
8.	Individual project	30.38	32.69	36.92
9.	Model making	25.38	32.31	42.31
10.	Tutorial	20	48.08	31.92
11.	Industrial visit	17.69	56.92	22.69
12.	Technical presentation	17.69	44.23	38.08
13.	Literature survey	17.30	30	52.69
14.	Group activity	15.76	66.53	17.69
15.	Career guidance	15.38	52.30	32.30
16.	Technology integrated teaching	12.69	61.92	25.38
17.	Experimental learning	12.31	63.85	23.84
18.	Industrial training	12.30	59.23	28.46
19.	Problem based learning	11.92	63.46	21.92
20.	Online study	10	33.07	56.93
21.	Peer guidance	9.61	45.38	45
22.	Demonstration	7.69	47.69	44.61
23.	NPTEL video lectures	7.69	26.53	65.77
24.	Quiz	7.69	36.93	55.38
25.	Debate	2.69	59.23	38.07
26.	Brain storming	2.69	44.23	53.07
27.	Real time videos	2.69	14.62	82.69
28.	Open courses	2.31	25.38	72.92

From the table 51 it is clear that lecturing and assignments are always used by self-financing college teachers along with laboratory experiments for curricular transaction. Technology integrated teaching, Experimental learning, Problem based learning, Group activities, Group projects, Discussions, Debates, Demonstrations, Brain storming, Industrial visit, Seminar, workshop, industrial training, technical presentation are used sometimes for curricular transaction.

A good percentage of self-financing students expressed that individual project, model making, NPTEL video lectures, Real time videos, Quiz, Literature survey, Online study and Open courses are least used in their colleges.

Discussion

From the responses, it is understood that teachers favour lecturing mainly for teaching students. They have given importance also to assignment, laboratory experiment, workshop, seminar and problem based learning. At the same time the strategies like NPTEL, video lectures, open courses, Quiz, online study, literature survey are rarely used as teaching learning strategies. Mere lecture based teaching alone does not have the potential of achieving objectives of engineering education.

Responses of students with respect to satisfaction on the teaching learning strategies.

Analysis of the data obtained from the students of engineering colleges regarding satisfaction on teaching learning strategies revealed that majority (70%) of the students from government colleges are satisfied on the methods their teachers adopt in the classrooms for teaching them. While 64.33% of the aided college students expressed satisfaction, only 43.67% of the students from self-financing engineering colleges expressed that they are satisfied with the current methods. The unsatisfied students pointed out various reasons, such as

- teaching methods are exam oriented
- practical/experimentation activities are less
- everything is theory based
- for presentations done by the students, teachers do not take part in teaching / explaining
- workshops and innovative seminars are too less
- other than lecturing and mandatory assignments/seminars, teachers generally do not use other methods.

Regarding the satisfaction on the strategies used by the faculties, students responses revealed that the least satisfied category is self-financing colleges. This may be due to the lack of competency and skill of their faculties. In Government and Aided colleges most of the faculties are experienced and highly qualified than that of self-financing colleges.

Responses of students and graduates on medium of instruction.

Medium of instruction is the language of communication between the students and the teachers. In engineering colleges of Kerala, the medium of instruction is English. Students were asked about the medium of instruction in their colleges and whether they are feeling any difficulties with the language.

Majority of Government and Aided (90 & 73%) students responded that the medium of instruction is English and they do not have any problems with the instructional medium. A good percentage of students from self-financing colleges (60%) responded that they are having problems in understanding the concepts explained in English. Thirty eight percentage of the graduates remarked that they had problems in the medium of instruction during their study period. Self-financing college graduates expressed that their faculties taught them in regional languages and use English only for technical terms.

Discussion

Language as medium of communication determines the student success in engineering. It helps the students to understand the concepts that taught in the instructional places. Majority of Government and aided students does not have problems regarding medium of instruction, but more than half of the self-financing students face problems regarding medium of instruction. This may be because of their low competency in English. If there is any problem regarding the medium of instruction, concepts are not transferred to students completely. This ultimately affect the development of competencies and skills in students. Also proficiency in English is very important for technical profession. To develop students' language skills, it is mandatory to set Language laboratories in each college as per AICTE norms.

Industrial Training/Internship

To get better exposure to the industrial atmosphere KTU has introduced an internship for engineering students in industries during the two-month break between the second and third semesters. Through this the university aims to expose the students to the industrial atmosphere which will enable them to get placements after graduation. The regulation about the industrial training and visit suggested by the KTU are,

- minimum required duration is at least 5 full days
- could not take up 3 working days of students

The activity point for industrial training/ internship is 20 and for industrial visit 5/ one visit. A student can earn maximum 10 points through industrial visit. Data about internship were collected from principals and students.

Responses of principals and faculties on internship.

To know about the internship programmes of engineering colleges data were collected from principals about the internship of the students: the duration, the destinations and the evaluation.

All principals responded that the duration and the destinations of industrial internship depend on the course of study. All of them expressed that internship is not evaluated by faculties and industrial person. For internship only activity points (20) is given. After finishing the internship students must submit their internship report and certificate to the HOD of their college. More than half (55.43%) of the faculties opined that the internship is not compulsory it is only for activity point. All expressed that is good for familiarising company activities and future placement of the students. A good percentage of the faculties expressed that most of the students complete their internship during they semester break after their second semester examinations, but it has no uniformity. Some of them conducted it only for producing certificate to get activity points. The faculties also pointed out that, students may produce certificate without internship.

Responses of students on internship.

Majority (90%) of Government, (88.67%) aided and (60%) self-financing students responded that they done internship in some industry as part of their study. 40% of self-financing students have not undergone any internship. Regarding the duration of internship the collected data were analysed and the analysis revealed that the duration depends on courses and it ranges from 5 days to 6 months.

Regarding the limitation on internship, students opined that the time is not enough. It give very good practical exposure, so need a minimum one month for internship. 43.33% self-financing students responded that it is very effective for familiarising company activities. If it is done in proper way it is very effective. Now it is only for the sake of completing the course.

Discussion

The regulation about the industrial training/internship, the KTU suggested that minimum required duration is at least 5 full days. In regulation it is also noted that it could not take up 3 working days of students from engineering. It is also noted that internship is not compulsory, no evaluation and only activity point. This revealed that the authority not much consider the internship of B.Tech students. From the analysis about the duration of internship it is noted that there were different responses from students and it ranges from 1 day to 6 month and it is depends on the course.

The opinion of faculties and students about the industrial training is very positive. They opined that the days allotted for the training was not enough. The exact practical experiences is only given by company set up. In colleges labs and workshop activities are not give these experiences to students. For a professional course like engineering internship is very effective for students to apply their theoretical knowledge to practical situations. But the concerned authority does not consider in its importance.

Co-curricular and Extra-Curricular Activities

To be a competent and capable engineer, engineering student should develop leadership quality, teamwork ability, soft skills etc in addition to technical knowledge and skill. In the KTU ordinance for B. Tech stressed the importance of co curricular and extracurricular activities are specified. For participation in co curricular and extra-curricular activity , activity points are allotted. Minimum activity point earned by a student is 100. It is mandatory for the award of the degree.

Responses of principals on co-curricular and extracurricular activities.

Principals were asked about the co curricular and extracurricular activities of their college

All the sampled principals responded that NSS (National Service Scheme) is active in their colleges. All principals responded that Seminars, workshops, National events' celebrations, Organisation of Exhibitions were conducted on a timely basis. Arts fest, Sports fest, Technical presentations etc. were organised in all colleges. Student union, with the help of college authorities organise most of the programs. In the colleges, where there is no students' union, programs were organised by college authorities and students representatives with the help of the management.

Responses of students on co-curricular and extra-curricular activities.

To know about the responses of students on co-curricular and extracurricular activities of engineering colleges, students were asked about the organisers of the activities and what are the programmes

Regarding the organisers of co curricular activities of engineering colleges, majority of government (70%) , Aided (76.67%) and 40 percentage of self-financing engineering college students responded that student union of the college organise the activities. (15%) Government engineering students responded that students with the help of college authority and PTA organises the co curricular activities of engineering colleges. Few Aided (3.33%) students responded that the student union with the assistance of institutional authority organises co curricular activities and responded that management organises the co curricular activities of aided engineering colleges. Ten percentage of self-financing students responded that student union with the help of institution and PTA organises co curricular activities of engineering colleges. Few (3.33) percentage self-financing students responded that the institutional authority organises the activities and 1.67 % opined that management of the college organises the activities.

The responses of students regarding the programmes of co curricular activities were pooled and reported separately for the three categories.

In government engineering colleges.

Technical fest, Dythri, Vybhava, Confluence, Chitram, movie fest, arts fest, sports fest, carrier development programs, Personality development programs were organised. Also NSS and NCC are active.

In Aided engineering colleges.

Arts, sports, college fest , department fest, Onam celebrations Technical fests, Samba football league, cricket league, nostalgia (Photography), fresher's day, blood donation camp, NSS.

In Self-financing engineering colleges.

Arts, sports. Technical fests. Seminars, workshop, SAYA, TECH FEST, IDEA, BLAZE,KITES, FUTSAL, RAVE, Annual day, Iftar, Onam KASAVE, Christmas, NSS etc were organised.

Students club activities.

Responses of students on club activities.

Participation in any of the club activity help students to earn minimum 5 activity points in a year. A student can earn maximum 40 points through club activities. The responses of students about the club activities were pooled and percentage of respective items were analysed.

Table 52

Percentage of Category wise Responses of Students on Club Activities

Particulars	Percentage of responses					
	Government		Aided		Self-financing	
	Yes	No	Yes	No	Yes	No
Is there Club activities	100		100		66.33	33.67
Have you participated	40	60	36.67	63.33	36.67	63.33

All the government, aided students and majority (66.33%) of self-financing engineering students responded that different clubs are active in their colleges. 33.67% self-financing engineering students responded that there were no club activities in their college. The responses of the government students revealed that different clubs are active in government engineering colleges such as Sports club, music club, nature club, literary club, eco club, movie club, ideator, innovation club and dance club.

In the Aided engineering college photography club, music club, nature club, literary club, eco club, movie club and dance club are active.

The students of self-financing colleges opined that Sports club, music club, nature club, literary club, eco club and movie club are active in their college. It is also noted from the result that majority of students, that is 60% government, 63.33% aided and 63.33% self-financing were not participated in any of the club activities.

Responses of faculties on student club activities.

All faculty members from govt, aided and self-financing colleges responded that Club activities are there. 44.18% government, 45.45% aided, 34.45% self-financing faculty members were not satisfied on the participation of students in different student club activities**.** 56.67% faculties responded that students are not interested in club activities. 33.33% faculties said that only few students join club activities.

Discussion

The findings regarding the co-curricular activities revealed that in all engineering colleges different co curricular programmes were organised. A good percentage of students responded that student union organises the co curricular activities. Few of them responded that student union with the help of college authority / management of the colleges organises co-curricular activities in engineering colleges. In all engineering colleges club activities are active. The participation of students in club activities were not satisfactory based on the responses of faculties and students. Majority of the students of engineering colleges generally do not actively participated in club activities.

From the analysis it is also noted that in three categories of colleges different extra- curricular and co curricular activities were organised. From the responses of faculties' it is understood that the participation of students in co-curricular and extra-curricular activities are not satisfactory. Students were not interested to do such activities. They participate only for activity points. This is not fair, as for complete development curricular, co curricular and extra-curricular aspects are also equally important. To be a competent and capable engineer co curricular and extra-curricular activities are also equally important with curricular components.

Examination and Evaluation

End semester examination will be conducted in all lecture based courses at the end of the semester for all B.Tech courses. Supplementary examination shall be conducted in engineering courses before the commencement of next semester for needed students. University follows continuous and comprehensive evaluation. The maximum marks for internal evaluation is 50 and for end semester/ external evaluation is 100. For internal evaluation 40 marks for internal examination (20/ one internal) and 10 for assignment/ tutorial/mini project.

For laboratory/practical/workshop courses exam conducted only internally as per KTU. The maximum marks is 100, that is 60 for practical record/output, 10 for regular class viva and rest 30 for final written test/quiz. Each students should conduct a seminar on professional topic, individual or group design project and a final semester project (individual or small group (maximum 4 member)). A student should earn a minimum cumulative credits at the end of even semester(2nd, 4th and 6th) to eligible for registering in the next semester. The total cumulative credit for all semester is 180. The minimum credits required for entering to higher semester is 35 for 2nd, 80 for 4th and 126 for 6th semester.

Responses of Principals examination and evaluation.

For theory examination internal and external examinations are conducted. For Practical up to 2014 internal and external examinations were conducted by the concerned universities. Under KTU for practical only internal examination is needed. Principals were asked about the agency which conduct examinations, chances for reappearances for students and diagnostic test & remedial measures for week students.

All principals responded that for external examination, concerned universities and KTU are the only agency which conducts final theory examination. Regarding practical examinations, all principals opined that the concerned universities were responsible for conducting external examination up to 2014 admission, but for students under KTU practical examination is internal, there is no external examination for laboratory work. 14 self-financing engineering college principals responded that internal examination was conducted by internal examination committee of college. The committee consists of staff coordinator and five faculty members from each department.

All government and aided and 72% self-financing engineering college principals responded that up to 6th semester yearly one chance for reappearance. For 7^{th} and 8^{th} semester yearly 2 chances for reappearance. Other 28&% principals not responded to the item.

Regarding diagnostic test to identify weak students, all government, aided and 52% Self-financing principals responded that they conduct diagnostic tests to identify the week students. All government, aided and 52% self-financing engineering college principals responded that Class committee (Class committee members: two student representatives nominated by the head of the department and all faculty members teaching courses in that semester) identify the week students and rectify the problems and faculties' give additional teaching on difficult papers for weak students.

Responses of faculties on evaluation.

Faculties were asked about examination and evaluation of students activities and its limitations.

Regarding examination, all faculties responded that internal and external examination were conducted for theory paper. The university conducted external written examination for each semester. Majority(66%) of faculties responded that practical also same as that of written examination. But now under KTU it is only internal.

Faculties were asked about the time of continuous evaluation of each activities. The responses are analysed and presented in the Table 53

Table 53

Percentage Occurrence of Evaluation of Activities

Sl. No.	Activity	Period of conduct of evaluation				
		During the instruction	At the end of the class	At the end of the term	At the end of the semester	At the end of the year
		Percentage of responses				
1.	Written examination			74.32	80.43	
2.	Practical Examination				100	
3.	Viva Voce				18.48	81.52 at the end of the course
4.	Seminar		19.02	77.71		
5.	Assignment		32.06	88.04		
6.	Group Discussion	39.13	83.15			
7.	Group Project				100	
8.	Individual Project			100		
9.	Demonstration	79.34				
10.	Research Article Presentations			29.34		
11.	Experimental ideas sharing	72.28				
12.	Quiz	72.28				
13.	Fair Record			100		
14.	Industrial Visit Report				100	
15.	Designing	75.54		43.47		
16.	Sports activities Arts Performance				100	
17.	Attendance(Regularity in the class)	100				
18.	Club activities				100	
19.	Educational Tour Report				100	
20.	If any other (Please Specify)					

Regarding evaluation of student's activity, majority of faculties responded that written examination, practical examination, industrial visit, club activities, sports and arts activities evaluated at the end of the semester. For Club activities, sports and arts activities give only activity points. Seminar, assignment, project and records evaluated at the end of a term, Group project evaluated at the end of the semester.

Majority of government (58.13%), aided (59.09%) and self-financing engineering(53,33%) college faculties were not satisfied on evaluation strategies. Government engineering faculties expressed their reason for dissatisfaction on the evaluation strategies as the engineering education system not measure the correct ability. Feedback and evaluation is not possible in class time (minimum 60 students in a class). Evaluation system not measure the correct ability of students, only few tested internally. Attitude and aptitude are not correctly measured. Now in KTU the lab exam is internal it is also create some problem in effective evaluation. Now exam evaluation is very liberal.

Self-financing engineering college faculties opined that lab work is a very important thing for engineering. Now the evaluation of lab is only internal. So there is a chance of corruption or there is a chance of mutual understanding between faculties of different departments so the system give more importance for external valuation for practical and project work. If only internal evaluation there is a chance for missing some lab work it is very costly or difficult to do easily. Teachers try to pass all students if anyone fail it will question their credibility.

Examination- responses of students.

Majority that is, 65% government and 56.67% aided and 73% self-financing students not satisfied on examination system. The dissatisfied students opined that the examination not come in right time, it is lousy and not convenient. The Aided engineering college students opined that university should not conduct exam on time and not give semester break. Some of them expressed that the university not published the result timely, examination is not application oriented and university not publish the time table and date of exam before 1 month. Self-financing engineering students expressed their reason for dissatisfaction regarding examination as, the present examination system is not good ,it does not help the student to present their ideas in front of a crowd. Other reasons are

- There is delay of exams
- lack of exams in every 6 months
- the result do not come in time
- exam get postponed
- paper valuation and result publishing is too slow
- no time gap for supplementary exams
- long waiting duration for supplementary exam
- valuation also have some problems
- Too lag in publishing Revaluation result.
- Exam itself is a wrong system building up burden on students.

Certificate

A student who have completed B.Tech course, a consolidated grade card will be given by the University. Classifications like first class or distinction is not have for B.Tech degree. Principals were asked about value of these B. Tech certificate.

All responded that except for courses like printing technology (in abroad) the certificate is valid to get job in Kerala, India and Abroad in Government and private sector.

Discussion

Based on KTU regulation it is noted that the semester examination of all theory / lecture based courses will be conducted at the end of each semester and supplementary examination shall be conducted before the commencement of the next semester. From the analysis of the data of different sample regarding the conduction of examination the result is contradictory. Students are not satisfied and they complained about the examination and publication of results, that is publication of result is always late and also it is noted that the examination system is not systematic according to the response of students. Problems in the examination system affect the students confidence and finally their result. The evaluation process does not measure the actual engineering competency and skills of engineering students according to the faculties. It is also noted that faculties complained that continuous evaluation was not possible in the mass class room. The certificate is valid to get a job in Kerala, India and abroad.

Financial Resource Availability of Engineering Colleges

With the help of the questionnaire the investigator collected information of the financial resources and analysed the data. The investigator collected data regarding the financial resources from the principals of engineering colleges as they were the authority that give the credible data regarding the financial resources. With the aid of questionnaire responses regarding the financial resources were collected from the three category of principals and analysed the data.

Responses of principals on financial resources.

Principals were asked about the authority which give financial aid, the amount collected from students, amount spent during the last academic year and proposed for the current year and limitation regarding the financial resources.

Most of the colleges reluctant to give data regarding financial resources. The Government and aided Engineering colleges have direct financial aid from Government. All the self-financing colleges responded that their only financial source is students' fee and it is as per the government rule. (As per the Government order (G.O (MS) No 683/15/H.Edn. Dated 11/12/15) the annual fee shall be same for all the 4 years of study for the students admitted in self-financing engineering colleges of the 2016-17 ; same as that of 2015-16 in Kerala. The seat allotted for Government merit to be 50% and for management it is to be 50% in all self-financing colleges. Out of the 50% management seat 15% is reserved for NRI seat and the rest 35% is management.

The 50% government merit seat to be filled from the list of Commissioner of Entrance Exam. The Government merit seat of self-financing engineering colleges which offering scholarships for others category is again divided in to two category that is 25% seat for lower income group and 25% for others (they are eligible for scholarship). The annual fee for lower income group was 50000 as per the order. The 'others' in addition to 50000 annual fee there is a special fee 25000 also. In total the fees for 'others' category in government merit quota of self-financing is 75000. This 'others' is eligible for scholarship at 25000/ year.

Candidates admitting in management seat will pay 99000+ 25000 (special fee) + 1.5 lakhs (interest fee(Refundable deposit for 4 years). This fee structure is applicable to 35% management seats. The rest 15% NRI seats the fee per annum is 1.5 lakhs + 25000 special fee / year + 1.5 lakhs interest fee refundable fee 4 years.

The colleges which is comes under the group 'not given scholarships' to students the percentage of seat allotted for government and management seat is same. The fees also same but the students who remit 25000 special fee are not eligible for scholarship.

The order also state that, no consideration in cash or kind other than those as specified in the in the order may collected, received or accepted from any of the student or from other persons regarding admission to the college is a punishable offence. If any problem regarding this it shall be the duty of the government to take steps to redress the complaints. In case of any violation from management the admission supervisory committee shall initiate proceedings against such self-financing managements.)

None of the 26 engineering colleges produce dependable data regarding amount spent during the last year and proposed for the current year**.** 4 self-financing colleges produces few data regarding this.1 colleges responded that 90 lakhs spent during the last academic year. 1 college said that 2.3 crore spent. Other 2 responded that it is above 1 Crore. Amount proposed for the current year each of the self-financing colleges were 1 crore, 1.14 Crore , 3.5 crore and 3.9 crore .

Limitations regarding the availability of financial resource.

All Government and Aided college principals satisfied on their financial resource availability. 60% self-financing colleges point out the limitations regarding financial resource as student fee is the only sources of their money. Now many of the seats are vacant so they struggled to raise enough fund to all academic matters. 20% Self-financing Principal responded that the allocation of fund is not in timely manner. 28% principals of self-financing category opined that the scarcity of fund negatively affect the infrastructure development, purchase of books for library etc. 40% self-financing colleges were not respond properly.

Discussion

From the analysis of the data obtained regarding the availability of financial resources of engineering colleges did not revealed a satisfactory picture. Most of the engineering college principals were not responded properly. The majority of self-financing college principals opined that the decrease of students enrolment in the engineering colleges effect the financial source of their college. They claimed that the only income of their is the students fee. So this will create issues in self-financing colleges. The enrolment rate of the students were going down year by year it creates financial issues. Many of the seats in engineering colleges are vacant. The is mainly in self-financing colleges. If they do not have enough money they will ready to compromises in quality of facilities, faculties and resources. It negatively affect the quality of engineering colleges.

Percentage Analysis of Open Ended Questions regarding the General Opinion on Engineering Colleges in Kerala

The responses on the open ended questions on the general aspects of engineering colleges in Kerala were analysed. The similar responses of principals, faculties, students, graduates and parents were pooled and presented under two subheadings Quality versus quantitative expansion of engineering colleges and Academic activities.

Quality versus quantitative expansion of engineering colleges.

The responses with respect to the quality and quantitative expansion of engineering colleges collected from all the samples are categorised and similar responses are pooled. A summary of the responses are presented in the Table 54.

Table 54

Percentage of Responses about the Quality and Number of Engineering Colleges in Kerala.

Responses	Percentage
Not satisfied on the quality of engineering education in Kerala	65
Lowering of the value of B.Tech	42
Employment opportunity is less in Kerala	48
Professional standard of B.Tech graduates is below average	45
Private institutions make the standard of education lower	27
Not satisfied on the activities of management of colleges	11
Engineering colleges are good	3

Majority of the respondents expressed their dissatisfaction on the quality of engineering colleges in Kerala. The following were the responses with respect to quality of education at these colleges and the effect of increased number of colleges:

- The number of engineering colleges in Kerala is very high, more than that is required.
- Most of these colleges are not keeping required standards
- Increase in the number of colleges decreases the value of engineering degree and at the same time leads to unemployment among engineering graduates.
- Before, with a limited number of seats in the Government and Aided sectors, only the very talented and able students gained admission to premium courses like engineering. Now, with the many self-financing colleges and the large number of seats, anyone with even as low as 10

marks in the entrance examination and 45% in the higher secondary level can gain admission in these colleges.

- The premier institutions maintain quality unlike the majority of the private engineering colleges.
- Government and Aided colleges are better with respect to the quality of students, but in self-financing engineering colleges the quality of students and education imparted are not satisfactory.
- Private engineering colleges are making the standard of the engineering education low.
- Many self-financing engineering colleges are not providing sufficient facilities to students.
- Education is purely business in our society, some managements focus only on profit not the future of the students, and they are spoiling the entire education system.
- There are scarcity of committed & competent faculties and infrastructure facilities in many of the engineering colleges. It affects the quality of education.
- Many of the graduates are not having the expected professional standards. There are too many engineers in Kerala not having job connected to engineering and the state is not able to accommodate the huge number of engineers coming out year by year.
- Job opportunity to engineers is very few and also limited except in some specific professions like IT. Many of the graduates in Electronics, Mechanical and allied branches are working in IT companies.

Few among them opined that now the engineering education in Kerala is only capable of creating 'machines' not quality engineers. The graduates (except few) are only able to solve previously solved or proved problems and are not capable of handling new problems independently. The academics in most of the engineering colleges are good, but the students fail to apply their knowledge in new situations. Three percentage of respondents remarked that engineering colleges in Kerala are good and work in an orderly manner.

Academic activities.

The responses about the admission, curriculum, teaching learning activities are pooled and analysed. The results are presented below.

The percentages of similar responses are presented in the Table 55.

Table 55

Percentage of Responses Related with Syllabus, Quality of Faculties and Admission

Responses	Percentage of responses
Syllabus is out dated	53
Practical, workshop, skill development, research level activities are less in curriculum	51
Time and syllabus not matched	6
Shortage of competent and experienced faculties	48
Teacher-pupil relation is not good	47
Low commitment of the faculties	31
Students are not interested to study engineering	24
Dissatisfied on minimum marks required for admission	45

About the present syllabus, several issues/problems were pointed out by many of the respondents. These are:

- The syllabus of engineering degree is out dated.
- In the B. Tech curriculum, more importance is given to theory than to practical and workshop activities.
- The scope to technical orientation and activities for soft skill development are less in the curriculum.
- The course is not activity oriented and was not refined according to the changing needs of the society.
- Research level activities are less.
- Opportunities to self learning, innovations, creativity, involvement, attitude development, etc are less in the curriculum.
- There is less scope to evaluate the technical capacity and skills of a student.
- The content included is useless and out dated.
- Modern advancements are not introduced in the syllabus.
- Syllabus of a semester is difficult to cover fully in time, and also that the theory and corresponding laboratory works are not in the same semester.

Nearly half (48%) of the respondents remarked that the shortage of competent and experienced faculties in engineering colleges, especially in the self-financing sector, make the quality of education low in Kerala. Teachers lack teaching skills and competency. Few of the respondents expressed that spoon feeding mode of teaching is followed in many of the self-financing colleges. A good percentage of faculties opined that the use of innovative strategies in the class room is not possible, mainly due to time constraints. They always are in a hurry to complete the syllabus in time. A good percentage (48%) of the respondents reported that teacher - pupil relation is not good in the engineering colleges. Students cannot / will not approach faculties with freedom. Some remarked that some of the teachers of engineering colleges are not considering the psychology of students. A good percentage (31%) responded that commitment from the part of faculties is less.

Twenty five percentage of the respondents reported that some students are not interested in engineering. After gaining admission to the course, students' passion towards engineering decreases which makes them struggle to reach the end. Few faculties opined that students are not having enough knowledge in basic subjects of engineering. Mathematics is an important subject in engineering, but students are either not interested or lacking in the knowledge of basic aspects to master the complex parts in engineering.

Few faculties opined that admission to engineering courses without proper aptitude affects the quality of education. Many are dissatisfied on the minimum marks required for the admission for engineering. The poor quality and capacity of students are also the contributing factors for the poor quality of education.

Summing up briefly it can be said that the majority of the respondents are dissatisfied on the quality of engineering education in Kerala. Many of them pointed out the reason for the quality deterioration as increase in the number of colleges, shortage of faculties, problems in admission procedure and curriculum. It is a general perception of the majority that the establishment of large number of self-financing colleges is the main reason for the deterioration of the quality of engineering education.

Analysis of the Responses of unstructured interview.

Of late there has been an unprecedented growth of engineering colleges in Kerala. It has led to the deterioration of quality in engineering education system of Kerala. The issues and controversies related with engineering colleges are discussed in this section. To get an in-depth understanding of the same, the investigator tried to collect observation and perceptions of academicians, faculty members of engineering colleges, social/media activists and students on different issues related with engineering colleges and education in Kerala.

The similar responses were pooled & analysed and separate responses considered separately in order to have a real picture of engineering education system of Kerala.

Growth and Development of Engineering Colleges in Kerala

A considerable number (92%) of respondents expressed their displeasure over the growing number of engineering colleges in Kerala especially in the self-financing sector. With increase in the number of colleges, the intake capacity of B.Tech courses also increased. In response, one of the academician remarks that this increase in the number of intake led to a high degree of unemployment in engineering graduates. Another expert expressed that in Kerala many industries and firms pay a low salary to engineering graduates as below as Rs. 10,000/- as availability of engineering graduates in Kerala is much more than required.

One of the academicians observed that with respect to the intake capacity of B.Tech course, the intake capacity of M.Tech courses has not increased. Only a few colleges offer M.Tech courses. Though many private engineering colleges came forward to start M.Tech courses, the government and universities have not considered the requests.

Another perception regarding the establishment of colleges is that, with enough money anybody can open a new college. Many view engineering colleges as a lucrative business only. One of the experts also was also has the same view that most of the self-financing engineering colleges in Kerala are looking only for profit not for quality education. Though they are charging a hefty sum as fee for the courses, sufficient facilities or quality teaching is not being given to students.

As many as thirty percent of the respondents expressed that the increase in the number of engineering colleges also bring forth the issue of vacant seats in colleges. Few among them responded that many colleges struggle to generate enough money through admission. Now both AICTE and KTU are taking up steps to close down the colleges with low number of students and low pass percentages.

Admission.

Admission in engineering colleges in Kerala is based on the KEAM entrance examination. The performance in the entrance examination and qualifying examination (Plus Two) are considered for admission. Generally the students with high rank in entrance and high mark in qualifying examination will join the Government and Aided colleges, which are considered as better colleges, for their study. Earlier, the minimum marks fixed by the AICTE for admissions to engineering colleges were 50 per cent in the qualifying examinations. Now it is lowered by AICTE to help the many engineering colleges having large number of vacant seats. Kerala Government also decided to relax the norms of the engineering entrance examinations. The investigator asked the respondents to comment on these issues.

The data revealed that majority (56%) of the respondents think that the admission process has several problems. A considerable number of academicians viewed that the Government's decisions to dilute the eligibility criteria is not good for quality engineering education in Kerala. One of the activists expressed that the move of Government was to save those engineering colleges, mainly in the self-financing sector, which are at the edge of closure due to the non availability of engineering aspirants. One of the academicians remarked that the dilution in the criterion of minimum marks in the entrance examination is to help the students who scores zero or negative mark in the entrance examination.

One of the activists opined that the entrance coaching is a business in Kerala. Lots of students are entering in to entrance coaching centres before they get admission in plus two classes. Through continuous coaching, they manage to get good ranks in the entrance examination and thus gain admission in engineering colleges. Many of these students do not have the right aptitude for technical courses. They got admission in engineering colleges because of their rote learning in basic subjects and also on the compulsion of parents. One of the academicians also remarked that access to the many famous coaching centres for students who are residing in the rural areas are limited. This will also create inequality in admission.

Another expert also pointed out the same issue that majority of the engineering students are coming from economically sound family. He said that this is because of the high cost of entrance coaching. Some parents invest lakhs for entrance coaching. A student who have the right aptitude but do not have much money to spent on coaching will not get admission in engineering colleges and entrance examination is a great barrier for students who have the right aptitude in engineering.

An activist opined that for admission in management and NRI seats of self-financing colleges, the minimum requirement is very low when compared to merit seats. Students who have very less marks in qualifying examination and entrance examination get admission in engineering colleges through management seats. The quality of these students is also an issue. One of the academicians remarked that low input quality with respect to the students negatively affects the whole engineering education system. Another expert opined that now the engineering seats in Kerala are equal to the number of students opted for entrance examination. Most of the students who got admission in self-financing colleges lack basic knowledge in subjects and also they have lots of issue with communication and medium of instruction.

Another perception from an expert is that now the evaluation of higher secondary education in Kerala is very liberal and lavishly giving marks in the examination. This is also an issue with respect to the quality of education. A faculty opined that the entrance examination is not correctly measuring the aptitude of students, it is not an aptitude test, but tests only the knowledge in Physics, Chemistry and Mathematics or allied courses. Another academician has an opinion that the KEAM predicts the success of students in engineering courses but this success is not a sign of correct aptitude and skill in engineering.

More than half (55.26%) of the respondents expressed that some students study engineering because of parental pressure. Parents do not consider students' ability, skill and interest. They force their children to join engineering to keep their status in the society and are not even aware about the employability of the courses. Some of the parents are not even aware of the structure and difficulty of course. Eight percentage of respondents opined that majority of girls are joining in engineering to get a good marriage proposal. According to them many girl students after completing the course do not opt for engineering jobs. They prefer other jobs especially administration or clerical jobs. This phenomenon is may be because of lack of aptitude in engineering.

A high (94%) percentage of respondents opined that the government should take measures to increase the cut off marks in entrance and qualifying examination to improve the standard of engineering education. All colleges should admit students purely on the merit basis. Before giving admission to engineering courses, colleges should take measures to gauge the aptitude and skills of the students.

Vacant seats.

It is a well known fact that thousands of seats in engineering colleges are left vacant in self-financing colleges over the years. Some of the colleges are closing down courses because of low admission. To overcome this issue, government and managements of the colleges are ready to cut short the minimum criteria in marks and also by lowering fees. It is viewed by the academicians that this vacant seat issue has occurred because of the high intake capacity of engineering courses in Kerala. Another one opined that the quality of education in some of the self-financing colleges is not up to the mark, due to this reason student may not opt for studying engineering in these types of colleges.

Majority remarked that the main reason for the large number of vacant seats is the large number of colleges. They also pointed out that Government authorities are not considering previous years' records of seat vacancy of engineering colleges on giving Non-objection certificates to start yet more new colleges. One of the members from the self-financing management association also complained that even with this many colleges having large number of vacant seats, the government is again giving permission to start new engineering colleges. This creates issues on financial viability of old colleges, ultimately leading to low quality education.

More than half of the faculties opined that the problem of seat vacancy is in self-financing colleges only, not in government and aided colleges because of the low quality education and high fee structure of these colleges.

Many students are opting for entrance examinations of other states also. One of the activists opined that many of the engineering aspirants move to other states to study engineering because of the issues of lag in completing the courses in Kerala with respect to examination and results. One of the experts in the field of engineering remarked that the academics in the self-financing colleges is not well, so students opt for Government & Aided engineering colleges of Kerala or engineering colleges in the nearby states.

Five percentage of teachers observed that many low-ranked self-financing engineering colleges offer seats in management quota with fee less than that of the government colleges and also offer 100% placement to attract students. According to another faculty, the establishment of KTU is one of the reasons for vacant seats in Kerala. To avoid the strict rules and regulations of the university, many students go to Tamil Nadu or Karnataka state. Another one opined that, there is lag in the admission procedure in Kerala.

To sum up the issue of vacant seats in Kerala, it is can be seen that the main reason of the large number of vacant seats is because of the high intake capacity of engineering as per the opinions of the people concerned. Another major reason is the low quality of education of some of the colleges. A drastic reduction in the intake capacity of engineering is inevitable to secure a credible engineering education in Kerala.

Low pass percentage.

Another prevailing issue in the engineering colleges is the low pass percentage among students. The result analysis of Directorate of Technical education, Kerala in the year 2012 and the result analysis of KTU in 2016 revealed that the performance of majority of engineering colleges is very low with respect to the examination results. The investigator elicited responses from the respondents about this issue and reasons behind it.

More than half of the respondents observed that the pass percentage of engineering colleges in Kerala is not satisfactory. Majority of academicians, social activists and faculties opined that the pass percentage of majority of self-financing colleges is unsatisfactory. One of the experts expressed the reason that the best brains are getting admissions in Government and Aided engineering colleges, the rest of the best students opt for top ranked colleges in which high quality education imparted. Only the rest gets admitted in self-financing colleges. They may not have adequate ability and capacity to complete the course easily.

Another expert has a view that, identifying students' aptitude and interest is very important, and the students should choose right engineering courses based on their capacity and interest. In many cases, students are forced to enter engineering disciplines due to the pressure from family and also society. This may also results in poor performance of the students.

Many of the faculties (42%) opined that after getting admission to the course, student's passion towards engineering is going down alarmingly every year. Majority of the respondents are of the view that lack of experienced and competent faculties in self-financing colleges is another reason for the poor performance of the students. Three percentage of the respondents opined that the continuing unrest on campuses due to political activities has an impact on the academic calendar which ultimately leads to the low pass percentage in some of the colleges.

Twenty five percentage of the faculties viewed that within the stipulated four years, only half of the students gets graduated. Others with lots of back papers (failed papers) take six to nine years to complete their courses or drop the courses. Another perception on this issue by an activist is that the defects in the secondary education system, i.e. liberal valuation and 100 percentage pass system, are the reasons for low pass percentage in engineering colleges.

The respondents also pointed out that dilution of admission criteria also is negatively affecting the performance of colleges. Students who have low marks in entrance and qualifying examination got admission because of this dilution. Students without having the actual capacity to study may fail in engineering examination.

Many reasons are pointed out by the respondents about the low pass percentage of engineering colleges especially self-financing colleges.

- Low input quality of students and faculties
- Lack of experienced and qualified faculties
- Lack of good academic environment
- Poor knowledge in basic subjects
- Poor teaching practises
- No aptitude, skills and capacity among students

To increase the pass percentage, government and college authorities should provide quality inputs. In addition to that, some of the academicians recommended increasing the cut off marks for admission in entrance and qualifying examination for all categories of students.

Shortage of faculties.

Most of the respondents expressed their dissatisfaction over the deterioration of quality of engineering education in Kerala. They expressed that the main handy cap in the engineering colleges is the scarcity of quality faculties. Moreover, most of the respondents revealed that in many of the self-financing colleges there is a shortage of faculties. A good percentage of (54%) respondents opined that in most of the self-financing engineering colleges, many of the faculties are fresh hands or just pass outs from the colleges. An activist opined that Self-financing colleges appointed faculties who settle for low salary. They do not consider academic records of faculties.

Nearly twenty five percentage of the respondents observed that in majority of the self-financing colleges, there is high turnover of faculties. One of the academicians revealed that faculty shortage is more in the middle level (associate professor) and also expressed that people well positioned in the industry are not attracted to teaching positions in engineering colleges. One of the faculties also opined that engineering graduates generally do not prefer teaching profession, but mostly prefer company related jobs.

In response to the matter about the shortage of faculties, one of the experts opined that shortage of hands leads to overloading of the rest of the faculties. The students suffer at all levels, when the faculties are over loaded. One of the experts remarked that the AICTE stipulation of teacher-student ratio (1:15) is very high. The expert said that 1:10 is the international standard and suggested bringing down the ratio to 1:12. Another academician opined that in many of the self-financing colleges there is high ‘migration’ of faculties either from one institution to other institution or some other avenues.

A good number of respondents (76%) opined that unattractive pay is one of the reasons for the lack of faculties in engineering colleges. Many of the self-financing colleges are not offering AICTE stipulated pay scale to faculties. AICTE has made M.Tech Degree mandatory for faculties, this is the another reason for faculty shortage as per the view of an activist. He said that in many of the self-financing college faculties only have B.Tech degree. Another reason pointed out by an expert is that there are not enough M.Tech graduates to teach. Another faculty is of the view that majority of M.Tech graduates prefer jobs other than teaching.

Another perception of a social activist regarding the quality and dearth of faculties is that, some of the self-financing colleges hire faculty members from different places during the time of inspection or affiliation team visit. In some other self-financing engineering colleges, faculties are appointed on the basis of 'bargaining' on the pay they given. They select the candidate who settles for the lowest wage than the others. One of the self-financing college faculty expressed that their status is very low in the engineering colleges. So as soon as they get another job, they leave the institution.

The shortage of faculties affects the students in many ways. When there are not enough teachers, more students are often assigned to a single project, leading to lack of attention from teachers and an eventual dilution in quality. Besides, the choices before the students for their elective subjects are considerably reduced. Engineering industry often give due weight to students who have done good projects during their study for employment. The faculty shortage has a direct bearing on the quality of projects on all engineering college campuses.

The shortage of faculties also is a pressing issue in engineering colleges. The issue is more prominent in self-financing colleges. The main reason of this issue is the unattractive pay, given by the self-financing colleges. Another reason is the shortage of M.Tech graduates in Kerala when compared to the number of colleges.

Infrastructure.

Majority of the respondents opined that most of the colleges provide adequate infrastructure facilities. Some of the respondents (25%) expressed that in some colleges facilities are inadequate. One of the academicians opined that old colleges face some limitations in infrastructure facilities. An increase in the intake capacity also affects the adequacy of facilities in some of the colleges. One of the social activists has a different opinion that self-financing colleges does not have adequate facilities, but are claiming that all facilities are good and adequate. Few students expressed that facilities are there in their college but it is not utilised by the faculties for teaching learning process.

Effectiveness of curriculum.

A good majority (78.94%) of the respondents opined that the most of the out-coming students are only trained to pass examinations; not able to solve engineering problems independently. More than half of them remarked that the students fail to apply the theories they studied in the class room to practical situations. One of the faculties opined that the present curriculum is 'outcome based' and is very good for producing competent engineers, but the assessment strategies following in the engineering education system is old. One of the students opined that in their college some of the electives are out dated, but they were forced to take these electives to complete their courses. The structure of the curriculum also is not good. The subjects taught in the semesters have no connection. Some subjects are not in the relevant semesters as economics they studied in the first semester. According to a student, it will be very useful if it is taught in final semesters.

Suggestions for the improvement of engineering education in Kerala.

Responses of open ended items on the suggestions for the improvement of engineering education in Kerala and suggestions from the experts and stake holders were analysed. The important suggestions are listed below.

1. Put some limit on permitting self-financing colleges. Government should consider the number of vacant seats in engineering colleges, when giving permission to start new colleges.
2. Cancel the affiliation of colleges which are not providing enough facilities and having low pass percentage.
3. AICTE and Government should make sure the yearly inspection of every college to check facilities.

4. Cut down the intake capacity of engineering courses in Kerala.
5. Make sure admission to the college should be purely based on merit in all categories of engineering colleges.
6. Aware the parents to orient their children towards finding out their interest and aptitude in engineering.
7. Parents should not force students to choose course of study.
8. Make arrangements to check the interest and aptitude of students before entering in to the course.
9. Awareness should be given to students/parents to select good courses and colleges based on the accreditation status.
10. Government should develop a monitoring mechanism for the appointment of faculties in all the colleges including self-financing colleges.
11. Ensure availability of experienced faculties with excellent technical skills.
12. Performance evaluation of faculties should be done periodically.
13. Teacher quality will be enhanced through training programmes.
14. Authorities should take care of appointing at least 25% experienced faculties in self-financing colleges.
15. It is desirable to appoint Ph. D holders in faculty positions.
16. Increase the salary of self-financing college faculties to motivate them.

17. Teachers should be given proper training before entering in to teaching. The authorities should be given proper instructions regarding syllabus and portions to cover in each month.
18. Ensure practical oriented curriculum. Give more importance to lab works and projects than theory papers (like in the technical schools)
19. Update syllabus with latest technologies and refine according to the needs of the society.
20. Create the ability to think and habit of making new ideas and technologies in students' mind.
21. Improve communication skill of students
22. Ensure to implement good language labs and other laboratories
23. Arrange more seminars, workshops, conferences, technical fests, expert talks etc to make the students aware of current scenarios and new developments in the field of engineering.
24. Make sure that students are improving their moral and social values along with studying.
25. Include literature and social subjects in engineering.
26. Teach the students to study to understand and apply their knowledge and not to memorise theory.
27. Industrial training must be provided for all students at least for one month duration.
28. Create opportunities to apply knowledge completely in the course time itself through industrial training.

29. Conduct laboratory and theory examinations and valuation properly and timely.
30. Bring back external valuation for practical examination.
31. Evaluate the technical competency and skills of students.
32. Give less importance to internal evaluation
33. Keep year out system strictly.
34. Allow the formation of college union and election.
35. Avoid malpractices in hostels.
36. Avoid the interruption of managements in the academic activity of colleges.
37. Improve infrastructure
38. Government should provide sufficient fund for ensuring facilities

Chapter VI

SUMMARY FINDINGS AND SUGGESTIONS

- *Study in Retrospect*
- *Objectives of the Study*
- *Methodology*
- *Major Findings*
- *Analytical Derivatives*
- *Educational Implications of the Study*

SUMMARY FINDINGS AND SUGGESTIONS

This chapter intends to provide an overview of the study, major findings of the study, analytical derivatives of the study, educational implications of the study and suggestions for further research.

Study in Retrospect

The present study was intended to analyse facilities and issues of engineering colleges in Kerala, and is entitled as Engineering colleges in Kerala: An analytical Study.

Objectives of the Study

1. To study the general profile of engineering colleges in Kerala in terms of growth and details of courses, accreditation, intake capacity, enrolment, vacant seats, pass percentage and placement.
2. To investigate the availability of the physical facilities in the selected engineering colleges in Kerala.
3. To examine the availability of the human resources of selected engineering colleges in Kerala.
4. To study the planning, organisation and transaction of the curriculum of engineering courses.
5. To examine the financial resources of selected engineering colleges in Kerala.

6. To study the responses of principals regarding the planning and organisation and mode of transaction of the curriculum for the engineering courses followed in their institutions.
7. To analyse the responses of teachers regarding the planning, organisation, curriculum transaction and evaluation for the engineering courses followed in their institutions.
8. To analyse the responses of students regarding the facilities, curricular and co-curricular activities in their engineering colleges
9. To study the responses of B.Tech graduates regarding facilities and curriculum of engineering colleges in Kerala.
10. To analyse the parental responses regarding facilities and limitations of engineering colleges
11. To locate the deficiencies in the engineering education in Kerala, if any and suggest remedies.

Accomplishment of these objectives expected to lead to the evolution of the shortcomings that exist in the engineering education in Kerala and possible solutions to overcome.

Methodology

The study followed both qualitative and quantitative approaches. The investigator adopted multiple lines of approaches for studying the same issue and the study undertaken was a mixed type study.

The study was carried out in two phases. The first phase intended to analyse the current scenario (from 2013 to 2016) of engineering colleges in

Kerala. This phase describes and interprets the existing conditions of engineering colleges in Kerala, from the data collected using document analysis. The investigator used documents from Economic Review Reports of Government of Kerala, documents from the website of Kerala Technological University, All India Council of Technical Education (AICTE) and that of Kerala Entrance Commission, News paper reports etc. for analysing the following aspects of engineering colleges.

- growth in the number of colleges
- courses offered
- details of accreditation of courses
- intake capacity and enrolment from 2013 to 2016
- number of vacant seats during the academic years from 2013 to 2016
- percentage of pass for the academic year 2016 - 17
- details of placement of graduates from 2013 to 2016

In the Phase 2 of the study, the facilities and problems of engineering colleges in Kerala were analysed. The investigator selected 30 engineering colleges from the three main categories of colleges in Kerala for the study, viz. Government, Aided and Self financing engineering colleges and appropriate representation was given to each category of population in selecting the sample. Data were collected from principals, faculties, students, parents of engineering students and engineering graduates using questionnaires. The responses of academicians, activists, policy makers and other personalities related to engineering education in Kerala collected through unstructured interviews were also considered to arrive at conclusions.

The sample selected for the study consisted of the following from the above mentioned three categories of colleges.

1. Principals of engineering colleges in Kerala
2. Faculties of engineering colleges in Kerala
3. Students of engineering colleges in Kerala
4. Graduates of engineering colleges in Kerala
5. Parents of engineering students of Kerala

The investigator adopted stratified random sampling technique for collecting data from principals, faculty members and students. In the case of B. Tech graduates and parents of engineering students, the investigator adopted simple random sampling technique.

Sample \ Type of management	Government	Aided	Self financing	Total
Principals	4	1	25	30
Faculties	43	22	119	184
Students	80	60	300	440
Graduates		50		
Parents		50		

Tools and Technique used for the Study

The following tools and technique were employed for gathering relevant data for the study.

1. Questionnaire on Engineering Colleges to Principals (Musthafa & Surekha 2014)

2. Questionnaire on Engineering Colleges to Faculty Members (Musthafa & Surekha, 2014)
3. Questionnaire on Engineering Colleges to Students (Musthafa & Surekha, 2014)
4. Questionnaire on Engineering Colleges to Engineering Graduates (Musthafa & Surekha, 2014)
5. Questionnaire on Engineering Colleges to Parents of Engineering Students (Musthafa & Surekha, 2014)

Unstructured Interview for experts, social/media activists and stakeholders.

Statistical Technique Used

In order to find answers to the objectives specified, 'percentage analysis' was used wherever needed.

Summary of the Findings

The findings of the phase one of the study are summarised and presented below.

Number of Colleges

The number of engineering colleges in Kerala gradually increased from the year 1991 when only 9 colleges were there, and then showed a jump in the year 2011 when it became 142. In 2016 there were 183 engineering colleges in Kerala. Majority of the engineering colleges in Kerala belongs to the privately managed self financing category. From 2000 onwards the increase was only in the number of self financing colleges.

Courses

Only a few engineering colleges have accredited courses which are mainly belonging to the Aided and Government categories. The majority of the self financing colleges do not have even one accredited course. The result gives a clear indication of neglect from the part of private managements who manage the self financing colleges in adhering to the standards and lack of quality of engineering programmes in Kerala.

A total of 29 engineering courses were available for students in Kerala in 2016. The number of courses offered by engineering colleges was not equal. Majority of the engineering colleges offered five courses.

Intake Capacity / Number of Available Seats and Enrolment

The allotment of seats in engineering colleges also was not same for all colleges. Most of the engineering colleges were having an intake capacity between 201 and 300.

The intake capacity of engineering colleges offering B.Tech and M.Tech courses was increased from the year 2013 to 2016. The percentage of increase in intake capacity was high in self financing category and above 90 percentages of total allotted seats in engineering belongs to self financing colleges. The result indicated that every year, more seats are being allotted in self financing sector, making the engineering education a costly affair.

The branch - Electronics and Communication Engineering had the highest number of intake capacity and Industrial Engineering had the lowest number of seats.

The intake capacity of engineering technology courses at all the three levels (UG, PG, Diploma) increased from the year 2013 to 2016, though the number of students got admitted/enrolled in engineering courses was decreased for the years mentioned. The result showed that there was a huge difference in the intake capacity and actual enrolment in all the engineering and technology courses.

In undergraduate courses of engineering, the girls' enrolment was decreased from the year 2013 to 2016 while the enrolment of girl students in M.Tech courses increased. The low rates in B. Tech can be attributed to the general belief that the technology courses are mostly the boys' forte. Most boys prefer jobs than higher studies, but girls who have secured good marks opt for higher studies: hence the increase in their number at M.Tech level.

The percentage of vacant seats in the five engineering technology courses which have high intake capacities (showed that it is) increased from the year 2013 to 2016. (The percentage of vacant seat) It was high in private self financing engineering colleges when compared to the Government, Aided and Government & University owned self financing colleges.

Pass Percentages and Placement of Students

The pass percentage of engineering colleges revealed that Government and Aided engineering colleges were having good pass percentages in the year 2015-16. A high number of self financing colleges (59%) had pass percentages below fifty. The performance of majority of engineering colleges can be considered as poor based on the pass percentages. The pass percentage of courses having higher number of seats also decreased from 2013 to 2016. Among this, the lowest pass percentage was with Civil engineering.

The placement details of five engineering and technology courses having highest intake capacity revealed that the placement of students was increased from 2013 to 2016. This trend can be attributed to the low pass percentages for the year 2015-16. The less the number of successful students, the more will be the job opportunities.

Infrastructure Facilities

Majority of the engineering colleges have adequate class room facilities. The satisfaction level on class room facilities was least with Aided engineering college faculties and students.

Some of the self financing colleges have problems regarding laboratory and workshop facilities. The faculties of the aided colleges were least satisfied on the laboratory facilities. The students of the self financing engineering colleges were least satisfied on laboratory facilities.

Government and Aided engineering colleges have adequate workshop facilities. The self financing college faculties and students face problems regarding the workshop facilities. Majority of engineering colleges have adequate drawing hall and seminar hall facilities.

Some of the self financing colleges do not have adequate computer facilities. The faculties of self financing and aided colleges were least satisfied than government colleges on computer facilities of engineering colleges. The self financing students were least satisfied on computer facilities of engineering colleges.

Most of the engineering colleges have common room, but the students were not satisfied on the common room facilities of their colleges. In most of the engineering colleges, there is no common room for boys.

Government and Aided engineering colleges provided hostel facilities for students, while many of the self financing colleges were unable to provide hostel for all students.

The results indicated that there are some limitations regarding library facilities in engineering colleges. Majority of students were not satisfied on the library facilities of engineering colleges and the satisfaction level is least in the self financing category than the other two.

Many of the essential requirements are available in the engineering colleges, but in some colleges it was not so. The language laboratories, barrier free built environment and sewage disposal plants were not available in some of the self financing engineering colleges.

Majority of the engineering colleges have adequate desirable facilities too.

Majority of principals were satisfied on physical exercise facilities of engineering colleges, while majority of self financing students were not satisfied. The facilities for physical exercise were not satisfactory in self financing colleges when compared to the Government and aided engineering colleges.

Majority of the graduates were satisfied on the infrastructure facilities of engineering colleges, while a good percentage of parents were not satisfied on the infrastructure facilities of engineering colleges.

It can be seen from the results that most of the colleges, be it Government, Aided or Self financing, have almost all types of facilities, but the satisfaction of the concerned persons on the utilisation of the same was different for different colleges.

Human Resources

It was evident from the responses that the lack of competent and qualified faculties as a major problem particularly in self financing colleges. The main reason put forward by those who were unsatisfied with the condition is that the self financing engineering college faculties were often given a low salary and status. Most of them were very much concerned about the permanency of their job too.

Admission Procedure

- There were limitations in the admission procedure to the engineering courses. Majority of the sample opined that the interest, aptitude and ability of the students were not correctly measured during the selection process. Majority of the principals also were not satisfied on the minimum eligibility for admission in engineering colleges.

Teacher - Pupil Interaction

- In many engineering colleges, the teacher-pupil interaction was not healthy and fruitful.

Curriculum-Planning and Organization, Transaction and Evaluation

- Majority of the faculties and graduates were not satisfied on the curriculum of engineering courses followed in Kerala. Majority opined that the curriculum is out dated. It is not refined according to the needs of the society.
- Majority of faculties and students responded that the working days were not enough to complete all the activities of semester.
- Teachers favours lecturing, assignment and laboratory activities in engineering colleges. The use of innovative strategies was less in engineering colleges irrespective of the categories.
- Majority of the self financing engineering college students have problems regarding the medium of instruction.
- In all the Government, Aided and Self financing engineering colleges, different extra- curricular and co curricular activities were organised. The participation of students in the club activities was not satisfactory in engineering colleges.
- The students and faculties were not satisfied on the examination and evaluation aspects of present engineering education system. Conduct of examinations and publication of results were not done in timely manner.

PTA, College Union and Alumni Association

- PTA, College Union and Alumni association were active in majority of the engineering colleges. In some of the self financing colleges, there were no College union. Satisfaction level on the PTA was less in self financing engineering colleges. Majority of self financing college students were not satisfied on the activities of college union.

Financial Resources

- Students' fee was the main financial source for self financing colleges. Due to the shortage of students many of the self financing engineering colleges are facing financial issues.

Analytical Derivatives of the Study

The study mainly intended to analyse the facilities in engineering colleges of Kerala and also to explore the limitations prevailing there. With the view to locate the deficiencies, the findings of the objectives 1 to 9 (infrastructure facilities, financial resources, human resources and planning & organisation of the curriculum of engineering colleges) were analysed and the open ended responses of all the samples and responses of unstructured interview of the experts and other stakeholders in the field of engineering were pooled and analysed**.** The study revealed that there were some limitations regarding engineering education in Kerala.

It is analytically derived from the study that the growth of engineering education in Kerala is not being carried out in a satisfactory manner. The number of engineering colleges is clustered in the self financing sector. A study conducted in Punjab (Kumar & Singh, 2009) pointed out that the growth of engineering education had been uneven there. It can be concluded that the growth and uneven distribution of engineering colleges is not a unique phenomenon in Kerala. The situation is similar in many other states in India too.

NBA accreditation is an important criterion for assessing the standard of engineering courses or colleges. It is also very important that the accreditation would be beneficial for the Institution in receiving more research grants from AICTE and UGC. The study on the accreditation status revealed another insight that majority of engineering colleges do not have even one accredited engineering programme and majority of such colleges belongs to the privately managed self financing category. Some of the colleges might have applied and are waiting for the visit of expert teams to award them accreditation. Viswanadhan (2008) observed that programmes forwarded for accreditation were good in all the facilities. It is clear that even after many years since establishment, these colleges did not put in much effort for obtaining accreditations for their programmes. Also the low accreditation status of engineering programmes in Kerala may be due to the inadequate infrastructure, lack of qualified faculties, issues in curricular and co curricular processes etc.

Researcher also found that with respect to the increase in the number of colleges, the intake capacity of engineering courses has also been increasing in Kerala, at the same time the enrolment rate is showing a negative trend. That explains the reason for the large number of vacant seats in the engineering colleges**.** Almost all these vacant seats are in self financing colleges. This shows that the sudden growth in the number of colleges within a short span of time along with the high number of intake capacity, lack of much needed facilities in the colleges, lack of experienced and competent teachers, high donation and fee structure, very poor pass percentages, low job opportunities because of the flood of graduates etc. resulted in the high number of vacant seats in private engineering colleges.

It is also noted from the opinion of the experts that the number of seats allotted for engineering is almost equal to the number of applications received for entrance examination. This also is a contributing factor to the huge number of vacant seats in Kerala. It has been reported recently that nearly 800 colleges all over India are in the precipice of closing down due to excess vacant seats and low number of applicants. In Kerala also, many private colleges were already closed, and many other such colleges are trying to change from the status of 'Engineering Colleges' to 'Polytechnics'. The media is speculating that the number of engineering colleges will be 50 within the next five years.

Even with all these factors, the number of colleges and intake capacity increased in Kerala. From this it can be concluded that the authorities are not considering the enrolment rates/vacant seats while sanctioning more and more colleges and seats.

The examination results of students are one among the quality indicators of an educational institution. The analysis of the result of engineering colleges revealed that the pass percentage of the majority of the colleges was below fifty percentage. All the government and aided colleges have above 60% result. The number of failed students is more in self financing colleges. The poor performance of self financing engineering colleges with respect to the pass percentage of the students is due to the poor facilities, lack of qualified and competent faculties, lack of interest and aptitude of the students towards engineering and poor capacity of students. Many researchers have observed that the weaker students have dozens of back papers in engineering.

The researcher also found that with respect to the pass percentage the placement rate was increased. It is indicated that, less the number of successful student, the more will be the job opportunities and less competition for the existing post. The decrease in the pass percentage influences the percentage rate of placement.

Consolidating all the views regarding infrastructure facilities of engineering colleges, it can be seen that the lack of facilities are more pronounced in Self financing colleges than in Government and Aided engineering colleges. The self financing colleges set up most of the facilities needed for approval at the time of application and claim that most of the facilities have been satisfactorily provided. Contrary to their claim, the responses of actual stake holders - students - were somewhat different. According to them access of some of the facilities like computer, library, laboratory, common room and physical exercise facilities were not satisfactory.

Regarding the human resources' availability, the main issue is the shortage of competent and experienced faculties in engineering colleges. The shortage of quality faculty directly affects the entire education system. Majority of the self financing college students, faculties and parents were not much pleased with the availability and competency of faculties of their college. Some of the faculties from all the three categories of colleges opined that the teacher-pupil interaction in engineering colleges was bad. The experts and academicians in their interview with the researcher also suggested that the main handicap in the present day engineering colleges was the shortage of experienced faculties and their shortage has a direct bearing on the quality of engineering education imparted to students.

According to the opinions of students, graduates and faculties, the ability/ capacity of the curriculum in developing various competencies envisaged, is not of the same level but of varying level ranging from high to poor. To be a competent and skilful engineer, the attainment of all the competencies is very important. Any problem regarding the development of competencies is negatively contributed to the engineering education.

The working days and hour of instruction were found to be inadequate in completing all the activities of an academic year in engineering colleges. Coupled with many strikes, holidays etc. teachers and students are always in a hurry to get/have the syllabus completed in the available time. The hours allotted for laboratory work were found not enough. Laboratory and workshop activities in engineering are very important for developing engineering skills and competency in engineering students. Due to the lack of time, available facilities are not fully utilised. Lack of time make the students struggle very hard at everything: studies, other curricular activities, examinations, internal assessments etc. which negatively affect the actual development.

The researcher observed that lecturing is the most used teaching-learning strategies in engineering colleges. The usage of innovative strategies was very rare. To impart knowledge to students, different innovative strategies are very important. The old lecturing method is not a good one for transacting the technology oriented curriculum. Many researchers have pointed out that the old Chalk and Talk method is the most common teaching learning method extensively used by the engineering faculties.

A good percentage of self financing engineering students feel problems regarding the medium of instruction. Medium of instruction is very important for transacting or transferring knowledge to students. English is the medium of instruction of engineering education in Kerala. Most of the colleges have language laboratories for improving the language skills of engineering students. From the findings, Government and aided students do not have any difficulties regarding the medium of instruction. The difficulty expressed by many of the self financing college students can be attributed to the low academic competencies of students and language incompetency. The admittance of students with low marks in the higher secondary level and low entrance ranks into the high scholarly engineering courses in the many self financing colleges on account of fees only, brings forth this issue. Another factor to be considered is that in many of the foreign countries, subjects are taught in their mother tongue. The researcher also is of the opinion that with the medium of instruction as one's mother tongue, students with right aptitude in engineering and less competency in English can also excel in engineering courses. Yet another factor to be considered is that, English is getting more and more importance as a global language. If the incorporation of subjects in Malayalam not possible, then the ability of the students to adapt to the curricula, academic standards and better utilisation of language laboratories are to be given due weightage.

Evaluation strategies of engineering education also have certain problems. Now in engineering education, the evaluation does not measure the actual knowledge and skills needed for engineering. Majority of students complained about the examination system of University, which lean heavily on rote memorisation. Semester examination, publication of result, revaluation and supplementary exams are not conducted in a timely manner.

A good percentage of graduates opined that the out-coming students are only trained to pass examinations, not to face the practical side of engineering career independently. Most of them admitted to a lack of basic knowledge as they have resorted to rote learning without the right aptitude during their period of study.

Admission of students in to engineering courses who have no aptitude in engineering affect the quality of graduates. The students who get high ranks in engineering entrance examinations might not be having the right aptitude. The entrance examination only checks the knowledge in Mathematics, Physics and Chemistry. No other aptitude test is conducted by the college or admission authorities to measure the actual engineering aptitude of the students who gets admission in engineering colleges.

Financial difficulties mainly affect the functioning of self financing colleges. Some of the self financing colleges are struggling to raise enough money through admission. Many of the seats in these colleges were vacant. The low financial set up negatively affects the infrastructure development and appointment of quality faculty in these engineering colleges. Government and Aided colleges do not have any such problems as the Government is providing for all the financial needs.

Suggestions for the Improvement of Engineering Education in Kerala

Responses of open-ended items on the suggestions for the improvement of engineering education in Kerala from all the selected samples and those from the experts and stake holders were pooled. The important suggestions are listed below.

- Impose some limit on permitting new self financing colleges.
- Cancel the affiliation of colleges which are not providing enough facilities and having low pass percentage and adhere to the strict regulations of the AICTE in this regard.
- AICTE and Government should conduct inspection to check facilities annually or at specific intervals.

- Cut down the intake capacity for engineering courses in Kerala. It should be reduced to below 30,000 for B.Tech courses.
- Make sure that the admissions are purely based on merit in all categories of engineering colleges.
- Awareness programmes for parents to orient their children towards the profession of their interest and aptitude should be given. Parents should give freedom to students to choose their course of study.
- Make arrangements to check and gauge the interest and aptitude of students before giving them admission to engineering courses.
- Should arrange awareness programmes for students to select interested courses and colleges based the accreditation status, pass percentage and quality.
- Government should develop a monitoring mechanism for the appointment of faculties in all the colleges especially in self financing colleges.
- Ensure availability of experienced faculties with excellent technical skills and competencies.
- Performance evaluation of faculties should be done periodically.
- Teacher quality should be enhanced through in service training programmes.
- Should take care of appointing at least 25% experienced faculties in self financing colleges.

- It is desirable to appoint Ph. D holders in faculty positions.
- Increase the salary of self financing college faculties to motivate them.
- Teacher should be given proper training and instructions regarding the syllabus to be covered in each month that both the students and the teachers should not struggle to complete all in the stipulated time.
- Ensure practical oriented curriculum. Give more importance to lab works and projects than theory papers (like in the technical schools).
- Update and revise the syllabus periodically according to the needs of the society and the ever changing scenario of the technical world.
- Improve communication skills of students through the effective use of language laboratories.
- Organise and conduct more seminars, workshops, conferences, technical fests, expert talks etc to create awareness among students about current scenarios and new trends in the field of engineering.
- Make sure that students are improving their moral and social values along with studies.
- Include literature, humanities and social subjects in engineering.
- Teach the students to comprehend theories and not to resort to rote learning. Industrial training/ internships must be provided for all students at least for the duration of one month.
- Create opportunities to apply knowledge completely during the course itself through industrial training.
- Conduct laboratory and theory examinations and valuation properly and timely.

- Rethink to bring back external evaluation for practical examination.
- Evaluate the technical competency and skills of students.
- Give less importance to internal evaluation and remedial teaching.
- Strictly follow the 'year out' system.
- Encourage election and formation of college union. This inculcates in them a feeling of cohesion and also will create in them a feeling of having a platform to raise their issues and problems.
- Avoid malpractices in hostels.
- Avoid the unnecessary interventions of managements in the academic activities of colleges.
- Improve infrastructural facilities of colleges.
- Government should provide sufficient fund for ensuring facilities.

Educational Implications

Based on the results, findings and review of literature many suggestions and implications of the study are derived. Suggestions and implications of the study are listed below.

- The study revealed that the number and intake capacity of engineering colleges has been increasing and at the same time the enrolment is decreasing. The Government/ concerned authorities should consider the number of vacant seats and enrolment status in engineering colleges along with job opportunities, demand in the job market/ state/ country on giving permission to start new colleges.

- The study found that a huge number of seats are vacant in many of the self financing college for the last three years. A drastic reduction in the intake capacity of courses is inevitable to keep the engineering education credible.

- The issues regarding the aptitude of students towards engineering are very important. The entrance examination currently followed by the state to admit the students to these types of courses just measures their knowledge in three subjects - Mathematics, Physics and Chemistry. With so many entrance tuition centres, the children are trained to choose the correct option in the examination without too much logical or abstract thinking. It is more or less like rote memorisation of answers. Only a very low number of students gain admission to the engineering course with their actual learning and without the help of this type of tuition centres. Also the entrance examination does not measure the interest, aptitude and attitude of the students. So there has to be a correct method to check the interest and aptitude of students before admission to the course. Hence it is the right time to revisit the present Engineering Entrance Examination mode.

- Some students study engineering because of parental pressure. Without interest and right attitude, no one will be successful in engineering or any other course. So take measures to make the parents aware about the importance of the interest, attitude and aptitude of their children. Steps have to be taken to orient the children also towards finding out their natural interest and the aptitude for the particular subject or branch of study.

- The accreditation status of engineering colleges in Kerala is not satisfactory. Accreditation is also one of the quality indicators of professional courses, the college authorities should take necessary steps to get accreditation of every course they are offering. It should be made mandatory and the colleges should not be allowed ton run the courses which are not duly accredited by the concerned agencies.
- The study pointed out that pass percentages of some of the self financing colleges are very poor. College authorities and Government should take measures in maintaining quality of these colleges through inspection visits in specific intervals. Also the colleges are to be made to adopt remedial measures to solve the problem.
- It is also noted that the poor performance of the colleges may be due to the poor quality of students enrolled in the engineering courses. So it is to be ensured that in all categories of colleges, the admission is purely based on merit.
- In order to ensure the quality of engineering education, authorities should implement strictly the 'year out' system. Any dilution in this will deteriorate the value of engineering education. The rule mandated that a student should have stipulated number of credits to enter the third and sixth semester. They get a supplementary chance and if they fail in that, they will lose one year. This is necessary to maintain high

standards in technical education. This also helps in finding out the students who have low capacity to continue with a tough course, and in a way helps them to choose a more apt course than engineering before it is too late.

- The study found that in some of the colleges infrastructure facilities are not satisfactory. The authorities/ monitoring agencies should take measures to check availability and adequacy of infrastructure facilities.

- To ensure quality education all engineering colleges should provide quality faculties and facilities. These two are very important for every education system. Teaching is a profession which calls for a lot of skills to handle the students. Teachers should be given proper training before entering in to the profession of college teaching like the B.Ed. programs for school teachers. This will enable them to handle the students with good understanding, thus improving overall teacher-pupil relationships. This will also help them in transacting curriculum in a more effective way. The authorities should take proper steps to improve the quality and efficiency of faculties through in-service and pre-service training. At last a six month orientation programme should be there for those M.Tech holders who are aspiring to the teaching position in Engineering Colleges.

- The self financing college faculties are not satisfied on their salary, permanency and status unlike their counterparts in the Government and Aided sector. When those in the permanent posts enjoy higher salary and other benefits of governmental service, most of the self financing colleges faculties are drawing a paltry sum as salary. The insecurities regarding the temporary nature of their jobs, coupled with low salary and low status affects their attitude towards teaching. These factors make them view their position at these private colleges as a temporary sanctum until they get better positions. The incentives or hike in the salary can very well enhance the motivation of faculties. So the colleges should give remuneration as per the AICTE norms to motivate and keep experienced and qualified faculties in self financing colleges.

- Another important finding was about the inadequacy of the curriculum in developing the students into a competent and skilled engineer. Most of the stakeholders opined that the present curriculum is outdated. It is not considering the changing scenarios, and do not equip itself to meet the challenges of today. A curriculum should be flexible. It should be revised periodically and updated accordingly. It should be capable of developing in the students the required competencies to the fullest extent to enable them to survive in the real world. The learning should not be for passing the examinations only, but for application of what they have studied in real life. The curriculum should be able to develop creativity and innovative thinking in students and encourage them to build up technological skills. For a technical course, more or equal importance should be given to industrial training and internships. These should be made a compulsory part of the course after they master the fundamental theories of their respective courses.

- The evaluation of students also should be carried out scientifically. Though the implementation of continuous and comprehensive evaluation is for good, many at times it has been observed that internal evaluations are creating a lot of issues. Be it favoritism from the part of the teachers or affluent students having the capacity to present better projects/presentations/products. Transparency should be ensured in the internal examinations and evaluations conducted. Remedial teaching also should be given due importance after every internal evaluation, thus making the role of internal examinations important. Now a days much weightage is given to securing good marks in the written examinations, without checking more about the technical skills or the capacity of application of knowledge in to actual situations of the students. Timely completion of examinations and evaluations lessens the burden of students.

- To run a technical college smoothly and successfully, huge investments are required. Private managements invest such huge sums in the hope of high returns from the fee and donations collected from students. With low number of students and high completion among other privately managed colleges, getting good returns on investments becomes difficult. This makes them cutting down the wages of the faculties, arrangements on necessary requirements and overall upkeep of the colleges. The Government should look in to this matter also. This would not have been happened if only there is just the right number of colleges.

- Students are the back bone of education system. Develop all their capabilities by providing all the facilities. College should ensure all the facilities in a satisfactory manner.

Suggestions for Further Research

1. The study can be replicated in other states of the country.
2. Research can be conducted to validate the effectiveness of Engineering Entrance Examination to find out the aptitude of students in engineering.
3. The present study found that there is shortage of competent and experienced faculty in engineering. Thus research is needed to find out the number of qualified teachers required for different branches of engineering colleges.
4. Study observed that there are problems in teacher pupil relations in engineering colleges in Kerala. Thus research can be conducted to analyse the issues of teacher -pupil relation in engineering colleges.
5. Study can be conducted to check the commitment and job satisfaction of faculties in engineering colleges.

6. Study can be conducted to assess the training needs of faculty members in the engineering education system.
7. Study can be conducted to identify the determinants of teacher effectiveness of engineering faculties.
8. A comparative analysis of NIT and engineering colleges in Kerala can be done.
9. A longitudinal study of selected engineering colleges can be done to analyse the low pass percentage of students
10. Case study can be conducted to analyse the best performing and poor performing engineering colleges in Kerala.
11. Study can be conducted to find out the learning difficulties of engineering students of low performing colleges.
12. Study can be conducted to check the awareness of parents on the aptitude and interest of the students
13. A critical analysis of self financing engineering colleges in Kerala can be done.
14. A study can be conducted to analyse the quality of engineering colleges.
15. A study can be conducted to check the effect of aesthetic education in engineering.
16. A study can be conducted to check the employability of engineering graduates in Kerala.

17. A comparative analysis of the curriculum of IIT, NITs and University engineering colleges can be conducted

18. Study can be conducted to assess the moral ethical and environmental aspects of engineering students

19. Study can be conducted to analyse life skills of engineering students, how they tackle peer pressure, mental stress and depression as part of their strict academic life.

20. A study can be done to find out the motivation factor of engineering students to seek admission in engineering courses

BIBLIOGRAPHY

BIBLIOGRAPHY

Aguila, G.M., DeCastro, E.L., Dotong, D.I., & Laguador, J.M. (2016). Employability of computer engineering graduates from 2013 to 2015 in one private higher education institution in the Philippines. *Asia Pacific Journal of Education, Arts and Sciences, 3 (3), 48-54.*

Ahrens, A., & Zascerinska, J. (2012). Sustainable development in engineering education: A pedagogical approach. Paper presented in ATEE Spring University, 2012 Conference. *20 Years of Sustainable Development: Learning from Each Other*. Lithuanian University of Educational Sciences, May 3-5, 2012.

AICTE Approval Process Hand Book (2015). New Delhi: All India Council of Technical Education. *Retrieved from www.old.aicte-india.org/downloads/Approval_Process_Handbook_2015_16.pdf*

AICTE Approval Process Handbook. (2013-2014). New Delhi: All India Council of Technical Education. Retrieved from *www.old.aicte-india.org/downloads/Approval_Process_Handbook_2013-2014.pdf*

All India Council for Technical Education. (1999). Reshaping Post-graduate Education and Research in Engineering and Technology. *Report of the Review Committee of AICTE on Post Graduate Education and Research in Engineering and Technology, (P Ramarao Committee Report, 1999).*

Archana, S.N., & Kabir, S.H. (2010). Web presence of the engineering college libraries in Kerala: An analysis of content. *Kelpro Bulletin, 14*(1).

Ariadurai, S.A., & Manohanthan, R. (2008). Instructional strategies in teaching engineering at a distance: Faculty perspective. *International Review of Research in Open and Distance Learning, 9*(2).

Awale, S.D. (1996). *Engineering teachers in the development of technical*

Azeez, A.T.A., & Bavakutty, M. (2007). *Development of library consortium for engineering colleges in Kerala*. Ph.d Thesis, Department of Library and Information Science, University of Calicut.

Baker, I.O. (1900). Engineering education in the United States at the end of the century. *Science, New Series, 12*(305), 666-674.

Banerjee, R., & Muley, V. P. (2008). *Engineering education in India*. Bombay, Powai, Mumbai: Observer Research Foundation, Department of Energy Science and Engineering, Indian Institute of Technology.

Bhattacharya, U.K., & Maitra, S. (2016). Role of education and skill cultivation towards economic development. In Banargee *et.al*. (Eds), *New horizons in economic growth in India.* New Delhi: Madhav Books, p. 360-388.

Best, J.W., & Khan, J.V. (2006). *Research in education (10th ed.)*. USA: Pearson Education Inc.

Boles, W., & Whelan, K. (2017). Barriers to student success in engineering education. *European Journal of Engineering Education*, *42*(4), 368-381. doi: 10.1080/03043797.2016.1189879.

Brunhhaver, S.R., Korte, R.F., Barley, S.R., & Sheppard, S.D. (2011). *Bridging the gaps between engineering education and practices*. New Delhi: National Bureau of Economic Research.

Chandrakant, L.S. (1971). *Polytechnic education in India*. Bombay: Taraporevala & Sons.

Chaudhary, P.K. (2016). Growth of engineering education in India: Status issues and challenges. *Higher Education for Future, 3*(1), 93-107. doi: 10.1177/2347631115610223.

Chetia, B. (2015). Technical communication for engineering students- Relevance in the Indian context. *International Journal of Management and Applied Science, 1*(2), 15-19.

Chopra, K.L., & Sharma, P.B. (2009). *RETA- Report on Higher Technical Education in India - Profile of Growth and Future Perspective*. Asian Development Bank Regional Technical Assistance Project. Retrieved from http://www.namstct.org/ADB_RETA_Report/Prof_KL_Chopra_Prof_PB_Sharma.pdf Google Scholar.

Chua, C.E., Chuatoco, I.A.G., Dela Peña, A.M.C., Jimenez, D.L.F., & Co, D.A. (2017). The influence of participation in extracurricular activities to the employability of Industrial Engineering graduates of one Private University in the Philippines. *Asia Pacific Journal of Multidisciplinary Research*, *5*, (2), 163-170. Retrieved from https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=Chua%2C+Chuatoco%2C+Dela+Pe%C3%B1a%2C+Jimenez+and+Co+%282017%29+&btnG=

Cresswell, J.W., & Plano, C.V.L. (2006). *Designing and conducting mixed methods research*. Thousand Oaks, CA: Sage.

Dhanya, J.S., & Kinslin, D. (2016). A study on work life balance of teachers in engineering colleges in Kerala. *Journal of Chemical and Pharmaceutical Sciences*, *9* (4), 2098-2104.

Dhawan, S. (2004). 2000 seats vacant in engineering colleges. *The Tribune*, September 13, p. 4.

Gambhir, V., Grover, S., & Wadhwa, N.C. (2014). *Development of a quality enabled model for engineering education in India*. Department of Mechanical Engineering, Faculty of Engineering and Technology, Manav Rachna International University.

Garrett, H. (2005). *Statistics in psychology and education*. New Delhi: Paragon International Publishers.

Ghadban, S.S. (2007). Engineering education in Palestine: An analytical study. *European Journal of Engineering Education, 23*(2), 213-232. doi: 10.1080/0304379980892350.

Gosavi, V.P. (2013). Threat of vacant seats in engineering colleges: Reasons and remedies. *American International Journal of Research in Humanities, Arts and Social Science (AIJRHASS), 2*(1), 75-80.

Grayson, L. P. (1980). A brief history of engineering Education in United States. *IEEE Transaction of Space and Electronic Systems AES, 16*(3).

Good, C.V. (1963). *Introduction to educational research: Methods of design in the behavioural and social sciences*. New York: Appleton Century Crofts.

Hariharan, R. (2003). Globalization of technical education and WTO. *The Indian Journal of Technical Education, 26*(3), 6-25.

Hussain, M., & Khader, P.S.A. (2014). Analyzing student attrition and retention in engineering colleges of South India. *International Journal of Data Engineering (IJDE) Singaporean Journal of Scientific Research(SJSR)*, *6*(4), 213-218. Retrieved from www.iaaet.org/sjsr

IIT: Report of the Review Committee. (2004). *P. Ramarao Committee Report*. New Delhi: Government of India.

Issapour, M., & Sheppard, K. (2015). *Evolution of American engineering education*.

Jai Krishna Committee Report. (1974). *Report of the Reviewing Committee of Regional Engineering College*.

Jeba, K.J., & John, F.S. (2009). *Branding in higher educational institutions: With special reference to engineering education in Tamilnadu*. Ph.D. Thesis, Department of Management, Karunya University. Retrieved from http://hdl.handle.net/10603/10139.

Jestin, J.K.J., & Sornam, S.A. (2016). E-resources in engineering college libraries in Kerala: Awareness and availability- A study. *International Journal of Digital Library Services, 6*(2).

Jindal, M., & Aggarwal, H. (2011). Engineering education teaching evaluation based on SPSS in the state of Punjab. *International Journal of Computer Science and Technology, 2* (3), 56-63. Retrieved from www.ijcst.com.

Jose, K.J., & Mani, P. M. (2011). *Industry requirements for and competence of engineering graduates- A study*. Ph.D. Thesis, School of Gandhian Thought and Development Studies, Mahatma Gandhi University Kottayam.

Kale, S., & Sapali, S.N. (2014). Private engineering education scenario in India. International Mechanical Engineering Congress ASME and Exposition, November 14-17. *Education and Globalization, 5*.

KEAM (Kerala Engineering and Medical Entrance examination) 2013 prospectus, *www.cee-kerala.org › KEAM*

Kumar, B.R. (2013). Factors affecting the motivation of teaching staff (An empirical study with reference to engineering colleges, Krishna District). *Review of Arts and Humanities, 2*(1), 34-39.

Kumar, N. (2008). Competent faculty in engineering institutions: Requirement vs availability. *The Indian Journal of Technical Education, 31*(1), 58.

Kumar, R.R., & Khadir, F. (2013). A study on teaching effectiveness of self-financing engineering college teachers in Kerala. *International Journal of Asian Social Science, 3*(1), 1-9.

Kumar, N., & Singh, R. (2009). *A critical study of growth and development of engineering education in Punjab after independence*. Patiala: Department of Faculty of Education and Information Science, Punjab University. Ph.D. in Education, Department of Education & Community Service, Punjabi University, Patiala 2009.

Kumar., Prasanth., & Sundaram. (2013). Campus placements in Kerala- An empirical study at the selected engineering colleges in Kerala. *International Journal of Scientific and Research Publications, 3*(1).

Luciana, C., John R.R., & Cindy, M.W. (2018). Impact of first-year mathematics study groups on the retention and graduation of engineering students. *International Journal of Mathematical Education in Science and Technology*. doi: 10.1080/ 0020739X.2017.1423120

Maddocks, A.P., Diekens, J.G., & Crawford, A.R. (2002). *The skills, attributes and qualities of an engineer.* 'Encouraging lifelong learning by means of a web-based personal and professional development tool'. ICEE, Manchester, 18-22 August 2002. Retrieved from http://www.wblngc.wikispaces.com/file/view/Engineering+Skills+List+skills-attrib-qual.pdf.

Mahesalkar Committee. (1998). *Review on regional engineering colleges*. Retrieved from http://www.spicyindia.blogspot.com

Maitra, S. (2017). Development of technical education in India. *University News, 55*(7), 12-23.

Mani, S., & Arun, M. (2012). *Liberalisation of technical education in Kerala. Has significant increase in enrolment translated in to increase in supply of engineers?* Working Paper 448. Retrieved from www.cds.edu.

Marcus, A. I. (2005). *Engineering in a land-grant context: The past, present and future of an idea*. Indiana, United States: Purdue University Press.

McMillan, J.H., & Schumacher, S. (1989). *Research in education (2nd ed.).* USA: Harper Collins Publishers.

McGivern , J.G. (1960). *First hundred years of engineering education in the United States (1807-1907)*. Spokane, Washington: GonzaGa University Press.

Ministry of Human Resource Development. (MHRD). *Technical education - A historical perspective*. New Delhi: Department of Higher Education. Retrieved from http://mhrd.gov.in/technical-education

Mishra, S. (2010). Engineering curricula in the 21st century: The global scenario and challenges for India. *Journal of Engineering Science and Management Education, 1*, 29-33.

Mohanty, A.,& Dash, D. (2016). Engineering education in India: Preparation of professional engineering educators. *Journal of Human Resource and Sustainability Studies*, *4*, 92-101. Retrieved from http://www.scirp.org/journal/jhrss.

Mosely, Ibrahim. (2017). The significance of including an entrepreneurship course in engineering programmes. *Higher Education Studies, 7*(4),7-14.

Myers, B.A. (2016). *Evaluating admission practices as potential barriers to creating equitable access to undergraduate engineering education.* Ph.D. Dissertation, University of Colorado at Boulder. Retrieved http://www.proquest.com/en-S/products/dissertations/individuals.shtml

National Board of Accreditation- *NBA Accreditation Manual*. Retrieved from http://www.nbaind.org/accreditation-documents.aspx.

National Council of Educational Research and Training. (1970). *Education and National Development - Report of the Education Commission 1964-66.(Kothari Commission Report, First Edition 1966)*. New Delhi: NCERT.

National Education Policy. (1986) (as modified in 1992). National Informatics Centre. Retrieved from http://mhrd.gov.in/documents_reports?field_documents_reports_category_tid=19

National Policy on Education. (1986). Programme of Action. New Delhi: Ministry of Human Resource of Development, Department of Education, Govt. of India. Retrieved from http://mhrd.gov.in/documents_reports?field_documents_reports_category_tid=19

National Research Council Staff, Engineering Graduate Education and Research (1985). *Report on Evaluation of Engineering education in 1955, Grinter Report, The Presidents Science Advisory Committee (PSAC) Report 1962* entitled *Meeting Man power needs in Science and Technology, Goals study report of the period 1963-68* entitled *Goals of Engineering Education*.)

National Research Council Staff. (1985). *Engineering graduate education and research.* Washington ,DC, USA: National Academic Press, p. 11-16. Retrieved from http://site.ebrary.com/lib/unicalicut/docPrint.action?encr...

Oxford English Dictionary Online. Oxford University Press. Retrieved from http://www.oed.com/viewdictionaryentry/Entry/11125.

Palit, S.K. (1998), The development of engineering and technical education in India. *Global Journal of Engineering Education, 2*(3), 317-326.

Pandi, A.P., Jeyathilagar, D., & Kubendran, V. (2013). A study of integrated total quality management practice in engineering educational institutions. *International Journal of Management Science and Engineering Management, 8*(2), 117-125. doi: 10.1080/17509653.2013.798949.

Patton, M.Q. (1990). *Qualitative evaluation and research methods (2nd ed.)*. Thousand Oaks, CA: Sage.

Patton, M.Q. (2002). *Qualitative evaluation and research methods (3rd ed.)*. Thousand Oaks, CA: Sage.

Paulachan, K.J., & Gopal, R. (2014). *Impact of organizational culture and performance on social acceptability of private self financing engineering colleges in Karnataka and Kerala*. Doctor of. Philosophy (Ph. D) in Business Management Padmashree Dr. Patil University. Retrieved from www.dypatil.edu/.../Impact-of-Organizational-Culture-and-Performance-on-Social-Ac...

Pillai, S.G., Kiron, K.R., Kumar, G.A., Kumar, S.S., & Menon, B.R. (2013). An investigation about the characteristics of an engineering college teacher in the current scenario. *International Journal of Innovative Research in Science- Engineering and Technology, 2*(8).

Ponce, O.A., & Pagān-Maldonado, N. (2015). Mixed methods research in education: Capturing the complexity of the profession. *International Journal of Educational Excellence,* 1(1), 111-135. Retrieved from anagmendez.net/umet/pdf/ijee_ponce_pagon_maldonado_1_1_111-135.pdf.

Potti, S.R., Viswanadhan, K.G., Raghunandana, K., & Prasad, S.H.C. (2014). A few unique practices in high performance engineering colleges. *International Journal of Research in Advent Technology Special Issue National Conference "IAEISDISE"*, 12-13.

Pradeep, P.A., & Francis, A.T. (2014). Electronic information behaviour of engineering faculty members in Kerala state: An assessment. *Asian Journal of Library and Information Science, 6* (1-2), 11-18.

Prados, J.W., Peterson, G.D., & Lattuca, L.R. (2005). Quality assurance of engineering education through accreditation: The impact of engineering criteria 2000 and its global influence. *JEE - The Research Journal of Engineering Education*, *94*, (1), 165–184. doi:10.1002/j. 2168-9830.2005.tb00836.x

Prasanth, M.K., Kumar, N.S., & Sundaram, A. (2012). The chasing face of engineering education in Kerala: An empirical study of engineering colleges in Kerala. *International Journal of Engineering Research and Technology (IJERT), 1*(10).

Praveen. (2003). Prospects of engineering education and employment in India. *The Indian Journal of Technical Education, 26*(1), 16-18.

Rahman, M.A., & Unnikrishnan (2015). Scope and challenges of technical education :A Kerala perspective. *Higher Education for the Future, 2*(2). Retrieved from http://journals.sagepub.com/doi/pdf/10.1177/ 2347798915584117.

Rani, P.G. (2002). Financing higher education in India in the post reform period: Focus on Access and Equity. *NIEPA Occasional Paper 31,* p. 1-3. New Delhi: National Institute of Educational Planning and Administration. Retrieved from www.nuepa.org/Download/Publications/ Occasional%20Paper-31pgeetha.pdf

Rao, K.S. (1997). Quality of technical education and role of state government and local institutions. *Journal of Higher Education, 20*(2), 193-218.

Ravichandran, K., Kumar, S.A., & Venkatesan, N. (2012). Student's perception on service quality. *International Academic Research Journal of Business and Management*, *1*(1), 23-38.

Report IIT Review Committee. (1986), Nayudamma Committee Report. New Delhi: Ministry of Education & Culture, Government of India.

Report of the Secondary Education Commission (Mudaliar Commission) Report. (1952). Ministry of Education Government of India, P. 193-94. Retrieved from www.teindia.nic.in/Files/Reports/CCR/Secondary_ Education_Commission_Report.pdf

National Knowledge Commission, Govt. of India. (2008). *Report of Working Group on Engineering Education*, p. 55-60.

Nayudamma. (1980). *Report on the Review Committee on Postgraduate Education and Research*, Retrieved from www.indiana.edu/ ~ciec/Proceedings_2015/ETD/ETD315_IssapourSheppard.pdf

Review Committee Report for the Technical Teachers' Training Institutes. (1976). *Kelkar Committee Report.*

Revitalizing Technical Education, Report of the Review Committee on AICTE, Ministry of Human Resource Development, Government of India, September (2003). *U R Rao Committee Report, 2003*.

Reynolds, T.S. (1992). The education of engineers in America before the Morrill Act of 1862. *History of Education Quarterly, 32*(4): 459-482.

S.S. Bhatnagar Committee. (1947). *Committees and Commissions in India, Vol. 1:* 1947-54, By Virendra Kumar p 25. New Delhi: Concept Publishing Company, 1976(book).

Saha, S.K., & Ghosh, S. (2012). Commissions and committees on technical education in Independent India: An appraisal. *Indian Journal of History of Science, 47*(1), 109-138.

Sandhya, C., Chand, R., & Rajesh, R. (2016). Study of employee retention rate in self financing engineering colleges of Kerala. *IOSR Journal of Business and Management (IOSR-JBM),…,* 86-94.

Sankaran, M., & Mohanty, S. (2018). Practice vis-à-vis benefits: An assessment of the teaching-learning methods employed in engineering education. *Journal of Engineering Education Transformations*, *31*(3). doi:10.16920/jeet/2018/v31i3/120797

Sarkar Committee. (1945-1949). *Committee on Development of Higher Technical Institutions in India*, 1948. New Delhi: Manager of Publications.

Sayeda., & Rajendran, and Lokachari, P. (2010). An empirical study of total quality management in engineering educational institutions of India: An perspective of management. *Benchmarking: An International Journal, 17*(5), 728-767. doi: 114635771011076461.

Sen, B. (1989). Development of technical education in India and state policy- A historical perspective. *Indian Journal of History of Science, 24*(4), 224-248.

Sharma, M.K. (2015). Impact of globalization on Indian technical education system. *International Journal for Innovative Research in Multidisciplinary Field, 1*(3), 7-11.

Sharma, P.B. (2013). Higher technical education for unleashing the power of 3rd industrial revolution for sustainable development. *University News, 51*(17), 52-58.

Sharma, Y.K. (2001). *History and problems of education*. New Delhi: Kanishka Publishers.

Sharma. (2017). Celebrating success of India's engineering education: The road ahead. *University News, 55*(05), 78-87.

Shetty, N.R. (2006). OBC students fare better. *Hindustan Times*, October 12, p. 5.

Shirvasthav, J.P. (2003). National issues of technical education and suggested solutions. *The Indian Journal of Technical Education, 26*(1), 24.

Shukla, O.P., & Garg, S. (2016). Skills requirements for engineering graduates: Industry perspective. *IOSR Journal of Business and Management, 18* (10), 1-10.

Singh, A., & Singh, S. (2014). Private engineering education in India: Past, present and future. *International Journal of Management and Social Science Research (IJMSSR), 3*(1), 39-46.

Sivasankaran, C.J., Ravindran, P.K., & Babu, S.B.V. (2004). *An investigation in to the problem of wastage in the engineering colleges in Kerala. Projected report prepared.* Integrated Rural Technology Centre, Mundur, Palakkad, Kerala Research Development on Local Level Development, CDS, Thiruvananthapuram.

Sreejith, P.S. (2013). Problems, concerns and issues in technical education. *University News, 51*(16).

Subbarao, E.C. (2013). *India's higher engineering education: Opportunities and tough choices. Current Science, 104(1), 55-66. Retrieved from https://www.ugc.ac.in/mrp/paper/MRP-MAJOR-INFO-2013-12876-PAPER.pdf*

Subbiah, A. (2009). Engineering education in India: An overview. *University News, 47*(22), 6-13.

Taking IITs to Excellence and Greater Relevance: Report of Dr Anil Kakodkar Committee. New Delhi: MHRD. Retrieved from http://mhrd.gov.in/documents_reports?field_documents_reports_category_tid=14

Thacker, M.S. (1977). *Development of technical education in India, science and technology in India*. New Delhi: Vikas Publishing House.

Government of India. (1950). *The Report of the University Education Commission* (*Radhakrishnan Commission Report, 1st ed, p. 222-224*). (1950). Simla: Government of India Press. Retrieved from www.educationforallinindia.com/1949%20Report%20of%20the%20University%20Ed...

Viswanadhan. (2009). Performance under varied management styles- A comparative assessment of engineering education programmes in India. *International Business Research, 2*(1), 117-127. doi:10.5539/ibf.v2n/p117.

Viswanadhan. (2008). Status of undergraduate engineering education in India- An analysis of accredited engineering programmes. *International Education Studies, 1*(3), 99-107.

APPENDICES

Appendix A

DEPARTMENT OF EDUCATION
UNIVERSITY OF CALICUT

QUESTIONNAIRE ON ENGINEERING COLLEGES TO PRINCIPALS

Dr. M.N.Mohamedunni Alias Musthafa
Associate Professor
Dept. of Education,
Central University of Kerala, Kasargode

Surekha P.M.
Research Scholar,
Dept. of Education,
University of Calicut

Instructions

The purpose of the questionnaire is to seek information regarding the engineering colleges in Kerala. Please tick mark [✓] or full in information relevant to your college. The information will be kept confidential and use only for research purpose. If the space provided is not sufficient additional sheets may be used for answering.

General Information

Name of the college :

District :

Year of establishment :

Whether recognised/ not recognised :

Whether Government/ Aided/ Self financing :

A. Infrastructure and Instructional facilities :

Please look at the facilities given in column 1. Are there adequate number / availability of these in your college? Mark your response with a tick mark [✓] at the appropriate column. If you are not satisfied with the number / facilities of the items listed, cite your reasons in the third column.

No.	Facilities	Yes	No	If No, give reasons
1.	Classrooms			
2.	a. Laboratories for different subjects			
	b. Enough equipment/ machinery/ apparatus/ furniture			
3.	a. Workshops			
	b. Enough equipment in the workshop			

No.	Facilities	Yes	No	If No, give reasons
	c. Additional workshop			
4.	Drawing Hall			
5.	Seminar Hall			
6.	Computer facilities:			
	a. Central computing facility			
	b. Departmental Computer Room			
	c. Adequate number of computers			
	d. Internet facility			
	e. Wi Fi			
	f. Printers			
	g. Colour Printer			
	h. Central Photocopying			
7.	Students' resting room / Common room			
8.	Physical exercise facilities			
9.	Hostel facility			
10.	Cafeteria/ Canteen			
11.	Separate Departmental Libraries			
12.	Central Library			
	a. E-Journals			
	b. Multimedia PCs			
	c. Computerised indexing facility			
	d. Adequate reading room seating			
	e. Photocopying facility			
	f. Document scanning facility			
	g. Document printing facility			
	h. NPTEL facility			
13.	Details on Central Library: Give the number of,			
	a. Total books in the Central Library			
	b. Reference books			
	c. National journals			
	d. International journals			
	e. Library cards given to the students			
	f. Library cards given to the faculties			
	g. Total books in the Central Library			

Essential Requirements : Does your college has the following? Answer as Yes/ No

	Requirements	Yes	No
14.	Standalone Language Laboratory		
15.	Electric supply		
16.	Potable water supply		
17.	Sewage disposal facility		
18.	Fax		
19.	Telephone		
20.	Website		
21.	Barrier free built environment		
22.	Fire and safety measures		
23.	General insurance for calamities		
24.	General Notice Board		
25.	First Aid , Medical Counselling facility		
26.	Grievance Redressal Committee		
27.	Anti Ragging Cell		

Desirable Requirements: Does your college has the following? Answer as Yes/No

	Requirements	Yes	No
28.	Back up electric supply		
29.	Public Address System		
30.	Post / ATM / Bank		
31.	CC TV		
32.	Insurance for students		
33.	Display of courses in front of the college		
34.	Staff Quarters		

35. Any limitations with respect to infrastructural facilities other than the above:

B. Human Resources:

		Yes	No
36.	Are there adequate number of,		
	a. Faculties in each branch		
	b. Technical Staff		
	c. Non-Teaching Staff		

37.	Are you satisfied on the performance of the faculties?		
	If no, give your reasons:		
38.	Are you satisfied on the performance of the technical staff?		
	If no, give your reasons:		
39.	Are you satisfied on the performance of the Non-teaching staff?		
	If no, give your reasons:		
40.	Overall satisfaction regarding the human resources available at your college		

C. Financial Resources:

41.	Authority which provides Maintenance Grant		
42.	Amount collected from students		
43.	Amount spent during the last academic year		
44.	Amount proposed for the current year		
45.	Is there any financial difficulty in running the institution?	Yes	No
	If yes, write the reason		

D. Parent Teacher Association(PTA) , College union and Alumni association

	PTA	Yes	No
46.	Is PTA is active in your institute?		
47.	Are you satisfied with the activities of your PTA?		
	If no write the reason		
	College Union		
48.	Is there college union active in you institute?		
49.	Are you satisfied with the activities of college union of your college?		
	If no, write your reason		

	Alumni associations		
50.	Is Alumni association formed in your institute?		
51.	Is activities of Alumni satisfactory?		
	If no, write the reason		

E. Planning, Organisation and Transaction of the Curriculum

<table>
<tr><td>52.</td><td colspan="2">Which authority does the plan and organisation of the curriculum?</td><td colspan="2"></td></tr>
<tr><td>53.</td><td colspan="2">In which year was the curriculum revised last?</td><td colspan="2"></td></tr>
<tr><td>54.</td><td colspan="2">Is the present curriculum effective for preparing students for the job market?</td><td>Yes</td><td>No</td></tr>
<tr><td rowspan="5">55.</td><td colspan="4">Working days & hours of instruction</td></tr>
<tr><td colspan="2">a. Total no. of working days / academic year</td><td colspan="2"></td></tr>
<tr><td colspan="2">b. Working days taken to complete all admission procedures</td><td colspan="2"></td></tr>
<tr><td colspan="2">c. Total no. of teaching hours / week</td><td colspan="2"></td></tr>
<tr><td colspan="2">d. Hours for practicals / week</td><td colspan="2"></td></tr>
<tr><td>56.</td><td colspan="2">Are there enough time in an academic year to complete all the scheduled curricular and co curricular activities?</td><td>Yes</td><td>No</td></tr>
<tr><td>57.</td><td colspan="4">If no, please write the reasons in the space provided</td></tr>
<tr><td>58.</td><td colspan="2">Is Internship compulsory for the students?</td><td>Yes</td><td>No</td></tr>
<tr><td>59.</td><td colspan="2">How much time is allotted for internship?</td><td colspan="2"></td></tr>
<tr><td>60.</td><td colspan="2">Is there evaluation for Internship?</td><td>Yes</td><td>No</td></tr>
<tr><td>61.</td><td>If yes, purpose of evaluation?</td><td>For final grading</td><td colspan="2">For student improvement</td></tr>
<tr><td>62.</td><td colspan="4">Please list out major co-curricular activities of your college</td></tr>
<tr><td rowspan="6">63.</td><td rowspan="6">Who organises co curricular activities</td><td>Institutional authority</td><td>Yes</td><td>No</td></tr>
<tr><td>College union</td><td></td><td></td></tr>
<tr><td>Student union + institutional authority</td><td></td><td></td></tr>
<tr><td>PTA</td><td></td><td></td></tr>
<tr><td>Management of the college</td><td></td><td></td></tr>
<tr><td>If any other, please specify</td><td></td><td></td></tr>
<tr><td>64.</td><td colspan="4">Limitations regarding the curriculum of engineering, if any</td></tr>
</table>

Performance /Examination / Pass of students

65.	Which agency conduct final examinations for theory		
66.	Which agency conduct examination for practical		
67.	How many chances are given for reappearance?		
68.	Are the chances sufficient?	Yes	No
69.	If not, state your reasons		
70.	Any diagnostic tests are conducted for identifying weak students?	Yes	No
71.	If yes, how?		
72.	What are the remedial measures adopted, if any		
73.	Whether the certificate is valid to get job in	Yes	No
	• Government sector		
	• Private sector		
	• National level		
	• International level		

F. Opinions / Suggestions

74.	What are your observations regarding the engineering colleges in general?
75.	What are your suggestions to improve the functioning of engineering colleges in Kerala?

Appendix B

DEPARTMENT OF EDUCATION
UNIVERSITY OF CALICUT

QUESTIONNAIRE ON ENGINEERING COLLEGES TO FACULTY MEMBERS

Dr. M.N.Mohamedunni Alias Musthafa
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Central University of Kerala, Kasargode

Surekha P.M.
Research Scholar,
Dept. of Education,
University of Calicut

This is to seek information regarding the curricular competencies, experience and evaluation in your college. Please tick mark (✓) or fill in the responses that suit for you. Kindly use additional sheet if space provided is not sufficient. Your response will be kept confidential and use only for research purpose.

Name of Faculty Member:

Designation and Dept :

Name of the College :

Type of Management : Govt./Aided/Unaided Age: Sex:

Year of Experience : Email/Mobile:

GATE score :

In-service training programme Undergone:

Section A

This Section is to find out the curricular competencies envisaged in the present curriculum and experiences (class room activities) you had given in your class room to attain the same. It is having three columns. In the first column the curricular competencies are listed. In the second column you would have to tick mark (✓) on how much of these are envisaged by (High, Average and Poor). In the third column you are request to mention the specific activities you had given to attain these competencies.

Sl No	Competencies	High	Average	Poor	Teaching learning activities
1.	Knowledge Integration				
2.	Develop Ability to work in team				
3.	Develop Sensitivity towards environmental, sustainable and global issues				
4.	Develop sensitivity towards moral and ethical issues				
5.	Develop 'Readiness for lifelong' learning				
6.	Develop entrepreneurship				
7.	Develop ability to assist others				
8.	Develop ability to apply knowledge				
9.	Develop Designing Skills				
10.	Developing problem solving skills				
11.	Develop Technical competencies				
12.	Develop decision making skills				
13.	Develop analytical skills				
14.	Develop Research skills				
15.	Develop Experimentation skill				
16.	Develop communication skill				
17.	Develop project planning, management skill				
18.	Develop presentation skill				
19.	Develop mentoring skill				
20.	If any other please specify				
21.	Write limitations regarding the curriculum of engineering courses				
22.	List out teaching learning strategies used for curricular transaction				
		Always		Some time	

Evaluation of activities/ processes.

The objective of the section is to find out the evaluation strategies employed by you. In the first column deals with the specific strategy or activities are listed, the second column deals with the time of implementation of specific evaluation strategy. You will please put mark [✓] on the relevant column/ columns

Sl No	Activity	When you conduct evaluation				
		During the instruction	At the end of the class	At the end of the term	At the end of the semester	If any other time please specify
23.	Written examination					
24.	Practical Examination					
25.	Viva Voce					
26.	Seminar					
27.	Assignment					
28.	Group Discussion					
29.	Group Project					
30.	Individual Project					
31.	Demonstration					
32.	Research Article Presentations					
33.	Experimental ideas sharing					
34.	Quiz					
35.	Fair Record					
36.	Industrial Visit & Report					
37.	Designing					
38.	Sports activities & Arts Performance					
39.	Attendance (Regularity in the class)					
40.	Club activities					
41.	Educational Tour Report					
42.	If any other (Please Specify......................)					
43.	Are you satisfied on the evaluation strategies followed in engineering system					

44.	Are there enough time in an academic year to complete all the scheduled curricular and co curricular activities?	Yes	No
45.	If no, please write the reasons in the space provided		
46.	Are you satisfied with the club activities of students	Yes	No
47.	If no, please write the reasons		
48.	Write your opinion on internship programme		

Section B

1. Infrastructure and Instructional facilities:

Please look at the facilities given in column 1. Is there adequate number / availability of these in your college? Mark your response with a tick mark [✓] at the appropriate column. If you are not satisfied with the number / facilities of the items listed, cite your reasons in the third column.

No.	Facilities	Yes	No	If No, give reasons
49.	Are you satisfied on classroom facilities			
50.	Are you satisfied on laboratories for different subjects			
51.	Are you satisfied on Workshop facilities			
52.	Are you satisfied no Drawing Hall facilities			
53.	Are you satisfied on Seminar Hall facilities			
54.	Are you satisfied on Computer facilities			
55.	Are you satisfied on Library facilities			
56.	Are you satisfied on Students' resting room / Common room			
57.	Are you satisfied on Physical exercise facilities			

2. Essential Requirements : Does your college has the following? Answer as Yes/ No

	Requirements	Yes	No
58.	Standalone Language Laboratory		
59.	Electric supply		
60.	Potable water supply		
61.	Sewage disposal facility		
62.	Fax		
63.	Telephone		
64.	Website		
65.	Barrier free built environment		
66.	Fire and safety measures		
67.	General Notice Board		
68.	First Aid , Medical Counselling facility		
69.	Grievance Redressal Committee		
70.	Anti Ragging Cell		

71. If any other limitations regarding infrastructure facilities, please specify

3. Desirable Requirements: Does your college has the following? Answer as Yes/No

	Requirements	Yes	No
72.	Back up electric supply		
73.	Public Address System		
74.	Post / ATM / Bank		
75.	CC TV		
76.	Insurance for students		
77.	Display of courses in front of the college		
78.	Staff Quarters		

4. Human Resources:

79.	Are you satisfied on the human recourse availability of your college
	If no, give your reasons:

5. Parent Teacher Association(PTA) , College union and Alumni association

	PTA	Yes	No
80.	Is PTA is active in your institute?		
81.	Are you satisfied with the activities of your PTA?		
	If no write the reason		
	Alumni associations		
82.	Is Alumni association formed in your institute?		
83.	Is activities of Alumni satisfactory?		
	If no, write the reason		

84. If there any other limitations in your engineering colleges, please write

C. Opinions / Suggestions

85.	What are your observations regarding the engineering colleges in general?
86.	What are your suggestions to improve the functioning of engineering colleges in Kerala?

Appendix C

DEPARTMENT OF EDUCATION
UNIVERSITY OF CALICUT

QUESTIONNAIRE ON ENGINEERING COLLEGES TO STUDENTS

Dr. M.N.Mohamedunni Alias Musthafa
Associate Professor
Dept. of Education,
Central University of Kerala, Kasargode

Surekha P.M.
Research Scholar,
Dept. of Education,
University of Calicut

The purpose of this questionnaire is to seek information regarding the facilities, curricular and co curricular activities of your institute. Please put tick mark [✓] or fill in the column with information relevant to you. Your response will be kept confidential and use only for research purpose.

Section A

Name of the student :

Age :

Gender :

Name of the college :

Type of management :

Course :

Infrastructure and Instructional facilities:

Please look at the facilities given in column 1. Is there adequate number / availability of these in your college? Mark your response with a tick mark [✓] at the appropriate column. If you are not satisfied with the number / facilities of the items listed, cite your reasons in the third column.

No.	Facilities	Yes	No	If No, give reasons
1.	Classrooms			
2.	a. Laboratories for different subjects			
	b. Enough equipment/machinery/ apparatus/ furniture			

No.	Facilities	Yes	No	If No, give reasons
3.	a. Workshops			
	b. Enough equipment in the workshop			
	c. Additional workshop			
4.	Drawing Hall			
5.	Seminar Hall			
6.	Computer facilities:			
	a. Central computing facility			
	b. Departmental Computer Room			
	c. Adequate number of computers			
	d. Internet facility			
	e. Wi Fi			
	f. Printers			
	g. Colour Printer			
	h. Central Photocopying			
7.	Physical exercise facilities			
	• Out-door game facility			
	• Indoor game facility			
8.	Cafeteria/ Canteen			
9.	Separate Departmental Libraries			
10.	Central Library			
	• Document scanning facility			
	• Document printing facility			
	• NPTEL facility			
	• Adequate books available			
	• Adequate journals available			
	• Number of cards given for lending books			

2. Essential Requirements: Does your college has the following? Answer as Yes/No

	Requirements	Yes	No
11.	Standalone Language Laboratory		
12.	Electric supply		

	Requirements	Yes	No
13.	Potable water supply		
14.	Sewage disposal facility		
15.	Telephone		
16.	Website		
17.	Barrier free built environment		
18.	Fire and safety measures		
19.	General Notice Board		
20.	First Aid , Medical Counselling facility		
21.	Grievance Redressal Committee		
22.	Anti Ragging Cell		

3. Desirable Requirements : Does your college has the following?
Answer as Yes/ No

	Requirements	Yes	No
23.	Back up electric supply		
24.	Public Address System		
25.	Post / ATM / Bank		
26.	CC TV		
27.	Insurance for students		
28.	Display of courses in front of the college		
29.	Staff Quarters		

Human Resources:

		Yes	No
30.	Are there adequate number of,		
	a. Faculties in each branch		
	b. Technical Staff		
	c. Non-Teaching Staff		
31.	Are you satisfied on the performance of the faculties?		
	If no, give your reasons:		
32.	Are you satisfied on the performance of Principal?		
	If no, give your reason:		

		Yes	No
33.	Are you satisfied on the performance of the technical staff?		
	If no, give your reasons:		
34.	Are you satisfied on the performance of the Non-teaching staff?		
	If no, give your reasons:		
35.	Is there PTA in your institute		
	Are you satisfied with its functioning?		
	If no, give reason		
36.	Is there college union in your college		
37.	Are you satisfied on the activities of college union?		
	If no , give reason		
38.	Is there Alumni in your college		
39.	Do you satisfied on alumni association		
	If no, give reason		

Planning, Organisation and Transaction of the Curriculum

	Requirements	**Yes**	**No**
40.	Curriculum at par with international standard		
41.	Inculcate social concern		
42.	Providing training for future life		
43.	is over burden		
44.	is exam oriented		
45.	is work oriented		
46.	Consider importance of environmental education		
47.	Promote creativity		
48.	Enhance motivational level		
49.	Contemporary relevant		

50.	Are there enough time in an academic year to complete all the scheduled curricular and co curricular activities?	Yes	No
51.	If no, please write the reasons in the space provided		
52.	Satisfied on teaching learning strategies used in the class room?	Yes	No
53.	If no, please write reason in the space provided		
54.	Is there any problems regarding medium of instruction?	Yes	No
55.	If yes, please write your reason		
56.	Do teachers timely inform parents regarding your academic progress	Yes	No
57.	Does the parents discuss with teachers about your academic progress		
58.	Do you complete internship?	Yes	No
59.	How much time is allotted for internship?	....	
60.	Is there evaluation for Internship?	Yes	No
61.	If yes, purpose of evaluation?	For final grading	For student improvement
62.	Please write your views about internship		

Co curricular activities

63.	List out the major co-curricular activities of your college		
64.	Who organise co-curricular activities of your college, please tick mark on the relevant option	Institutional authority	
		Student union	
		Student Union assisting institutional authority	
		PTA	
		Student+ Institution+ PTA	
		Management of the college	
		Any other please specify	

65.	Is there student club activities		Yes	No
66.	Please put Tick mark on the relevant one which are active in your college	Eco club		
		Nature club		
		Sports club		
		Music club		
		Literary club		
		Media club		
67.	Any other please specify			
68.	Do you participated in any of the club activities		Yes	No
	If no, please write the reasons			

Examination and evaluation

69.	Were the examinations conducted timely in your college?	Yes	No
70.	What is your observation regarding the present examination and evaluation ? Please write		

Section B

Teaching learning strategies

This section is to find out teaching learning strategies adopted in your college. Some of the activities are listed below. Please put a tick [✓] mark on the activities that are adopted in your class room.

	Strategies	Always	Sometime	Never
71.	Lecturing			
72.	Assignment			
73.	Laboratory experiments			
74.	Workshop			
75.	Seminar			
76.	Problem based learning			
77.	Technical presentation			
78.	Industrial training			
79.	Technology integrated teaching			
80.	Experimental learning			
81.	Career guidance			
82.	Discussion			

	Strategies	Always	Sometime	Never
83.	Industrial visit			
84.	Individual project			
85.	Group activity			
86.	Tutorial			
87.	Group project			
88.	Demonstration			
89.	Real time videos			
90.	Peer guidance			
91.	Model making			
92.	Debate			
93.	Literature survey			
94.	Online study			
95.	Quiz			
96.	Open courses			
97.	NPTEL video lectures			
	Any other please specify			

Section C.

Opinions / Suggestions

98.	What are your observations regarding the engineering colleges in general?
99.	What are your suggestions to improve the functioning of engineering colleges in Kerala?

Appendix D

DEPARTMENT OF EDUCATION
UNIVERSITY OF CALICUT

QUESTIONNAIRE ON ENGINEERING COLLEGES TO ENGINEERING GRADUATES

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Surekha P.M.
Research Scholar,
Dept. of Education,
University of Calicut

This questionnaire is to find out your reactions regarding the effectiveness of your experience that you had in your college for graduation. Please tick mark (✓) or fill in the information relevant to you. Your response will be kept confidential and use only for research purpose. Kindly use additional sheets if the space provided is not sufficient.

1. Name :
2. Age :
3. Sex :
4. Name of the present occupation :
5. Educational Qualification

   B.Tech

   M.Tech

   Ph.D.

   If any other please specify

6. Name of the Engineering course that you had :
7. Name of the Institution from where had your graduation? :
8. Whether the college Govt./Aided/Unaided :
9. Are you satisfied with the physical facilities of your college? : Yes/No
   If No please give the reason.
10. Are you satisfied with the performance of teachers of your institute? : Yes/No

    If No please give the reason.

11. Are you satisfied with the working of non-teaching staff of your institute? : Yes/No

    If No please give the reason.

12. Are you satisfied with the administrative system of your institute? : Yes/No

    If No please give the reason.

13. Do you feel any problem related to instructional medium of your course : Yes/No

    If Yes please give the reason

Section B

This Section is to find out the curricular competencies envisaged in the curriculum and experiences (teaching-learning strategies) used by the faculties to transact the curriculum in your class room to attain the same. It is having three columns. In the first column the curricular competencies are listed. In the second column you would have to tick mark (✓) on how much of these are envisaged by (High, Average and Poor). In the third column you are request to mention the specific activities you had given to attain these competencies.

Sl No	Competencies	High	Average	Poor	Teaching Learning Activities
14.	Knowledge Integration				
15.	Develop Ability to work in team				
16.	Develop Sensitivity towards environmental, sustainable and global issues				
17.	Develop sensitivity towards moral and ethical issues				
18.	Develop 'Readiness for lifelong' learning				
19.	Develop entrepreneurship				
20.	Develop ability to assist others				
21.	Develop ability to apply knowledge				

Sl No	Competencies	High	Average	Poor	Teaching Learning Activities
22.	Develop Designing Skills				
23.	Developing problem solving skills				
24.	Develop Technical competencies				
25.	Develop decision making skills				
26.	Develop analytical skills				
27.	Develop Research skills				
28.	Develop Experimentation skill				
29.	Develop communication skill				
30.	Develop project planning, management skill				
31.	Develop presentation skill				
32.	Develop mentoring skill				
33.	If any other please specify				

34. Are you satisfied with these curricular competencies? Yes/No
    If No, please give the reasons.

35. Do you think the curriculum you have studied was useful to your job?

36. Were you able to successfully transact what you studied in to the present requirements?

37. Did you undergo any additional courses after B.Tech to master whatever knowledge and skills needed in the present job?

38. Any suggestions for improving the B.Tech curriculum

Section C

The objective of section C is to collect your general opinion about engineering colleges in Kerala.

39. What is your opinion regarding the engineering colleges in Kerala?

40. Give your suggestions to improve the standard of engineering colleges in Kerala.

Appendix E1

DEPARTMENT OF EDUCATION
UNIVERSITY OF CALICUT

QUESTIONNAIRE ON ENGINEERING COLLEGES TO PARENTS OF ENGINEERING STUDENTS

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നിര്ദ്ദേശങ്ങ ള്

താങ്കളുടെ മകന്/മകള് പഠിററുങ്ക എഞ്ചിനീയറിഗ്ഗ് കോളേജിനെററുറിഞ്ഞുള്ള താങ്കളുടെ അഭിപ്രായം അറിയുങ്കതിനുവേണ്ടിയാണ് ഈ ചോദ്യാവലി. ചോദ്യാവലിററനുസരിച്ച് അഭിപ്രായഗ്ഗ ള് (✓) മാര്ക്ക് ചെയ്തുകയോ വിവരഗ്ഗ ള് നിശ്ചിതത്ത ാനത്ത് എഴുതുകയുമാണ് വേണ്ടത്. തങ്കിരിററുങ്ക ത്ത ലം ഉത്തരത്തിന് തികയാതെ വങ്കാനു അനുബന്ധമായി തങ്ക പേപ്പറിനു എഴുതാവുങ്കതാണ്. നിഗ്ഗ ള് തരുങ്ക വിവരഗ്ഗ ള് രഹസ്യമായി സൂക്ഷിററും. ഗവേഷണ ആവശ്യത്തിന് മാത്രമേ ഉപയോഗിററുകയുള്ളൂ.

പൊതുവിവരഗ്ഗ ള്

പേര്	:	
വിദ്യാഭ്യാസയോഗ്യത	:	തൊഴിനു :
നിഗ്ഗ ളുടെ മകന്/മകള്		
പഠിററുങ്ക കോളേജിന്റെ പേര്	:	
കോളേജ് ഏത് വിഭാഗത്തിനു പെടുങ്കു?	:	Govt./Aided/Unaided

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1) കോളേജിന്റെ ഭൗതികസാഹചര്യഗ്ഗ ളിനു നിഗ്ഗ ള് സംതൃപ്തനാണോ?ആണ്/അസ്സ
അസ്സെങ്കിനു ദയവായി കാരണമെഴുതുക.

2) കോളേജിനു ആവശ്യത്തിനുള്ള ഫര്ണിച്ചറുകള് ഉണ്ടോ? ഉണ്ട്/ഇസ്സ

3) ഫര്ണിച്ചറുകളിനു താങ്കള് സംതൃപ്തനാണോ? ആണ്/അസ്സ
അസ്സെങ്കിനു കാരണം

4) കോളേജിലെ കംപ്യൂട്ടര് അനുബന്ധസൗകര്യഗ്ഗ ളിനു താങ്കള് തൃപ്തനാണോ?
ആണ്/അസ്സ
അസ്സെങ്കിനു കാരണം

5) കോളേജിലെ ലൈബ്രറിയുടെ പ്രവർത്തനത്തിലും സൗകര്യത്തിലും താങ്കൾ തൃപ്തനാണോ? ആണ്/അല്ല
അല്ലെങ്കിൽ കാരണം

6) കോളേജിന്റെ ഹോസ്റ്റൽ സൗകര്യങ്ങളിൽ താങ്കൾ സംതൃപ്തനാണോ? ആണ്/അല്ല
അല്ലെങ്കിൽ കാരണമെന്ത്?

7) ഈ സ്ഥാപനത്തിലെ പിടിഎ സജീവമാണോ? ആണ്/അല്ല

8) കോളേജിലെ പിടിഎയെക്കുറിച്ച് താങ്കളുടെ അഭിപ്രായം എന്താണ്?

9) കോളേജിലെ അനധ്യാപകരുടെ (non-teaching staff) പ്രവർത്തനങ്ങളിൽ താങ്കൾ സംതൃപ്തനാണോ? ആണ്/അല്ല
അല്ലെങ്കിൽ കാരണമെന്ത്?

10) കോളേജിൽ എല്ലാ വിഷയത്തിനും ആവശ്യത്തിന് അധ്യാപകരുണ്ടോ? ഉണ്ട്/ഇല്ല

11) കുട്ടിയുടെ പഠനപുരോഗതി യഥാസമയം അധ്യാപകർ താങ്കളെ അറിയിക്കാറുണ്ടോ? ഉണ്ട്/ഇല്ല

12) കുട്ടിയുടെ പഠനപുരോഗതിയെക്കുറിച്ച് അധ്യാപകരുമായി താങ്കൾ ചർച്ചചെയ്യാറുണ്ടോ? ഉണ്ട്/ഇല്ല
ഇല്ലെങ്കിൽ കാരണമെന്ത്?

13) കോളേജിലെ അധ്യാപകരുടെ പഠനപ്രവർത്തനങ്ങളിൽ താങ്കൾ തൃപ്തനാണോ? അതെ/അല്ല
അല്ലെങ്കിൽ കാരണമെന്ത്?

14) കോളേജ് അഭിമുഖീകരിക്കുന്ന പൊതുവായ പ്രശ്നങ്ങൾ എന്തെല്ലാം?

കേരളത്തിലെ എഞ്ചിനീയറിങ് കോളേജുകളുടെ പുരോഗതിക്കുള്ള നിർദ്ദേശങ്ങൾ

1) കേരളത്തിലെ എഞ്ചിനീയറിങ് കോളേജുകളെക്കുറിച്ച് നിങ്ങളുടെ അഭിപ്രായം എന്താണ്?

2) എഞ്ചിനീയറിങ് കോളേജുകളുടെ ഉന്നമനത്തിന് താങ്കൾ മുന്നോട്ടുവെക്കുന്ന നിർദ്ദേശങ്ങൾ എന്തൊക്കെയാണ്?

Appendix E2

DEPARTMENT OF EDUCATION
UNIVERSITY OF CALICUT

QUESTIONNAIRE ON ENGINEERING COLLEGES TO PARENTS OF ENGINEERING STUDENTS

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Dept. of Education,
University of Calicut

The purpose of this Questionnaire is to collect your opinion regarding the engineering college in which your child studying. Please tick mark (✓) or fill in the information in the space provided. The information will be kept confidential and use only for research purpose. If the space provided is not sufficient additional sheet may be used for answering.

General Information

Name of the parent :

Educational qualification : Occupation :

Name of the college
where your son or daughter studying :

Type of Management : Govt./Aided/Unaided

1) Are you satisfied with the physical infrastructure of the college? : Yes/No
   a. If 'No' Please give reason.

2) Is the college well equipped with furniture? : Yes/No
3) Are you satisfied with the furniture available? : Yes/No
   a. If 'No' Please give reason.

4) Do you satisfied with the computer facilities of the college? : Yes/No
   a. If 'No' Please give reason.

5) Are you satisfied with the facilities and functioning of the library?: Yes/No
   a. If 'No' Please give reason.

6) Do you satisfied with the hostel facilities of the college? : Yes/No
   a. If 'No' Please give reason.

7) Whether PTA is active in the institute? :Yes/No
8) What is your opinion about the PTA of the college

9) Are you satisfied with the manner of administration of principal? : Yes/No
   a. If 'No' Please give reason.

10) Are you satisfied with the manner of working of non teaching staff of the college? : Yes/No
    a. If 'No' Please give reason.

11) Is there adequate number of teachers for all subjects? : Yes/No
12) Do the teachers timely inform you regarding the academic progress of your child? : Yes/No
13) Do you discuss with the teachers regarding the progress of your child? : Yes/No
    a. If 'No' please give the reason.

14) What are the general constrains faced by the college?

Suggestion for Improvement of Engineering Colleges in Kerala

1) What is your opinion regarding the engineering colleges in Kerala?

2) Give your suggestion to improve the engineering colleges.

Appendix F

DEPARTMENT OF EDUCATION
UNIVERSITY OF CALICUT

UNSTRUCTURED INTERVIEW SCHEDULE

Dr. M.N.Mohamedunni Alias Musthafa
Associate Professor
Dept. of Education,
Central University of Kerala, Kasargode

Surekha P.M.
Research Scholar,
Dept. of Education,
University of Calicut

Personal information

a) Name :

b) Age :

c) Qualification :

d) Designation :

e) Name of the institute :

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1. Express your views on growth and development of the Engineering college in Kerala.
2. Narrate the influence of this quantitative expansion on the engineering education in Kerala.
3. What is your opinion about the private participation in engineering education system of Kerala?
4. What is your opinion about admission procedures of engineering education system of Kerala?
5. What may be the reason for the vacant seats in engineering colleges in Kerala?
6. Do you think that seats in engineering colleges are approved without examining the actual enrolment rate of students in engineering courses? Explain.

7. What are the specific reason behind low pass percentage of engineering college in Kerala
8. Do you agree that there is scarcity of quality faculties in engineering colleges in Kerala?
9. Do you agree that most of the private engineering institutions are unable to provide required competent faculties and other facilities? Explain.
10. Do you think all engineering college in Kerala provide required infrastructure facilities?
11. Do you think the present engineering curriculum develop adequate competencies and skills in graduates needed for industries?
12. What are your suggestions to improve the engineering education system in Kerala?