Chapter I

Conceptual Framework

1.0 Introduction

Global advancement in technology had contributed towards the economic development of nations. Communication and internet are bringing out changes in learning system around the world. The new era of online learning, teaching had changed the definition of traditional classrooms.

Learning in 21st century is quite challenging and different than the past times. In present times, learning and teaching focuses on the overall development of learners. The focus of educators is to implement different techniques to encourage today's generation on becoming active learners and critical thinkers. The economic viability, quality of life depends upon well-prepared future generation. Education system of any nation has the power to uplift the cultural, social, and economic status of the society. Malcolm X, (2009) mentioned in his studies that having colleges and universities does not mean you have good education as well. The education model needs to focus on the economic and social development of the nation. Teachers and learners need to improvise their role to sustain in the global transitioning situations. Instructional ways need to be amended to develop the competence and skills in the learners. The process to train learners or student's mind in case of education begins at primary level and evolves later through middle and secondary level programs. Emphasis is later needed to develop interest by encouraging learners in acquiring knowledge while pursuing higher education in their interested areas.

The education system should be reformed so that the future generations can successfully join competitive workforce and face the tough rigorous competition in the global market. In addition to the theoretical course work knowledge, the out of classroom experiences and industry exposure is also needed. Hence active learning practices should be incorporated in the form of project-based learning programs like internships, practical training, and field visits. It contributes to prepare the students in their respective chosen professional areas to help them flourish in the creativity, problem solving, technical analysis and in the soft skills.

Curriculum for (UG) Undergraduate Engineering and Technology (E and T) Degree Programs needs to lay special emphasis on educating the students well for being able to prove the competencies, intellectual skills, and knowledge through the productive and satisfying careers as innovators, decision makers and leaders to contribute to the national and global economic growth.

1.1 Need for Engineering and Technical (E and T) professionals in the developing Industry

E and T professionals play a major part in any country and are responsible for its economic progress and prosperity which leads to stabilized economies and developed nations. Globalization and liberalization of the industry had opened huge number of job opportunities for E and T Professionals.

Growing demand for innovative abilities and for enhancing efficient abilities in industry leads to restructuring of industry sector.

Global and rapid change in technology leads to increase in world-wide mobility of E and T skilled professionals. Advancement of competitive environment, emergence, and growth of new professional careers. The emphasize is more on research and development and industry-institute partnerships to meet the growing demand of skilled professionals. Improved worldwide access to information and knowledge areas brings solution to technology related concerns. The increase in concerns of protecting environment with the rapid growth which leads to deterioration of available natural resources. Finding environment friendly solutions for the developing and established manufacturing and construction industries.

1.1.1 History of Engineering

Since ancient times, the engineering concept has existed in humans when fundamental inventions such as wheel pulley and lever were invented. All these inventions paved a way for more innovative inventions by staying consistent with definitions and principles of engineering. The word ‘engineering’ was derived from engineer - (engine-er), means person who runs engines, which dates to 1325 AD.

With the construction of civilian structures like buildings and bridges branches out another kind of engineering as ‘Civil Engineering’, which at that time refers more to non-military projects or civilization development. (Source: Engineering. Encyclopedia Britannica).

The development of Engineering evolved along different eras in the history. Below are the eras describing the path of evolution of engineering.

Ancient Era: Around 2630-1211 BC or before, the civilizations were developed, different structures were constructed all around the world. The Aeroplic in Greece, the Colosseum, Mesopotamia, Pyramids in Egypt, Great wall of China were the engineering skill of civil and military engineers. The development of machines in ancient Greece did come under mechanics domain of engineering. The Archimedes inventions, gearing theory of machines, catapults were the earlier standup of industrial revolution.

Middle Era: In this Era, along with civil and structural development, the mechanical engineering or machines were innovated with the inventions of water pump, clocks, mechanical controls and by understanding the use of different materials.

Renaissance Era: This era can also be called as regeneration era. It was new beginning of the industrial revolutionary. Other inventions in this era were steam engine, which was built in 1698. Steam engine invention paved the way for global economic and engineering development. Hence, with the rise in engineering field in society as well as in profession, the term engineering got the definite meaning, narrowly applied to the field of mathematics and science. By 1702, the civil and military art field was redefined into engineering specializations known as civil engineering, mechanical engineering, geodesy.

Modern Era: With the development of machines and their tools, the industrial revolution grew rapidly in Britain and around the world. With the 18th and 19th centuries inventions, like electric motors, electricity shaped a different stream of engineering as electrical engineering. Further work in late 19th century in the field of electrical engineering led to the branch of electronics. Due to the demand of new materials needed in the manufacturing industry, the new stream of engineering as

materials engineering and chemical engineering. Later on in 20th century, with the further development in mechanical, electrical and electronics engineering, it helped in defining aeronautical engineering for aviation development, hence presently the global advancement in technology and engineering had made the world approachable. Though civil engineering appears with the history of human beings as caves were built, used for shelter, tree trunk was used to cross river, were the early demonstration of ancient age civil engineering. These earliest practices in 4000 B.C in ancient Egypt and Mesopotamian were earlier version of civil and construction engineering skills in their minds. Countless designs of aqueducts, bridges, monuments built by Romans paved the way for today's civil engineering infrastructure. (Source: Engineering. Encyclopedia Britannica)**.**

1.1.2 Civil and construction industry

The Civil engineering industry overlaps many other fields like archaeology and architecture. History of construction had evolved over by the different trends in time marked by few principles:

- Durability of material used. For example, Iron to steel, mud clay brick to concrete blocks, copper to Poly Vinyl Chloride (PVC).
- The increase in height, span and structure of the buildings.
- Innovation in architecture by using materials like glass and suspension cables.
- The degree of control exercised over the interior environment.
- Energy and monetary funds available for construction process.
- Construction practices and site management.

18th Century Construction Industry- Architects and engineers became increasingly professional as experimental science and mathematics was incorporated in the building design and construction practices. In case of construction material, breakthrough was use of cast and wrought iron. Brick built buildings were constructed instead of mud clay bricks construction, which results in significant increase in production of bricks.

19th Century Civil Engineering Construction Industry - With Industrial revolution, developments were manifested in new kinds of transport installations

like railways, canals, highways, link roads. For construction, the materials like steel were used for beams with reinforced concrete and glass panes for windows. This era also marked technical advancement in the construction equipment. Plumbing, drinking water supply, sewage collection and building codes for fire safety were some of the achievements in this century. These earlier ways of construction activities were not cost effective, productive, unsustainable, safer and some of them were even non-applicable with the industrial revolution demands.

20th Century Civil Engineering construction industry - Second industrial revolution in early 20th century had made the construction of high-rise buildings and skyscrapers possible. Modern technologies were prefabricated and computer–aided-design (CAD) was incorporated for better designs in construction. Personal protective equipment hard hats, earmuffs, steel toe shoes came into use. In the end of 20th century along with development, the other aspects like ecology, green building construction, energy conservation and sustainable development have also become important considerations of construction.

The 21st century construction industry is exploding into new realms with present technology and made the construction site activities productive and precise.

- Digital blueprint apps for mapping on smart phones, blueprint apps are quite resourceful in the field for overseeing plans and making changes digitally.
- Aerial drones for topography surveying enable the surveillance of large-scale projects from remote locations.
- Building Information Management, or BIM, provide the ability to create a 3D building plan and combine it with a construction schedule, Computer Aided Design (CAD) which allows for fast-track construction and reduced interferences.
- CAD systems can store large numbers of civil, structural and electrical schematics.
- Construction management software can streamline the entire process from start to finish and help to schedule every edge of the project without having to lay a brick.
- Laser based excavation and tunneling equipment have brought more

precision in laying down foundations, perimeters, and corners.

- Project Budgeting, billing processes and time management tools were the key contributors in project development.

1.2 Engineering and technical education History

In the 18th century, the first engineering school, The National School of Bridges and Highways, France was opened in 1747 AD. Smeatonian Society of Civil Engineers was formed in 1771. In 1818, world's first engineering society, the Institution of Civil engineers was founded in London in 1828, received a Royal Charter to formally recognize civil engineering as a profession. The first private college to teach civil engineering in United States was Norwich University founded in 1819 by Captain Alden Partridge. The first degree in civil engineering in United States was awarded by Rensselaer Polytechnic Institute in 1835. In UK, during early 19th century because of the need and demands of industrial revolution of more qualified engineers, the Civil engineering and Mining branch was founded at King's College London in 1838. Later, a private college for civil engineering was established in 1839. In 1840 UK's first chair of engineering was established at University of Glasgow. (Watson 2021). (Civil engineering. Encyclopedia Britannica)

1.2.1 History of technology

Engineering and humanities scholars had different approaches historically towards the development of technology. It is basically a collaboration and cooperation between these two fields. The need of the society leads to emergence of new ideas, which results in innovation and development in the technology and engineering areas and contributes in emerging of new inventions. Some scholars published research work for the period between 1760 and 1805. Some publications were done in 1909 in Germany for the contribution in the machinery and technological processes and their further progression towards the end of the 19th century.

When Industrial Revolution in Britain slowed down considerably, countries like US, Germany made rapid progress in industry area. In this period when US was

doing mass productions in the technology sector, other countries like Russia and Japan also followed the footsteps of USA. Industrial Revolution got the boost after Second World War and US model of success was based on the interaction between academic institutions, industries, and government organizations. Looking at that model of success, even today the need of the time is to adapt and boost the development in nation by bringing appropriate and efficient incorporations in the educational system so as to bring a favorable technological change in the society.

1.2.2 Emergence of technical education around the world.

Technical schools appeared in sixteenth century with artillery schools in Venice, Sicily and Burgos were the military institutes and schools for military engineering. In 19th century, French model of higher education boosted technical education enormously by focus on research, design and conduction fields and US engineers, scientists and educators combined the European engineering theory with their testing and experiments. Britannica, T. Editors of Encyclopedia (1998, July 20). This theory and practice had played a significant role in emergence of scientific community in U.S. The polytechnic school founded in Prague in 1803, which has a transfer and collaboration program of technical knowledge which brought students from different countries for understanding levels of technical knowledge and ability.

British emphasize more on practical knowledge with an old apprenticeship method or program called pupillage, which involved collaborating with skilled engineer or technician. The development in technical education was clearly recognized in Britain where Sir Alfred Ewing, British Engineer illustrated that theoretical and practical knowledge should be incorporated in the engineering curricula. In the 19th century, in Scotland the university of Glasgow was first British university to set up a chair of engineering and incorporate engineering in their academic curriculum. Then the engineering came up with name, ‘Engineering Science’. (Watson 2021 Civil engineering. Encyclopedia Britannica)

1.2.3 Technical education's origin in India

The technical education in India started back in epic period (1000 B.C) and Vedic period (before 500 BC) with carpentry, smithy, foundry, weaving as technical skills and were part of society education to pass onto other generations. Archaeological department discovered the remains of abandoned civilizations in the forms of structures, fabrics, jewelry, tools which supplied the evidence of technical skills education in past times. As per records, the technical education began in India as 'Survey School' established in Madras (presently Chennai) by foreign traders. Industrial revolution in 18th and 19th century brought major changes in socio-economic culture all over the world. The Industrial revolution in 19th century was the real beginning of engineering and technology. The machines were invented to help humans, but the lack of coordination was felt between scientists, innovators and technicians or technically skilled persons. The need was to put learning and training together for the socio-economic development, which leads to prepare technically skilled individuals and paved the way for engineering education. (Wikipedia contributors, History of engineering).

1.2.4 Pre-Independence technical education development period in India

Britisher's established 'Survey School' in Madras in 1794 and started first technical education program for lower, upper grade technicians for the construction of roads, bridges, buildings, railways, canals, docks. Surveyors were trained for surveying and measuring lands as needed for the army. In 1854, the need for the occupational education was introduced and highlighted, so the then governor General of India recommended for the establishment of engineering education. The technical education received more importance after 1940 in India. The recommendation on reforming education system by establishing vocational and technical educational institutes, lead to the existence of polytechnics, to train middle level technical personals. First polytechnic was established as Delhi polytechnic in 1941 and is present as Delhi Technological University. Established Technical education committee of the Central Advisory Board of Education in 1943, recommended the development of technical institutions as an integral part of the national development

system. Later, All India Council of Technical Education (AICTE) came into existence with the recommendation of Central Advisory Board of Education. Though during pre-independence few advancements of technical institutes was there offering degree and diploma courses but not in post-graduate and research studies in engineering.

1.2.5 Post Independence technical education development period in India: Though the transition period started around 1941 but after independence the country has seen huge development and improvement in the technical education system. AICTE had laid down the norms for technical institutes in the form of workshops, labs, and staff requirements. Dr S. Radhakrishna (1964), Professor of eastern religious and ethics and chairperson of 'Technical education commission' emphasized on setting up new types of engineering and technology fields or technical colleges in India. The recommendation was made to improve quality and quantity of various levels of engineering and technology by bringing a closer liaison between technical colleges and universities.

From 1947 - 1987, the significant improvement was made in the quality and quantity for different education levels of engineering and technology. In 1950, the importance of technical education was recognized for the future development of the country. In 1958, Planning commission decided to come up with a 'Five Year Plan' for the socio-economic development of nation. In 1959 -1970, there was lot of emphasis was given on introducing technical education in India. In 1971, the technical education committee suggested on the various aspects of education by conducting state boards, examination reforms and entrepreneurship programs. While in period between 1978 - 1985, new schemes were introduced such as 35 polytechnics and Teacher Training Institutes (TTI’s) were setup for improving the standard and quality of technical education. (Wikipedia contributors, History of engineering).

1.2.6 Government's Five-Year Plan for the development of engineering and technical education:

The Planning Commission of India had carried the 'Five Year Plans' as centralized and integrated economic programs to develop, execute and monitor the economic and technical development in the country. The First Five Year Plan was laid down and came into existence in 1951.

- First Five-Year Plan (1951-1956) - Focused mainly on the development of primary sector such as raw materials, manufacturing, and services. Five Indian Institutes of Technology (IITs) and University Grants Commission (UGC) were setup and the UGC was given the responsibility for funding and strengthening the higher education in country.
- Second Five-Year Plan (1956-1961) - Research institutes like Tata Institute of Fundamental Research and Atomic Energy Commission were established. The focus was to train young generation in research and the technical education.
- Third Five - Year Plan (1961-1966) - State education boards were formed and were held responsible for secondary and higher education. Dams were constructed, roads were built, and cement and fertilizer plants were established. The focus was to improve the socio-economic growth of country.
- Fourth Five -Year Plan (1969-1974) - The selective expansion in post-graduation education and attempt to consolidate other programs was done in period from 1969-1974.
- Fifth Five -Year Plan (1974-1979) - This plan focused on providing employment for graduates and on the economic infrastructure that was with the development in constructing roads, power generations and the transmission of electricity.
- Sixth Five - Year plan (1980-1985) - 'National Policy Education' (NPE) highlighted to reorganize the technical and management education systems to effectively deal with advancements in science, technology, and economic areas. Hence laboratories, workshops and other infrastructure of technical institutes were refurbished.

- Seventh Five - Year Plan (1985-1990) - Technician courses and post diplomas courses, different diversified sandwich courses were introduced in polytechnics. Women education was given importance by establishing women polytechnics in all over the country. Along with the paid and self-employment opportunities, the diploma holders were given an opportunity for getting enrolled into four-year part time and three-year full-time degree course in various engineering colleges.
- Eighth Five - Year Plan (1992-1997) - NPE National Policy education committee was amended, and focus was put on employability or capacity of job market for university graduates, also to promote healthcare, sanitation, communication, and provision for extensive education facilities at all levels. The plan was put for need to improve the quality of technical and management education through modernization and up gradation of infrastructures and by adopting futuristic approaches and strengthening industry-institutional and Research and Development laboratories interaction.
- Ninth Five - Year Plan (1997-2002) - Phenomenal increase in number of technical institutes, enrolment of students under the (AICTE) 'All India Council of Technical Education'. Hence to meet the growing demands of quality and technical manpower, 'Indian Institute of Technology', IITs had started using a greater use of technology in teaching and learning process.
- Tenth Five - Year Plan: (2002-2007) In this period, the number of technical institutes rose to 4512. The number of technical institutes and engineering colleges were upgraded to deemed universities. AICTE had also developed virtual classrooms in few identified technical institutes and other initiatives like Electronic Management Information Systems (EMIS) and National Technical Manpower Information System (NTMIS) were also introduced.
- Eleventh Five - Year Plan (2007-2012) - In this period eight new IITs, 6 new 'Indian Institute of Management' IIMs, ten new 'National Institute of technology', NITs were setup to meet the need of required annual growth of 15% for technical skilled personnel required by the growing economy.

- Twelfth Five - Year Plan (2012-2017) - Indian government planned to focus on skill development of 500 million people in India by 2022, through various initiatives in technical education of the country.

1.3 Current engineering and technical education in India

Twelfth Five Year plan 2012-2017 of Planning Commission of India was focused to skill 500 million people in India by 2022, through its various initiatives. The focus of 12th Five Year Plan is on the quality education both in schools and higher education. According to Twelfth Five Year Planning commission and M.M. Pallam Raju, Union Minister of Human resource development department, Indian government is planning to make more employable (Rediff, 2013) by viewing skill building as an instrument to improve the effectiveness and contribution of labor to the overall production. There are 10327 approved technical institutes, out of which 4472 are engineering and technology institutes and 5,114 Industrial Training Institutes (ITI's) along with number of private owned vocational training institutes. AICTE - All India Council for Technical Education has the responsibility for uniform development and qualitative growth of the Technical Education system and preparation of syllabi to keep uniform standards throughout the country. AICTE sets up 8 boards for different branches of technical studies such as engineering, technology, management. These boards recommend for the preparation, specification and regulating standards in the respective fields.

Technical education plays a vital role in the social and economic development of our nation. Strata of Technical Education by AICTE includes.

- Diploma in Engineering and Technology
- Bachelor's in engineering and Technology
- Master's in engineering and Technology
- Doctoral Degree
- Vocational Courses.

Below are the other initiatives by AICTE to promote technical education:

- Saksham: (Scholarship to differently abled students) Saksham is a scheme of AICTE aimed at providing encouragement and support to especially abled children to pursue Technical Education.
- Pragati: (Scholarship for girl Students) Pragati is a scheme of AICTE aimed at aiding for Advancement of Girls participation in Technical Education. “Empowering Women through Technical Education”.
- Smart India Hackathon - is digital programming competition and participating teams compete from all parts of the country. The digital and sustainable innovations and solutions are to be offered for real time challenges that are faced by nation. It helps to harness the creativity of millions of bright minds. It is also a brilliant effort to further improve the effectiveness of technical knowledge in the technical institutes.

Some of the professional courses in undergraduate program of Engineering and Technology (E and T) offered by AICTE are:

- Civil Engineering
- Computer Science and Engineering
- Electrical Engineering
- Electronics and Communications Engineering
- Mechanical Engineering

1.3.1 Role of Undergraduate Engineering and Technical education:

The economic progress and stability of developed countries relies on the knowledge and skills of technical graduates which plays a crucial part in strengthening the overall national economy. Implementation of well-designed curriculum for professional courses direct, guide and lead learners to develop their potential, abilities and prepare them to tackle the future professional challenges. The call of putting technical education learners on the right path forward requires proper orientation, incorporation and implementation of reformed education system inclined with the industry skill needs.

1.3.2 Undergraduate engineering and technology education curriculum:

The curriculum is designed to fulfill the required objective of preparing the learners to develop and improve competencies/ skills and providing professional learning environment for lifelong learning and productive careers. The objective of developing knowledge and industry needed skills in technical education undergraduates relies on the developed and designed professional course curriculum. The curriculum should incorporate elements to develop the competencies, intellectual skills and knowledge for productive and satisfying professional careers. The structure of the drafted curriculum for undergraduate learners need to focus on educating and preparing them with industry needed skills to face the future professional challenges.

Table 1.1

Typical Sequencing Plan for Courses at UG Engineering and Technology Programs

Semesters	Subject area coverage
I –II	HS, BS and ES Courses common for all Branches
III-IV	HS, BS and ES Courses common for all Branches
V-VI	PC, PE and OE Courses ; Branch-wise Orientation Add-On courses, Seminar
VII-VIII	Internship, PE and OE Courses; Project work and Dissertation, Seminar: Add-On Courses; Final wrap-up

UG - Undergraduate PC - Professional core E and T – Engineering and Technology PE - Professional Elective. BS - Basic Sciences, MC - Mandatory Course ES – Engineering Sciences OE - Other Engineering Courses

Table 1.2:

Revised curriculum structure by AICTE for Engineering and Technical Undergraduate Engineering Program

S. No	Category	breakup of credits, Total 160
1	Humanities and Social Sciences, Management courses	12*
2	Basic Science Courses	26*
3	Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer.	29*
4	Professional core courses	47*
5	Professional Elective courses relevant to chosen specialization/branch	23*
6	Open subjects – Electives from other technical and /or emerging subjects	11*
7	Project work, seminar and internship in industry or appropriate workplace/academic and research institutions	12*
8	Mandatory Courses	(non-credit)
	[Environmental Sciences, Induction program, Indian Constitution, Essence of Indian Traditional Knowledge]	
	Total	160*

- *Minor variation is allowed as per need of the respective disciplines.* **(**Source: www.AICTE.com)

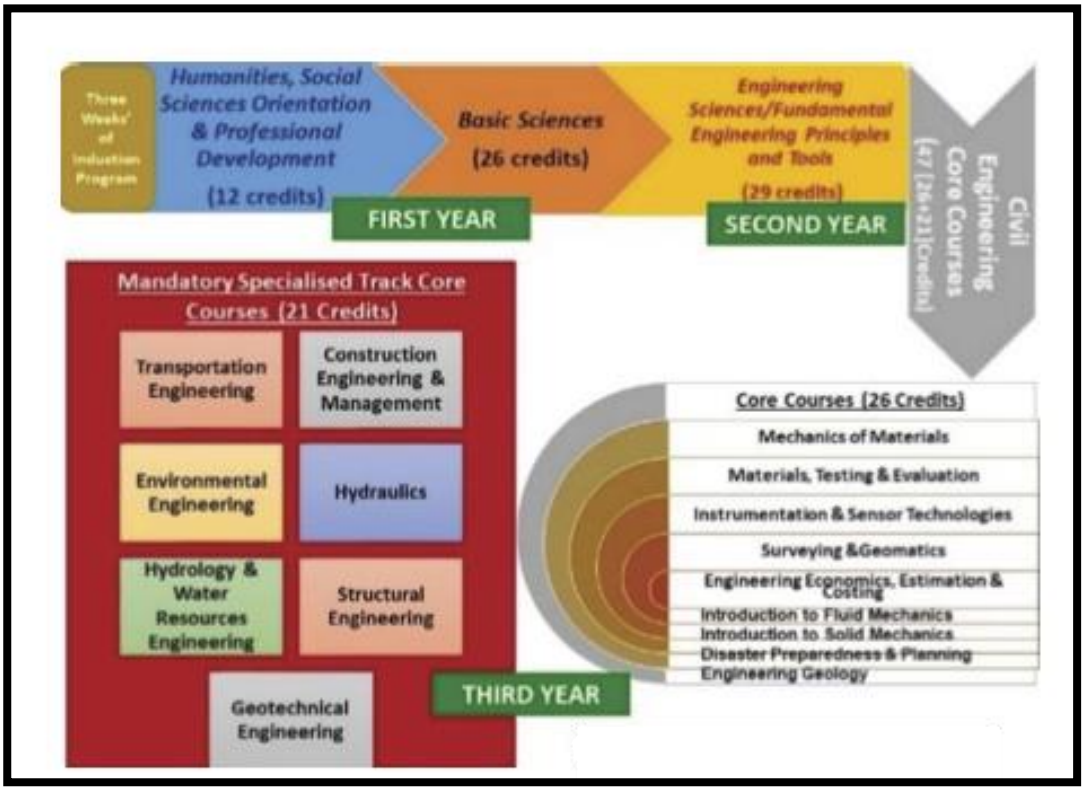


Figure 1.1 depicts the flow of courses from first year to third year of Civil Engineering Undergraduate Program. (Source: www.AICTE.com)

Figure 1.1 shows the professional course work schedule for undergraduate civil engineering program. The first-year course work includes the courses like humanities, social and basic sciences, communication, and professional development, while second year course work continues with basic engineering sciences, principles, and tools. The third-year civil engineering course work included the civil engineering core course work along with other courses such as mechanics of materials, material testing, surveying and geomatics, geology. The undergraduate civil engineering curriculum includes the practical work and classroom projects related to professional core course work. The assessment and evaluation of the courses has been decided by the affiliated institutions or universities as per AICTE norms and guidelines.

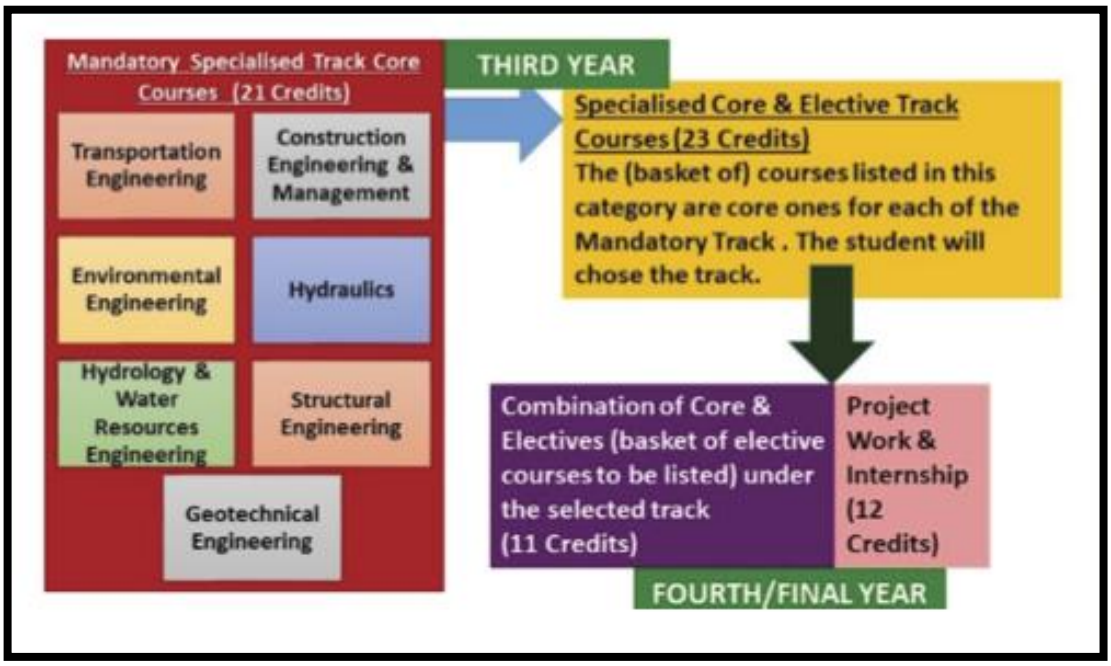


Figure 1.2 depicts the flow of courses from third year to fourth/final year of Civil Engineering undergraduate program. (Source: www. AICTE.com)

Figure 1.2 shows as per AICTE's curriculum for undergraduate engineering, learners finished general engineering course work during first two years of undergraduate civil engineering before learning the core civil engineering courses. The third-year civil engineering course work included the civil engineering core courses like geotechnical, hydraulics, environmental, water resources, environmental, structural, surveying and transportation and related class projects. The final year curriculum includes the combination of few cores and elective civil engineering courses and project work. As per AICTE's revised curriculum, Internship is made mandatory and had been given credits by conducting the assessments and evaluation for attended internship program as per AICTE's norms and guidelines.

1.3.3 Objectives of Civil Engineering Study:

The following are the objectives to study the development in knowledge level of students while involved in Civil Engineering field practices. The objectives are

chosen so that students will be able to reflect the classroom learned theory knowledge in the field by gaining field knowledge or improving technical competence, developing communication skills, technical problem-solving skills while conducting project practicums and attending internship programs.

- Students should be able to reflect and relate the learned theoretical content of civil engineering courses to construction site activities.
- Students should be able to apply basic knowledge, skills, and experience to the professional work environment.
- Student should be able to acquire knowledge and learning from challenging and field practicum activities.
- Student should be able to present their learning and acquired theoretical and field knowledge for future professional development projects.
- Student should be able to demonstrate professional skills at workplace by keeping and building positive professional relationships.

Project Work I - The learning objective of Project Work 1 is assigned by the department in third year or final year of their bachelor's in engineering program to the group of students to take up investigative study in the broad field of civil Engineering. Study or project can be either fully theoretical/practical or involving both theoretical and practical work

Project Work II and ddissertation - The learning objective of Project Work II and related dissertation is assigned in final year of their bachelor's in engineering program under the guidance of faculty from the department. It is to provide a good training for the students in developing knowledge, work and technical skills.

Internship - represents the work experience in chosen academic discipline. It is the interconnection between the academic or course program with the related learning or working experience in the industry. It is professionally supervised and structured experience that relates to students' future career goals in their respective professional field.

1.4 Teaching and learning approach in technical and engineering education:

Mode of classroom instructions in most institutes is to discuss, demonstrate, focus on application of concept and memorizing the content.

Classroom learning happens in following ways but is not limited to:

- Classroom lectures
- Practical sessions in laboratories
- Engineering Drawings

Learners learn and understand the theoretical course material which provides the learners an opportunity to reflect the learned classroom knowledge in the related practical assignments. The exposure to practical assignments /study is mostly done in a structured way as per designed course work by institutes/universities which may result in limiting their field knowledge exposure and learners remain unaware of the field challenges and scenarios. In such a way, students are not able to prepare themselves for the industry needed skills like decision making, critical thinking, long working hours on sites and to tackle the work site challenges. Internship programs offered in the curriculum is imperative for undergraduate students to gain an academic, professional experience and to develop competencies, skills, attitudes, and values to contribute to the industry, (Bee croft, Pauline C., FAAN; Kunzman, Lucy MS; Krozek, Charles MN. Skledar Susan J., Martinelli Barbara, Wasicek Kelley, Mark Scott, Weber Robert J. (2009).

AICTE had revised the undergraduate curriculum in January 2018 and offered mandatory and credited internships/field work experience as shown in table 1.1. As per table 1.2, the revised curriculum as structured by AICTE had made the internship program mandatory for engineering and technical undergraduate engineering program. Proper implementation, assessment and evaluation of internship program can contribute by preparing undergraduates with industry needed skills and the gap can be bridged from fresh graduates as career ready graduates.

1.5 AICTE's study report on employability of fresh graduates in India

In reference to AICTE's India skills report 2019, page 12 only 40% of engineering students are employable. The government is putting an effort to bring the number from 40 to 60% in next five years. (Source: Statista Research Department) The job industry reveals that 60% of our graduates are not fully career prepared so they need further training, and these 60% students won't also get compensated in terms of salary as compared to 40% of their peers. In spite of Technical Education Curriculum by AICTE which includes professional core courses, practical's related to professional course work, class projects and other promotional programs for technical education as it still lacks to keep up with the job industry requirements.

As per the Planning commission's 12th five-year plan 2012-2017 of India, government is proposing curriculum to include an appropriate mix of academic and vocational skills and which will be aligned to national occupational standards determined by employer led sector skill councils to make Indian youth more employable, by viewing skill building as an instrument to improve the effectiveness and contribution of labor to overall production. https://www.education.gov.in/sites

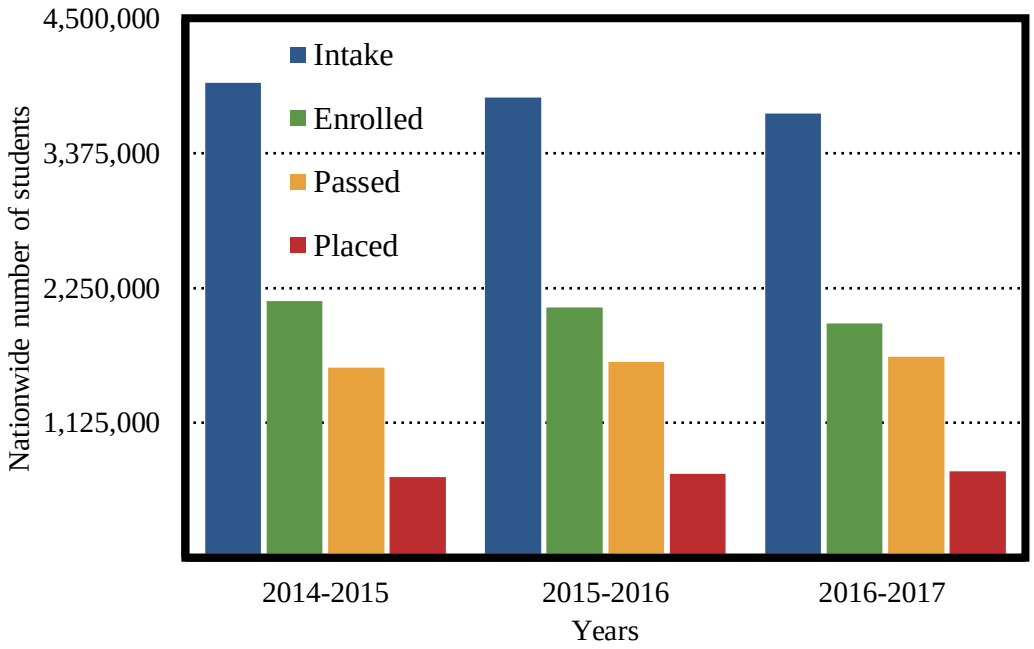
Table 1.3

Data collected by AICTE *for intake, enrolled, passed and placed Engineering and technology undergraduates for academic years from 2014 to 2017.*

Total number of Technical and Engineering undergraduates from 2014-2017			
No of Students	2014-2015	2015-2016	2016-2017
Intake	3961670	3836163	3702582
Enrolment	2141789	2085334	1953701
Student passed	1584016	1634455	1674229
Placement	672839	700090	719789

(Source: https://facilities.aicte-india.org/dashboard/pages/dashboardaicte.php)

The above table 1.3 shows the total number of engineering and technical under graduates for the year 2014-2017. The total intake for year 2014-2015 was 3961670, 3836183 for year 2015 - 2016 and for year 2016-2017 was 3702582. The enrolled were 2141789 for 2014-2015, 2085334 for 2015-2016, 1953701 for 2016-2017. The passed/graduated were 1584016 for 2014-2015, 1634455 for 2015-2016 and 1674229 for 2016-2017. The placement was only 672839 for year 2014-2015 ,700090 for year 2015-2016 and 719789 for year 2016-2017. It can be seen from the data given in table 1.3 that though enrolment was high placement of students has been low.



(Source: https://facilities.aicte-india.org/dashboard/pages/dashboardaicte.php)

Figure 1.3 Number of intakes, enrolled, passed, and placed E and T undergraduates.

Figure 1.3 histogram shows the bars as for number of intakes, enrolled, passed, and placed technical and engineering undergraduates for the academic years 2014 to 2017. The bar of the graph reveals that the number of enrolled undergraduates decline from 2014 to 2017 and the passing and placed numbers for technical and engineering undergraduates were quite same for the years from 2014 to 2017. The

placed or employed percentage was 42.3% in 2014-2015, 42.6 % in 2015-2016 and 42.9% in 2016 - 2017, respectively.

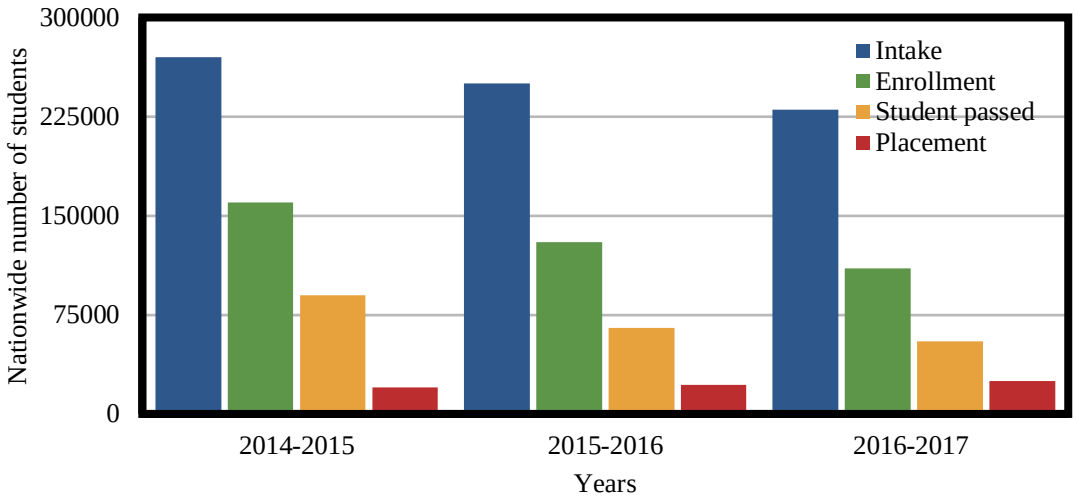
Table 1.4

Data collected by AICTE for Intake, Enrolled, Passed and Placed civil engineering undergraduates

Total number (appx) of civil engineering undergraduates			
No of Students	2014-2015	2015-2016	2016-2017
Intake	270000	250000	230000
Enrolment	160000	130000	110000
Student passed	90000	65000	55000
Placement	20000	22000	25000

(Source: https://facilities.aicte-india.org/dashboard/pages/dashboardaicte.php)

The above table shows the total number of civil engineering under graduates for the year 2014 to 2017. The total intake for year 2014-2015 was 270000, 250000 for year 2015 - 2016 and for year 2016-2017 was 230000. The enrollment number was 160000 for 2014-2015, 130000 for 2015-2016, 110000 for 2016-2017. The number of students passed were 90000 for 2014-2015, 65000 for 2015-2016 and 55000 for 2016-2017. The placed number of graduates were 20000 for year 2014-2015, 22000 for year 2015-2016 and 25000 for year 2016-2017.



(Source: https://facilities.aicte-india.org/dashboard/pages/dashboardaicte.php)

Figure 1.4 Number of intakes, enrolled, enrolled, passed and placed civil engineering undergraduate program

Figure 1.4 histogram shows the bars as for total number of intakes, enrolled, passed, and placed civil engineering undergraduate from the year 2014 to 2017. The bar of the graph reveals that the number of enrolled and passing graduates declined from academic year 2014 to 2017 but the placed percentage for civil engineering undergraduates is 22.2% in 2014-2015, 33.8% in 2015-2016, 45% in 2016-2017.

1.6 AICTE curriculum's shortcomings

AICTE's curriculum, teaching and learning mode in technical education includes theoretical and practical knowledge of technical courses. AICTE's data revealed in above figures 1.3 and figure 1.4 that only 40% (average % from year 2014 to 2017) (AICTE- India skills report 2019, page 12) of engineering and technical graduates got placed in their professional careers and 60% of remaining graduates were considered as unemployable or unskilled technical graduates. Experts in industry and technical educational field had given their opinion regarding why large number of fresh engineering graduates remain unemployable. As per AICTE - India skills report 2019, page 35, industry experts shared that fresh technical graduate lacks knowledge in field activities and real-life scenarios from their experience in hiring

process of individuals. A human resource expert reveals that fresh technical graduates not only lag in technical knowledge but also in soft skills. Fresh graduates fail in expressing themselves in the areas of decision making and critical thinking skills due to lack of exposure of experience of site or field activities. The site supervisor field experts felt that fresh technical graduates lack in understanding the construction design drawings that questions their capabilities at project construction sites.

Fresh technical graduates face challenges while preparing a detailed project report for the projects. They are unable to identify some areas of construction management which can be the shortcomings in their work abilities. Technical industry experts recommended that technical education students must visit the industry sites or construction sites during their ongoing semesters. To be career ready, technical students need to get engaged in outside classroom project activities. It is needed to acquire the development of key skills required by industry such as group work, time management along with improved Technical Competence skills.

Thus, need was felt to enhance and reform the quality and standard of UG E and T education curriculum as the fresh graduates failed to meet the challenges in this advancing engineering and technological industry.

As per AICTE's report (Times of India, July 2017) only 5% of technical institutes or universities offer internship programs which were not given any credit in the curriculum. In perspective of engineering education, internship or field experience are visualized as an opportunity and effective platform for engineering and technical education students as to experience the work environment and challenges outside the classrooms. But due to the lack of providing such temporary work placement or field training in the form of internship program to undergraduate learners, institutes fall behind on preparing the fresh graduates as skilled or career ready technical graduates.

To tackle the problem of unemployable fresh graduates and prepare the fresh graduates as career ready graduates, AICTE initiated on revamping the technical education undergraduate program by revising the curriculum and incorporating credited internship programs. As per the revised curriculum the field experiences

are made mandatory, and degree will be rewarded only after the completion of the internship programs. The Internship programs also needed to be strictly implemented monitored, assessed and evaluated by the respective institutions for the expected benefits, improvement and gain in technical competence or field knowledge as well as industry needed skills for the fresh technical graduates.

1.6.1 Internship program for engineering undergraduates

Internship is the element of performing practicums of the gained academic information to visualize or get a glimpse of future professional careers. It binds the learners, educators, employers, industries to the required standards, requirements and demands of the job market and economies. Internship is a temporary–work placement or field training opportunity to learn about field scenarios and experience field activities. In perspective of engineering, it is seen as an effective platform for engineering students to have experience about the corporate world. Pieratt, J. (2010), sought on uniting the processes of education and related experience for providing intellectual base for experiential learning. Lewin, K. and Cartwright, D., 1951, mentioned the action research methods like Project Based Learning. It is the educational environment and the work experience practice related to academics but provided outside the classroom and institute campus.

Internship is becoming increasingly popular as an essential pedagogy for the undergraduate education. Active participation through internship or in field activities provides the students with an active learning experience in a professional environment in the industry. The initiative is needed in making Field experience or Internship a core component of academic programs so that learners are compelled to participate and learn from this experience. Industry support and commitment are essential to training and enhancing sustainable design practices that eventually promotes in transferring technical knowledge and soft skills related to sustainable design and construction to young professionals that eventually enhance their employability in the industry. The challenges include finding industry-based placements for students to engage in field activities, formal articulations between academic institution and industry to support internship programs.

As per AICTE - skills report, only 5% of colleges practice internship program and currently less than 1% participates in summer internship programs. Some institutions had made to attain 3-5 weeks field experience mandatory in the curriculum of the respective undergraduate professional program but failed on measuring the effectiveness of the field experience gained by students with the designed evaluation program.

Internship program is much needed element to be incorporated in civil engineering curriculum. The capability of the construction industry to develop, procure and deliver innovative, complex, and demanding projects is driven by the involvement of highly knowledgeable and skilled professionals. Training through experiential learning has long been identified and recognized as one of the fundamental and key processes within the construction industry to assist organizations and to meet the need of construction professionals with these qualities. An engineering internship is an opportunity to apply theoretical concepts from the classroom to the realities of the field.

1.6.2 Project based learning – PBL

PBL is a student-centered educational approach. The focus shifts from a method of instruction that is teacher-driven and led to one where the student is empowered to conduct self-directed learning. PBL is not about passively absorbing knowledge and experience but involves active engagement, learning, use and application of the absorbed knowledge in various subject related projects.

PBL is the instruction where learners gain the knowledge of complex and multifaceted content of the subject matter by relating it with realistic world problems. The role of instructor comes as a facilitator who drafts, implements the PBL program and encourages the learners for identifying problems, discussing, finding solutions, making reports, and presenting the respective subject matter. PBL is the learning approach which teaches the strategies and skills to face challenges in today’s global and technically advanced world. Such challenges of identifying and working on ill-defined and ill structured problems drives the learners on the learning path. The learning process in PBL had set wider learning styles, which promotes

critical and proactive thinking. PBL also facilitates the learning through inquiry, working collaboratively, problem solving and enhancing communication.

The approaches of PBL learners may vary and range from classroom projects, laboratories to field learning or internship programs. The common approach in all sources of PBL learning is keeping the learners engaged and motivated in the assigned projects. PBL is helpful for developing long term learning skills which aims to make students acquire interdisciplinary skills and develop behavior on a collective responsibility and cooperation as compared to traditional learning.

1.6.3 PBL in relation to Engineering disciplines:

Engineering education accomplished throughout the history are examples of individuals striving to solve problems that are often considered untenable at the time. PBL presents on opportunity to reintroduce the breadth into engineering curriculum by participation in the field projects as practical implementation of knowledge-based education approach. Project based learning is an important pedagogical tool of the engineering education. PBL challenges students to connect theory with field challenges. Students are required to work on project scenarios with technical and non-technical skills. PBL is also adequate approach for engineering education, as it resembles the professional behavior of the engineering discipline. Engineering projects may vary in complexity, but it is related to the fundamental theories and techniques of an engineering/professional discipline.

The PBL programs should be designed for in depth investigation learning goals and with the sequential process:

- Define scope of project.
- Define process of investigation and measure progress of each phase.
- Resources for subject matter or investigation process.
- Teacher - student interaction at every phase of project investigation report.
- Team collaboration and peer reviews.
- Project reports and presentation.
- Rubric discussions on reflection and transfer of classroom knowledge.

But the assessment of PBL program can be a challenge as the constructive and authentic feedback should be provided for the in-depth investigations. The rubrics of PBL should include all the related verticals of knowledge, reasoning and communication like multiple choice questions, short answers, discussions, student feedback form and associated expert or supervisor's feedback for learners.

PBL contrasts with traditional and mainstream engineering education where focus is largely on teaching individual points rather than educating individuals. The Project based learning and internship can help in building robust careers in their disciplines.

1.7 Need for PBL approach as internship program in Civil Engineering discipline:

Technological advancements in the engineering and construction industry is contributing to achieving sustainable construction practices, however industry has been complaining regarding lack of training to produce construction professionals with sustainability competencies. (AICTE - skill report 2018) Academic institutions have a responsibility to address this emerging need of the industry to support national economy. The competence of an academic program in the core area is to impart its students the necessary expertise to practice professionally and to sustain in the industry. Project-based learning is a proper paradigm for addressing design and construction project management problems. As the technical expertise is needed for building projects, it is integral for learners to go through a practicum environment to understand the different aspects of a civil engineering and construction projects in the work environment.

Industries can also play a good role to pair with academia. by letting academia, learners or interns to involve and participate in the planning on long-term development programs. The close coordination between academia and industry would result in the fruitful progress in current systems.

The internship, industry or field programs allow the students or interns for:

- Observance of work hours, the importance of punctuality virtue of the individuals and its implementation in an organization.

- Observance of time management skills as preparing and submitting the reports or logbooks on scheduled time and meeting deadlines of projects.
- Enhancing presentation skills which includes proper expression, presentation, oral and written communication, and self-confidence.
- Experiencing and understanding the mission, vision, values, and goals of work organizations
- Identifying their own strengths, weaknesses and the areas that need improvement when exposed to outside working world.
- Observance of job responsibilities carried by professionals at various levels while working in the organization.
- Self-evaluation of the technical competence or knowledge of the subject matter while observing and taking part in the field and an opportunity to explore and learn the latest development techniques.
- Lifelong learning skills like ability to adapt, decision making and teamwork.

Several industries or construction companies do extend their support for the academic programs especially for the field internship programs for the students during their professional course work. It is also an excellent platform for the students to experience the work environment where they could be working upon successful completion of their academic programs. The curriculum of technical and engineering education should incorporate the components to prepare them for successful professional career. It is imperative for undergraduate students to gain an academic, professional, or vocational education, competencies, skills, attitudes, and values that equip them to contribute to the industry. Internship is the vital component of curriculum to develop learners mind with a clear vision of career path open to any future direction. Students can explore problems that encourage skills beyond training analytic intelligence. (Paul S. Chinowsky et. al 2012)

The AICTE curriculum chart showed that core professional courses like Surveying, geotechnical, foundation and building design, structural and hydraulics had been covered till third year or six semester of undergraduate Civil Engineering course. Precast and construction management were included as of the area’s relatedness to construction field activities, to provide overall knowledge of the field scenarios and

other learning skills. Students or learners can identify and reflect classroom theoretical knowledge of the offered and learned professional core courses to the related field activities. Hence, Researcher in the present study had proposed the following areas to be covered in the three-week field internship program offered after the completion of the sixth semester or third year of undergraduate civil engineering program.

1. Site Survey and Ground Investigation
2. Construction Site Excavation Activities
3. Soil Testing Reports, Foundation Design
4. RCC Foundation Construction
5. Building Construction Activities
6. Precast Structures
7. Construction Management and Administrative practices

The details about the offered Field Internship Program's curriculum and implementation are discussed in later chapters.

Studies have reported that incorporation of Project Based Learning pedagogy as internship programs in the civil engineering curriculum had provided advantages and supported the learners and educator. As supported by the theory of constructionism, learners could expand beyond a knowledge point by concentrating actively to construct or build the knowledge.

1.7.1 Constructivism

Global changes and rapid advancement around the world bring new challenges and expectations on our education system. There has been growing awareness of the necessity to change and improve the preparation and holistic development of the learners to sustain and function efficiently in the demanding and competitive world. So, the learning in 21st century can no longer sustain on the traditional way of passive learning from the classroom lectures to meet the upcoming trends.

To confront this challenge, the instruction strategy must contend the different factors which affect the education system, and there felt the need to amend the instructional theories. Constructionism (Papert, 1993) is both a theory of learning

and strategy for education. It builds on the “constructivist theories” of "Jean Piaget" that the knowledge needs to be actively constructed in the mind of learner than simply transmitting from a teacher to the student. Constructionism provides a better understanding for more active forms of learning. Classroom environment can be promoted as learner oriented by assigning the tasks or projects for learners and facilitated and guided by the instructors. The construction of learning happens as learners investigates, create, analyze, or solve the problem. The elements like group collaboration, class discussions, presentations, field trips, field experiences, project development allows the learning to take place with more meaningful context.

First and Second order realities: Reality is constructed once we establish our interaction with others through communication. First-order realities are physically observable qualities of a thing or situation for example, a job interviewer asks how is your day going? Second-order realities involve attaching meaning to first-order things or situations, for example, this is reasonable question for the situation. A first order reality in context with the classroom learning is what students or learners are observing, listening during the lecture hours. Educators or teachers communicate with the students in the classroom by delivering lectures which is the part of first order reality as well. Second order realities involve of attaching meaning to the first order observations or learning. Making meaning of what has been learnt can be analyzed or seen if the classroom learning i.e. (first order reality) get linked with outside world conception for better understanding and the knowledge.

Second order realities where meanings or practical concepts are learned happens with certain sequence of steps, like a proper method of presenting learning material, organizing it in one’s mind and the interpretation and understanding of that learning content. (Adler, Rosenfeld, Proctor II, Oxford University Press 2020.)

'Erwin Schrodinger’s', a great Physicist who have contributed a new view to the world. He is fully aware of the distinction between the first order and the second order thinking, between the body of our knowledge and representation of knowledge, (Erwin Schrodinger’s: Johann Gotschl, 1992). The subject matter in theory can be more challenging to understand compared to the learning material supported by depicting it with the pictures. The learner’s perception varies a lot by

the way learning material is presented. For example, engineering students need exposure to the outside world problem scenarios along with the theory and the practical learning to get a better perception of their professional field. Well organized learning material benefits learner's mind in approach to second order realities for better meaning making and conceptual understanding. (A Fullan,1982) point out that curriculum change is not a single entity, it is multi-dimensional and identified three dimensions of change the use of materials, new teaching approaches and alteration of pedagogical assumptions and underlying theories. (Gwyn, Kelly, Blenkin, Edwards, V. Kelly, 1992)

The process of interpretation and understanding and deriving meaning out of it largely depends upon the course work curriculum. Curriculum should include theory related practical work, field trips and field experiences for holistically developing the learners mind of attaching meaning and understanding to learned content in approach to the second order realities.

(Thomas Markham, 2011) describes PBL is knowing and then doing it. (James Greeno, 2006) has associated PBL with the 'situated learning' perspective. Thus, by focusing on the conception of adding practical knowledge in the form of practical work, field trips and field experiences along with passive learning method of classroom lectures, the second order realities that is adding meaning to the learning can be improved a lot.

The learner's positive feeling of educator and expectation of both teacher and student of each other can be the other factors which benefit second order realities. The good interpersonal communication between teacher and learners will enhance them to adapt problem-orientation methods, group work and group discussions. Such above methods will help to bring harmony between first order realties of classroom observing and learning to second order realities of adding logic, reasoning and conceptual meaning to the basic learning and observing. Professional Courses which include problem and project-based learning proved to be more acceptable by the learners' mind as it gives them the opportunity to explore the real-life problems and the scenarios. (Edutopia, 2016)

1.7.2 Internship program and Project based learning (PBL)

PBL is the critical component in the applied or authentic internship program's settings. Project based learning internship program branch out from similar profiles such as learner-centered, inquisitive environment, problem solving and communicative approaches. A learning aspect of Project based learning (PBL) that can be achieved in form of internship or field experience in the industry where learner will be able to learn how to strategically work in field or industry challenges or scenarios. The internship programs give the learners an opportunity to experience the corporate structure, processes and gain authentic learning and practice in their respective disciplines (Johari, Bradshaw, Augilar, 2002)

Internship is the experience of learning by observing, monitoring, and performing project or onsite activities with the field professionals. Internships are designed or structured in a way to provide the students, practical work experience and exposure to the field challenges. The interns also get an opportunity to explore various areas of its professional education, which provides them an insight to explore, choose and focus on the career path in their professional area.

The learning profiles of PBL and internship for learners can be enhanced as internships intended on to let learners or interns experience the in-depth knowledge of the subject matter. For keeping internships and PBL programs motivational, the design, implementation and evaluation of internship program should use the measuring tools or rubric to find the scope of the authentic learning and other gained skills. Planned project-based learning internship programs can provide meaningful learning experience for learners. Focusing attention on project-based learning, theoretical and practical framework of subject matter and learner-centered environment can make internship successful and worthy.

1.7.3 Constructionism and Project based learning

Constructionist theory involves or emphasizes on student-centered learning by incorporating PBL in the courses to make connections between theory and real-world scenarios. Constructionism Seymour Papert, 1999 observed the reconstruction of knowledge and learning by connecting it with real life projects

rather than transmitting knowledge or information passively from one source to another. The constructionism has been primarily used in science as inquiry-based learning which can be viewed as project-based learning for engineering learning grounds. The instructional principles of constructionist theory or teaching are to facilitate and encourage the students to explore for the problems and construct their understanding by solving the problems. According to constructionist theory, the instructor should facilitate learner's stimulating mind by incorporating PBL as project activity or field trip to connect them with real life scenarios. Students should be able to reflect on the classroom learning theoretical content during field experiences. Class discussions, small group collaboration by doing meaningful and practical activity will let the student do voice sharing and collaboration, which helps in constructing knowledge and developing meaning. Educators or teachers can provide conceptual clusters of situations, problems, questions, and develop new insights while connecting them with the previous learning. Learning process of constructing knowledge can be developed with student centered activities as a field experience. Learners should be encouraged to observe, monitor, do thoughtful discussions and ask open ended questions for analyzing the experiential learning.

In the current research, constructionism with PBL approach engaged the third-year civil engineering students for 3-week internship program to experience civil and construction engineering work in the field. Classroom theoretical learning provided the base for the learners to construct new understandings, develop skills, knowledge and concepts while experiencing PBL activities or field experiences.

1.7.4 Constructionism, Project based Learning and Internship Program

Constructionism is a process of constructing knowledge step by step. Individuals learn best when Harel and Papert,1991; Kafai and Resnick, 1996 they seek the problem and construct a solution, shared with others for their reflection.

Constructivism (Perkins, 1991; Piaget, 1996, Vygotsky, 1978) Knowledge constructed by individuals in interactional environment and the observance and knowledge gain is different for everyone. The new knowledge can be constructed by interacting, investigating, and involving in the activities based on their current

knowledge. In 1900's John Dewey expressed 'learning by doing.' Another essential element of constructionism is an engaged learning as individuals construct their own project or experience to gain knowledge.

PBL pedagogy is an engaging instructional method to actively construct the knowledge. Project based learning and construction of new knowledge enable the learners to grasp on abilities and skills experienced during the process. Hence, the constructionism, PBL and Situated learning or internship program goes together in the successful achievement of learning.

1.8 Research Questions:

- When applied to internship program is the PBL approach in curriculum effective for Civil Engineering students?
- Can the developed curriculum (field practice/ internship) incorporating PBL for Civil Engineering students make learning effective?
- Can the implementation of the developed curriculum for field practice incorporating PBL for Civil Engineering students make learning effective?

1.9 Rationale of the Study:

Due to the global advancement in technology, scientists and engineers are getting the international attention in the global economy. Globalization of technical ideas and overall development brings the focus on the education and availability of technical skilled professionals. The research done in technology and engineering programs brought immense improvements in teaching and learning environments which brings digital sources of knowledge that can be accessed by all. Learners can learn the subject content theoretically in classrooms and from the e-sources but lacks in experiencing field work scenarios. Despite Technical Education Curriculum by AICTE which includes professional core courses, laboratory practical work related to Course work at institutes, class projects and other promotional programs for technical education, technical society still lacks to keep up with the job Industry. More than 60% of the engineering graduates every year remain unemployed and this is the potential loss of 20 lakh man days annually

(Times of India Report 07-27-2017). The response to above concern by 'Anil Sahasrabuddhe', Chairman, AICTE that fresh graduates are under employable and lacked in industry needed skills. The job industry reveals that 60% of our graduates are not fully career prepared so they need further training, these 60% students won't also get compensated in terms of salary as compared to 40% of their peers. Thus, there is a felt need of incorporating the method or a program of Project Based Learning for individual or small groups of students to engage them in the field practicum which will let students reflect their course work learning and understanding.

Researcher has the professional education in Civil engineering and had experienced the gap and had faced challenges in the professional career path as a fresh engineering graduate with no civil engineering field experience. The researcher had personally experienced the incapability of linking academic theory to civil engineering professional practice and her inability in reflecting the relating learned professional course content to it. So, this remained Gap has initiated the research process in researcher's mind to find out what aspects of our technical education or curriculum are missing which limits the fresh graduates as unskilled individuals and not the career ready skilled individuals of which there is shortage in the job industry. In reference to Times of India Report 07-27-2017, researcher felt that engineering students needs the exposure to the real field challenges and onsite work scenarios along with their theory and practical course work content to get a better knowledge of their professional field.

Reality is constructed as communication happens, in two ways. First order reality and second order reality (Oxford University Press, 2017). A first order reality in context with the classroom learning is what students or learners are observing, listening during the lecture hours. Second order realities involve of attaching meaning to the classroom learning (first order reality) by getting linked with outside world with PBL conception (second order) for better understanding and knowledge. Researcher felt that a strong bridge between first order to second order reality can help to cover the gap from fresh graduate to career ready professional. In context to it researcher reviewed the instructional principles of Constructionism as per

Seymour Papert which are viewed as the reconstruction of knowledge and learning by connecting it with the real-life projects. Constructionist theory, (Seymour Papert, Idit Harel (1991), David L. (2014)) involves learning-by-doing or emphasis on student centred learning by incorporating PBL method in the learning courses to make connections between theory and real-world scenarios which can benefit the professional career of students.

Researcher has reviewed the Literature and found that the studies had been done by (Asan, Askin and Haliloglu, Zeynep (2005) and Panasan, Mookdaporn, Nuangchalerm, Prasart (2010)) by incorporating (PBL) Project based learning method in curriculum at various levels of education such as elementary, middle, high school, polytechnic, undergraduate and graduate level. Earlier researchers had identified the benefits of using PBL in terms of enhancing academic skills and soft skills. Some studies revealed the student's satisfaction with the PBL process, and they recognized the key skills required by industry such as group work, time management and development of technical competence were enhanced.

Related studies (Lee, Peiyu (2010) Yam, Lee Hong Sharon and Rossini, Peter (2010)) had inclined towards the benefit of incorporating PBL in classroom and outside classroom activities. Literature indicated that the studies conducted by (Lee, S.H. and Leong, Helene (2005), Hashim, Roslan, Azizi Mohd Din, Mokhtar (2009), Musthak Ahmed Syed, G. Madhuri, Reddy M. Sampath, Condoor Sridhar S. (2018)) for incorporating PBL in design course for Civil engineering students and a field engineering surveying camp of two weeks revealed positive results in developing critical thinking and professional skills in addition to improved academic skills. Students or learners show more reflectiveness for the learning experience to course content.

The benefits of studies conducted for Civil Engineering students convince researcher's mind and increase researcher's confidence in working towards research process of how to fill the gap and trace the path from fresh graduate or unskilled individual to career ready or technically skilled individual. As per AICTE's norms for Civil Engineering curriculum for 2017, the student's study most of their professional core courses during first three years of total four-year B. Tech program.

The exposure to practical study is done in a controlled way and only in the institution which blocks their exposure to real field challenges and problems. The field knowledge and experience can be obtained by joining respective industry operations as an intern or attending internship programs.

As per AICTE's 2017 curriculum, the Internship Program or field experience has not been made mandatory in all engineering institutes, even the institutes which does have Internship program does not count towards its credibility or has been given no credits in the undergraduate course curriculum.

Hence, a need was felt for incorporating the method or a program of Project Based Learning for individuals or group of students to engage them in field work activities which will give the students an opportunity to reflect their course work learning and understanding. Field work assignments or internship programs incorporate and emphasize on reflecting the lessons learned in the classroom into real world experience which are set in a professional oriented environment. It offers students the opportunity and exposure to develop professional skills such as teamwork, effective communication, social interaction and professional networking, an understanding of corporate procedure, leadership, and critical thinking skills along with enhancing academic skills.

Considering the benefits of PBL and internship for previous done studies and reviewing the related literature, Researcher was convinced and had proposed a PBL based three-week field internship program for third year civil engineering students. Researcher believed that the learners would get an opportunity to explore the different branches of civil and construction engineering and the associated field challenges to them. For the proposed curriculum PBL based Internship program students or interns performed project-based learning field practicum assignments for Site Survey and Ground Investigation, Construction Site Excavation, Understanding Soil Testing Reports, Foundation Design and Construction, RCC foundation Construction, Building Construction, coordination of construction plans, Precast structures, Construction management and Industry Administrative Practices. It also provided an exposure to understand the business procedures, budget aspects and time management skills. Students experienced and identified the

challenges of transition process from construction design plans or drawings to actual construction and building practices. However, as far as the best of researcher's knowledge while reviewing the related studies, no research has been reported to find the impact or effectiveness of incorporating PBL approach in the form of Internship Program for Undergraduate Civil Engineering Students. Hence the researcher proposed this study to measure the effectiveness of employing PBL approach in the form of internship program in the present Civil engineering curriculum for B. Tech Civil engineering students.

1.10 Statement of the problem:

"Developing, Implementing and Studying Effectiveness of Internship Curriculum Based on Project Based Learning (PBL) For Third Year Sixth Semester Students of Civil Engineering for Construction Field Preparedness"

1.11 Objectives of Study:

- To assess the need and scope for implementing Project based Learning for internship program at bachelor's level of Civil Engineering.
- To develop the Project based Learning curriculum for internship program at bachelor's level of Civil Engineering.
- To implement the Project based Learning curriculum for internship program at bachelor's level of Civil Engineering program.
- To study the effectiveness of the developed Project based Learning curriculum for internship program at bachelor's level of Civil Engineering program.
- To study the improvement in technical competence at the bachelor's level of Civil engineering program.
- To study the development and improvement in soft skills at the bachelor's level of Civil engineering program.

1.12 Operational definition of the terms

Effectiveness in the present study was seen in terms of the gained academic knowledge or improvement in technical competence (improvement in scores for pre-test and post-test), development and improvement in problem solving and other soft skills like technical writing, communications, and teamwork.

1.12.1 Explanation of terms

Project Based learning (PBL) - PBL is a student-centered educational approach. To fill the gap from fresh graduates to technically skilled or career ready individuals the bridge needs to be incorporated in the curriculum for the students by involving them in the outside classroom field practicum which may help in developing the needed professional and soft skills such as teamwork, problem solving along with improvement in the academic knowledge.

Curriculum: For the present study, the designed field Curriculum for the internship program incorporates the method or a program of experimental learning in the form of PBL based Internship program for individuals or small group of students to engage in the field practicum which gives an opportunity to the students to reflect their course work learning and understanding during project practicum activities.

Implémentation : In this present study, project based learning internship program curriculum was implemented for the third year Civil engineering students. Students were divided into groups with six to seven students in each group. All the groups were engaged in field practicum activities as per researcher designed field practicum assignments for four to five hours a day for a period of fifteen days on the respective site/ field at construction site under the supervision of civil engineering site supervisors and the researcher. Students monitored, identified, and collected the information for the assigned practicum and submitted daily reports, weekly reports, final project reports and delivered project presentations along with appearing for Pre-test, post-test for the attended PBL based internship program. Delayed Post-test was also conducted after three months to review the retention level of students for the gained knowledge during internship program.

Technical Competency: It is the skill or technical knowledge of area in the specific industry. Technical competence or field knowledge is the gained field or technical knowledge while getting engaged in field or site civil and construction engineering activities. It is measured as the understanding skills (improvement in understanding skills specific to internship practicum activities), confidence (professionalism, knowledge of field practicum, challenges, or strategic planning for finishing projects before designated deadlines), gained field knowledge (administered test scores) and classroom discussions. Technical competences were measured by the difference in the scores obtained by the interns or students for pre-test and post-test, observations made by the researcher and feedback analyses from the evaluation forms duly filled by students and site supervisors at the end of Field practicum for this designed PBL internship program for present study. Technical competence or gained field knowledge for this study was measured by comparing the mean achievement scores of pre-tests and post-tests of program participants, retention of gained knowledge by comparing mean achievement scores of pre-tests, post-test and delayed post-test and post site visit questionnaire performance.

Soft Skills: are subtle behavior and communication styles that help make work environment or interaction with team members and supervisors comfortable. Soft skills were measured in terms of teamwork, time management, problem solving, technical report writing and communication and presentation skills.

Problem solving Skills: It is the process of conceptualizing, applying, analyzing, and evaluating the information to reach an answer or a conclusion. Learners' ability to define, analyze and evaluate the challenges or problems during the construction practicum activities showed the improvement in solution seeking skills for learners while experiencing practicum activities compared to the foreseen theoretical challenges. The feedback analysis from student and supervisor evaluation/feedback forms provided an insight about the development and improvement in the problem-solving skills of the students.

Teamwork Skills: was measured in the terms of behavior of students in rapport (building relationship, demonstrate respect), openness (work productively in diverse perspectives), effort (does fair share of group work), synthesis (drawing

conclusions with other team members) while participating in their respective teams for the assigned internship group practicum of field internship program. The researcher's observation during practicum activities and analysis of students and supervisors evaluation/feedback forms gave an insight about the development and improvement of teamwork skills in the learners.

Technical Report Writing and Presentation: was measured in the terms clarity (clear and understandable expression of technical information), relevance (synchronizing the relevant material), organization (logically organize the structure with reasonable approach) of technical writing for daily reports, weekly reports, final project report of field practicum assignments and delivering as final internship project presentations for the designed practicum activities for PBL based Internship program of this present study.

1.13 Limitation of the study

This study was limited to Internship of three weeks covering the areas listed as below as per researcher's designed curriculum for summer internship for third year, six semester undergraduate civil engineering students.

1. Site Survey and Ground Investigation
2. Construction Site Excavation Activities
3. Soil Testing Reports, Foundation design, coordination of construction plans
4. RCC Foundation Construction
5. Building Construction Activities
6. Precast Structures
7. Construction Management and administrative practices

1.14 Hypothesis

The null hypothesis was assumed for the present study for third year civil engineering students or participants of PBL Internship program. The hypothesis was tested by comparing the mean achievement scores of Pre-tests and Post-tests and delayed post-test. The development and improvement in soft skills was

measured, compared by designed tools of data collection such as student evaluation form, supervisor evaluation form, project reports and project presentations and researchers' observations during PBL based internship program and tested for the assumed hypothesis.

1. There will be no significant difference between the mean achievement scores of Pre-tests and Post-tests of third year Civil Engineering students at 0.05 level.
2. There will be no significant improvement in technical competence level or gained field knowledge of third year civil engineering students at 0.05 level.
3. There will be no significant development and improvement in the soft skills of third year civil engineering students at 0.05 level.
4. There will be no significant retention observed in mean achievement scores of Delayed Post-test of third year Civil Engineering students at 0.05 level.

1.15 Summary

This chapter explains the globalized change in technology demand for the need in reformation of education system. The course curriculum for technical undergraduate studies was discussed and emphasis is made to involve the Project Based Learning pedagogy to prepare today's generation to sustain in this new era of technology. The need to develop and improve competence skills in individuals is discussed by emphasis on making the internship/field experience program as mandatory for all technical undergraduates. Moreover, the focus was on incorporating structured implementation and evaluation of internship program for four-year civil engineering bachelors' program. At the end, rationale, objectives of the study are included.

1.15.1 Chapters included in the thesis

First chapter "Conceptual framework" expresses the global advancement and the economic changes and need of trained individuals in industry. It also discusses the current education system and need of amending the education system to meet the increasing need of skilled technical graduates. In the latter half of the chapter, the technical education curriculum, teaching learning approach in technical education,

Project based Learning approach in engineering discipline is discussed. It is followed by rationale, research questions, objectives of study, hypothesis, and limitations of the study towards the end of chapter.

Second chapter included the review of related literature and the reviewed PBL studies are divided into three categories:

The research related studies have been classified at following education levels:

- Primary and middle school
- High School
- Higher education

Third chapter deals with the research methodology for this study. Variables of study, population, sample for the study, sampling technique. Research methodology and design are discussed, explaining data collection process. Tools of data collection, validation process and data analysis methods are discussed towards the end of the chapter. Fourth Chapter includes process of preparation of curriculum and implementation of the designed program at the undergraduate level for Civil engineering students. Fifth chapter includes the process of data analysis and interpretation of the study. The statistical form of results for the study are revealed in this chapter. Sixth chapter reveals the summary and findings of the study based on the quantitative and qualitative analysis of data collected. Bibliography and appendices are included after the sixth chapter.