LEARNING ANALYTICS IN HIGHER EDUCATION WITH SPECIAL REFERENCE TO NATIONAL PROGRAMME ON TECHNOLOGY ENHANCED LEARNING(NPTEL)

UNIVERSITY OF DELHI

PROJECT 2022-23

FINAL REPORT

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CERTIFICATE OF ORGINALITY

This is to certify that the research work carried out and the final report submitted by the project investigators and the students of innovation project having CODE_____ and titled **Learning analytics in higher education with special reference to national programme on technology enhanced learning(nptel)** college/institute RAMANUJAN COLLEGE is original. Any plagiarism/academic dishonesty reported at any stage will be our responsibility.

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STATEMENT OF PURPOSE

This project is designed to investigate information retrieved from online courses that are offered by IISc and IITs under the National Programme on Technology Enhanced Learning (NPTEL). This is also a project to study the information garnered to improve the quality of learning outcomes from these online courses.

ACKNOWLEDGEMENT

Milestones in life are achieved not only by individual effort but also by the blessing and guidance of our elders, near and dear ones. The present project analyzes the information retrieved from online courses offered by the Indian Institutes of Technology (IITs) and Indian Institutes of Science (IISc). All these institutes offer online courses through the National Programme on Technology Enhanced Learning (NPTEL), under the Ministry of Human Resource Development, Government of India.
Our long cherished dream of accomplishing this project would not have come true without the blessings, indispensable guidance, constructive criticism, and constant motivation of our mentors and colleagues. Their valuable guidance, constant help, and extremely useful suggestions helped us a great deal throughout the project's work.
We owe our sincere thanks to Dr SP Aggarwal (Principal, Ramanujan College, University of Delhi), for his constant motivation and encouragement, who helped us a great deal to complete this project work.
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Once again, we express our heartfelt thanks to Dr. S.P Aggarwal for always being a helping hand during this project's work.
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INTRODUCTION

One of the most essential needs in our lives is education. An individual without it is incomplete. In other words, education teaches us how to have a successful and satisfying life. It also teaches us how to think, work, and make decisions. With the help of knowledge, one may quickly tell the difference between right and wrong, truth and falsity, and even more importantly, between violence and humanity. For humans, education offers various benefits. For instance, it enlightens a person's thoughts and mind. It aids students in making plans for employment or further study after completing their undergraduate studies. Education in a subject area enables people to think, feel, and act in a way that supports their success and raises both their level of personal happiness and that of their community. Education also fosters the development of a person's personality, way of thinking, interpersonal skills, and readiness for life events. It elevates people to a higher social rank both within their own culture and around the world. Everyone has a right to education "from cradle to death," in my opinion.

The advantages of education range from having a successful profession to having a high social position to having self-assurance. First and foremost, education increases our chances of having a successful profession. There are many opportunities for us to work at whatever place we want. In other words, there may be more and simpler chances for better jobs. Our chances are higher the more educated we are. Additionally, education sharpens our minds, supports our ideas, and bolsters our morality and interpersonal actions. It provides us with knowledge on a variety of subjects in general and our area of expertise in particular, especially what we must learn for our professional careers. So, without education, we might not be able to survive properly or have a respectable job. Additionally, knowledge elevates our social prestige. We are regarded as a vital source of knowledge for our society since we are educated. Education enables us to pass on morality, etiquette, and ethics to others in our society. People see us differently and more favourably because of how industrious and resourceful we are because of this. Additionally, education transforms us into role models in society when our people look to us for direction or when they need to make a decision.

In reality, having a decent education helps our individuals and society as a whole. Furthermore, it is commonly known that gaining confidence always results from schooling. Being self-assured brings us numerous benefits and success in life, thus it is a tremendous blessing for us. We can manage specialised duties, face problems in life, and uphold optimistic attitudes, for instance. Additionally, a good education usually serves as the foundation for self-confidence, paving the way for our achievement. In light of this, self-confidence helps us become aware of how successfully we carry out a task or a series of acts. In summary, having a good education will surely lead to success in life. All things considered, education is the process of obtaining facts and knowledge that pave the way for a prosperous future. As was already said, having an education has several advantages, including a successful profession, a high social standing, and self-assurance. Through education, we learn to perceive problems as opportunities to try new things without fear.It is the primary cause of prosperous people and developed nations' prosperity. Therefore, it is believed that education is the true foundation for all future achievements.

The effects of globalisation are rapidly changing the world's landscape and having a significant influence. The physical or figurative borders between countries have been rapidly diminishing due to globalisation. The process has been pushed along by the unheard-of explosion of technology. In 1991, when new economic policies were implemented, India unlocked the doors to the outside world in many spheres, including education. Due to these implications, the Indian educational system now needs to change to meet global demands and adapt to changing circumstances. For this reason, it caused the country to mimic the west. Technology will unavoidably play a part in these events. To assess the currently existing conditions and demands throughout the world, new trends and tactics have arisen in the field of education as a result of this process. The advent of e-Education is one of the many new trends that have evolved in the world of education.It is clear at this point that e-Learning has gained popularity. Universities and educational institutions were shuttered due to the COVID-19 pandemic. It helped e-learning gain popularity.

The deadly coronavirus started spreading over the planet in late 2019. The pandemic's effects are influenced by the number of cases, ease of transmission, and severity of its clinical symptoms. As a result, COVID-19 patients may be asymptomatic or present with mild to severe illness symptoms, which results in acute respiratory distress syndrome. This airborne transmission of the disease is caused by respiratory droplets. Almost all nations made an effort to stop the spread of this deadly disease by employing crisis management techniques including donning face masks, keeping a physical distance, enforcing transportation limits, and suspending all activities. Even though e-learning has been around for a while, many academic institutions had not yet adopted it before the COVID-19 epidemic. As a result, the closure of educational and academic institutions during the COVID-19 pandemic had an unprecedented impact on the education services system since the training process required face-to-face interaction.

New choices have to be made to make up for the disturbance to the educational process. In this sense, cutting-edge technologies and learning education systems have given instructors and decision-makers an alternate way to employ information technology to carry on the educational process while enforcing the limitations brought on by the epidemic. Online or offline learning activities can be a part of e-learning methodologies. Additionally, this kind of instruction can offer e-learning, ranging from the straightforward translation of in-person information to digital format to the more complex application of digital technology (such as mobile learning, virtual patients, and virtual reality). To guarantee students the best access to instructional information during a pandemic, instructors performed e-learning using a variety of e-learning software programs, including Adobe Connect, Sky Room, etc. Following the COVID-19 pandemic, educational institutions and universities throughout the world were shuttered by the government.However, the Ministry of Education mandated that all colleges and universities provide online courses to ensure that there would not be disruption in terms of teaching or learning.

Compared to traditional learning techniques, e-learning has several benefits, such as easier access to educational resources, quicker communication, and academic cooperation. It is hard to create a novel theory of e-learning since technology is always evolving. E-learning is the process of learning via technology, according to several research. Others have described it as a system of information that may ingest a range of educational resources via email, conversation, tasks, quizzes, and live chat sessions. The remote learning paradigm from the 1980s has evolved into the e-learning paradigm. The world's universities have all made significant investments in online education, and in many universities, E-learning has replaced traditional classroom-based education. ICT (information and communication technology) developments have led to significant advancements in all connected fields. ICT has accepted new paradigms to maintain its long-term survival, including blockchain, the Internet of Things, big data, e-learning, cloud computing, and Massive Open Online Courses (MOOCs). These ICT-driven advancements have led to the emergence of new platforms, goods, systems, and facilities. Education has profited from the explosion of ICT-driven inventions. ICT has paved the way for a variety of new learning paradigms, such as e-learning and mobile learning. E-learning and mobile learning are tools that may be used to promote formal, non-formal, and informal learning. The e-learning system is a crucial source of knowledge because of its accessibility (anywhere, at any time), cheap cost, and simplicity. usefulness and interactivity. At first, glance, using e-learning in higher education looks to be a viable strategy. In comparison to conventional education, e-learning often employs less rigorous methods and methodologies. Additionally, it was shown that using online learning promotes sustainability by efficiently reducing content demand and energy use. Because of this, although early attempts to adapt and employ e-learning were uncommon, the transition to higher sustainability education has now reached a level of global importance that is difficult to ignore. The efficacy of e-learning systems has been the subject of several recent studies

This subject has been studied using a variety of analytical models, including the acceptance model, information systems success, and deconstructed theory of planned behavior. There have been several models for e-learning performance and quality, including those for e-learning system success, assessing e-learning system success, e-learning quality, and student academic performance. Similar evaluations have been done for factors including usefulness, perceived satisfaction, grade anticipation, benefits, gadget use, adoption, and acceptability. Over time, e-Education is also becoming important in India. The goals and objectives of distance learning can be connected to e-education. The Indira Gandhi National Open University was founded in 1985, and it is said that this marked the beginning of India's remote education system. The main goal of distance education is to make education accessible to all of the nation's citizens. The emergence of e-Education in India has completely changed the way that education is delivered, including correspondence courses. Numerous new trends are being introduced in the sphere of education as a result of the quick development of technology and telecommunications. Many Students are drawn to these programs and get something by enrolling in them. The classes' success rate is rather excellent.

According to author Tamar Lewin, "In the past few months, hundreds of thousands of determined students throughout the world who lack access to prestigious colleges have been embracing them as a road toward advanced skills and high-paid employment, without paying tuition or obtaining a college degree." The effectiveness of an online learning system depends on learners' readiness and acceptability to embrace this method. The use of e-learning systems hinders the advantages' realization. Due to the lack of in-person interactions with teachers or instructions, e-learning may prove to be less successful than other modern forms of education. Since evaluations are typically conducted online with e-learning methods, there is little chance of limiting illegal behaviors such as plagiarism, cheating, etc. The biggest problem with e-learning, not just between students but also between instructors and learners, is the loss of crucial personal connections.

As student-student involvement is far less of a concern than student-instructor connection, there is a lack of community in the online learning environment. Numerous education portals are available throughout India due to the vast potential for these online courses. They cover topics like foreign languages, professional skills, employability skills, etc. The administrators of these portals periodically research market demands and produce the courses, such as Big Data and Analytics, Digital Marketing, IT Services, and Architecture, to name just a few of the recently offered courses. Through these courses, teaching faculty members also refresh their knowledge. These e-learning courses are a priority for the institutions that provide distance education, such as Symbiosis Centre for Distance Learning, which provides virtual classrooms, e-monitoring self-material, and learning CDs. In the age of globalisation and the technology revolution, the globe is experiencing numerous recent developments. Every single field is being impacted. The same is true of education. We must embrace all of these changes by implementing positive ones. With the launch of e-learning and new online courses, there is no question that the future of the educational system will see incredible changes.

Teacher’s quality is a general term to describe the quality of teachers in terms of explicit teacher qualifications and latent teacher characteristics such as ability, commitment, and motivation, supported by the adequacy of recruitment procedures, faculty availability, career development, and recognition of teaching skills. The teachers actively learn and keep abreast of the latest developments, innovate, constantly research, improve their work, and strive for personal and organisational excellence. With the assumption that knowledge is power and that information is fundamental to the acquisition of knowledge and knowledge sharing, the school aims to provide quality education to its students and improve school performance. By providing undergraduate and graduate students training in business management, computer applications and social work, colleges provide educational services in key areas of social importance.

Quality is paramount in any higher education institution. "Teacher quality" is a general term to refer to the quality of teachers in terms of explicit teacher qualifications and latent teacher characteristics such as ability, commitment, and motivation, supported by the adequacy of recruitment procedures, faculty availability, career development, and recognition of teaching skills. Teachers take initiative to learn and keep abreast of the latest developments, to innovate, continuously seek improvement in their work, and to strive for individual and institutional excellence. Insofar as it contributes significantly to the institution's total quality index, teacher quality is directly related to learning outcomes. The institution is responsible for implementing the best practices and applying the most effective techniques, from recruiting through nurturing, maintaining, and harvesting.Growth is a continuing process in capacity development, where it both acts as an output and an input for more growth. As a consequence, innovations and best practices are produced. Teacher quality impacts curriculum, including its creation, implementation, and adjustment. It also increases the potential for research, consultation, and extension. It also makes the best use of infrastructure and learning resources.

How many of us have thought about the role our instructors play in this virtual learning environment, despite the fact that we are all aware of the fast growth of online schools and how they are transforming the way our children learn? It seems simple to set high standards for schooling. We appear to be falling short when it comes to making sure that our kids can live up to those ideals, and our teachers are the only ones who can assist. When it comes to constructing the educational groundwork for our kids, teachers are by far the most important building block, so we ought to provide them with more comprehensive assistance.
While the value of teachers in society is well understood and appreciated, few people give much thought to their compensation. This is one challenge that online colleges have aided in solving. In conventional schools, instructors are required to perform a variety of duties in addition to their main duty of imparting academic knowledge.

Considering that kids are already under a great deal of pressure to perform in terms of academic outcomes, this has added a tremendous amount of stress. Teachers are expected to produce on those counts as well as handle other obligations that are entrusted to them because financing for the school is frequently based on student grades.

This is one of the main explanations for why virtual learning institutions have advanced our educational system significantly. These platforms give teachers a ton of freedom when it comes to controlling the course curriculum and providing the high-quality instruction that most professors strive to provide. They also save them the trouble of having to handle extraneous duties that have nothing to do with their primary duty of providing instruction.

Students have access to resources that are distinctive of 21st-century technology through online learning environments. Traditional schools may have helped us in the past, but they are no longer a reliable source of the knowledge we need to provide our children today. Students are expected to adapt to quickly changing corporate contexts, but our existing educational system is failing to support them in doing so. We can no longer count on outdated strategies and methods to assist us in overcoming the problems we confront in the information age.

However, it is clear that we require more than simply a reform of the educational system when you take into account the various problems afflicting the existing system as well as financial challenges. Different teaching and learning approaches are required, as well as more proactive approaches to identifying and analyzing a student's strengths and limitations. Virtual learning environments have shown to be most helpful in this situation. They not only provide students, parents, and teachers with a great deal of freedom, but they also make possible a variety of possibilities that were previously not possible because of the constraints of conventional learning settings.

When it comes to teaching opportunities, teachers in traditional institutions are limited. They only have access to a small number of students in terms of geography. However, they may now communicate with students from almost anywhere on the globe thanks to online schooling. This not only provides instructors with a wealth of chances, but it also enables them to engage in meaningful interactions with a varied student body that is not geographically restricted. Additionally, they are given the opportunity to accept chances that are offered elsewhere without having to actually move.

Today, teachers may essentially educate kids from anywhere on the globe as long as they have access to a computer and an internet connection. In this way, virtual learning institutions support teachers by giving them access to possibilities that are financially feasible without requiring them to make significant adjustments to their living arrangements. They also provide instructors the flexibility they need to make the most of their careers. Additionally, in some circumstances, instructors are not constrained by rules requiring them to instruct students from a particular school. They are free to interact with and instruct students from various schools and backgrounds.

Most instructors enter the field with the intention of providing students with more than simply an education. They aspire to improve their lives in some way. For many years, teachers have been given the duty of shaping our kids into role models. Their primary duty has changed with time, though, and now they are fixated on their kids' grades. Online learning environments have allowed teachers to go back to what they enjoy doing most - Teaching. They have given them the resources and tools necessary for them to concentrate on their students' essential learning processes while guaranteeing that their pupils receive the marks they are looking for.

While online learning platforms have certainly opened up new avenues in terms of delivering information and independent learning, the importance of our teachers and the role they play should never be forgotten. They add a dimension to our lives that technology can never replace, which is why it is essential that we combine the power of online schools with the experience of our teachers to deliver the best possible education system for our children.

The "National Program of Technology Enhanced Learning" is a name for an online course in e-learning. It is an event organized by the Indian Institute of Technology, Madras (IIT-Madras) in collaboration with the Indian Institute of Science and IITs in Bombay, Delhi, Guwahati, Kanpur, Roorkee, and Kharagpur. In Bangalore, this took place. This programme was mainly established to revamp and improve engineering education. In other words, it was launched to supply academic institutions and individuals with subtle course material in all areas of engineering, science, management, technology, and humanities subjects that make up an advanced education. Human Resources Development is funding this initiative (HRD). This initiative began in 1999 and ran through the end of 2012. All significant undergraduate and graduate programmes are believed to have been protected by the availability of 40 lectures for more than 1000 courses. The primary objective of NPTEL was to expand on the engineering and fundamental science courses that were launched earlier in NPTEL Phase I. In all major engineering disciplines, physical sciences at the undergraduate and graduate levels, and postgraduate management courses, an extra 600 online and video courses were developed. Many upgrades were made, including the indexing of all online video courses and keyword searches.

“Nowadays some universities have mandatory NPTEL Exams in their academic regulations. The credits of NPTEl will carry to students in the final score. Some MNCs also accept these credits.”

Anyone who is not a part of the IIT System can now complete an online certification course through NPTEL and receive a certificate from the IITs. Through this programme, IITs are reaching out and bringing education to people's homes. Making students employable in the industry or able to pursue an appropriate higher education programme is the goal of providing them with the opportunity to receive certificates for courses. 4, 8, and 12-week online courses, often on subjects of interest to students in all years of higher education, as well as foundational core courses in the sciences and humanities with exposure to pertinent tools and technology, are provided through an online portal. Of course, they administer an online exam.Exam scores are calculated using 25% of the marks from the assignment and 75% of the final exam result.

NPTEL courses are a fantastic way to gain a conceptual knowledge of the subject because of how amazing their lectures and course material are. In essence, NPTEL may be described as an online E-learning system. It offers online Web and video lecture courses for e-learning in a variety of fields. Those that are interested in online courses will find this learning to be of great use.

NPTEL registers each participant’s information about what occurs at the time of the online course, like course content, the presentation of the instructor, and any other technical problem faced by the learners. However, the large number of records stored as raw data in the database makes its analysis and interpretation difficult and burdensome. Therefore, extracting knowledge and actionable information that allow observers to reach insightful conclusions and apply remedial measures to make this data more informative.Performing this kind of analysis requires the application of different sets of tools and techniques. Learning Analytics offers these kinds of tools and methods.

Learning Analytics (LA) is an emerging branch of data science that deals with the analysis of large amounts of academic data and converts this data into insights. Long and Siemens (2011) define Learning Analytics as**, "the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimising learning and the environments in which it occurs"**

Learning analytics covers a broad set of tools and techniques, and allows teachers and students to obtain information about student progress, at-risk students, suitability of course contents and design, student, teacher, and group interaction, etc. Institutions and instructors may then use that information to plan interventions and changes oriented toward helping students, redesign courses, adopt learning contents and methods, and use specific tools.

In the proposed research project, we will collect data from students who have completed NPTEL courses and also from those instructors who are offering the online courses through NPTEL. We will get information about the learning outcomes of the students, course content, and quality of audio/video lectures. Similarly, we will also take feedback from the instructors about the interaction with the students, the students' suggestions, and remedial measures to improve the quality of e-learning process. This data will be further used for the purpose of Learning Analytics in which we will develop Predictive Models with the help of statistical software like SPSS and R. Predictive analytics will help us draw significant conclusions and recommendations that can be used for forecasting purposes and efficient policy making regarding e- learning.

REVIEW OF LITERATURE

The study is analyzed with the help of various statistical measures. The data has been collected from the official website of NPTEL.

There are a plethora of terms and definitions used for analytics in the academic domain. Examples include business analytics, educational data mining, academic analytics, Learning analytics (LA), predictive analytics, or action analytics. Some of these terms are conceptual, while others are more functional. However, this is basically due to the observation that these new forms of analytics can begin to address some of the concerns challenging the HE sector, such as improving retention, addressing curriculum standards, increasing accountability, measuring teaching quality, graduation rate, and employment placement (Arnold &Pistilli, 2012; Dawson, 2011; Kovacic, 2012).Therefore, in line with conceptual framework of analytics in HE by Barneveld et al; (2012), we can say that LA in the academic domain is focused specifically on learners, learning processes, and their learning behaviors (Greller & Drachsler, 2012), gathering data from LMS and SIS in order to establish indicators of concepts such as knowledge construction, creativity, self-directed learning, sense of community, and assessing academic progress based on assessment and structured activities (Bienkowski, Feng, & Means, 2012, Dawson, 2011).

This can be achieved by: predicting the learner's performance; suggesting relevant learning resources; increasing reflection and awareness on the part of the learner; detecting undesirable learning behaviors; and detecting emotional states such as dullness or frustration in the learner.There is increasing competition in the higher education sector to adopt practices to ensure organisational success at all levels by addressing questions about educating and retaining a larger and more diverse student population, admissions, fundraising and operational efficiency (van Barneveld, Arnold & Campbell, 2012). In this competitive environment, higher education (HE) institutions have entered the era of "big data " and are collecting large volumes of data relating to their learners and educational process.

These vast amounts of data are stored in the student information system (SIS), including learner interactions with various educational technologies such as learning/ course management system (LMS/CMS) and in various databases such as admission files, library records, and other systems (Tair & El-Halees, 2012). The extraction of data derived from these technologies is potentially accessible for data mining and analysis (interpretation) and has captured the attention of HE administrators, academics, researchers, and government agencies

The 2013 Horizon Report identified LA as a key future trend in technology enhanced learning and teaching (Johnson et al.; 2013). As an emerging field, the process of LA uses the data associated with learner's interactions to draw out pedagogical patterns to inform decisions and evaluations (Arnold & Pistilli,2012; Gammell, Allen &Banach,2012; Long & Siemens,2011; van Barneveld et al., 2012). A key motivation for LA is to improve internal institutional cross collaboration and setting an agenda for the larger learning and teaching community (via socialization, pedagogy, and technology). The basic definition of Learning Analytics has given by Long & Siemens (2011). Learning analytics is still in its infancy; however, its short life has produced numerous conceptualizations.

Improving Student Satisfaction With Large-Scale, Compressed Timeline Online Courses (2014), this study focuses on the reasons why students who are enrolled in a lengthy, compressed timeline online course are less satisfied with it than they were with earlier courses. The researcher examined course evaluations, the architecture of this course, and smaller size online courses to determine improvements to the large-scale, compressed timeline online course. In order to boost students' sense of relatedness, autonomy, and competence, the researcher raised the frequency and supportive character of student-faculty interactions while somewhat reducing the amount of tasks.The second large-scale, shortened timeline online course's evaluation results and student responses suggested that these alterations had an impact on satisfaction.

There has been increasing interest in analytics as part of the solution to many of the issues experienced by the higher education sector, e.g. student attrition and learner support (Daniel & Butson, 2014). The major objective of learning analytics is the creation of beneficial information for data-driven decision-making. However, the greatest challenge in higher education is to determine how data is captured, processed, stored, presented, and used for the benefit of tomorrow’s outcomes (Daniel, 2017). The most common application used by universities consists of early warning systems, which rely on student performance data to predict and detect students at risk of failure.However, these pilot implementations of early warning systems adopt a limited number of analytic techniques and data features. The majority of current systems focus on a single outcome, with many relying on online educational data. This data may provide only a proportion of the potential insight into a student’s engagement with a university. The education sector benefits from valuable research outcomes from previous studies.

The Emerging Trends In E- Education With Reference To Moocs And Other Online Courses (2020) this paper discusses how globalisation has affected education. It also discussed the emergence of e-Education which completely transformed the educational landscape. There are a lot of newly created and provided free online courses. The MOOCs, EDX, NPTEL, etc. are famous examples of these courses. In the end, it was concluded that in the age of globalisation and the technology revolution, the globe is experiencing numerous recent developments. Every single field is being impacted. The same is true for education. We must embrace all of these changes by implementing the positive ones. With the launch of new online courses, there is no question that the future of the educational system will see incredible changes.

Dr. P.S. Aithal and P.M. Suresh Kumar‘s study on “Teacher’s Quality(2016)” mainly focused on the Quality of teachers in higher educational institutions and their impact .This paper aims to outline the education service model developed by Srinivas Institute of Management Studies (SIMS) for maintaining teacher quality. By providing undergrad and postgrad education in business management, computer applications, and social work, the college has been providing education services in major areas of importance to society.In this paper, they have analysed the strategies followed by Srinivas Institute of Management Studies, Mangalore, in planning and managing its human resources to meet the changing requirements of the curriculum, student learning, and time challenges, as well as the strategies adopted by the institution to enhance the teacher quality.From this article, we were able to conclude that other than the course structure , content, and various other things, a good teacher, a good mentor, is of paramount importance for any mode of education, be it remote or physical.

We learn in depth from Forest Trail Academy's blog on "Understanding The Importance Of Teachers To Online Learning" why teaching is not a desirable career option for many, what challenges teachers face, and the importance of good quality teachers.

Technology Enhanced Learning: A Case Study Of NPTEL(2018) discusses a significant trend in higher education in the twenty-first century is technology enhanced learning (TEL). In India, the government has taken on a number of e-learning-related projects. One of the key projects is the National Programme on Technology Enhanced Learning (NPTEL). In the current study, many facets of this software are evaluated. It attempts to assess the project's main results.It concluded that India needs a lot more instructors if higher education in professional courses is to be implemented effectively. Therefore, strategies for educating new and inexperienced instructors are essential if they are to fulfil their academic duties successfully. NPTEL materials are utilised as the foundation of training curricula. Through NPTEL, many students who are unable to attend academic institutions get access to their high-quality information. Many people who are gainfully working in many fields and walks of life and who need ongoing training and knowledge upgrading have profited from the IITs' and IISc's well-developed and peer-reviewed course materials.As a conclusion, it should be mentioned that the history of technology-enhanced learning in India demonstrates that NPTEL has been successful in achieving its goals.

Exploring the critical challenges and factors influencing E-learning system usage during the COVID-19 pandemic (2020), this research aims to look at the major issues and elements that influence how people use e-learning systems during the COVID-19 pandemic. It also covers the key elements that influence how well an e-learning system is used during the COVID-19 Pandemic.

The research's conclusions, which are supported by empirical data, identify the elements that encourage the use and adoption of e-learning systems and promote other academics' comprehension and analysis of the difficulties that face the existing e-learning system. Based on the findings, the respondents stated that: (1) technological factors, (2) e-learning system quality factors, (3) cultural aspects, (4) self-efficacy factors, and (5) trust factors; were the most important factors that influence the use of e-learning systems and should be considered by universities in their future plans. The results also showed that the use of an e-learning system is hindered by three key problems: (1) change management concerns, (2) technical problems with the system, and (3) problems with financial assistance.

The Emerging Trends In E- Education With Reference To Moocs And Other Online Courses (2020) this paper discusses how globalisation has affected education. It also discussed the emergence of e-Education which completely transformed the educational landscape. There are a lot of newly created and provided free online courses. The MOOCs, EDX, NPTEL, etc. are famous examples of these courses. In the end, it was concluded that in the age of globalisation and the technology revolution, the globe is experiencing numerous recent developments. Every single field is being impacted. The same is true for education. We must embrace all of these changes by implementing the positive ones. With the launch of new online courses, there is no question that the future of the educational system will see incredible changes.

Neha Lata ,Dr. Sharad Kumar Sonkar and Anshu Mishra in their article “Use and Awareness of NPTEL among Engineering Students of UIET, Babasaheb Bhimrao Ambedkar University, Lucknow (India): A Study(2020)” discussed the use and awareness of the National Program of Technology Enhanced Learning (NPTEL), the effect on both continuing educations of engineering students as well as certificate looking engineering students.The major findings were that more respondents were browsing NPTEL from the college library and engineering students at BBAU, and most of the respondents were interested in NPTEL online learning courses. Presently a day's NPTEL is a new concept of advanced library collection, as a librarian and staff should know all the specialized or technical parameters of this video and web courses to give to the client viably, this study will definitely focus the evaluation of utilisation and guide to get to effectively.

OBJECTIVES

To provide affordable and quality education to all its citizens is not only the duty of the state but also an international obligation since quality education is now one of the Sustainable Development Goals of the United Nations.

E- Learning may be a better option in this direction. Students, instructors, host institutes, funding agencies, and policy makers are important stakeholders in this e-learning process. Communication among these bodies is very important for effective learning outcomes and quality assurance. The present project will bridge the gap among these stakeholders.

The important objectives of the project are given as-

- To determine which IIT is least active in offering courses for online learning.
- We will also discuss the increasing/decreasing value of the courses with respect to time.
- On the basis of data, we will determine the most active and least active IIT based on the number of courses they conduct throughout the year.
- To determine the registration to enrollment ratio course wise.
- To determine the relationship between enrollment and registration using correlation analysis.
- To determine a relationship between registration and certification using correlation analysis.
- To check if the IITs have equal average certification discipline wise using ANOVA.

RESEARCH METHODOLOGY

The literature shows the different learning analytics applications used by different universities across the globe. To satisfy the various needs of the University and Institute of Higher Education, Learning Analytics applications are developed and used. In many cases, higher education institutions in India are unaware of the courses needed by their students. Knowledge from data mining should be brought to higher education institutions so that courses could be structured based on need. The literature review shows that the various research activities are concerned mainly with students after they join a particular course. Education is a basic need for developing countries like India. To increase the number of students continuing higher education, future research will focus on the design of a system for students to choose courses in Indian universities using Learning Analytics. Employability can be enhanced if the requirements of the industry are incorporated into the education system. This project provides a detailed review of various aspects of e- learning especially NPTEL, and problems that students and faculty face during the course. It will also focus on various Learning Analytics tools and applications which can be developed by using data obtained from learners and instructors of NPTEL courses. The present project will give insights from the educational data and provide blueprints to the policy makers for making efficient policy making regarding the e-learning system in India.

Research is a process of steps used to collect and analyse information to increase our understanding of a topic or issue. It consists of three steps: Pose a question, collect data to answer the question, and present an answer to the question. The methodology includes research design, sampling technique, publication, interviews, surveys and other research techniques, and could include both present and historical information. This section of the report will explain the methodology used for conducting the research.

- **Research Design**

TThis study has a descriptive focus. Researchers can organise and carry out descriptive studies that are intended to provide rich descriptive details about people, locations, and other phenomena with the aid of the descriptive technique of research design. The descriptive approach frequently entails in-depth narration, as well as intensive observation and note-taking.

- **Sampling Technique**

AFor the research's discipline section and duration, respectively, a random sample method and a purposeful sampling method have been used.

Random sampling, also known as probability sampling, enables the randomization of sample selection, meaning that each sample has the same chance of being chosen to reflect the entire population. One of the most common and straightforward data collection techniques in study domains is random sampling (probability and statistics, mathematics, etc.). It enables the collection of objective data, which enables studies to draw objective conclusions.

A non-random sampling technique is a method that uses purposeful sampling. Purposive sampling refers to the purposeful selection of a sample by the researcher that is most likely to yield data that will address the research issue. In qualitative research, this kind of sampling strategy is frequently employed since it enables the researcher to choose participants who have first-hand knowledge of the topic under investigation.

- **Data Analysis and Interpretation-**

All statistical analyses were performed using hypothesis testing and data visualization techniques after successful cleaning of data, using Microsoft Office Excel 2016, IBM SPSS Statistics 24.0, R programming language version 3.5.2, and Python 3.7.1.

- **Visualisation Techniques-**

Visualisation is the first step to making sense of data. To transcribe and present data and data correlations in a simple way, data analysts use a wide range of techniques - charts, diagrams, maps, etc. Choosing the right technique and its setup is often the true way to make data understandable. And vice versa, the wrong tactics may fail to present the full potential of data or even make it irrelevant .

Line and bar charts are used to demonstrate comparisons. Bar graphs use rectangular blocks to represent many different types of data, whereas line graphs use lines and represent trends over time particularly well. A doughnut chart represents your data as a part of a whole. It is primarily a circle with a large hold in the middle of it. The doughnut chart is generally used to divide a certain field by percentage coverage. The research also uses subdivided graphs for the interpretation of the data. A simple bar diagram represents only one characteristic, and it is unable to present the components of the variable. Sub-divided bar diagrams can be represented as more components of the variable. In general, sub-divided bar, diagrams are to be used if the total magnitude of the given variable is to be divided into various parts. For example, the total magnitude of the students in a college can be divided by faculty, sex, etc.

Many diverse industries make extensive use of maps. They enable positioning of elements on pertinent objects and surfaces, such as maps, floor plans, website designs, etc. Heat maps, dot distribution maps, and cartograms are some of the most commonly used map visualisations. Diagrams are frequently used to illustrate intricate data links and relationships that combine many forms of data into a single display. They can have a tree-like structure, several dimensions, and hierarchy.

- **Hypothesis Testing-**

All statistical analyses were performed using hypothesis testing and data visualization techniques after successful cleaning of data, using Microsoft Office Excel 2016, IBM SPSS Statistics 24.0, R programming language version 3.5.2, and Python 3.7.1.

- **<u>Visualisation Techniques-</u>**

Ronald Fisher, Jerzy Neyman, Karl Pearson, and Pearson's son Egon Pearson all contributed to the development of hypothesis testing. A statistical technique called hypothesis testing is employed when generating statistical judgments based on experimental data. In essence, hypothesis testing involves making an assumption about the population parameter.

Key terms and concepts:

Null Hypothesis: A null hypothesis is the statistical hypothesis of no difference. It is usually denoted by H0.

Alternative Hypothesis: Any hypothesis that is complementary to the null hypothesis is an alternate hypothesis. It is usually denoted by H1.

Type I error: Reject H0 when H0 is true.

Type II errors: Accept H0 when H0 is false.

Level of significance: Level of significance is the size of a type I error or the maximum producer's risk.

Power: Usually known as the probability of correctly accepting the null hypothesis. 1-β (size of type II error) is called power of the analysis.

One-tailed test: A test of any statistical hypothesis where the alternate hypothesis is one-tailed is called a one-tailed test. It is either right tailed or left tailed.

Two-tailed test: A test of any statistical hypothesis where the alternate hypothesis is two-tailed is called a two-tailed test.

A test of a statistical hypothesis is a two-action decision problem after the experimental sample values have been obtained, with the two actions being the acceptance or rejection of the hypothesis under consideration.

ANOVA Test-

According to Prof. RA Fisher, ANOVA is the "separation of variance ascribable to one group of causes from the variance ascribable to another group." By this technique, the total variation in the sample data is expressed as the sum of the non-negative components, where each of these components is a measure of the variation due to some specific independent source/factor/cause. It consists of comparisons of estimates of variation due to assignable causes with estimates of variation due to chance causes.

One-way ANOVA- The scheme of classification due to one factor or criteria is called one-way classification, and its analysis is called one-way analysis of variance. The main objective of the ANOVA technique is to examine if there is significant difference between the class means in view of the inherent variability within separate classes.

Two-way ANOVA- The scheme of classification due to two factors or criteria is called two-way classification, and its analysis is called two-way analysis of variance. In two way classification, the values of response variables are affected by two factors.

DATA COLLECTION

Any procedure for preparing and gathering data, such as those used in process improvement or other comparable projects, is referred to as data collection. Data collection is done to gather information that will be used for record-keeping, to help with essential decision-making, or to share with others. Information about a certain subject is primarily sought after when data are collected.

Primary Data- Primary data is information that has been gathered from first-hand experience. Primary data is more dependable, authentic, and unbiased and has not yet been published. Primary data has a higher level of validity than secondary data because it hasn't been changed or manipulated by humans.

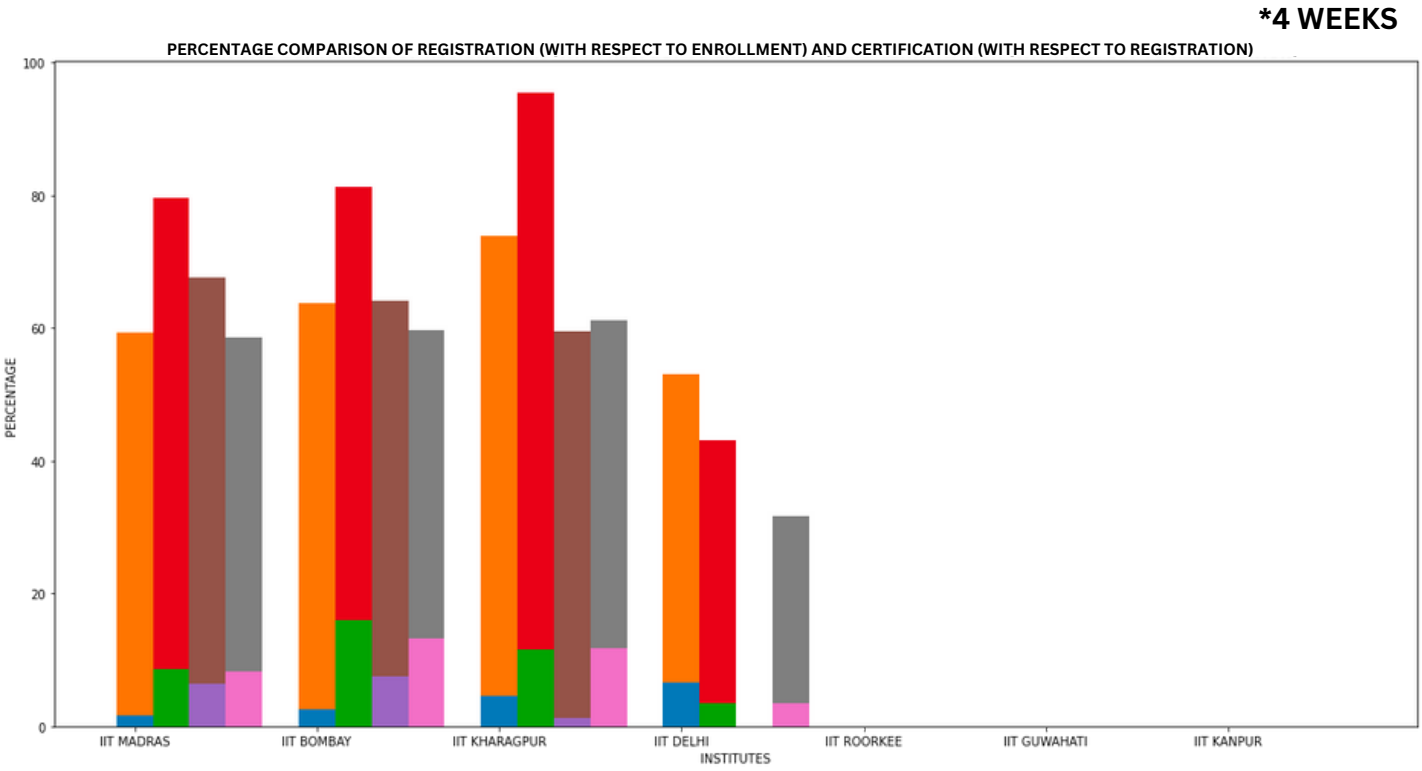
Secondary data- Secondary data is information gathered from a source that has already been released in any format. Any research project uses secondary data to inform the review of the literature.

In this research, we collected all our data using a secondary means of collection. On the basis of secondary data collected objectives were defined and team members started analysing. All the data was collected from NPTEL's website and then assembled in Excel sheets. The data for the number of people who enrolled, registered and were certified was collected and further analyzed. The duration of all the courses with respect to each institute for every discipline was also collected through the same means. The main purpose was to <insert some objectives>. After the collection of raw data, the big task at hand was to clean the data in order to perform analysis on them. The biggest hurdle among them was cleaning the data for all the zero values. The data that was acquired was also very vague and skewed in nature. So, we deleted all the non-required data by filtering it.

- **Graphs and their interpretation**

Computer Science

- **Graph 1**



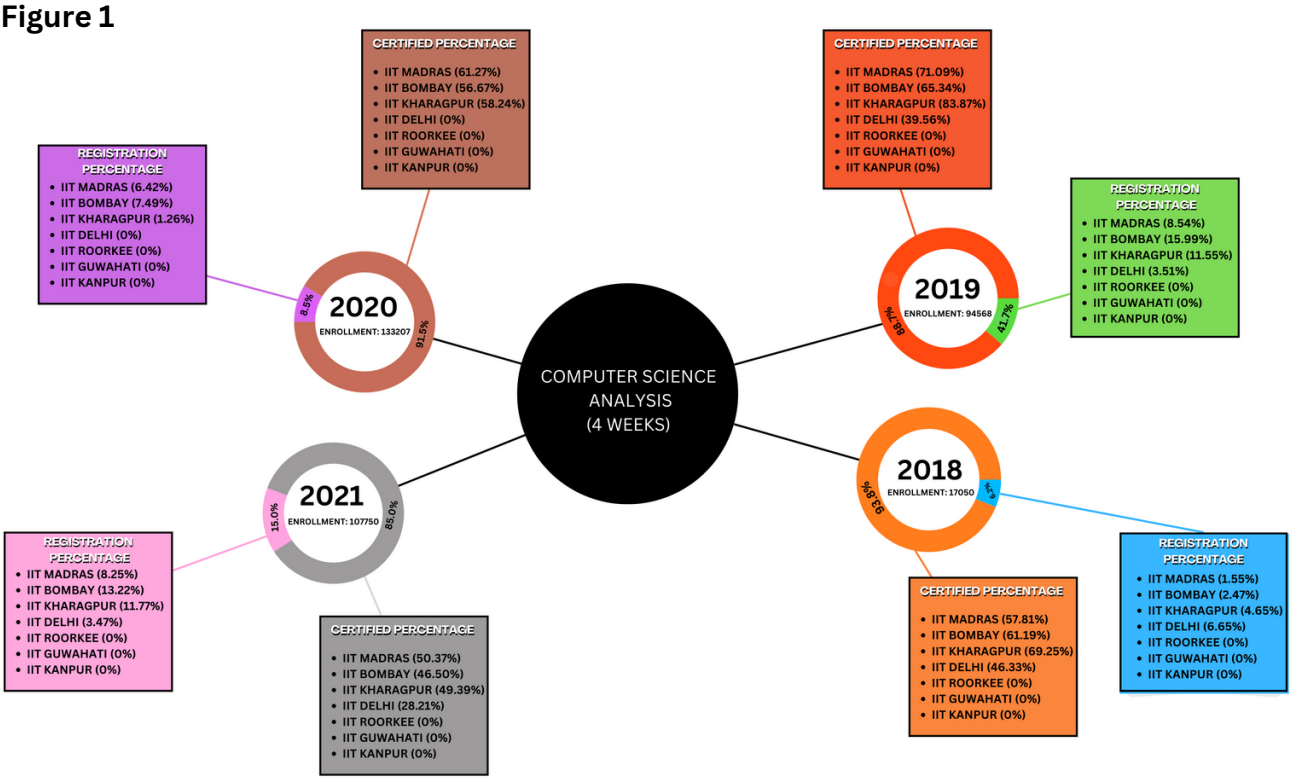
- In **Graph 1,** each bar is divided into subsections where the upper bar represent the percentage of the offered certification with respect to total registration, while the lower bar represents the percentage of registration with respect to total enrollment, for several Institutes. The Bar Graph has been plotted for the years 2018, 2019, 2020 and 2021.

OBSERVATION

- The ratio of the registration with respect to enrolment has been found to be relatively low.
- Institutions like IIT Guwahati, IIT Kanpur, and IIT Roorkee , we found that they do not provide four-week courses in the discipline of computer science.
- In comparison to all other Institutes, IIT Bombay had the highest registration rate in the year 2019.
- The largest percentage of certificates were awarded in the years 2018, 2019, and 2020, 2021 by IIT Kharagpur and IIT Madras, respectively.
- No more than 20% of enrolled students may register to complete the course, and this goes for any and all IITs.
- It was observed that in all IITs , the registration with respect to enrolment ratio was less than 20 percent.

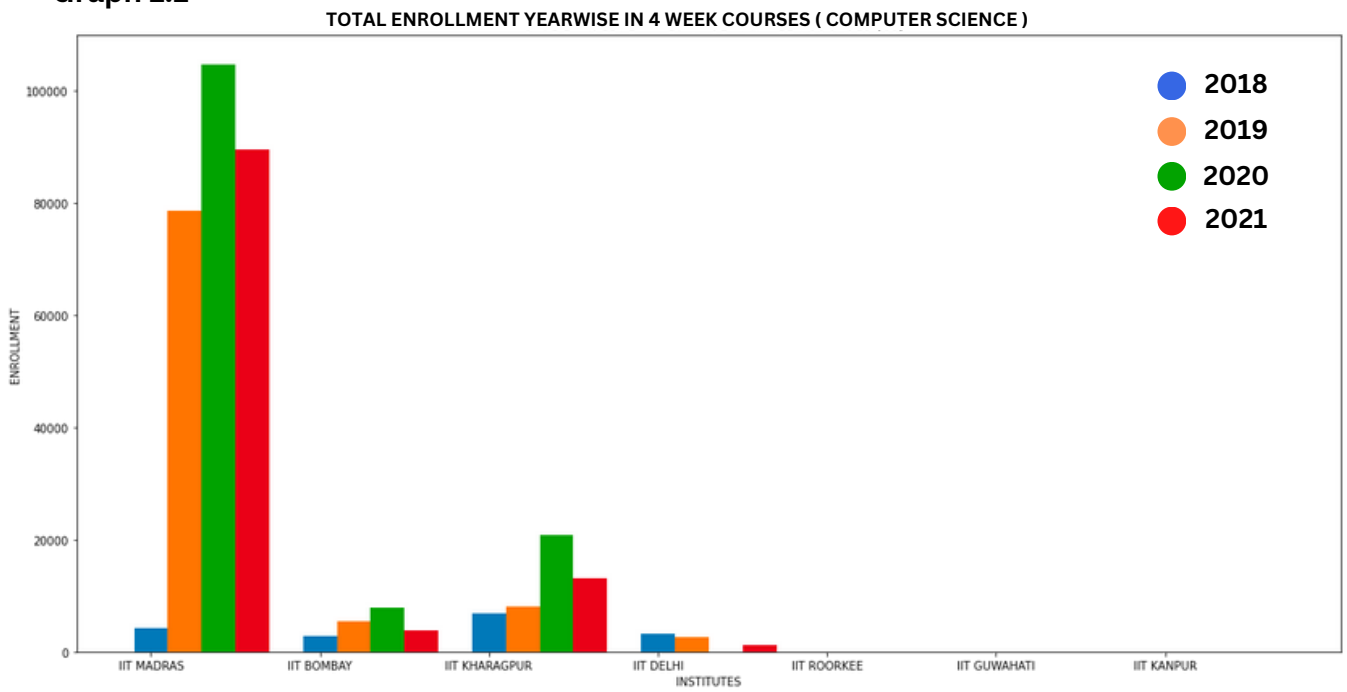
For help understanding the aforementioned graph, please see the representation below-

- **Figure 1**



- The Figure 1 shows the values of registration ratio and certification of different courses offered by IIT's in the field of Computer Science for 4 weeks where same colours from the graph 1 were used for representation for different year. The percentage shown in the coloured wheels is the representation of overall registration (with respect to enrollment) and certification (with respect to registration). Total Enrollment is also represented in the above figure.

- **Graph 1.1**

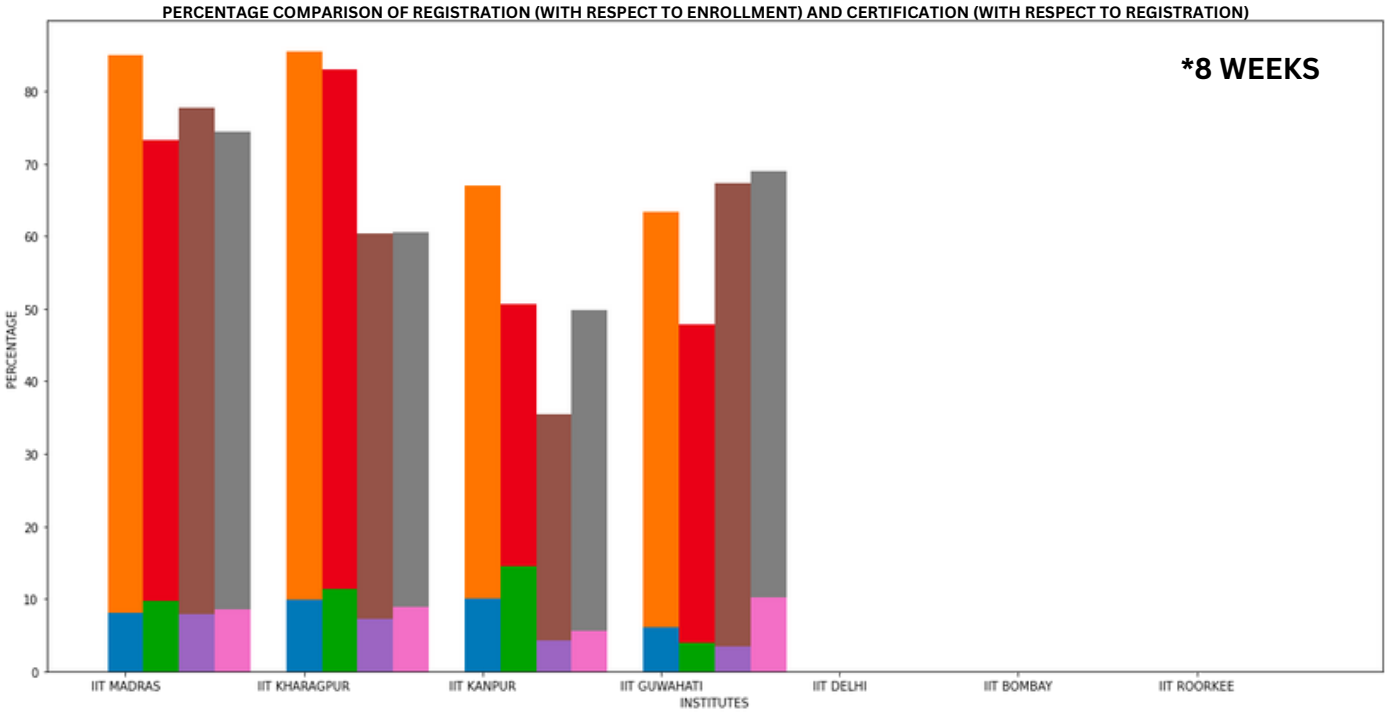


- The Graph 1.1 represents the Total Enrollment in 4 Week Courses in Computer Science Field for different IIT's in different years.

OBSERVATION

- In Year 2018 IIT Kharagpur has the highest Enrollment whereas in 2019,2020,2021 IIT Madras marks the highest Enrollment in their 4 week online courses
- In year 2020 IIT Madras had the highest Enrollment wrt to all the year as well as all the IIT's that is 104653
- IIT Roorkee, IIT Guwahati, IIT Kanpur offered no 4 week courses so there was no Enrollment in them.
- There were no Enrollment in IIT delhi for the year 2020

- **Graph 2**



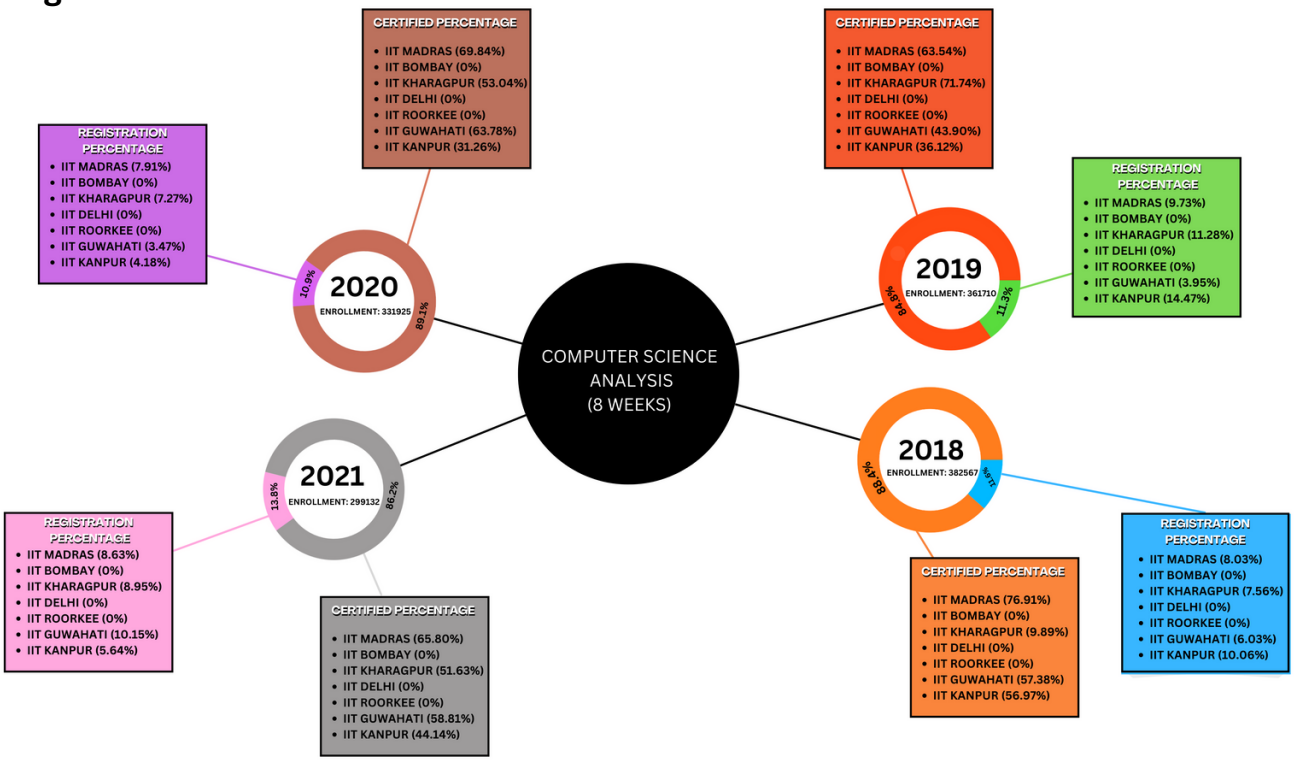
- In **Graph 2,** each bar is divided into subsections where the upper bar represent the percentage of the offered certification with respect to total registration, while the lower bar represents the percentage of registration with respect to total enrollment, for several Institutes. The Bar Graph has been plotted for the years 2018, 2019, 2020 and 2021.

OBSERVATION

- The ratio of the registration rate to enrollment is relatively low.
- Institutions like IIT Delhi, IIT Bombay, and IIT Roorkee do not provide eight-week courses in the discipline of computer science.
- In comparison to all other Institutes, IIT Kharagpur has the highest registration rate in the year 2019.
- The largest percentage of certificates were awarded in the years 2019 by IIT Kharagpur and in 2018 ,2020, 2021 by IIT Madras.
- No more than 20% of enrolled students may register to complete the course, and this goes for any and all IITs.

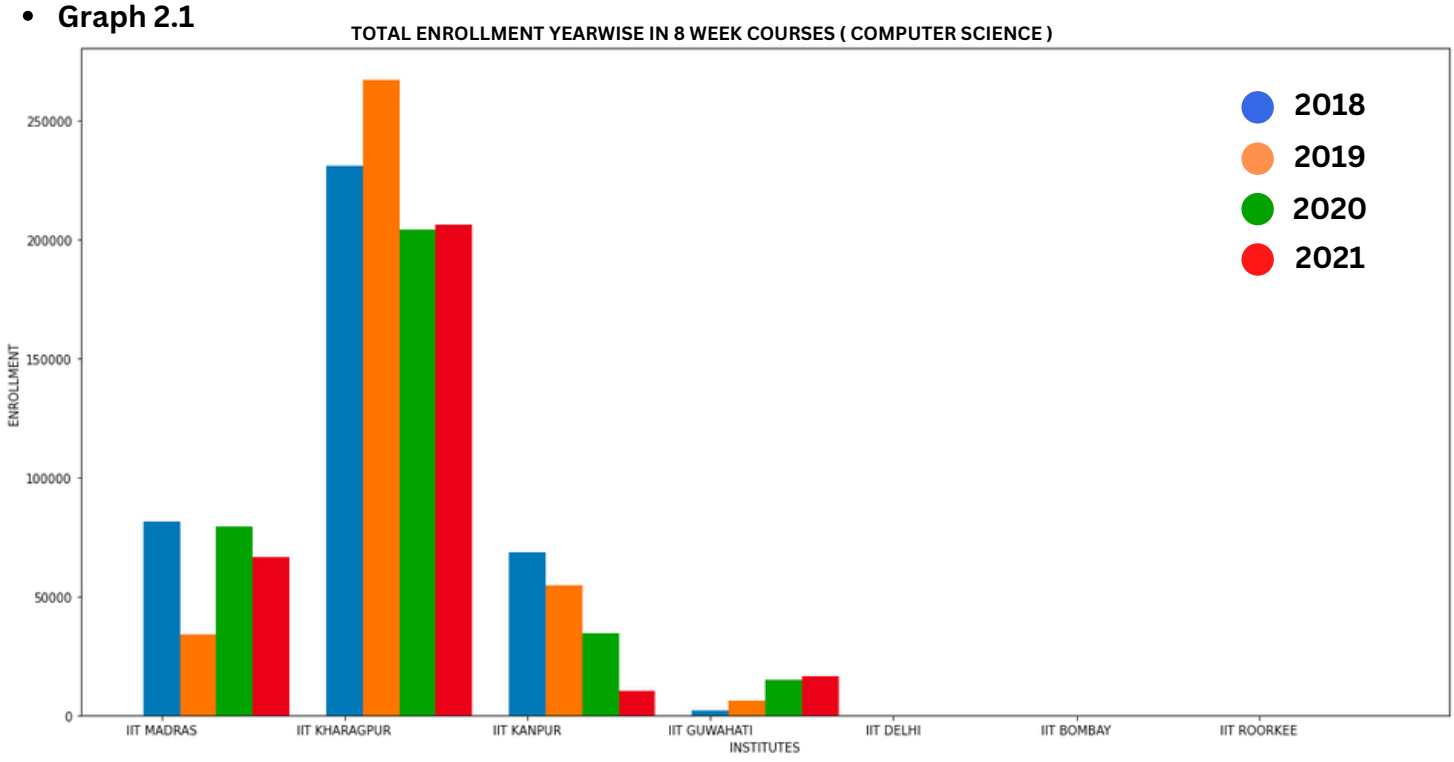
For help understanding the aforementioned graph, please see the representation below-

- **Figure 2**



- The representation above shows the values of percentage of registration and certification of different courses offered by IIT's in Computer Science field 8 weeks each color in the wheel above is with respect to the **Graph 2** for different years . The percentage in color wheel is the representation of overall registration (with respect to enrollment) and certification (with respect to registration). Total Enrollment is also represented in the above figure.

- **Graph 2.1**

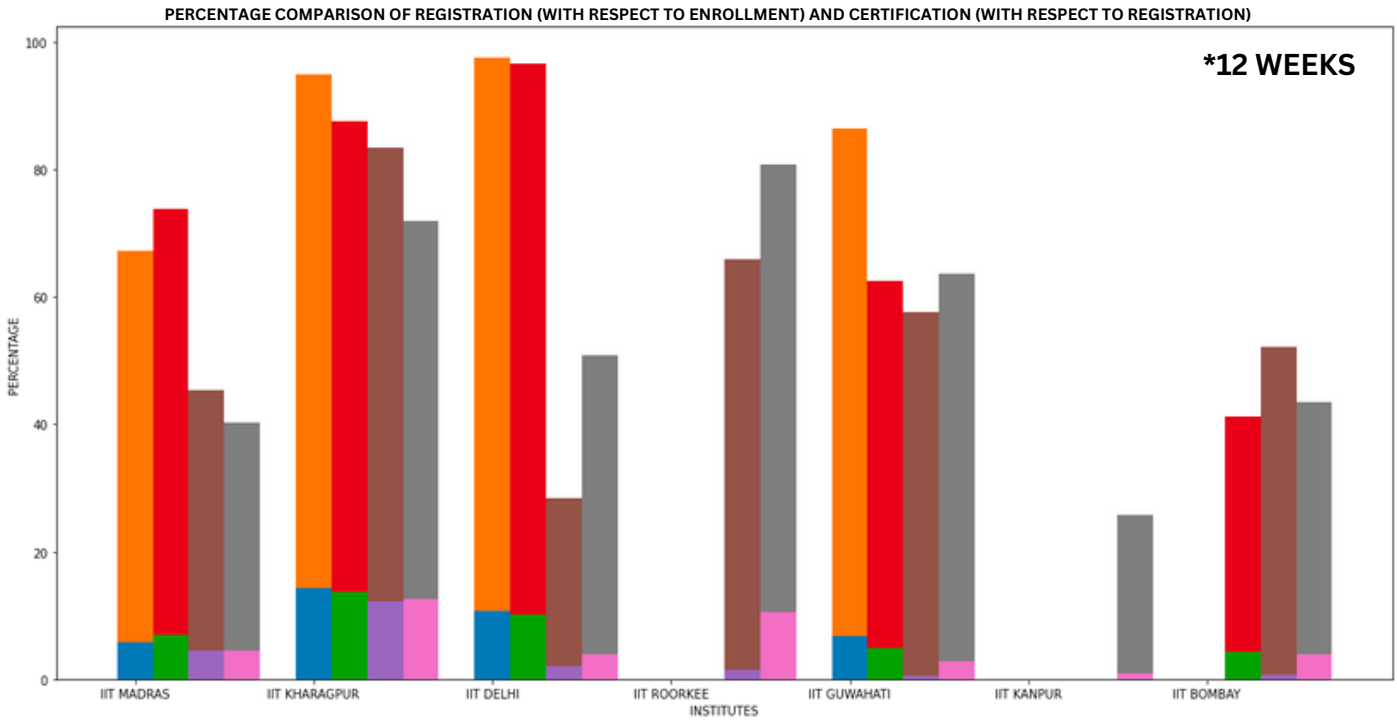


- The Graph 2.1 represents the Total Enrollment in 8-weeks courses in Computer Science Field for different IIT's in different years.

OBSERVATION

- In Year 2018 IIT Kharagpur has the highest Enrollment whereas in 2019,2020,2021 IIT Madras marks the highest Enrollment in their 8-weeks online courses.
- In year 2019 IIT Kharagpur had the highest Enrollment with respect to all the year as well as all the IIT's that was above 250000 .
- IIT Roorkee, IIT Delhi, IIT Bombay offered no 8-weeks courses so there were no enrollments in them.

- **Graph 3**



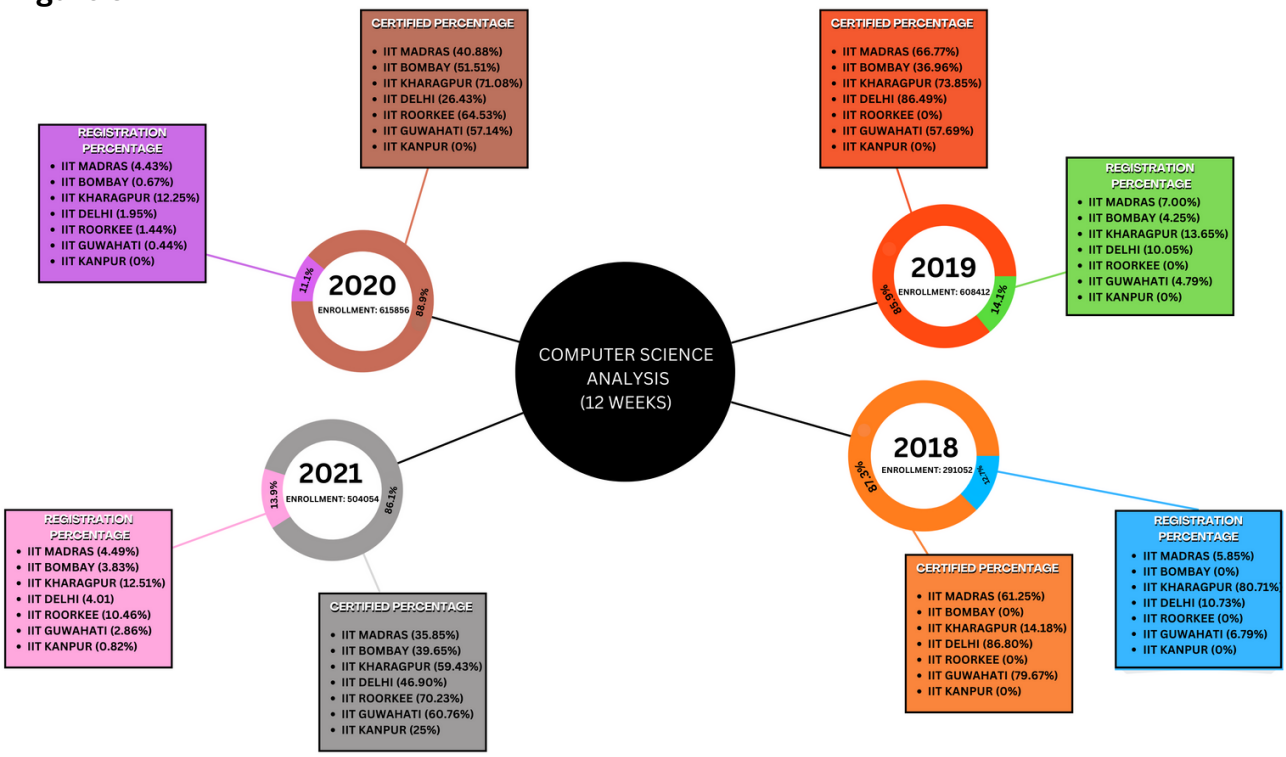
- In **Graph 3** bar is divided into subsections; the upper bar shows the percentage of offered certification in relation to total registration, while the lower bar shows the percentage of registration in relation to total enrollment, for several Institutes. The bars indicate various years 2018, 2019, 2020, and 2021.

OBSERVATION

- The ratio of the registration rate to enrollment is relatively low.
- IIT Bombay did not provide a 12-weeks coursefor the year 2018 and same goes for IIT Kanpur and Roorkee for the years 2018, 2019, 2020 and 2018, 2019 respectively.
- In comparison to all other Institutes, IIT Bombay has the highest registration rate in the year 2021.
- The largest percentage of certificates were awarded in the years 2018, 2019, and 2020, 2021 by IIT Kharagpur and IIT Madras, respectively.
- No more than 20% of enrolled students may register to complete the course, and this goes for any and all IITs.

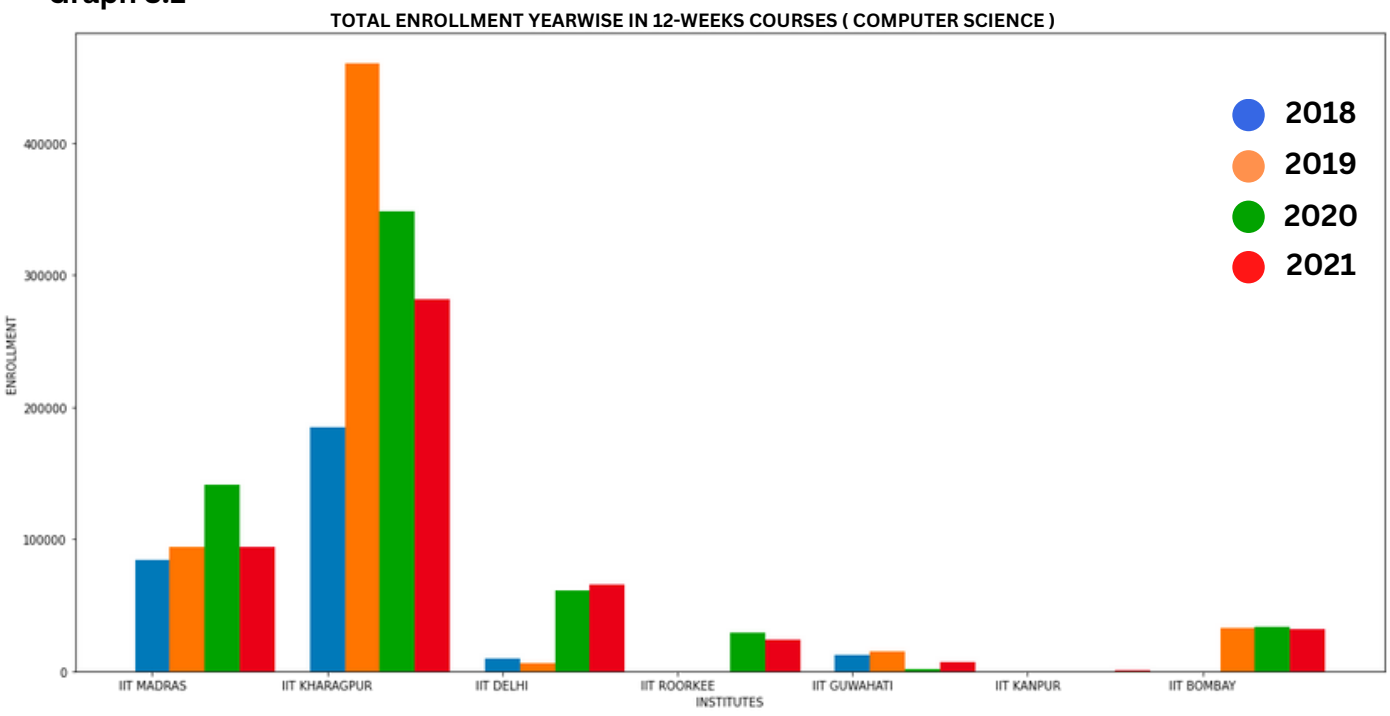
For help understanding the aforementioned graph, please see the representation below-

- **Figure 3**



- The representation above shows the values of percentage of registration and certification of different courses offered by IIT's in Computer Science field 12 weeks each color in the wheel above is with respect to the **Graph 3** for different year. The percentage in color wheel is the representation of overall registration (with respect to enrollment) and certification (with respect to registration). Total Enrollment is also represented in the above figure

- **Graph 3.1**



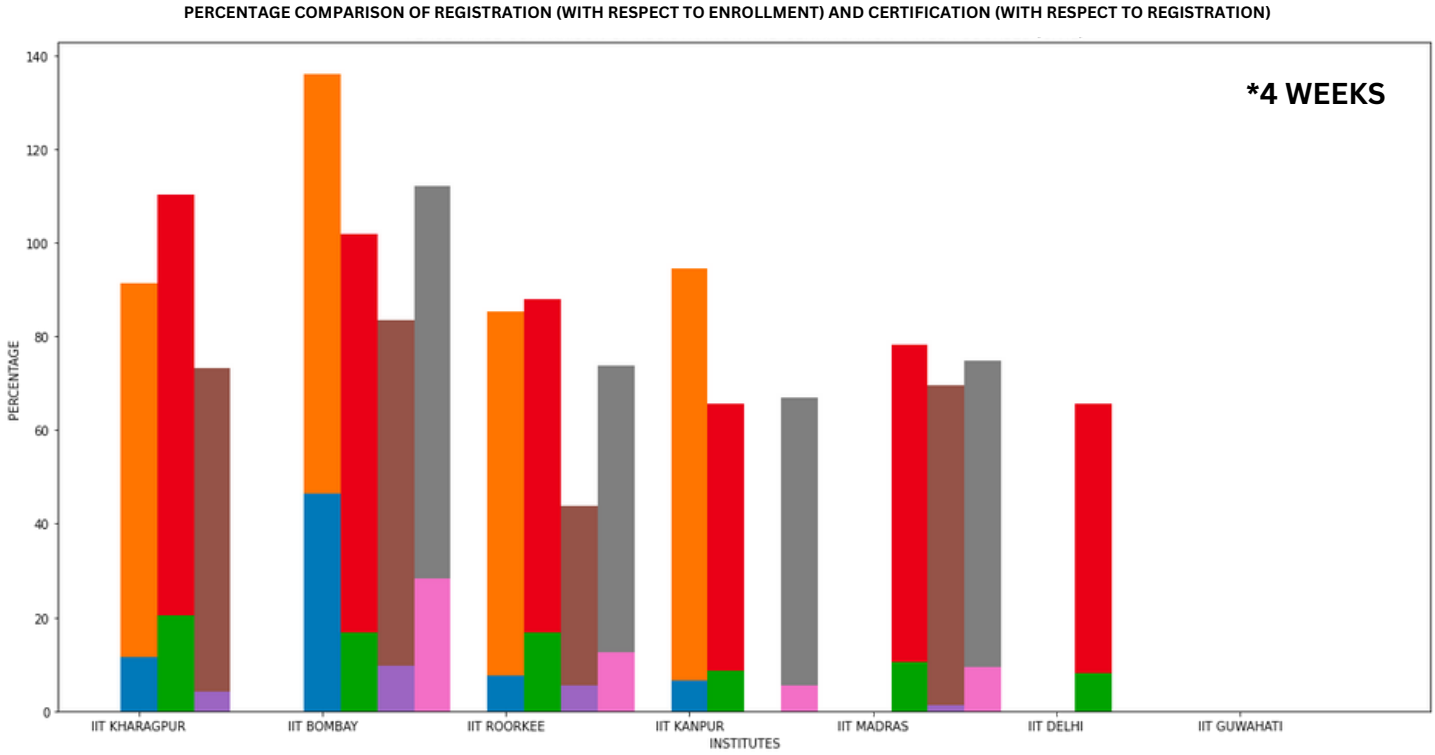
- The Graph 3.1 represents the Total Enrollment in 12 Weeks Courses in Computer Science Field for different IIT's in different years.

OBSERVATION

- IIT Kharagpur has the highest number of enrollments in all the years taken into consideration.
- In year 2019, IIT Kharagpur had the highest Enrollment with respect to all the years as well as all the IIT's, which was more than 400000.

CIVIL ENGINEERING

- **Graph 4**



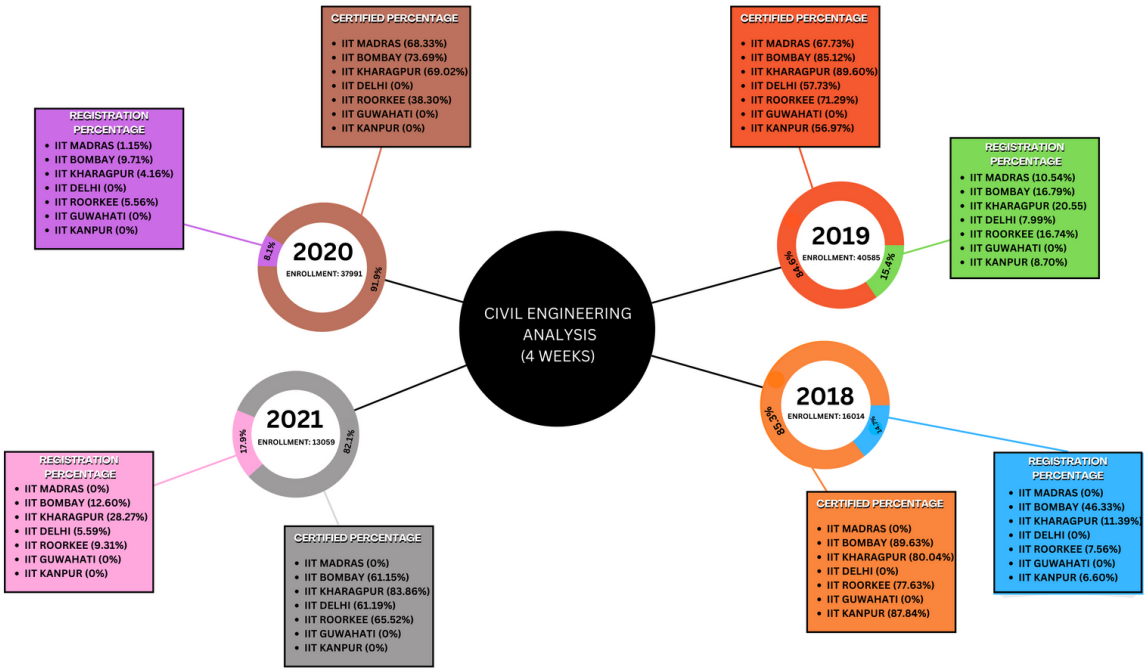
- In **Graph 4** bar is divided into subsections; the upper bar shows the percentage of offered certification in relation to total registration, while the lower bar shows the percentage of registration in relation to total enrollment, for several Institutes. The bars indicate various years 2018, 2019, 2020, and 2021.

OBSERVATION

- The ratio of the registration rate to enrollment is relatively low.
- Institution like IIT Guwahati, do not provide four-week courses in the discipline of Civil Engineering.
- In comparison to all other Institutes, IIT Bombay has the highest registration rate in the year 2018.
- The largest percentage of certificates were awarded in the years 2020, 2018, and 2019, 2021 by IIT Bombay and IIT Kharagpur, respectively.
- No more than 50% of enrolled students may register to complete the course, and this goes for any and all IITs.

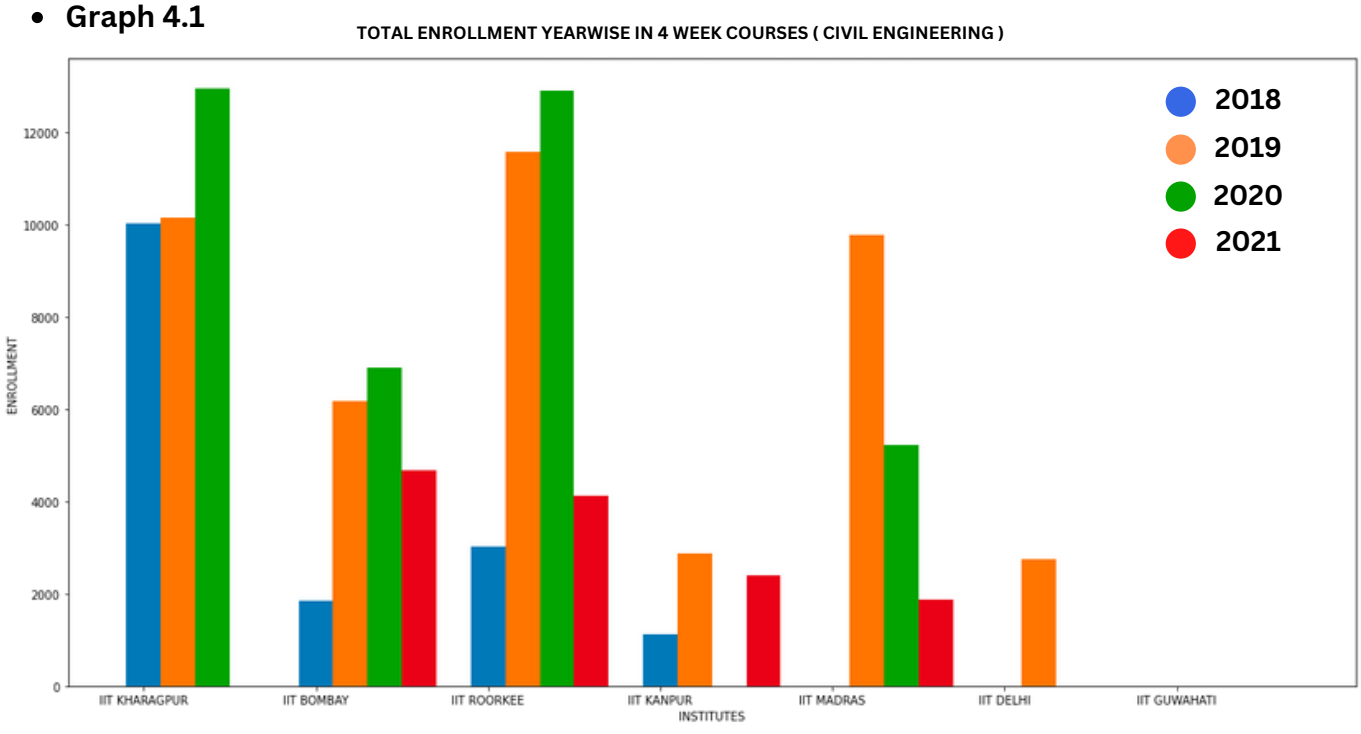
For help understanding the aforementioned graph, please see the representation below-

- **Figure 4**



- The representation above shows the values of percentage of registration and certification of different courses offered by IIT's in Civil Engineering field 4 weeks each colour in the wheel above is with respect to the **Graph 4** for different year. The percentage in colour wheel is the representation of overall registration (with respect to enrolment) and certification (with respect to registration). Total Enrolment is also represented in the above figure

- **Graph 4.1**

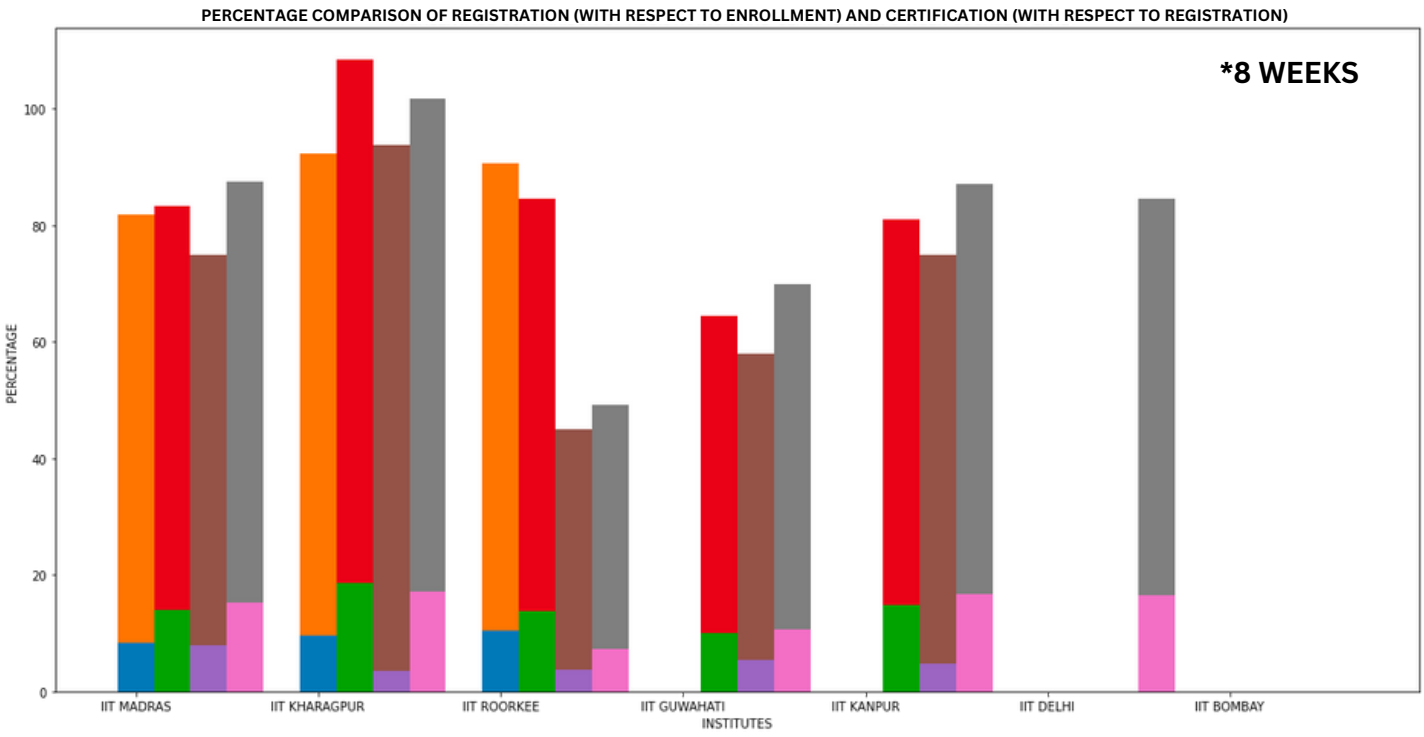


- The Graph 4.1 represents the Total Enrollment in 4 Week Courses in Civil Engineering Field for different IIT's in different years.

OBSERVATION

- In Year 2020 IIT Kharagpur has the highest Enrollment whereas in 2018,2019 IIT Roorkee and in 2021 IIT Bombay marks the highest Enrollment in their 4 week online courses
- In year 2019 IIT had the highest Enrollment wrt to all the year as well as all the IIT's that is 43338.
- IIT Guwahati offered no 4 week courses so there was no Enrollment in them.
- There were no Enrollment in IIT Kanpur, IIT Madras, IIT Delhi for the year 2020, 2018 , (2018,2020,2021) respectively .

- **Graph 5**



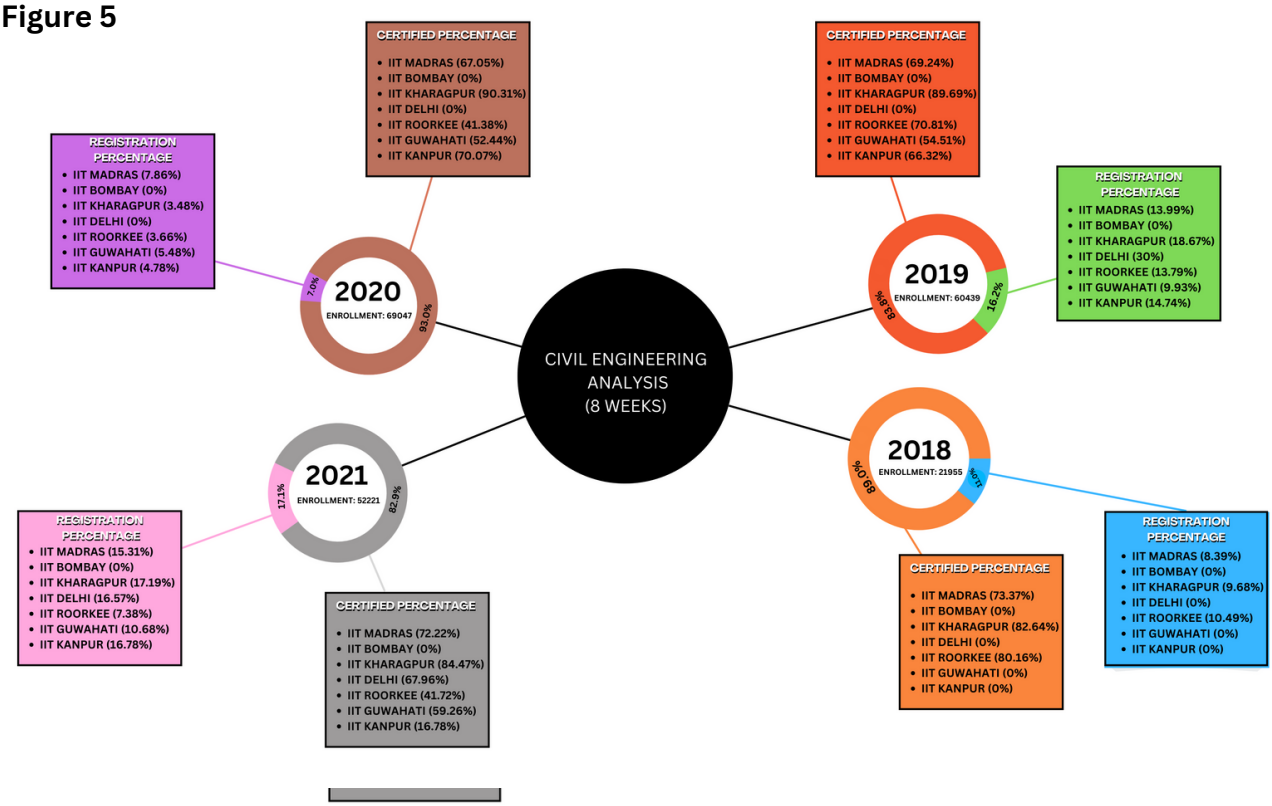
- In **Graph 5** bar is divided into subsections; the upper bar shows the percentage of offered certification in relation to total registration, while the lower bar shows the percentage of registration in relation to total enrollment, for several Institutes. The bars indicate various years 2018, 2019, 2020, and 2021.

OBSERVATION

- The ratio of the registration rate to enrollment is relatively low.
- IIT Bombay do not provide eight-week courses in the discipline of civil engineering .
- In comparison to all other Institutes, IIT Kharagpur has the highest registration rate in the year 2021.
- The largest percentage of certificates were awarded in the years 2018, 2019, 2020, 2021 by IIT Kharagpur.
- No more than 20% of enrolled students may register to complete the course, and this goes for any and all IITs.

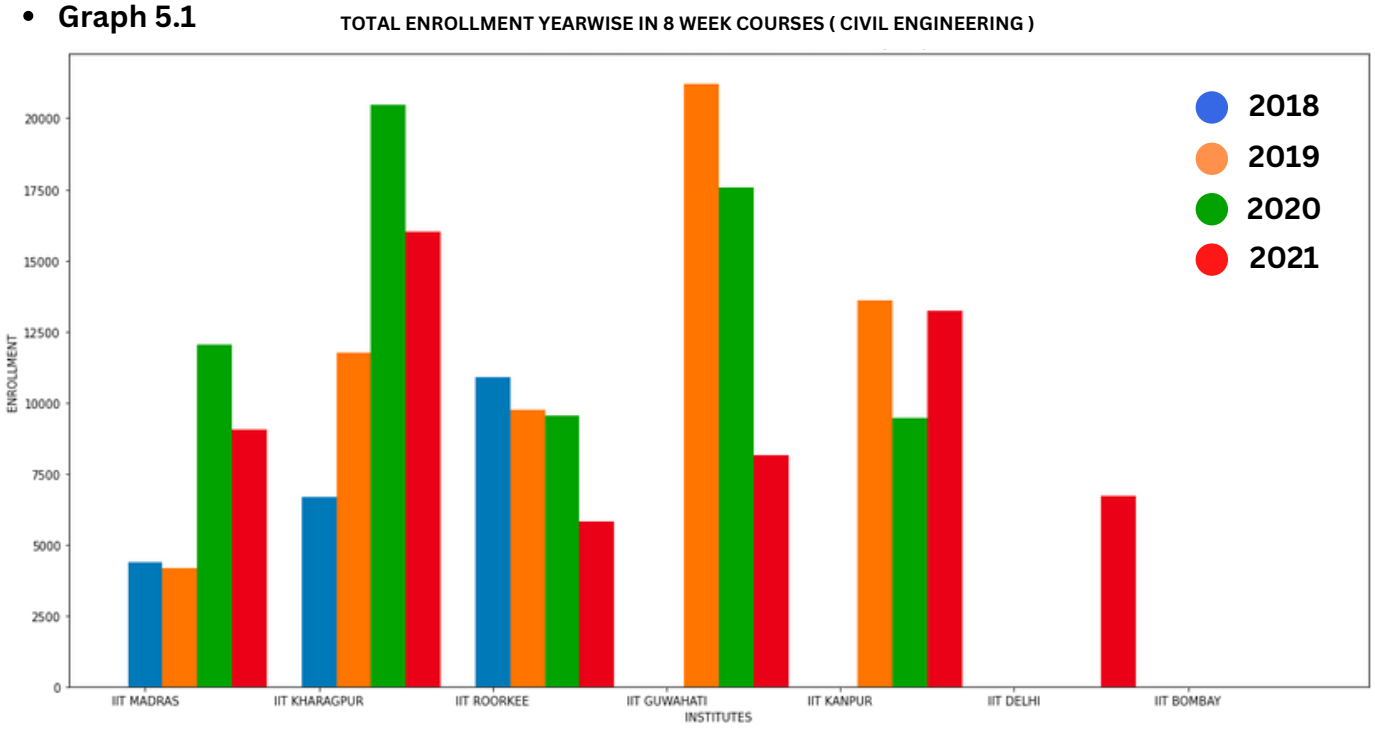
For help understanding the aforementioned graph, please see the representation below-

- **Figure 5**



- The representation above shows the values of percentage of registration and certification of different courses offered by IIT's in Civil Engineering field 8 weeks each color in the wheel above is with respect to the **Graph 5** for different year. The percentage in color wheel is the representation of overall registration (with respect to enrollment) and certification (with respect to registration). Total Enrollment is also represented in the above figure

- **Graph 5.1**

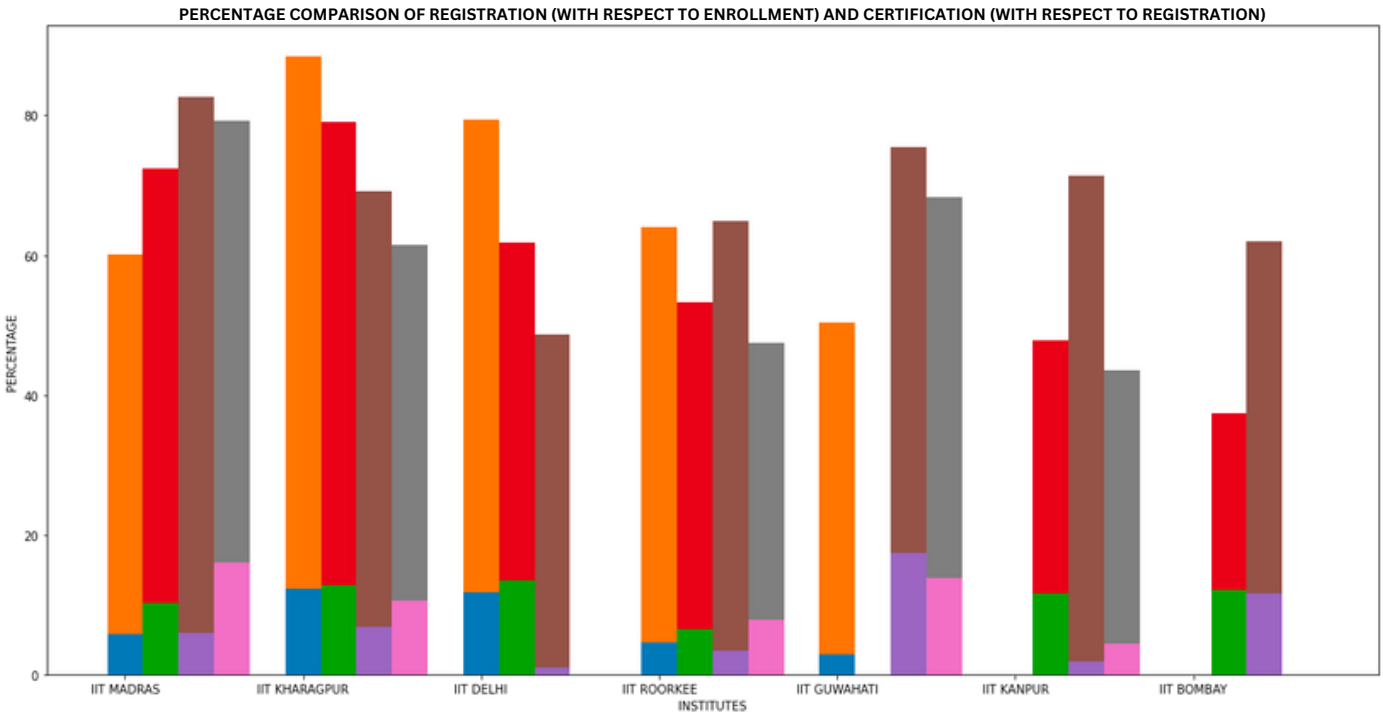


- The Graph 5.1 represents the Total Enrollment in 8 Week Courses in Civil Engineering Field for different IIT's in different years.

OBSERVATION

- In Year 2018 IIT Roorkee has the highest Enrollment whereas in 2019 IIT Guwahati and in 2020, 2021 IIT Kharagpur marks the highest Enrollment in their 8 week online courses.
- In year 2020 IIT had the highest Enrollment wrt to all the year as well as all the IIT's that is 69047.
- IIT Bombay offered no 8-week courses so there was no Enrollment in them.
- There were no Enrollment in IIT Guwahati, IIT Kanpur, IIT Delhi for the year 2018, 2018, (2018, 2019, 2020) respectively.

- **Graph 6**



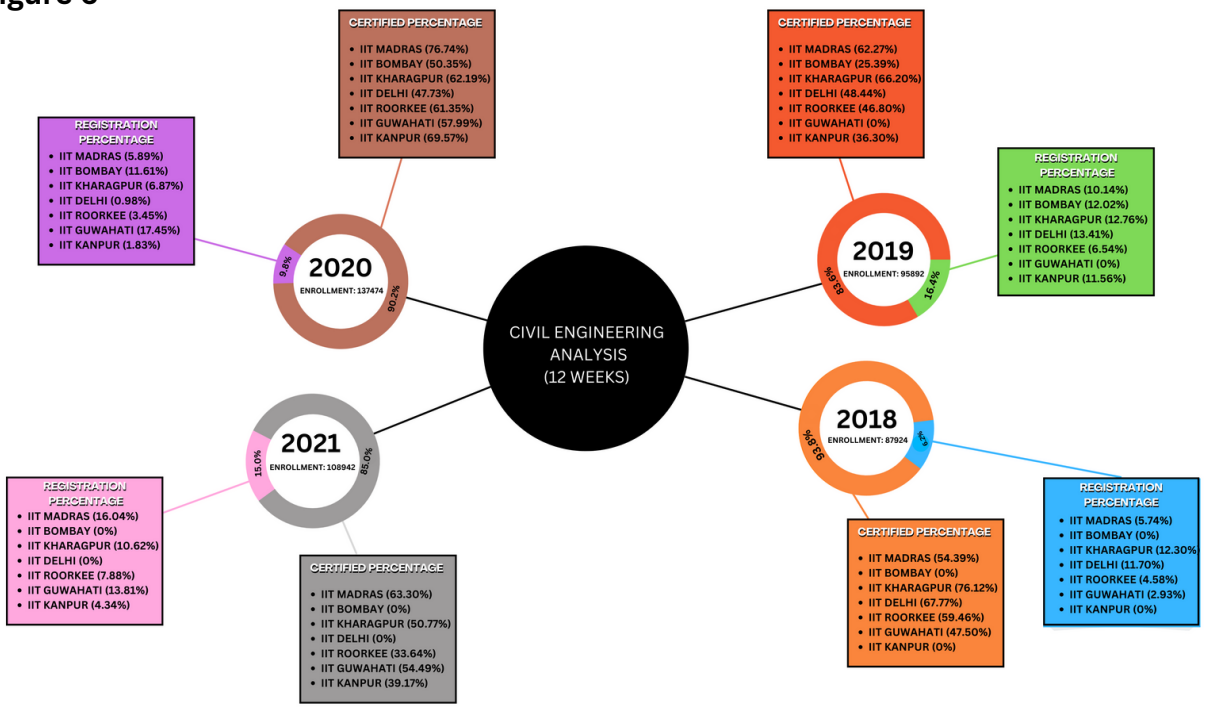
- In **Graph 6** bar is divided into subsections; the upper bar shows the percentage of offered certification in relation to total registration, while the lower bar shows the percentage of registration in relation to total enrollment, for several Institutes. The bars indicate various years 2018, 2019, 2020, and 2021.

OBSERVATION

- The ratio of the registration rate to enrollment is relatively low.
- In comparison to all other Institutes, IIT Kharagpur has the highest registration rate in the year 2019.
- The largest percentage of certificates were awarded in the years 2018, 2019, and 2020, 2021 by IIT Kharagpur and IIT Madras, respectively.
- No more than 20% of enrolled students may register to complete the course, and this goes for any and all IITs.

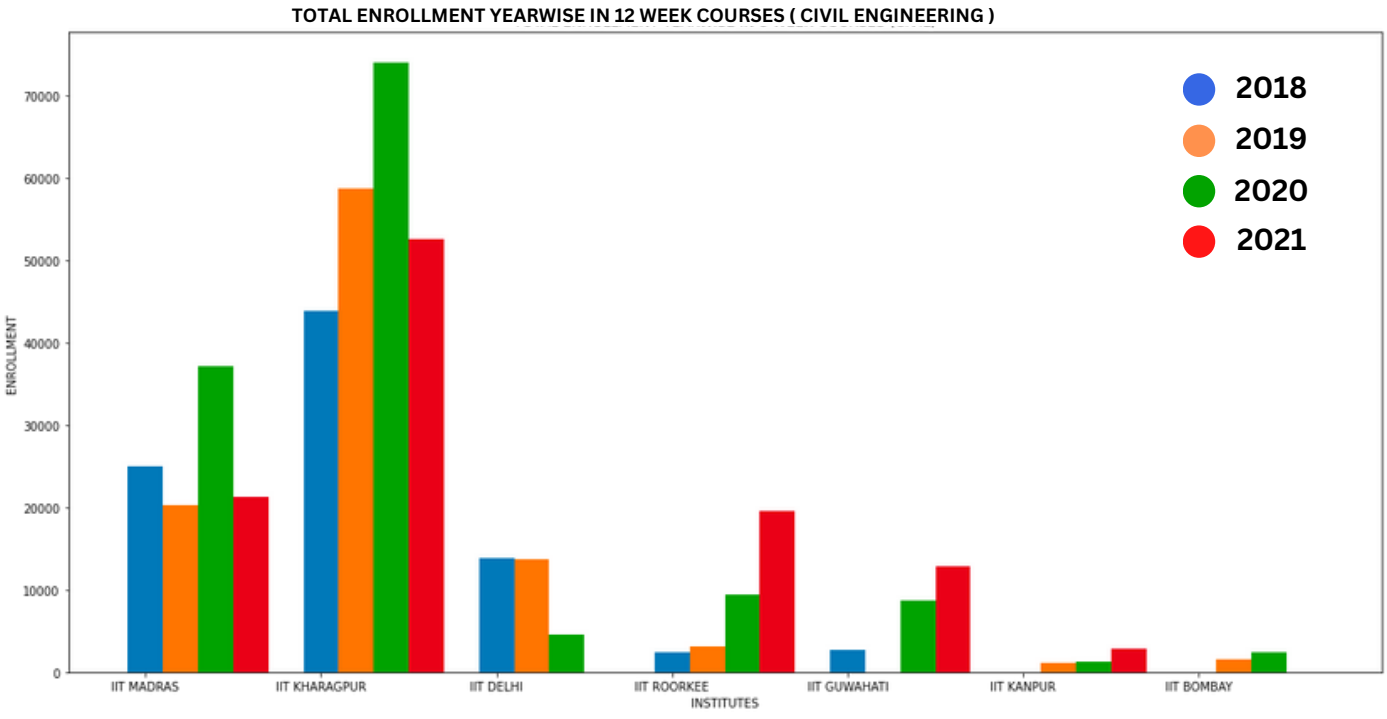
For help understanding the aforementioned graph, please see the representation below-

- **Figure 6**



- The representation above shows the values of percentage of registration and certification of different courses offered by IIT's in Civil Engineering field 12 weeks each colour in the wheel above is with respect to the **Graph 6** for different year. The percentage in colour wheel is the representation of overall registration (with respect to enrollment) and certification (with respect to registration). Total Enrollment is also represented in the above figure

- **Graph 6.1**



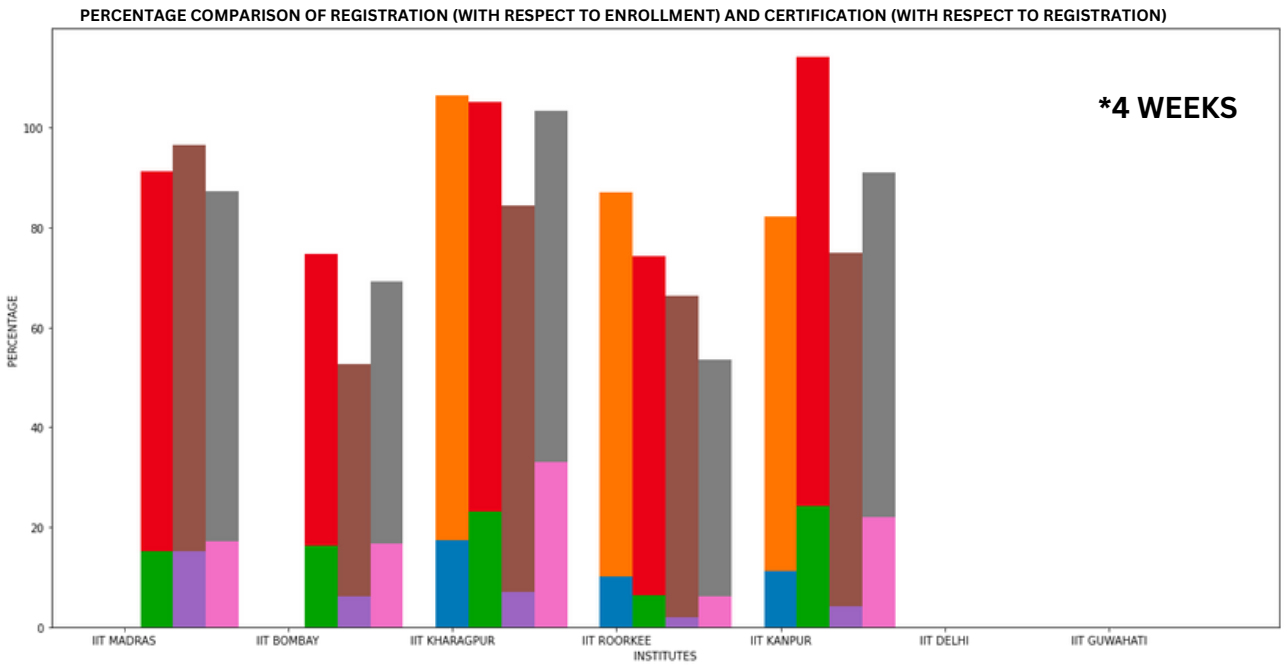
- The Graph 6.1 represents the Total Enrollment in 12 Week Courses in Civil Engineering Field for different IIT's in different years.

OBSERVATION

- For all the four year 2018, 2019, 2020 and 2021 IIT Kharagpur has the highest Enrollment.
- In year 2020 IIT had the highest Enrollment wrt to all the year as well as all the IIT's that is 137474.
- There were no Enrollment in IIT delhi, IIT Guwahati, IIT Kanpur, IIT Bombay for the year 2021, 2019, 2018, (2018,2021) respectively.

MANAGEMENT

- **Graph 7**



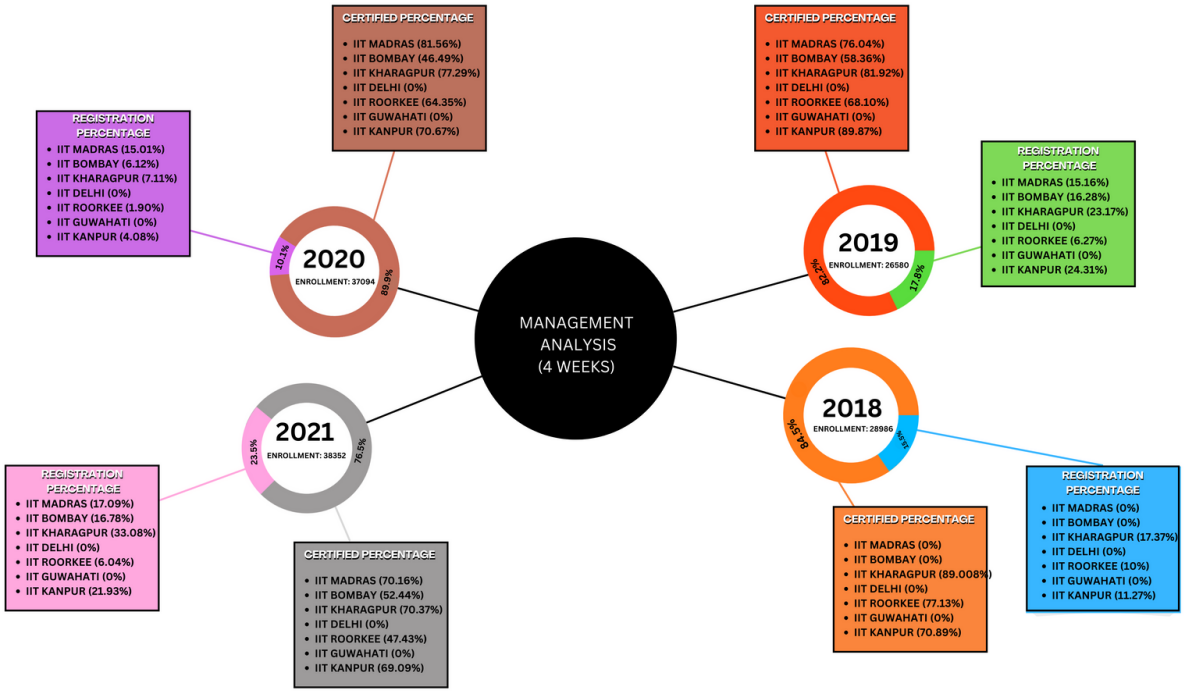
- In **Graph 7** bar is divided into subsections; the upper bar shows the percentage of offered certification in relation to total registration, while the lower bar shows the percentage of registration in relation to total enrollment, for several Institutes. The bars indicate various years 2018, 2019, 2020, and 2021.

OBSERVATION

- The ratio of the registration rate to enrolment is relatively low.
- Institutions like IIT Delhi and IIT Guwahati do not provide four-week courses in the discipline of managment.
- In comparison to all other Institutes, IIT Kharagpur has the highest registration rate in the year 2021.
- The largest percentage of certificates were awarded in the years 2018, 2019, and 2020, 2021 by IIT Kharagpur and IIT Madras, respectively.
- No more than 20% of enrolled students may register to complete the course, and this goes for any and all IITs.

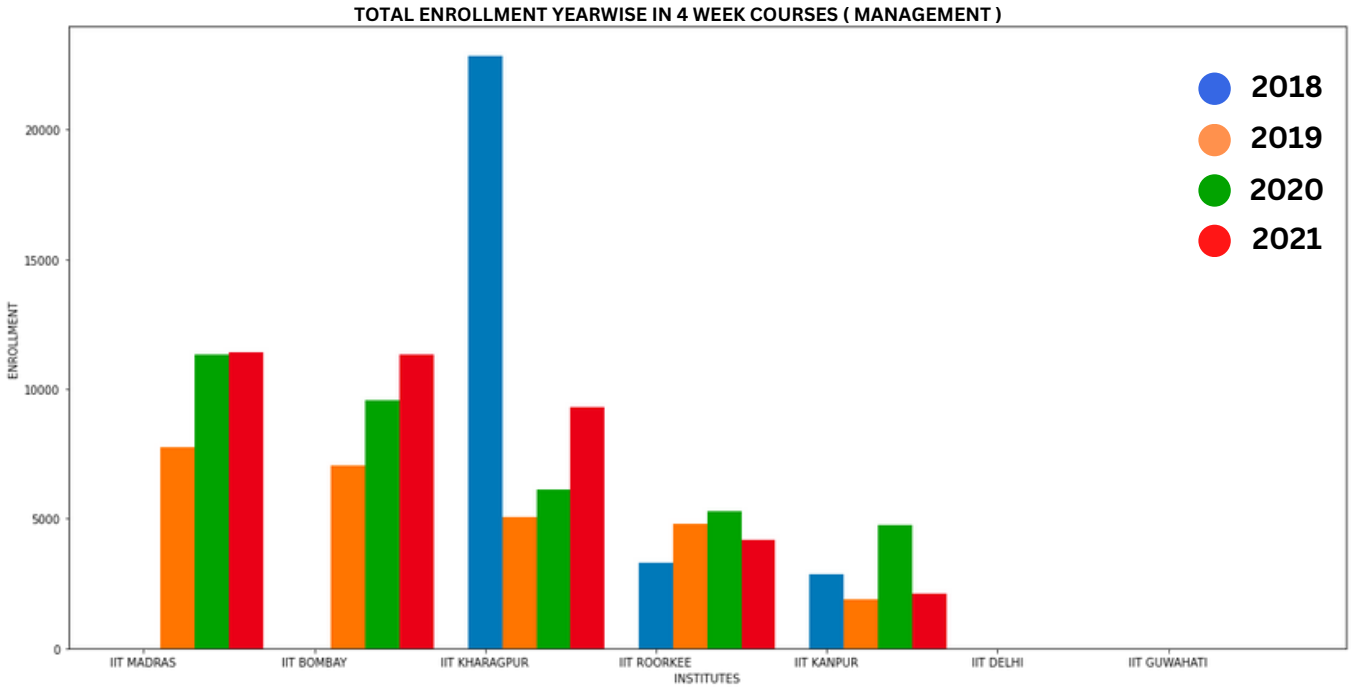
For help understanding the aforementioned graph, please see the representation below-

- **Figure 7**



- The representation above shows the values of percentage of registration and certification of different courses offered by IIT's in Management field 4 weeks each colour in the wheel above is with respect to the **Graph7** for different year. The percentage in colour wheel is the representation of overall registration (with respect to enrollment) and certification (with respect to registration). Total Enrollment is also represented in the above figure

- **Graph 7.1**

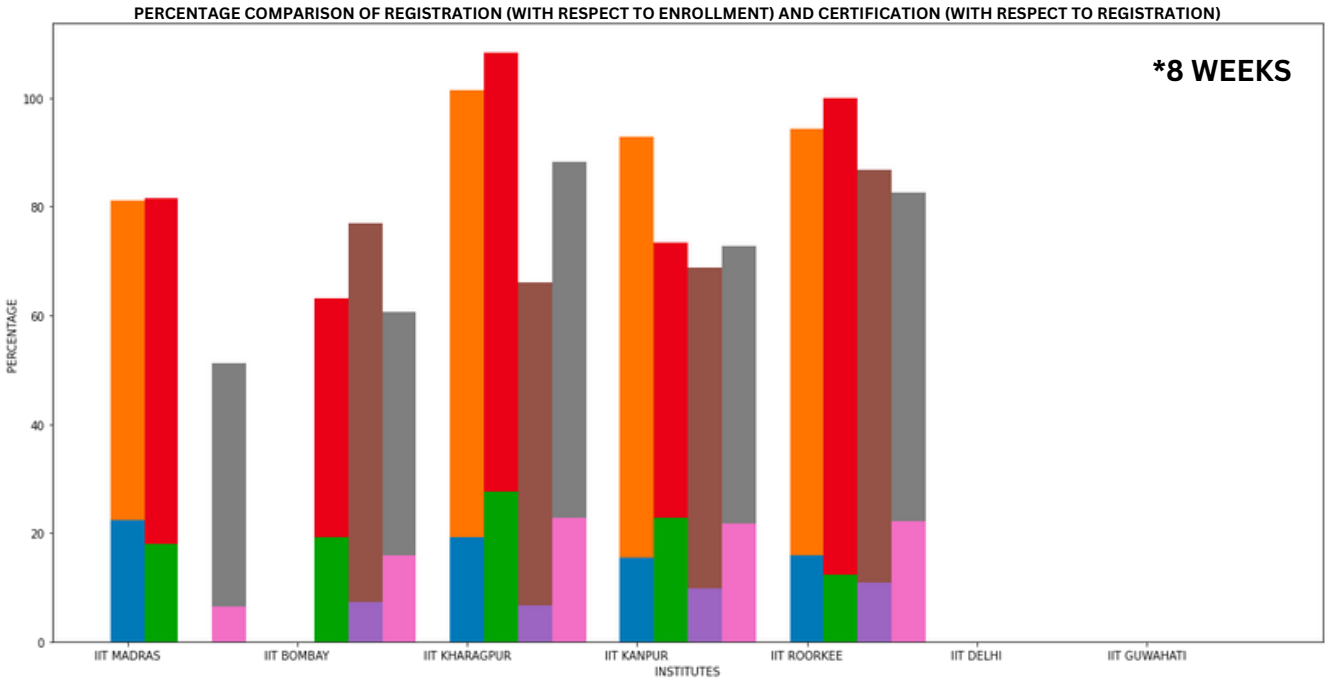


- The Graph 7.1 represents the Total Enrollment in 4 Week Courses in Management Field for different IIT's in different years.

OBSERVATION

- In Year 2018 IIT Kharagpur has the highest Enrollment whereas in 2019,2020,2021 IIT Madras marks the highest Enrollment in their 4 week online courses
- In year 2021 IIT had the highest Enrollment wrt to all the year as well as all the IIT's that is 38352.
- IIT Delhi , IIT Guwahati offered no 4 week courses so there was no Enrollment in them.
- There were no Enrollment in IIT Madras, IIT Bomaby for the year 2018.

- **Graph 8**



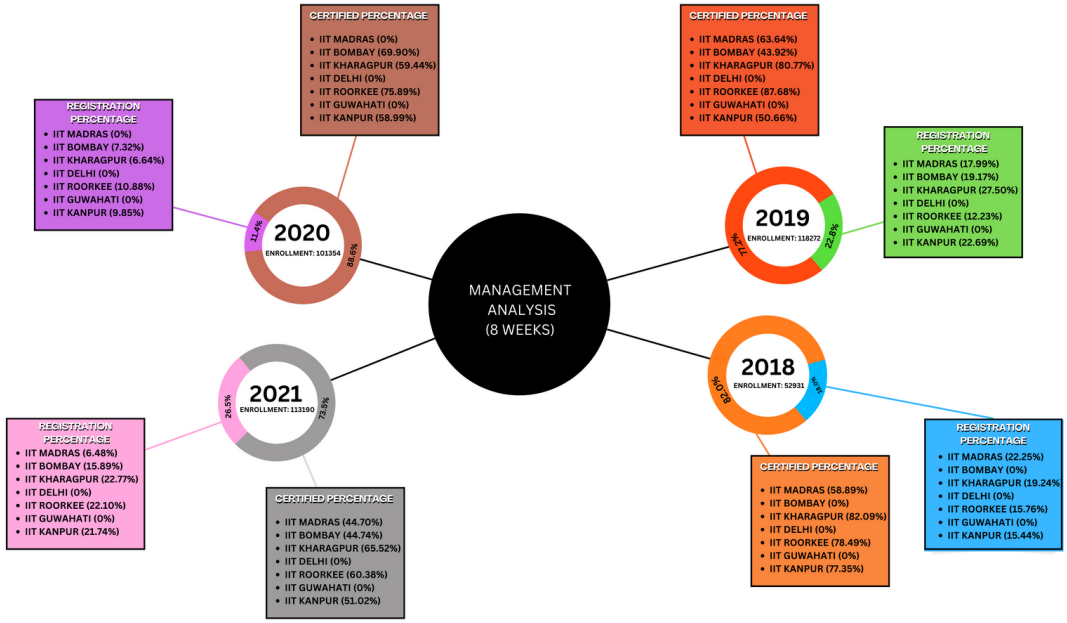
- In **Graph 8** bar is divided into subsections; the upper bar shows the percentage of offered certification in relation to total registration, while the lower bar shows the percentage of registration in relation to total enrollment, for several Institutes. The bars indicate various years 2018, 2019, 2020, and 2021.

OBSERVATION

- The ratio of the registration rate to enrollment is relatively low.
- Institutions like IIT Delhi, IIT Guwahati do not provide eight-week courses in the discipline of Management .
- In comparison to all other Institutes, IIT Kharagpur has the highest registration rate in the year 2021.
- The largest percentage of certificates were awarded in the years 2018, 2021, and 2019, 2020 by IIT Kharagpur and IIT Roorkee, respectively.
- No more than 20% of enrolled students may register to complete the course, and this goes for any and all IITs.

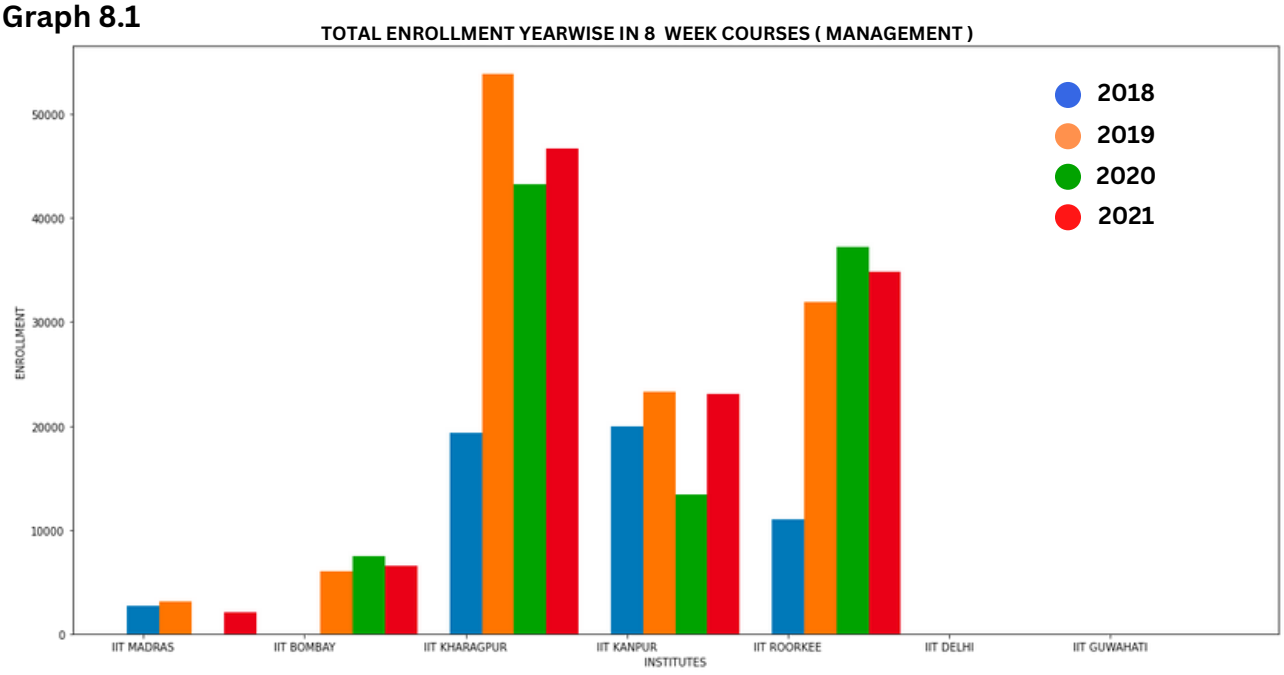
For help understanding the aforementioned graph, please see the representation below-

- **Figure 8**



- The representation above shows the values of percentage of registration and certification of different courses offered by IIT's in Managment field 8 weeks each colour in the wheel above is with respect to the **Graph 8** for different year. The percentage in colour wheel is the representation of overall registration (with respect to enrollment) and certification (with respect to registration). Total Enrollment is also represented in the above figure

- **Graph 8.1**

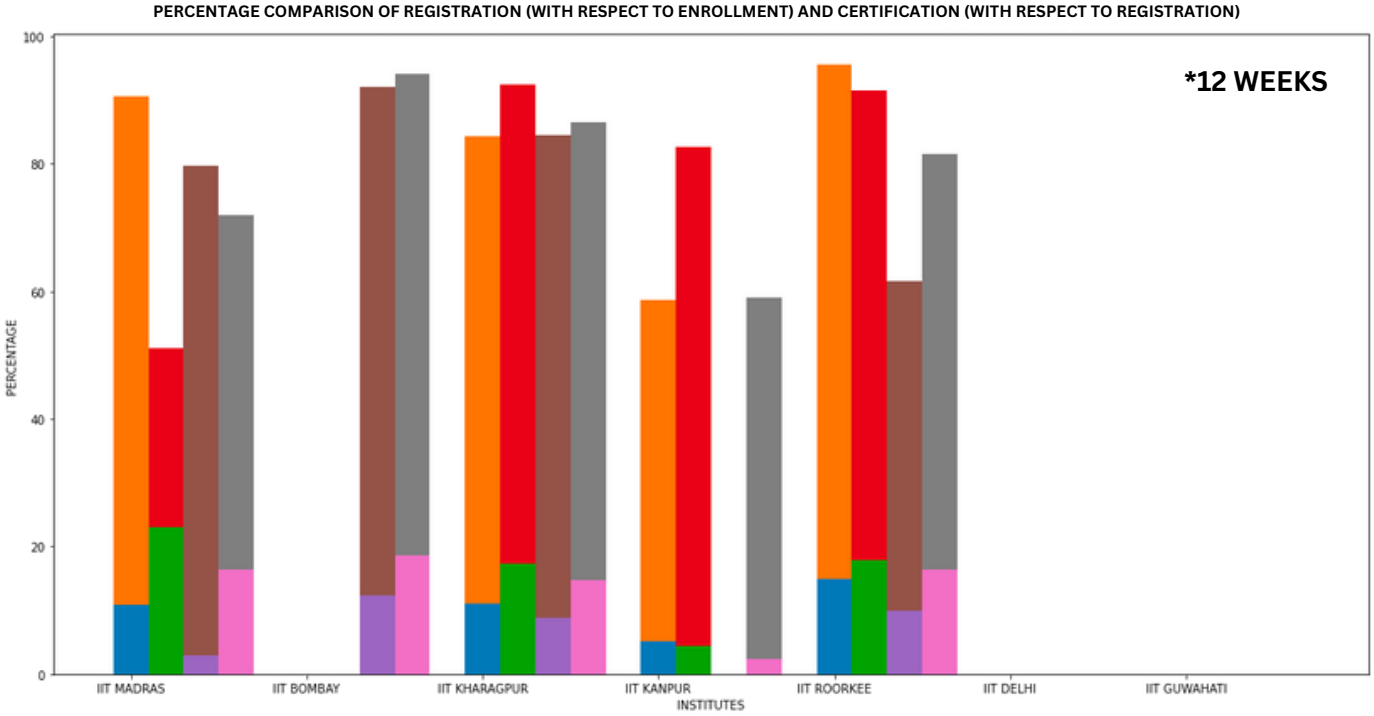


- The Graph 8.1 represents the Total Enrollment in 8 Week Courses in Management Field for different IIT's in different years.

OBSERVATION

- In Year 2018 IIT Kanpur has the highest Enrollment whereas in 2019,2020,2021 IIT Kharagpur marks the highest Enrollment in their 8 week online courses.
- In year 2019 IIT had the highest Enrollment wrt to all the year as well as all the IIT's that is 118272.
- IIT Delhi, IIT Guwahati offered no 8 week courses so there was no Enrollment in them.
- There were no Enrollment in IIT Madras, IIT Bombay for the year 2020, 2018 respectively.

- **Graph 9**



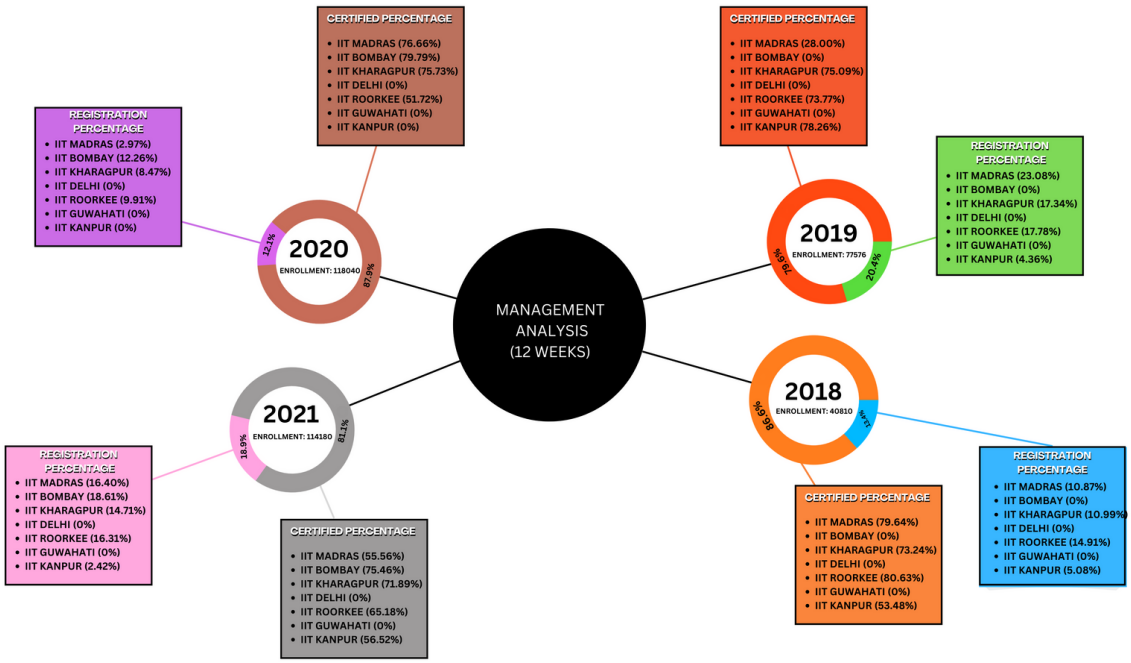
- In **Graph 9** bar is divided into subsections; the upper bar shows the percentage of offered certification in relation to total registration, while the lower bar shows the percentage of registration in relation to total enrollment, for several Institutes. The bars indicate various years 2018, 2019, 2020, and 2021.

OBSERVATION

- The ratio of the registration rate to enrollment is relatively low.
- Institutions like IIT Delhi, IIT Guwahati do not provide twelve-week courses in the discipline of management .
- In comparison to all other Institutes, IIT Madras has the highest registration rate in the year 2021.
- The largest percentage of certificates were awarded in the years 2018, 2019, and 2020, 2021 by IIT Roorkee and IIT Bombay, respectively.
- No more than 20% of enrolled students may register to complete the course, and this goes for any and all IITs.

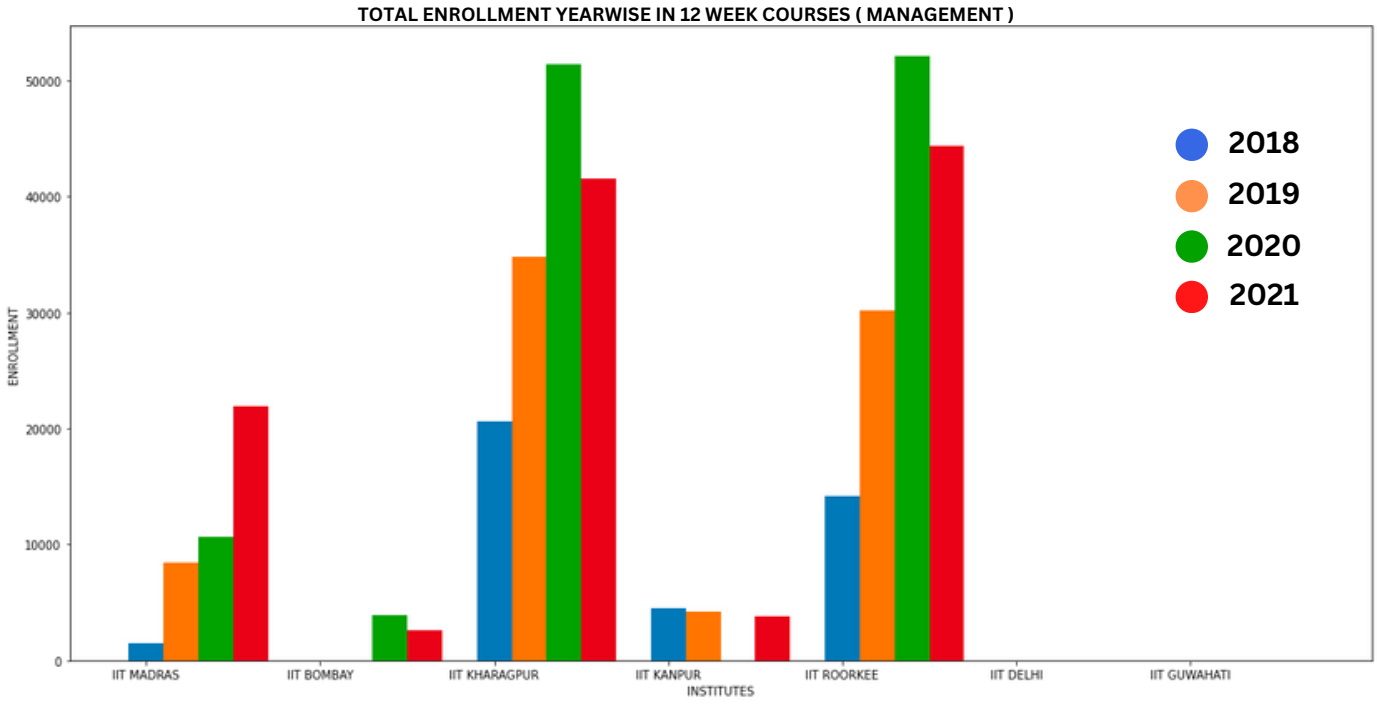
For help understanding the aforementioned graph, please see the representation below-

- **Figure 9**



- The representation above shows the values of percentage of registration and certification of different courses offered by IIT's in Management field 12 weeks each color in the wheel above is with respect to the **Graph 9** for different year. The percentage in color wheel is the representation of overall registration (with respect to enrollment) and certification (with respect to registration). Total Enrollment is also represented in the above figure

- **Graph 9.1**



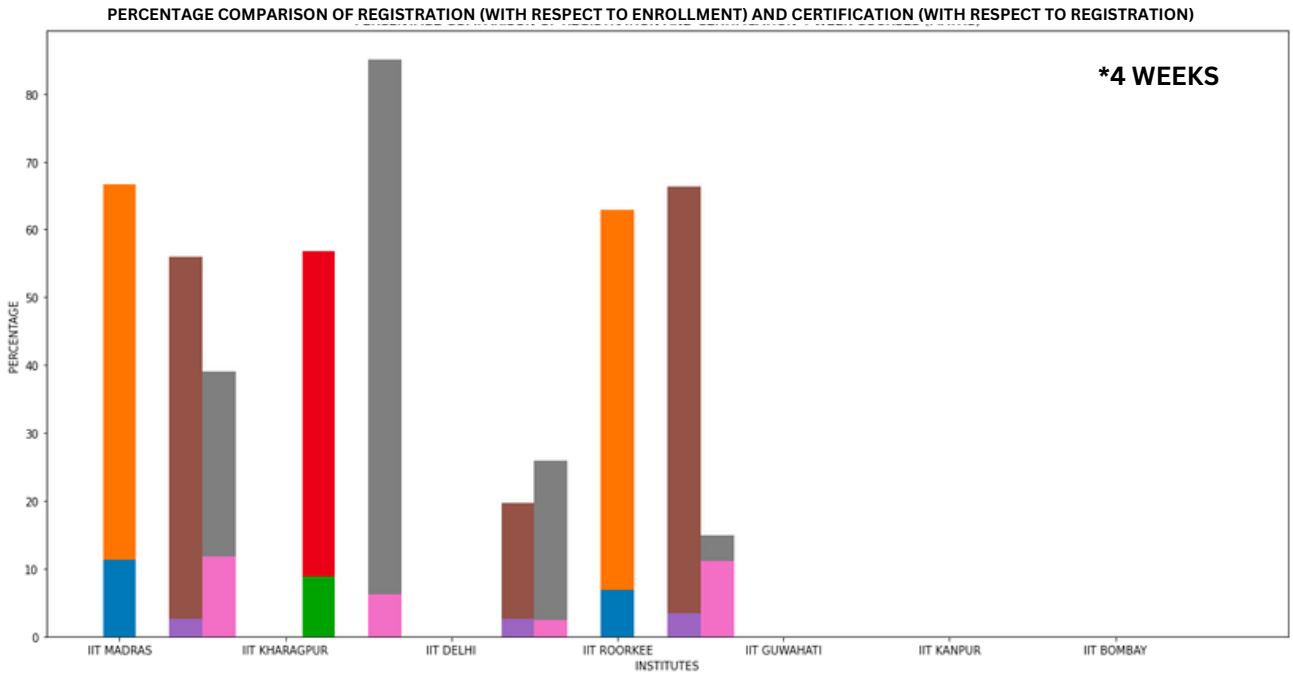
- The Graph 9.1 represents the Total Enrollment in 12 Week Courses in Management Field for different IIT's in different years.

OBSERVATION

- In Year 2018 IIT Kharagpur has the highest Enrollment whereas in 2019,2020,2021 IIT Roorkee marks the highest Enrollment in their 12 week online courses
- In year 2020 IIT had the highest Enrollment wrt to all the year as well as all the IIT's that is 118040.
- IIT Delhi, IIT Guwahati offered no 12 week courses so there was no Enrollment in them.
- There were no Enrollment in IIT Bombay and IIT Kanpur for the year (2018, 2019) and 2020 respectively.

MATHEMATICS

- **Graph 10**



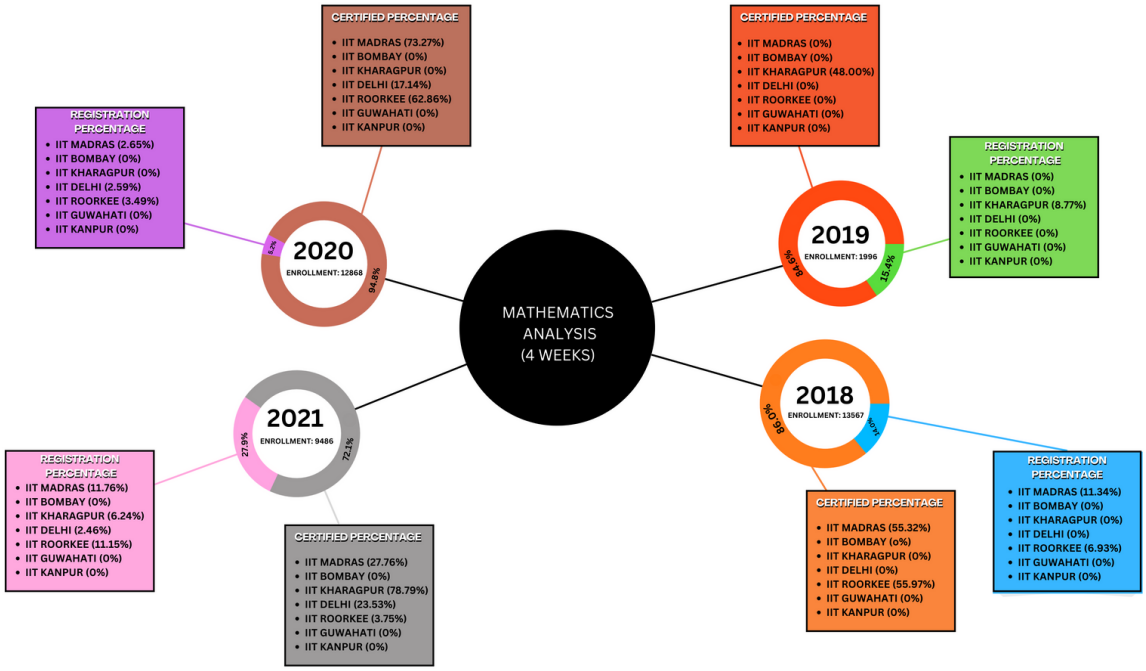
- In **Graph 10** bar is divided into subsections; the upper bar shows the percentage of offered certification in relation to total registration, while the lower bar shows the percentage of registration in relation to total enrollment, for several Institutes. The bars indicate various years 2018, 2019, 2020, and 2021.

OBSERVATION

- The ratio of the registration rate to enrollment is relatively low.
- Institutions like IIT Bombay, IIT Kanpur, and IIT Guwahati do not provide four-weeks courses in the discipline of Mathematics.
- In comparison to all other Institutes, IIT Madras has the highest registration rate in the year 2021.
- The largest percentage of certificates were awarded in the years 2018, 2019, and 2020, 2021 by IIT Kharagpur and IIT Madras, respectively.
- No more than 20% of enrolled students may register to complete the course, and this goes for any and all IITs.

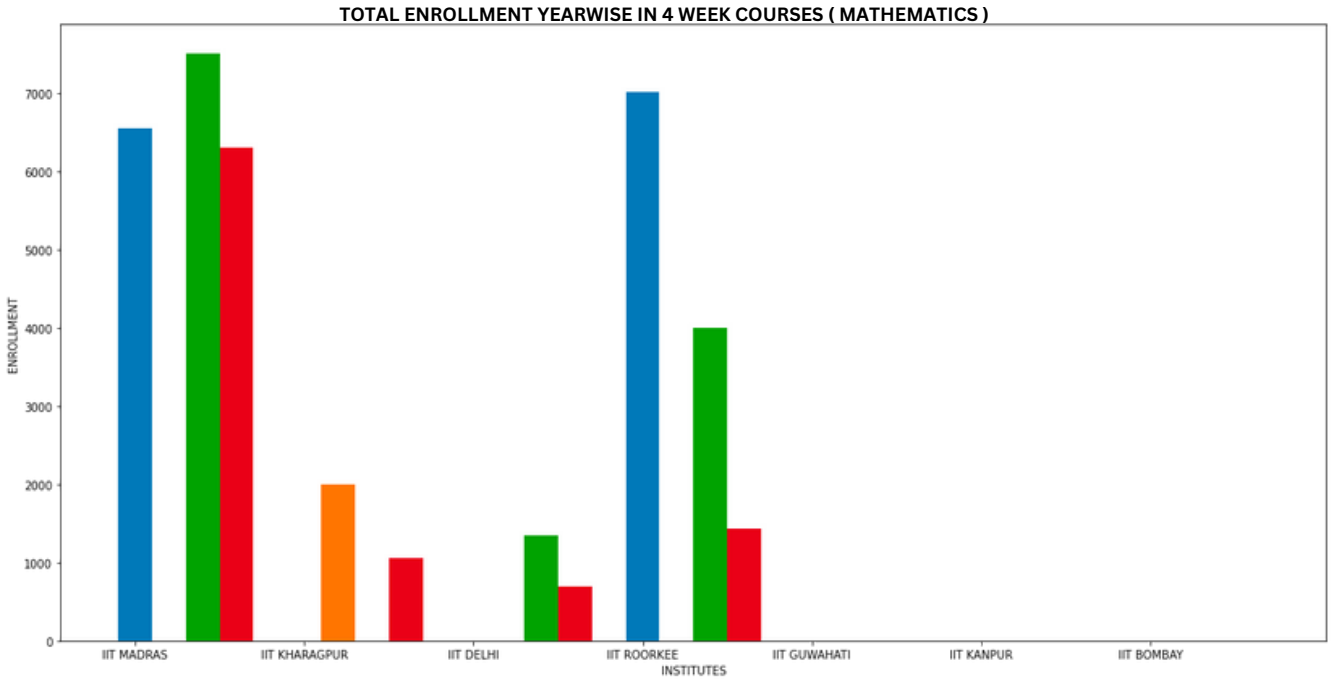
For help understanding the aforementioned graph, please see the representation below-

- **Figure 10**



- The representation above shows the values of percentage of registration and certification of different courses offered by IIT's in Mathematics field 4 weeks each color in the wheel above is with respect to the **Graph 10** for different year. The percentage in color wheel is the representation of overall registration (with respect to enrollment) and certification (with respect to registration). Total enrollment is also represented in the above figure.

- **Graph 10.1**

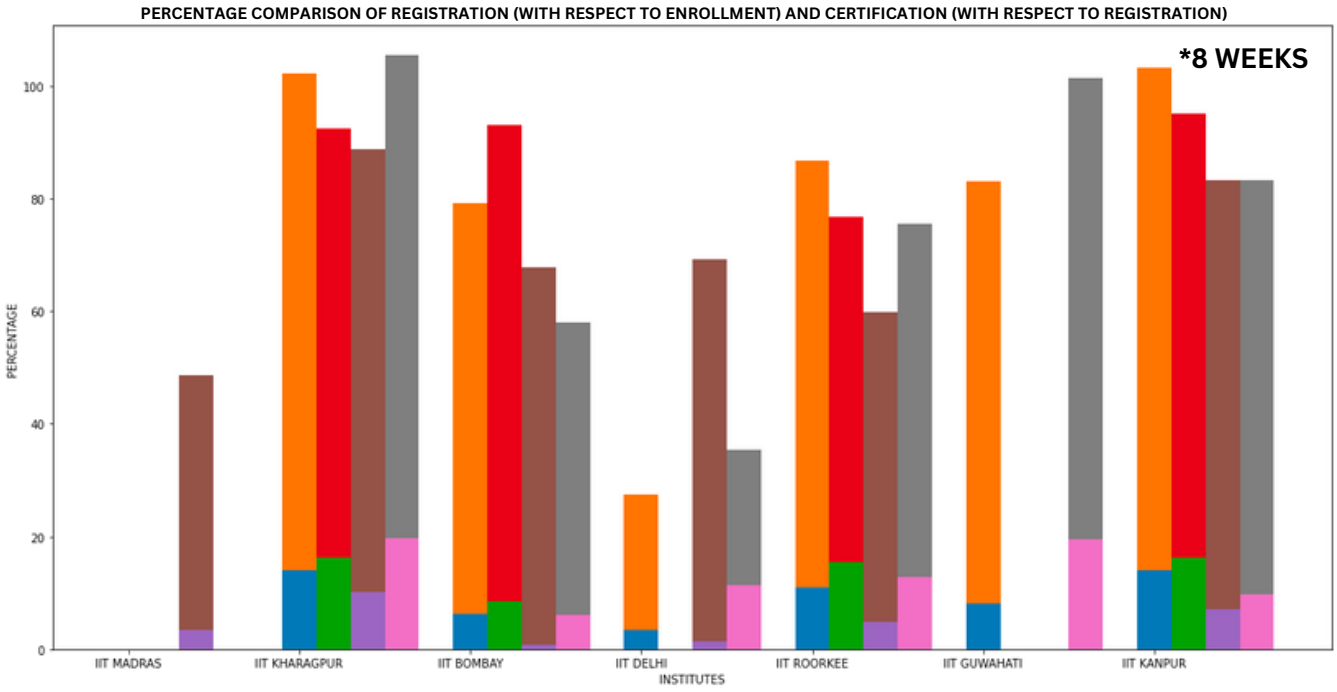


- The Graph 1.1 represents the Total Enrollment in 4 Week Courses in Mathematics Field for different IIT's in different years.

OBSERVATION

- In Year 2018 IIT Roorkee had the highest Enrollment whereas in 2020, 2021 IIT Madras marks the highest Enrollment in their 4 week online courses
- IIT Kharagpur was the only one to provide 4-weeks courses in the year 2019
- In year 2020 IIT Madras had the highest Enrollment with respect to all the year as well as all the IIT's that was above 7000.
- IIT Bombay, IIT Guwahati, IIT Kanpur offered no 4 week courses so there was no Enrollment in them.
- IIT Kharagpur and Delhi both didn't offer online courses for the year 2018.

- **Graph 11**



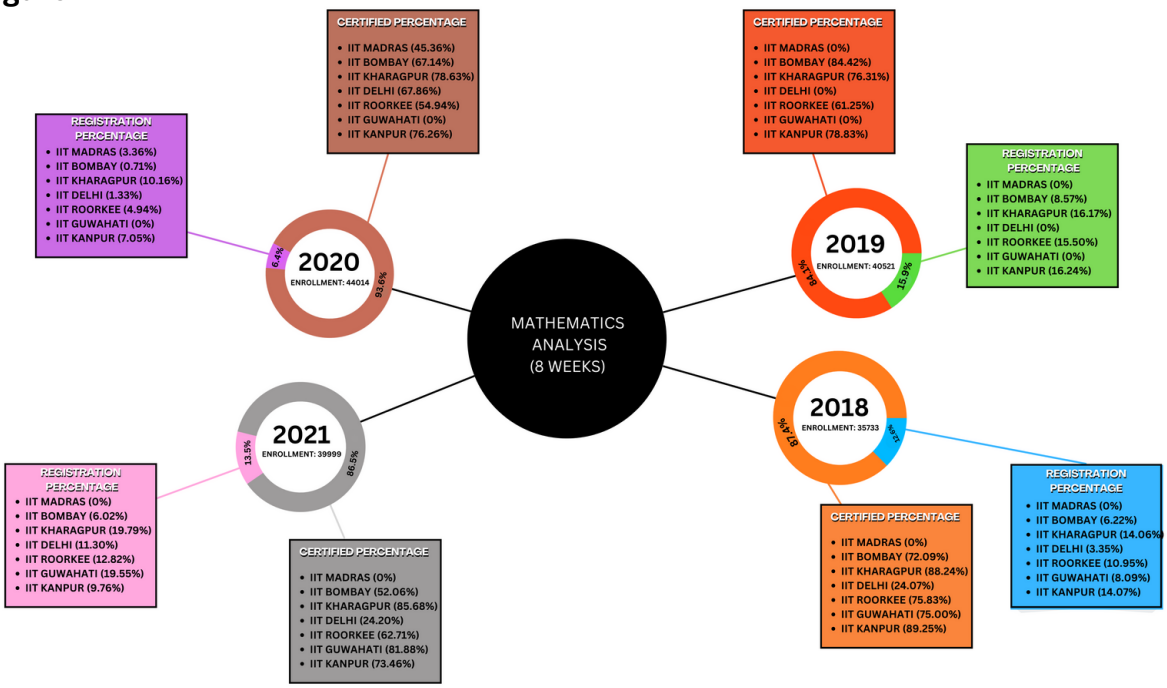
- In **Graph 11** bar is divided into subsections; the upper bar shows the percentage of offered certification in relation to total registration, while the lower bar shows the percentage of registration in relation to total enrollment, for several Institutes. The bars indicate various years 2018, 2019, 2020, and 2021.

OBSERVATION

- The ratio of the registration rate to enrollment is relatively low.
- In comparison to all other Institutes, IIT Kharagpur has the highest registration rate in the year 2021.
- The largest percentage of certificates were awarded in the years 2018, 2020, 2021 by IIT Kharagpur and in the year 2019 by IIT Bombay.
- IIT Madras did not offer any course for the year 2018, 2019 and 2020 and IIT Delhi and Guwahati for the years 2019 and 2019, 2020, respectively.
- No more than 20% of enrolled students may register to complete the course, and this goes for any and all IITs.

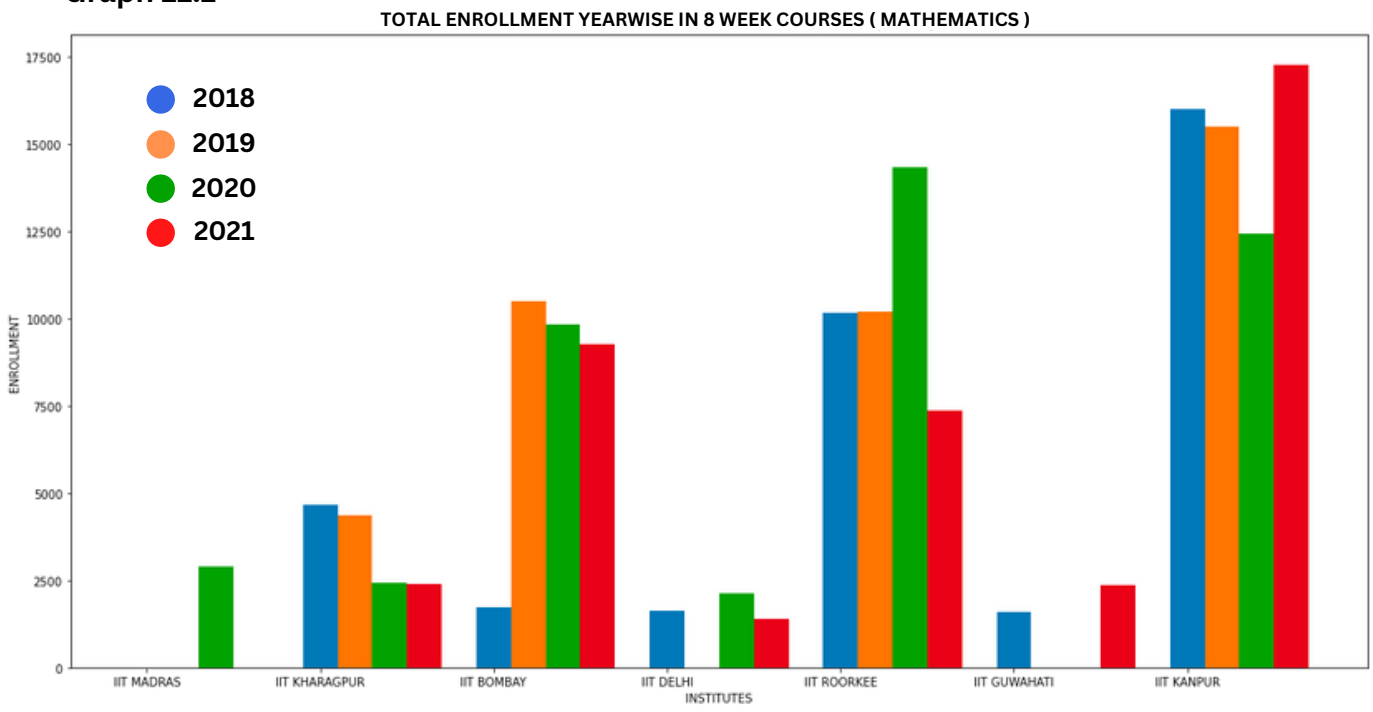
For help understanding the aforementioned graph, please see the representation below-

- **Figure 11**



- The representation above shows the values of percentage of registration and certification of different courses offered by IIT's in Mathematics field 8-weeks each color in the wheel above is with respect to the **Graph 11** for different year. The percentage in color wheel is the representation of overall registration (with respect to enrollment) and certification (with respect to registration). Total Enrollment is also represented in the above figure

- **Graph 11.1**

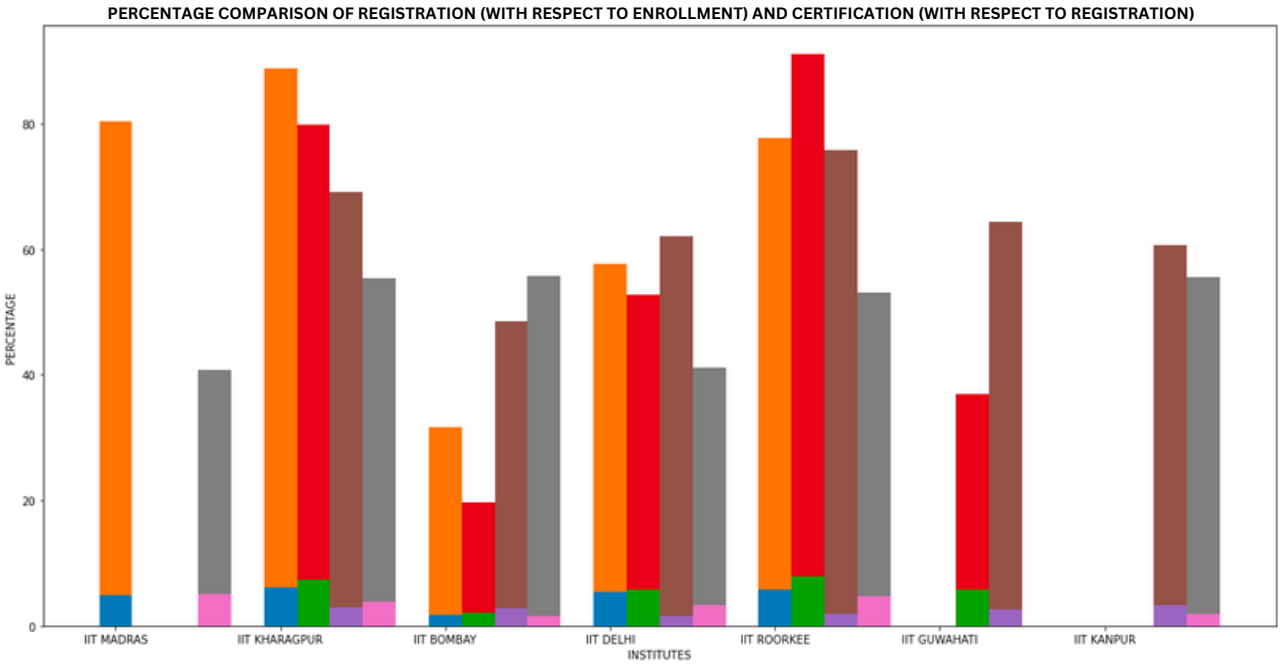


- The Graph 11.1 represents the Total Enrollment in 8-Weeks Courses in Mathematics Field for different IIT's in different years.

OBSERVATION

- The highest enrollments over the years have been at IIT Kanpur.
- In year 2021 IIT Kanpur had the highest enrollment with respect to all the year as well as all the IIT's that was nearly 17500.
- There were no Enrollment in IIT Delhi for the year 2019 and in IIT Madras and IIT Guwahati for the years 2018, 2019, 2020 and 2019, 2020, respectively.
- With the exception of 2020, when IIT Roorkee took the top spot, IIT Kanpur has the greatest enrollment overall.

- **Graph 12**



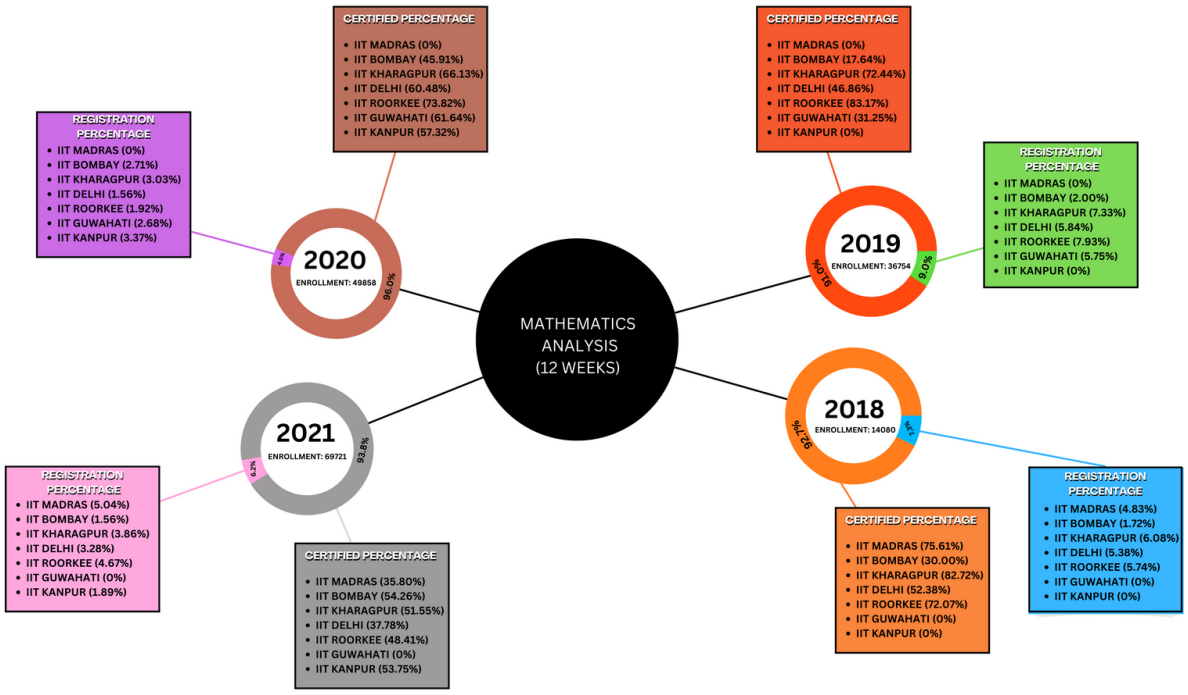
- In **Graph 12** bar is divided into subsections; the upper bar shows the percentage of offered certification in relation to total registration, while the lower bar shows the percentage of registration in relation to total enrollment, for several Institutes. The bars indicate various years 2018, 2019, 2020, and 2021.

OBSERVATION

- The ratio of the registration rate to enrollment is relatively low.
- In comparison to all other Institutes, IIT Roorkee has the highest registration rate in the year 2019.
- The largest percentage of certificates were awarded in the years 2018, 2019, and 2020, 2021 by IIT Kharagpur and IIT Madras, respectively.
- No more than 20% of enrolled students may register to complete the course, and this goes for any and all IITs.

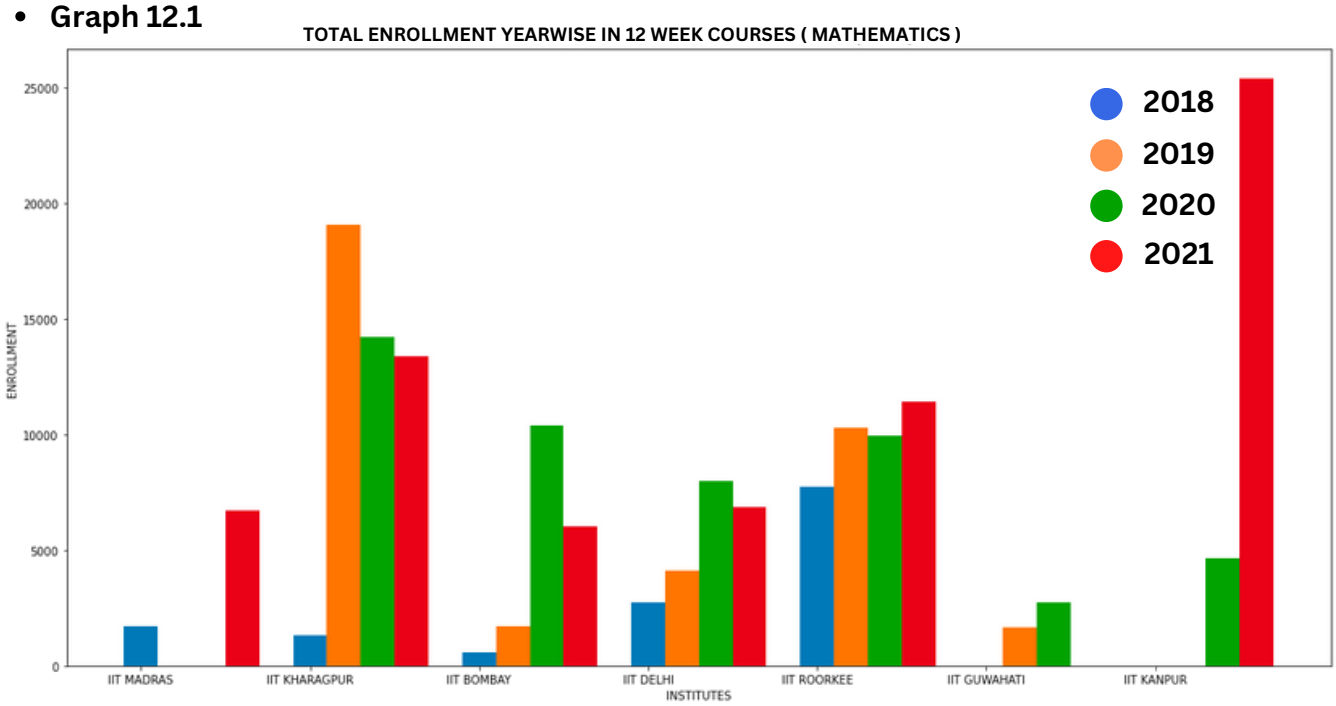
For help understanding the aforementioned graph, please see the representation below-

- **Figure 12**



- The representation above shows the values of percentage of registration and certification of different courses offered by IIT's in Mathematics field 12-weeks each color in the wheel above is with respect to the **Graph 12** for different year. The percentage in color wheel is the representation of overall registration (with respect to enrollment) and certification (with respect to registration). Total Enrollment is also represented in the above figure

- **Graph 12.1**



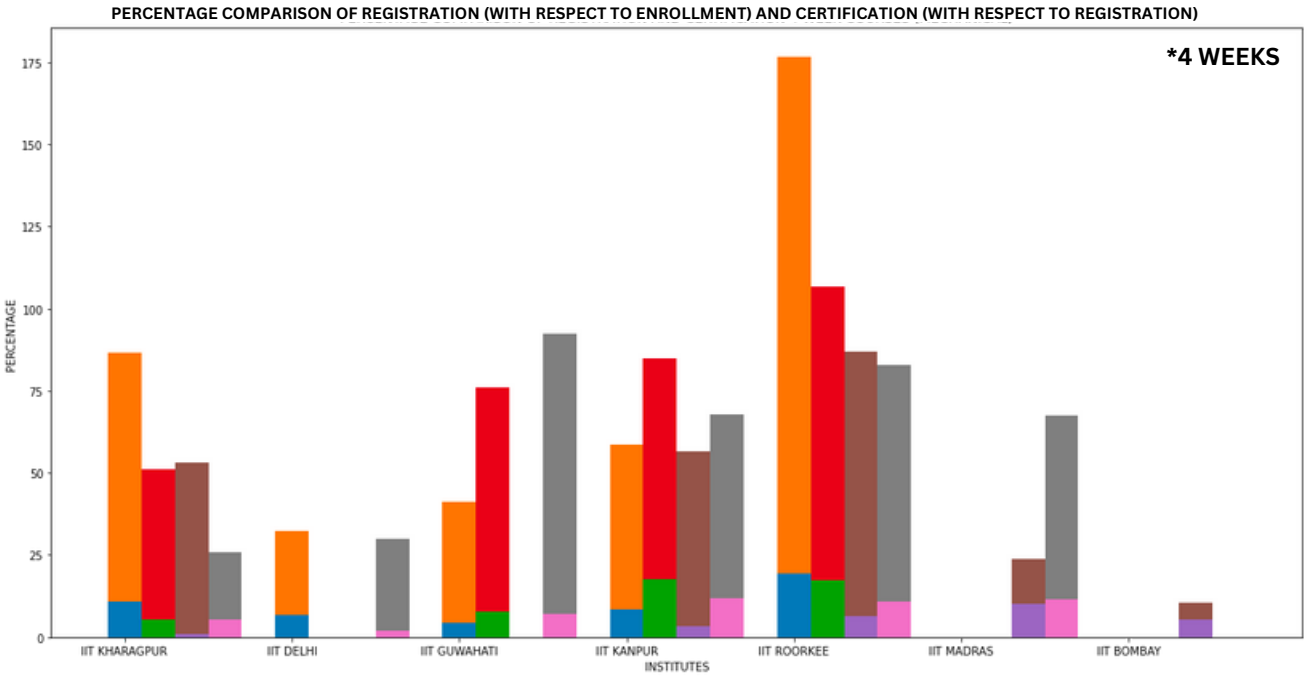
- The Graph 12.1 represents the Total Enrollment in 12-Week Courses in Mathematics Field for different IIT's in different years.

OBSERVATION

- In Year 2019, 2020 IIT Kharagpur has the highest enrollment whereas IIT Roorkee and IIT Kanpur has the highest enrollment in 2018 and 2021, respectivelly.
- In year 2021 IIT Kanpur had the highest enrollment with respect to all the year as well as all the IIT's that was above 25000.
- IIT Kanpur offered no 12-weeks courses in the years 2018 and 2019 and IIT Madras didn't offer in 2019 and 2020 so there was no enrollment in them.

MECHANICAL ENGINEERING

- **Graph 13**



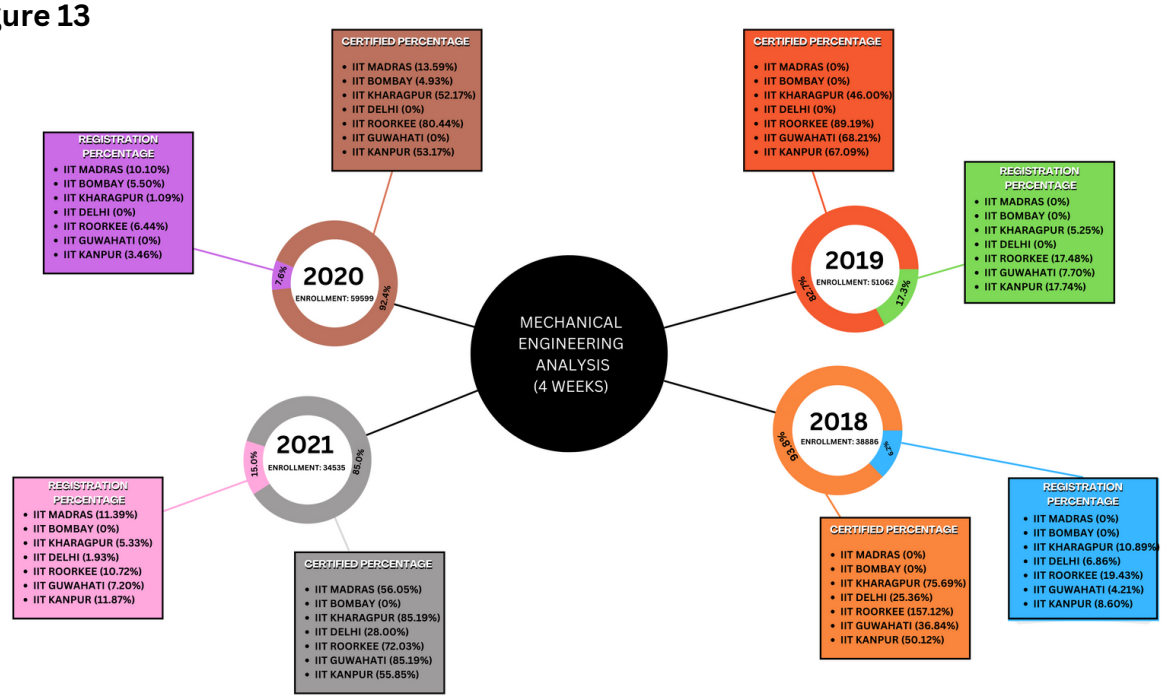
- In **Graph 13** bar is divided into subsections; the upper bar shows the percentage of offered certification in relation to total registration, while the lower bar shows the percentage of registration in relation to total enrollment, for several Institutes. The bars indicate various years 2018, 2019, 2020, and 2021.

OBSERVATION

- The ratio of the registration rate to enrollment is relatively low.
- In comparison to all other Institutes, IIT Roorkee has the highest registration rate in the year 2018.
- The largest percentage of certificates were awarded in the years 2018, 2019, and 2020, 2021 by IIT Kharagpur and IIT Madras, respectively.
- No more than 20% of enrolled students may register to complete the course, and this goes for any and all IITs.

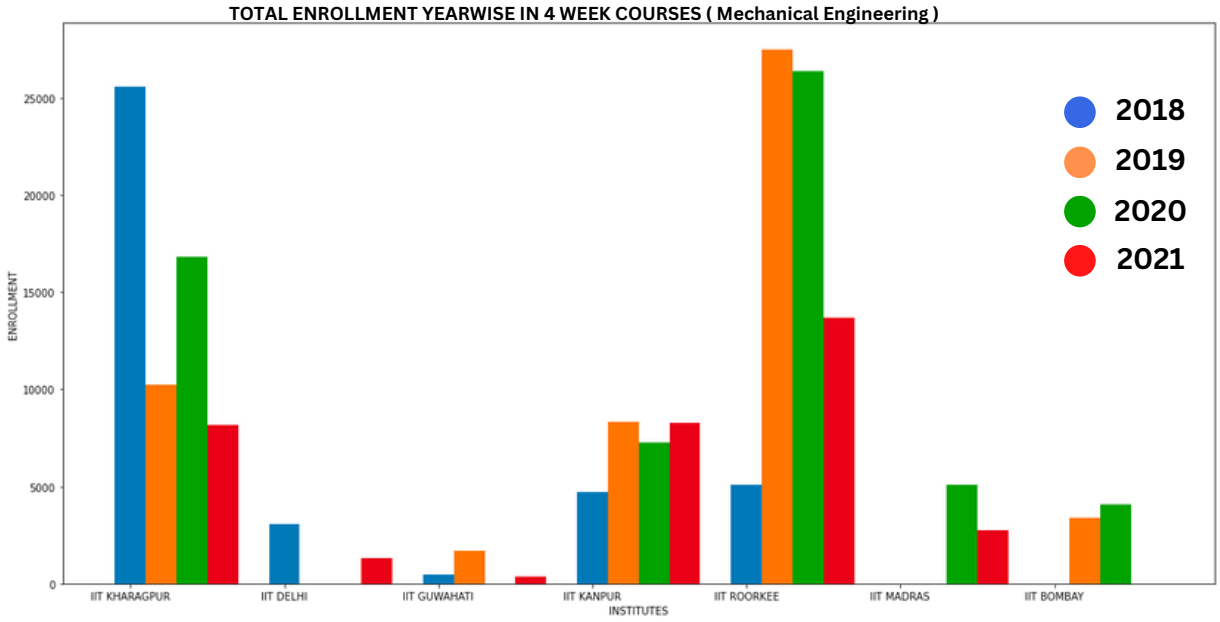
For help understanding the aforementioned graph, please see the representation below-

- **Figure 13**



- The representation above shows the values of percentage of registration and certification of different courses offered by IIT's in Mechanical Engineering field 4 weeks each color in the wheel above is with respect to the **Graph 13** for different year. The percentage in color wheel is the representation of overall registration (with respect to enrollment) and certification (with respect to registration). Total Enrollment is also represented in the above figure.

- **Graph 13.1**

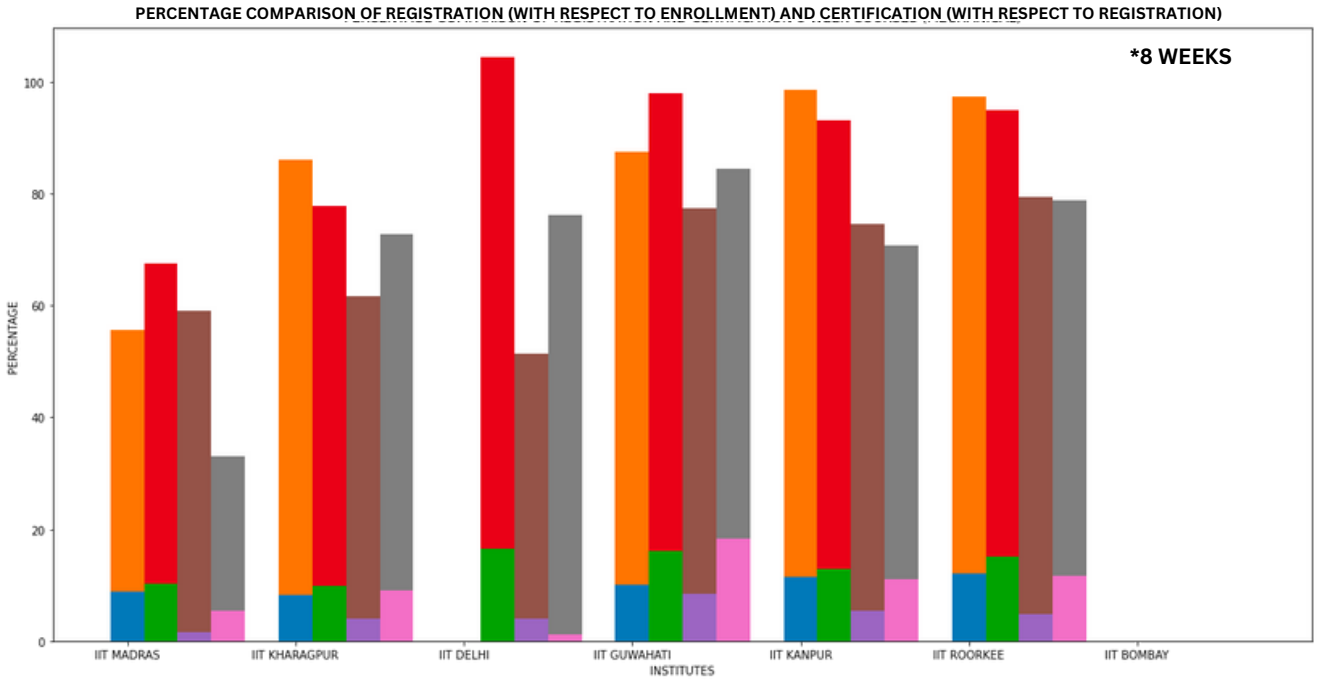


- The Graph 13.1 represents the Total Enrollment in 4 Week Courses in Mechanical Engineering Field for different IIT's in different years.

OBSERVATION

- In Year 2018 IIT Kharagpur has the highest Enrollment whereas in 2019,2020,2021 IIT Roorkee marks the highest Enrollment in their 4 week online courses
- In year 2019 IIT Roorkee had the highest Enrollment with respect to all the year as well as all the IIT's that was above 25000.

- **Graph 14**



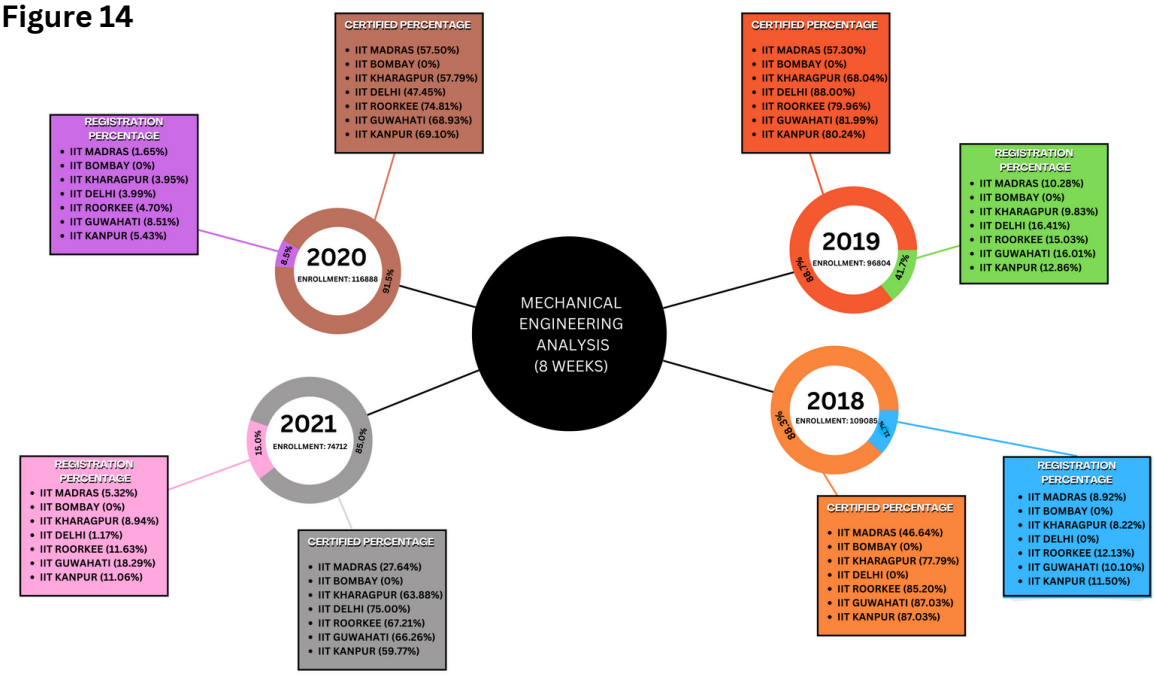
- In **Graph 14** bar is divided into subsections; the upper bar shows the percentage of offered certification in relation to total registration, while the lower bar shows the percentage of registration in relation to total enrollment, for several Institutes. The bars indicate various years 2018, 2019, 2020, and 2021.

OBSERVATION

- The ratio of the registration rate to enrollment is relatively low.
- Institutions like IIT Bombay does not offer 8-weeks courses in the discipline of mechanical engineering.
- In comparison to all other Institutes, IIT Guwahati has the highest registration rate in the year 2021.
- No more than 20% of enrolled students may register to complete the course, and this goes for any and all IITs.

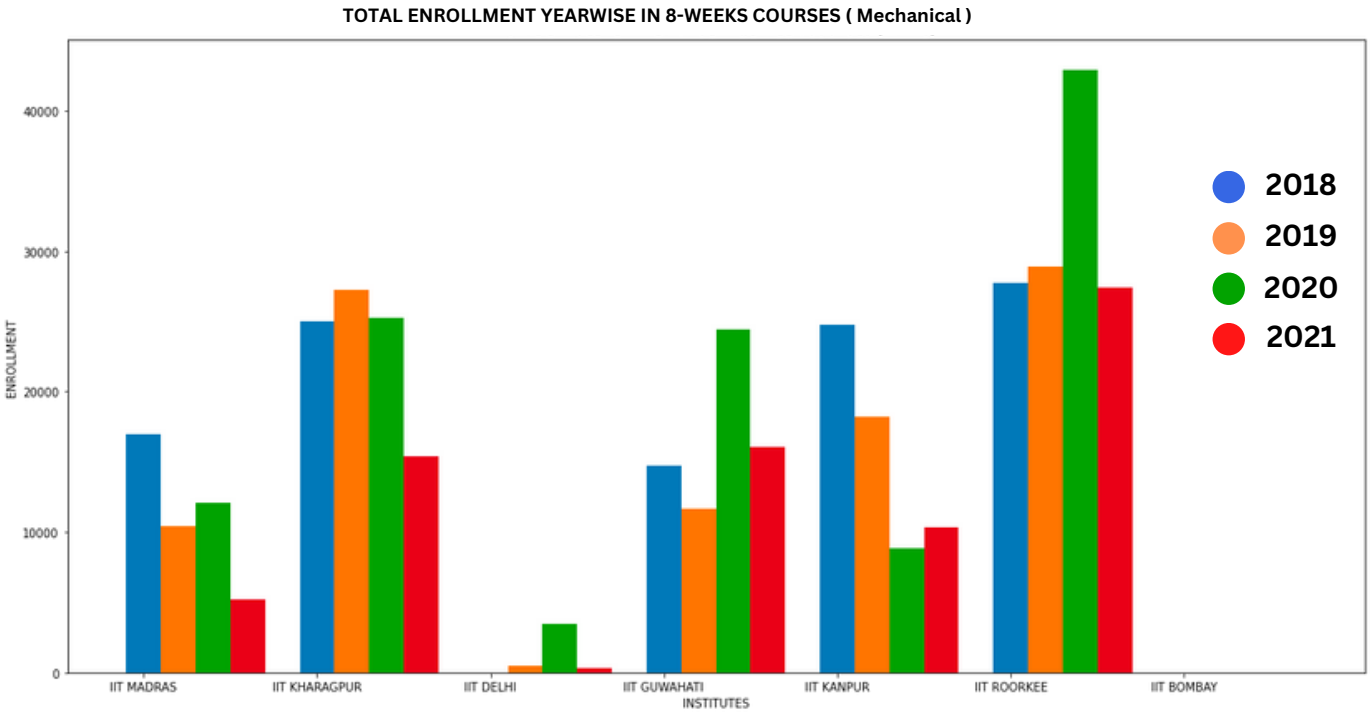
For help understanding the aforementioned graph, please see the representation below-

- **Figure 14**



- The representation above shows the values of percentage of registration and certification of different courses offered by IIT's in Mechanical Engineering field 8-weeks each color in the wheel above is with respect to the **Graph 14** for different year. The percentage in color wheel is the representation of overall registration (with respect to enrollment) and certification (with respect to registration). Total Enrollment is also represented in the above figure

- **Graph 14.1**

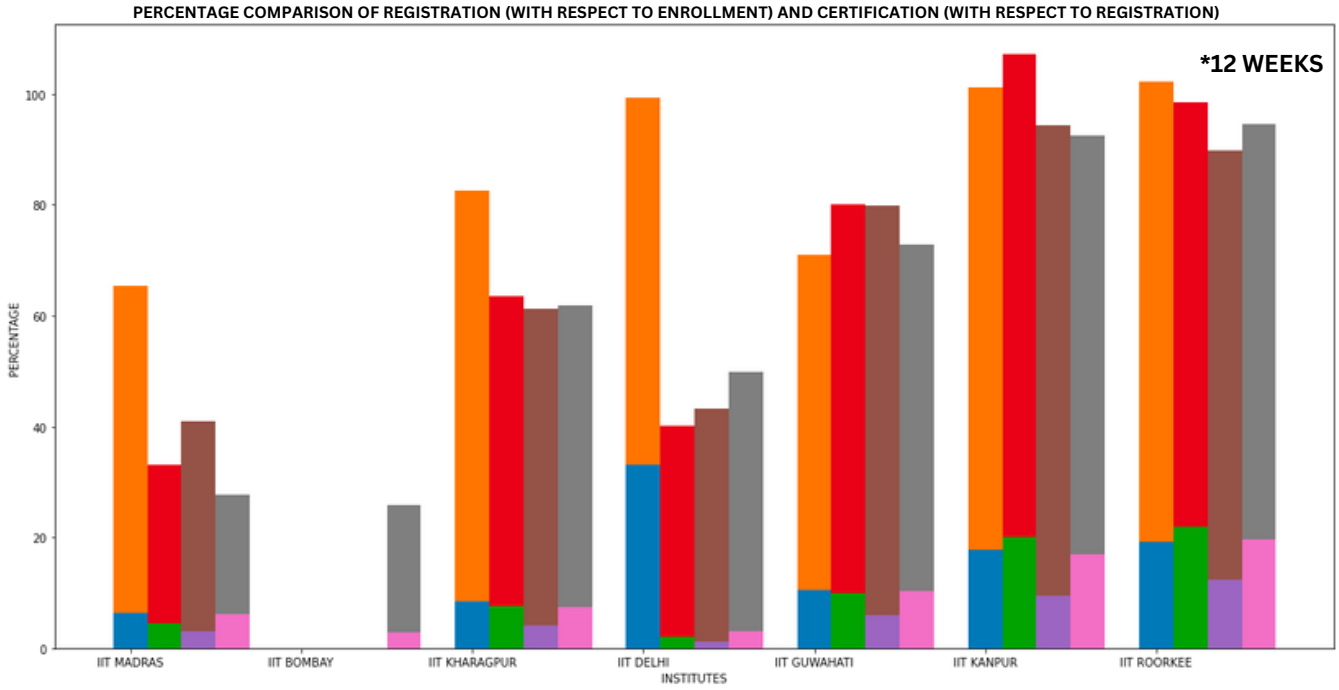


- The Graph 14.1 represents the Total Enrollment in 4 Week Courses in Mechanical Engineeering Field for different IIT's in different years.

OBSERVATION

- In Year 2018 IIT Kharagpur has the highest Enrollment whereas in 2019,2020,2021 IIT Madras marks the highest Enrollment in their 4 week online courses
- In year 2020 IIT Roorkee had the highest Enrollment with respect to all the year as well as all the IIT's that was more than 40000.
- IIT Delhi did not offer any 8-weeks online course in this field in the year 2018.
- For all the years taken into consideration, there were no enrollments at IIT Bombay.

- **Graph 15**



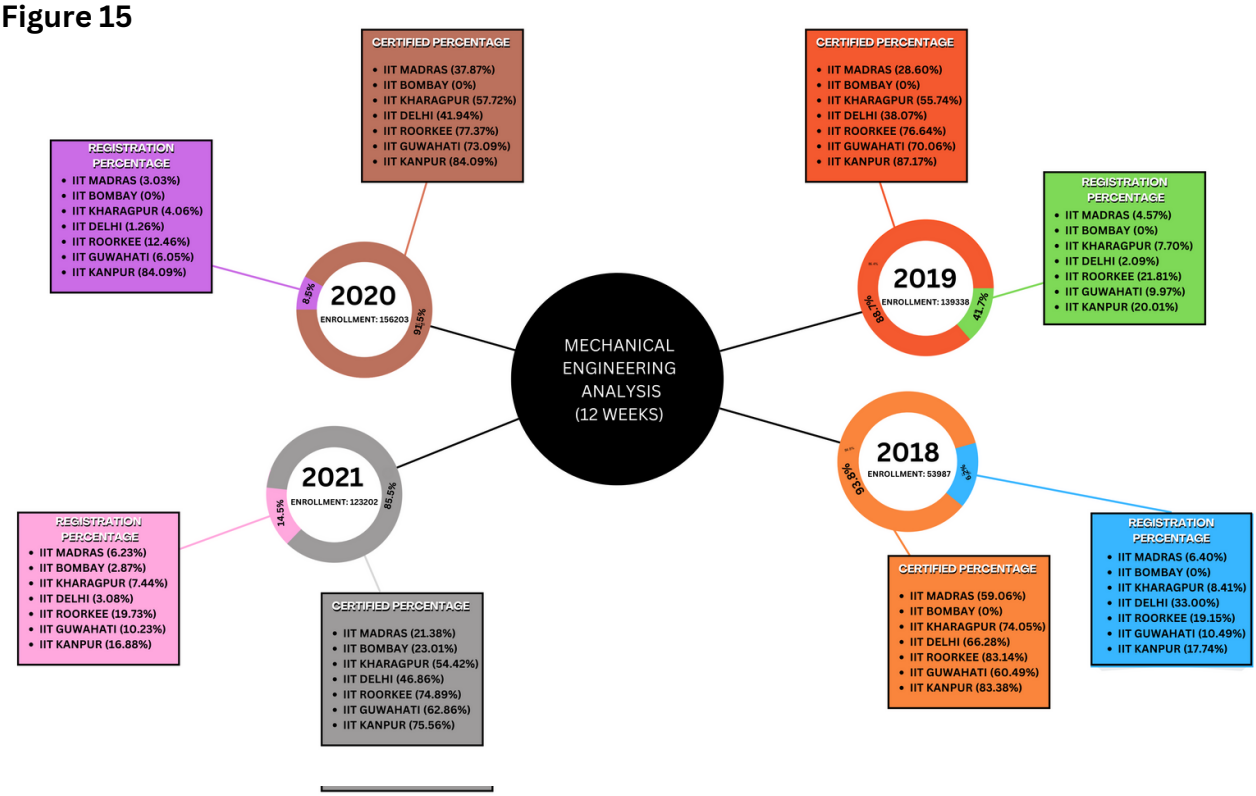
- In **Graph 15** bar is divided into subsections; the upper bar shows the percentage of offered certification in relation to total registration, while the lower bar shows the percentage of registration in relation to total enrollment, for several Institutes. The bars indicate various years 2018, 2019, 2020, and 2021.

OBSERVATION

- The ratio of the registration rate to enrollment is relatively low.
- IIT Bombay did not offer 12 week courses for the years 2018,2019 and 2020.
- In comparison to all other Institutes, IIT Delhi has the highest registration rate in the year 2018.
- The largest percentage of certificates were awarded in the years 2018, 2019,2021 by IIT Kanpur and 2020 by IIT Roorkee.
- No more than 20% of enrolled students may register to complete the course, and this goes for any and all IITs.

For help understanding the aforementioned graph, please see the representation below-

- **Figure 15**



- The representation above shows the values of percentage of registration and certification of different courses offered by IIT's in Mechanical Engineering field 12-weeks each color in the wheel above is with respect to the **Graph 15** for different year. The percentage in color wheel is the representation of overall registration (with respect to enrollment) and certification (with respect to registration). Total Enrollment is also represented in the above figure

- **Graph 15.1**

- The Graph 15.1 represents the Total Enrollment in 8-Week Courses in Computer Science Field for different IIT's in different years.

OBSERVATION

- In Year 2018 and 2019 IIT Kharagpur has the highest Enrollment whereas in 2020 and 2021 IIT Guwahati marks the highest Enrollment in their 12-weeks online courses
- In year 2020 IIT Guwahati had the highest Enrollment wrt to all the year as well as all the IIT's that is above 50000.
- There were no Enrollment in IIT Bombay for the years 2018, 2019 and 2020.

DATA ANALYSIS

- **Map Representation-**

India Map:

The above graph displays the number of courses conducted discipline wise in each IIT. The red pin marks the location of IIT's. From the above map, we can conclude that the maximum number of courses were held by IIT Kharagpur with 158 courses in the domain of computer science and engineering alone followed by 116 courses in the field of management and 84 in the field of civil engineering that were the highest in the respective domains.

- **Visualisation Techniques**

Visualisation is the first step to making sense of data. To transcribe and present data and data correlations in a simple way, data analysts use a wide range of techniques - charts, diagrams, maps, etc. Choosing the right technique and its setup is often the true way to make data understandable. And vice versa, the wrong tactics may fail to present the full potential of data or even make it irrelevant .

Line and bar charts are used to demonstrate comparisons. Bar graphs use rectangular blocks to represent many different types of data, whereas line graphs use lines and represent trends over time particularly well. A doughnut chart represents your data as a part of a whole. It is primarily a circle with a large hold in the middle of it. The doughnut chart is generally used to divide a certain field by percentage coverage. The research also uses subdivided graphs for the interpretation of the data. A simple bar diagram represents only one characteristic, and it is unable to present the components of the variable. Sub-divided bar diagrams can be represented as more components of the variable. In general, sub-divided bar, diagrams are to be used if the total magnitude of the given variable is to be divided into various parts. For example, the total magnitude of the students in a college can be divided by faculty, sex, etc.

Many diverse industries make extensive use of maps. They enable positioning of elements on pertinent objects and surfaces, such as maps, floor plans, website designs, etc. Heat maps, dot distribution maps, and cartograms are some of the most commonly used map visualisations. Diagrams are frequently used to illustrate intricate data links and relationships that combine many forms of data into a single display. They can have a tree-like structure, several dimensions, and hierarchy.

- **Hypothesis Testing-**

Ronald Fisher, Jerzy Neyman, Karl Pearson, and Pearson's son Egon Pearson all contributed to the development of hypothesis testing. A statistical technique called hypothesis testing is employed when generating statistical judgments based on experimental data. In essence, hypothesis testing involves making an assumption about the population parameter.

Key terms and concepts:

Null Hypothesis: A null hypothesis is the statistical hypothesis of no difference. It is usually denoted by H0.

Alternative Hypothesis: Any hypothesis that is complementary to the null hypothesis is an alternate hypothesis. It is usually denoted by H1.

Type I error: Reject H0 when H0 is true.

Type II errors: Accept H0 when H0 is false.

Level of significance: Level of significance is the size of a type I error or the maximum producer’s risk.

Power: Usually known as the probability of correctly accepting the null hypothesis. 1-β (size of type II error) is called power of the analysis.

One-tailed test: A test of any statistical hypothesis where the alternate hypothesis is one-tailed is called a one-tailed test. It is either right tailed or left tailed.

Two-tailed test: A test of any statistical hypothesis where the alternate hypothesis is two-tailed is called a two-tailed test.

A test of a statistical hypothesis is a two-action decision problem after the experimental sample values have been obtained, with the two actions being the acceptance or rejection of the hypothesis under consideration.

Whereas in the case of mechanical the maximum number of courses is 103, held by IIT Roorkee alone followed by 95 courses by IIT Kanpur, 78 by Kharagpur, 74 by IIT Guwahati and so on. In the case of Mathematics as a domain, the maximum number of courses was found to be 41 which were held by IIT Roorkee, followed by 30 in IIT Kharagpur and 24 in IIT Kanpur. The overall minimum number of courses were held by IISc Bangalore, 25 courses by which we can say that the IISc might have had less resources than the IITs which could've been the main reason for the less number of courses. Another justifiable explanation could be focusing on the quality of courses rather than the quantity. The top rated IITs like IIT Bombay and IIT Delhi had a very low number of courses.

- ## Anova Analysis:

The two-way ANOVA compares the mean differences between groups that have been split on two independent variables (called factors). The primary purpose of a two-way ANOVA is to understand if there is an interaction between the two independent variables on the dependent variable.
The interaction term in a two-way ANOVA informs you whether the effect of one of your independent variables on the dependent variable is the same for all values of your other independent variable (and vice versa).

Assumptions of Two way Anova:

- I**ndependence of variables:** The two variables for testing should be independent of each other. One should not affect the other, or else it could result in skewness. This means that one cannot use the two-way ANOVA test in settings with categorical variables.
- **Homoscedasticity:** In a two-way ANOVA test, the variance should be homogenous. The variation around the mean for each set of data should not vary significantly for all the groups.
- **Normal distribution of variables**: The two variables in a two-way ANOVA test should have a normal distribution. When plotted individually, each should have a bell curve. If the data does not meet this criterion, one could attempt statistical data transformation to achieve the desired result. We can also prove normality by drawing P-P plot and Q-Q plot.

Hypothesis:

The null hypothesis was H01: All the IITs have equal average certification with respect to discipline for the given data.
The alternative hypothesis was H11: At least 2 IITs do not have equal average certification with respect to discipline for the given data.
H02: All the disciplines have equal average certification IIT wise.
H12: At least 2 disciplines do not have equal average certification IIT wise.

We divided our data into 4 sub divisions on the basis of the duration of each course for every discipline. The divisions in which we divided our data were:

- 4 weeks
- 8 weeks
- 12 weeks

We also excluded IIT Guwahati from this analysis as a significant amount of data was missing for the same.

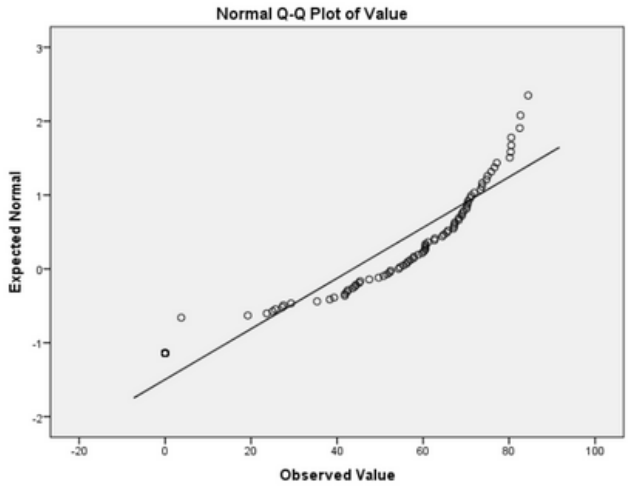
All the analysis was performed using the R studio 4.2.1.

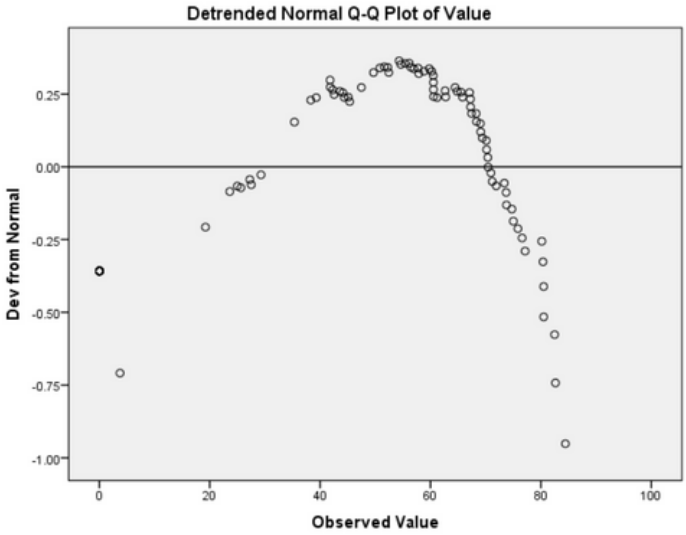
Our data met all the assumptions of the two way ANOVA. To prove that we checked the normality of the data by drawing a P-P and Q-Q plot for the data using SPSS.

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Value	.180	105	.000	.855	105	.000

a. Lilliefors Significance Correction





4-weeks

```
> two.way <- aov(Value ~ IIT+Discipline, data = data)
> summary(two.way)
             Df Sum Sq Mean Sq F value Pr(>F)
IIT           6   7256  1209.3   1.339  0.274
Discipline    1    828   828.3   0.917  0.347
Residuals    27  24378   902.9
>
```

From the ANOVA results, you can conclude the following, based on the p-values and a significance level of 0.05:

- The p-value of IIT vs Values(certified percentage) is 0.274 (statistically insignificant).
- The p-value of Discipline vs Values(certified percentage) is 0.347 (statistically insignificant)

So we can say that we do not reject the null hypothesis for both the cases. This also indicates that our result came out to be statistically insignificant. So we can further say that all the IIT's have equal percentage certification on all disciplines.

8-weeks

```
> two.way <- aov(Value ~ IIT+Discipline, data = data)
> summary(two.way)
             Df Sum Sq Mean Sq F value Pr(>F)
IIT           5   2531   506.2   0.569  0.723
Discipline    1    702   701.5   0.789  0.387
Residuals    17  15122   889.5
>
```

From the ANOVA results, you can conclude the following, based on the p-values and a significance level of 0.05:

- The p-value of IIT vs Values(certified percentage) is 0.723 (statistically insignificant).
- The p-value of Discipline vs Values(certified percentage) is 0.387 (statistically insignificant)

So we can say that we also do not reject the null hypothesis for both the cases. This also indicates that our result came out to be again statistically insignificant. So we can further say that all the IIT's have equal percentage certification on all disciplines.

12-weeks

```
> two.way <- aov(Value ~Discipline+Institute, data = data)
> summary(two.way)
             Df Sum Sq Mean Sq F value Pr(>F)
Discipline    4   3585   896.3   2.124  0.109
Institute     6   4597   766.1   1.816  0.138
Residuals    24  10128   422.0
>
```

From the ANOVA results, you can conclude the following, based on the p-values and a significance level of 0.05:

- The p-value of IIT vs Values(certified percentage) is 0.109 (statistically insignificant).
- The p-value of Discipline vs Values(certified percentage) is 0.138 (statistically insignificant)

So we can say that we again do not reject the null hypothesis for both the cases. This also indicates that our result came out to be also statistically insignificant. So we can further say that all the IIT's have equal percentage certification on all disciplines.

CONCLUSION

During the course of the project, a week-wise analysis was done on the different disciplines and the conclusions were found to be as:

- The overall highest courses were held by IIT Kharagpur. It had the maximum number of courses(158) in the field of Computer Science and Engineering, followed by 116 Courses in the field of management. The second highest number of courses were conducted by IIT Madras and the least number of courses were held by IISc Bangalore.
- In the case of Computer science, the maximum number of enrollments were found to be in the year 2020, followed by the years 2021, 2019, and 2018. A major spike was seen as there was a sudden increase in the number of enrollments from 2018 to 2019. A total increase of 77518 registrations was found.
- For most of the disciplines, there was a hike in the total number of registrations during the years 2019 and 2020 compared to the previous years.
- The registration to Enrollment ratio was very low(<20%) for most of the cases. No more than 20% of enrolled students may register to complete the courses and this remains the same for all disciplines and IITs irrespective of the course duration.
- Upon conducting the Analysis of Variance test for the independence of variables for the different IITs and disciplines for multiple course durations, it was found that all IITs have equal percentage certification in all disciplines and all disciplines have equal percentages of certification in all IITs.
- Upon looking closely at the data, it was found that the enrollment in 4-week courses was very less compared to those in 8 and 12 weeks. The main reason for the same would be that a lot of IITs don't offer 4-week courses which makes them less popular than courses with longer durations. Also, the course content on 12-week and 8-week courses is more vast in comparison to that of 4-week courses which would've made more people register for those types of courses.
- It was later found that the registrations in 12-week courses were very less (<20%) compared to the enrollments. The reason for the same could be a loss of interest due to the high duration of courses. Lack of consistency in self-paced courses was a major reason that made fewer people register for the same. However, the certification-to-registration ratio was found to be around 55-65%.
- There was a high correlation between Total registrations-total enrollments and total certification-total registration. From this, we can interpret that the total certifications were dependent on both. The correlation was significant at a 0.01 level of significance for almost all disciplines.
- On applying ANOVA, it was found that all IITs have equal percentage certification in all disciplines and vice-versa. Not any single IIT is more popular compared to others for any specific discipline.

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