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Research Performance Of IIT Roorkee During 2013-2022: A Scientometric Study

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Abstract

The study aims to assess the research productivity of the Indian Institute of Technology (IIT) Roorkee in terms of publications. It evaluates IIT Roorkee's research performance by analyzing bibliographic data extracted from the Web of Science (WoS) database for 10 years period from 2013 to 2022. Total 12826 research papers were published by IITR researcher during this period. To examine the data various data analysis and visualization tools (Excel, Biblioshiny, etc.) were used. The study provides a quantitative analysis of the institution's overall research productivity, focusing on metrics such as the number of articles, citations, degree of collaborations,trend topics, and most used keywords, most prolific authors, etc. Additionally, the study highlights publication trends, publication growth rate, and the other characteristics of the research activities undertaken.
Keywords: *IIT Roorkee, Research Productivity, Scientometric, Quantitative analysis, Performance evaluation.*

INTRODUCTION

Established in 1847, the Institute of Technology (IIT) Roorkee is one of India's premier engineering institutes, known for its academic excellence and historical legacy. Originally established as Thomason College of Civil Engineering, it attained IIT status in 2001. Located in a stunning landscape of Uttarakhand near Haridwar. IIT Roorkee belongs to the category of first generation

IITs along with other six IITs. IIT Roorkee offers a wide range of undergraduate, postgraduate and PhD programmes in engineering and technology, Management, Humanities and social sciences subjects. Contribution of IIT Roorkee in research is very significant, the institute is committed towards all the possible dimension of research to serve the society.

Scientometric examination of scientific publications explained by the fact that Bibliometric studies are employed to determine growth of the subject, publishing patterns, authorship, citation trends, and coverage of tertiary journals. These elements may provide information about the dynamics of the subject topic. "Scientometrics," the scientific field that characterizes the characteristics of organizational research structures, resource inputs, and outputs, creates standards to assess the caliber of information produced. The growth pattern and other characteristics are used by Scientometric research to describe the fields.

The present study is to undertake the statistical evaluation of research outputof the researcher using Scientometric tools and techniques. The bibliographic details of publications were extracted from Web of Science database. The study tries to establish some facts about the research characteristics of IITR research output on the basis of research objectives.

1 RELATED STUDY

Yadav, P. R., & Mallikarjuna, C. **(2023)** conducted a comprehensive evaluation of research excellence at IIT Hyderabad by examining its research output from 2008 to 2022. Utilizing scholarly metrics, the study assesses the institution's research performance. The analysis shows that IIT Hyderabad has achieved impressive research

output, with over 7,848 papers published in high-impact journals and more than 111,151 citations. The research conducted at IIT Hyderabad has made significant contributions to engineering and sciences, positively impacting society. These results firmly establish IIT Hyderabad as a prominent institute with a strong record of research excellence. The article concludes that IIT Hyderabad is well-positioned to continue its contributions to knowledge and society, making it a vital resource for policymakers, researchers, and stakeholders in higher education.

The study by Ghosh **(2022)** examines the publication trends of research articles from IIT Kharagpur, focusing on Physics, Chemistry, and Mathematics (PCM). Data from SCOPUS reveals a total of 32,892 research publications, with 14,130 in PCM. The study quantitatively measures research productivity over 20 years (2001 -2020), analyzing growth rates, citations, h-index, authorship patterns, collaboration, and top authors and publication sources.

Maharaj, N., Parmar, R., & Tandel, R. **(2021)** conducted a study analyzing the websites of 43 Indian institutions, specifically focusing on IITs and IIMs. The research explores webometric factors such as domain name, domain age, internal and external linkages, and overall web presence. It also investigates the usage of these websites by domestic and international stakeholders. The objective is to examine the webometric characteristics of all IIT and IIM institutions in India, including ranking university websites based on criteria like domain age, extension, links, page speed, web impact factors, and Alexa Ranking.

Kumar, S. (2020). This study is aimed to analyze the research productivity of the Indian Institute of Technology (IIT) Dhanbad. The data was harvested from Web of Science (WoS) bibliographical database for the period 1989-2014. The scientometric analysis of research productivity of IIT(ISM) was performed. The average Impact Factor was calculated 1.789 for the top twenty most prolific journals. The H-Index for 1077 papers of the prolific journals was recorded 37. The study explores the research performance of an institution.

B. Jeyapragash, & T. Rajkumar. **(2019)** examines the memberships and research contributions of Indian Institute of Technology's (IITs) in ResearchGate. The data were extracted from ResearchGate website (https://www.researchgate.net) for this study during first week of September 2017. It was found that 18 IITs have contributed and also shared the research information through ResearchGate. Further the data was analyzed by Memberships of Faculties and Research Scholars, Research Contributions, ResearchGate (RG) Scores of IITs. It is found that the Indian Institute of Technology; Bombay has more members (8,439) with 6,320 publications and very less members by the Indian Institute of Technology; Palakkad has 15 members with no publications. It is suggested that Mandi, Gandhinagar, Jodhpur and palakkad IITs should come forward to contribute their research contributions in ResearchGate.

Banshal, S. K., Singh, V. K., Basu, A., &Muhuri, P. K**. (2017)** presented a computational analysis of the research performance of 16 relatively older Indian Institutes of Technology (IITs) in India. The research publication data indexed in Web of Science for all the 16 IITs is used for the analysis. The data is computationally analysed to identify productivity, productivity per capita, rate of growth of research output, authorship and collaboration pattern, citation impact and discipline-wise research strengths of the different IITs. The research performances of the IITs have been compared with those of two top ranking engineering and technology institutions of the world (MIT-USA and NTU-Singapore) and most cited papers from these IITs have also been identified. The analytical results are expected to provide a informative, up-to-date and useful account of research performance assessment of the IITs.

Bid, S. **(2016)**analysed publications from the Indian Institute of Technology Kharagpur between 2000 and 2015 as indexed in the SCOPUS database. It aims to evaluate the growth and development of research activities at IIT Kharagpur based on publication output. A total of 18,927 publications were downloaded and analyzed according to the study's objectives. The findings indicate that the growth of literature follows an exponential trend, with journal articles being the predominant type of publication (74.37%). The most prolific research areas include engineering and materials science, computer science, and physics and astronomy. The United States, Germany, and the United Kingdom are the preferred countries for collaborations, and the analysis of authorship patterns shows a high degree of collaboration (0.95). The study suggests that such data should be period ically updated alongside the institutional repositories of the respective institutions

2 OBJECTIVES OF THE STUDY

The study was conducted to evaluate;

- To determine the Year-wise growth of research publications
- To determine the authorship pattern and degree of collaboration

- To find the most used keywords
- To measure year wise distribution of the publications and growth
- To calculate doubling time of the publication and RGR
- To find most productive author and institutions
- To evaluate the citation count
- To find top funding agencies

3 SCOPE AND LIMITATIONS OF THE STUDY

This study is limited to the research output of IIT Roorkee published during 2013 to 2022. The study covers the publications of IIT Roorkee indexed in Web of Science database. The publication data of selected institutions may differ in other indexing databases. The records were extracted from web of Sciencedatabase searching the keywords "Indian Institute of technology Roorkee" and "IIT Roorkee". The scope of the study is limited to IIT Roorkee only.

4 METHODOLOGY

The publication data was extracted from Web of Science database using following queries;
Indian Institute of Technology (IIT) - Roorkee (Affiliation) and **2022** or **2021** or **2020** or **2019** or **2018** or **2017** or **2016** or **2015** or **2014** or **2013** or **2012** or **2011** or **2010** or **2009** or **2006** or **2005** or **2004** or **2003** or 2**002** or **2001** or **2000** (Publication Years)

The extracted was then evaluated using MS-excel, biblioshiny, VosViewer and other statistical tools.

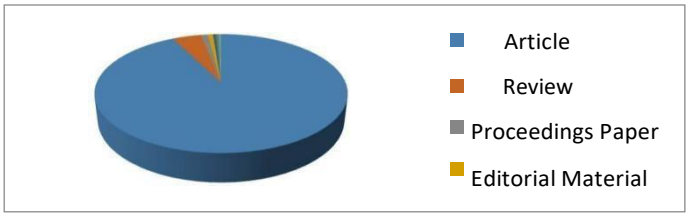
5 DATA ANALYSIS AND INTERPRETATION

5.1 PUBLICATION TYPES

IIT, Roorkee published 12826 research articles during the study period. IIT, Roorkee used a total of fourteen forms of publication. The highest research publications were published in the form of an article with 11851 records which was 92.40% of the total. The second and third highest forms were review articles and Proceedings Paper, with 563 records (4.39%) and 136 records (1.06%), respectively. During the research period, contribution of authors in Book chapter and book review is trivial.

Sl. No.	Document Type	Records	Records %
1	Article	11851	92.40
2	Review	563	4.39
3	Proceedings Paper	136	1.06
4	Editorial Material	98	0.76
5	Correction	58	0.45
6	Early Access	50	0.39
7	Meeting Abstract	41	0.32
9	Letter	5	0.04
11	News Item	2	0.02
12	Biographical-Item	2	0.02
13	Book Review	2	0.02
14	Book Chapter	1	0.01

table -1



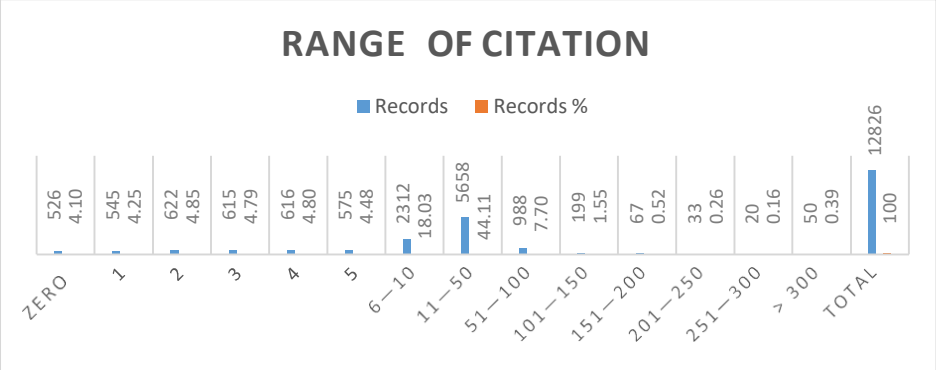
graph-1 (Publication Types)

5.2 CITATION DISTRIBUTION OF PUBLICATION OF IIT, ROORKEE

Range of Citation	Records	Records %
Zero	526	4.10
1	545	4.25
2	622	4.85
3	615	4.79
4	616	4.80
5	575	4.48
6—10	2312	18.03
11—50	5658	44.11
51—100	988	7.70
101—150	199	1.55
151—200	67	0.52
201—250	33	0.26
251—300	20	0.16
> 300	50	0.39
Total	**12826**	**100**

table-2 Citation Distribution

table-2 indicates that 526 articles received zero citations. 545 articles received 1 citation, 622 articles received 2 citations, 615 articles received 3 citations, 616 articles received 4 citations, 575 articles received 5 citations, 2312 articles received 6-10 citations, 5658 articles received 11-50 citations, for more than 100 citations received by 199 articles, more than 200 citations received by 33 articles. There are only 50 documents that received more than 300 citations.



graph -2

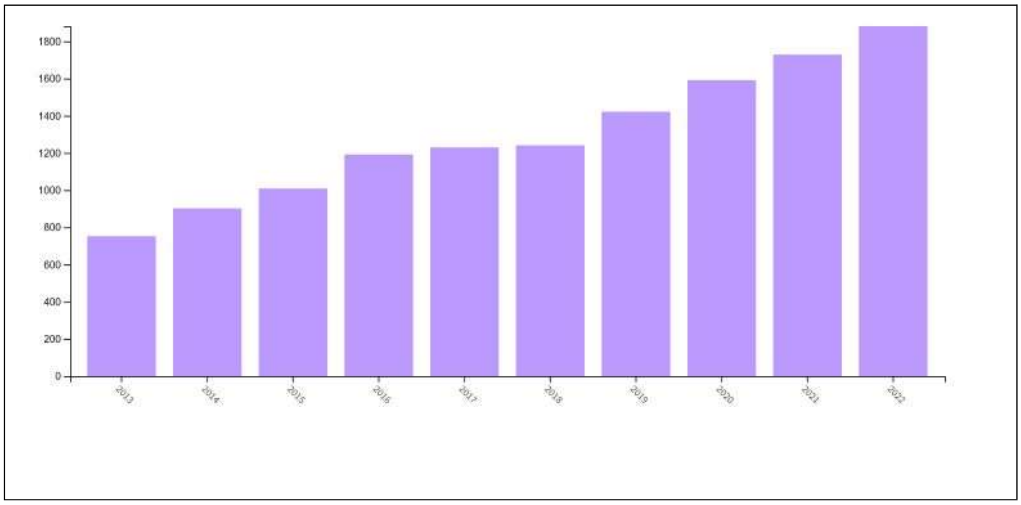
5.3 YEAR-WISE GROWTH OF RESEARCH OUTPUT

The investigation starts with the total distribution pattern of contributions made by the faculty and research scholars from IIT, Roorkee. There were 12826 documents that gotindexed in the WoS database during the period of 2013-2022. The research found that 807 articles(6.29%) has published in the year 2013, and it was increasing rapidly 2059 (16.05%) in 2022. The maximum number of articles indexed in theWoSDatabase was 2059 (16.05%) in 2022.

Sl. No.	Year	Records	Records %
1	2013	807	6.29
2	2014	909	7.09
3	2015	1025	7.99
4	2016	1192	9.29
5	2017	1230	9.59
6	2018	1241	9.68

7	2019	1327	10.35
8	2020	1464	11.41
9	2021	1572	12.26
10	2022	2059	16.05
Total		**12826**	**100**

table-3



graph-3 (Year wise growth of publications)

5.4 TIME SERIES ANALYSIS OF RESEARCH OUTPUT

Year	Articles (Y)	X	X2	X*Y	Trend Value
2013	807	-5	25	-4035	805
2014	909	-4	16	-3636	900
2015	1025	-3	9	-3075	996
2016	1192	-2	4	-2384	1092
2017	1230	-1	1	-1230	1187
2018	1241	1	1	1241	1378
2019	1327	2	4	2654	1474
2020	1464	3	9	4392	1569
2021	1572	4	16	6288	1665
2022	2059	5	25	10295	1760
2030		13			2525
2035		18			3002
2040		23			3480
	12826		110	10510	

table -4

Straight Line equation Yc = a+bX

a= ∑y/N = 1282.6

b= ∑XY/∑X 2 = 95.55

Estimated literature in 2030is when X = 2525 (2030-2017 = 13)

Estimated literature in 2035 is when X = 3002 (2035– 2017=18)

Estimated literature in 2040 is when X = 3480 (2040– 2017 = 23)

With the help of the time series analysis formula, it calculates the future productivity of the IIT, Roorkee. The

predicted value of the IIT, Roorkee research output for 2030 is 2525, 2035 is 3002, and 2040 is 3480. There is a positive growth in the research output of IIT, Roorkee publications.

5.5 RGR AND DOUBLING TIME

The growth rate of the research literature of each year expresses in terms of relative growth rate (RGR), its widely used to quantify the pace of publications each year. Also used Doubling time (Dt) to know the time to double the publication.

Relative Growth Rate **(RGR)= lnW2-lnW1 /T2-T1**

lnW2= log of the final number of articles in a specific period of interval

lnW1 = log of the initial number of articles.

T2- upper limit time interval,

T1- lower limit time interval,

Doubling timing (Dt.)= 0.693/ RGR

Sl. No.	Year	Records	Cum.	log W1	log W2	RGR	DT
1	2013	807	807	6.693324	6.693324	-----	--
2	2014	909	1716	6.812345	7.447751	0.635406	9.16892
3	2015	1025	2741	6.932448	7.916078	0.98363	14.1938
4	2016	1192	3933	7.083388	8.277158	1.19377	17.22612
5	2017	1230	5163	7.114769	8.549273	1.434504	20.69991
6	2018	1241	6404	7.123673	8.764678	1.641005	23.67973
7	2019	1327	7731	7.190676	8.952993	1.762317	25.43027
8	2020	1464	9195	7.288928	9.126415	1.837487	26.51497
9	2021	1572	10767	7.360104	9.284241	1.924137	27.76533
10	2022	2059	12826	7.629976	9.45923	1.829254	26.39616

table -5

table-5 forecasts data of RGR (relative growth rate) and DT (doubling in time) for total research output by IIT, Roorkee. It was observed that the Relative Growth Rate of the publications was highest 1.924 in the year 2021 and lowest 0.63 in the year of 2014. The RGR is continuously increasing from year 2013 to 2022. The Doubling Time for publication of IIT, Roorkee research output has been increasing from year 2013 to 20222. The DT was highest at 27.76 in 2021. Mean DT and RGR are 19.10 and 1.32 respectively.

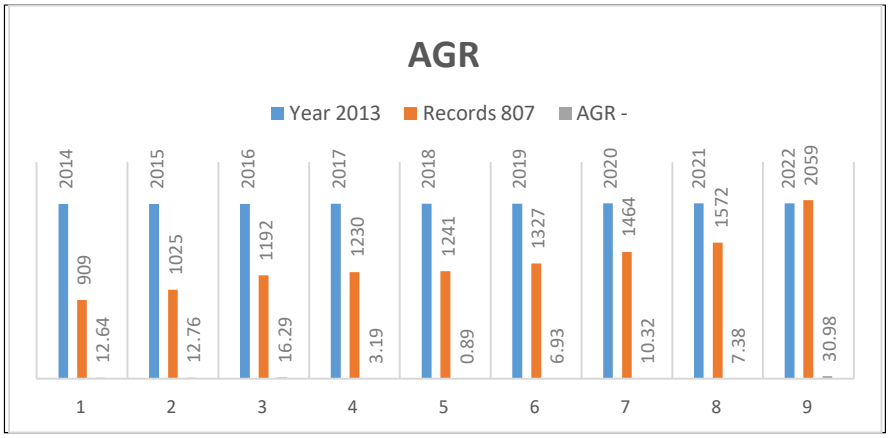
5.6 YEAR-WISE ANNUAL GROWTH RATE

Sl. No.	Year	Records	AGR
1	2013	807	-
2	2014	909	12.64
3	2015	1025	12.76
4	2016	1192	16.29
5	2017	1230	3.19
6	2018	1241	0.89
7	2019	1327	6.93
8	2020	1464	10.32
9	2021	1572	7.38
10	2022	2059	30.98

table-6

The table-6 reveals the fluctuation in annual growth rate in the study period. In the year 2013 to 2022increasing trend and the year 2017 is decreasing trend and again 2020 to 2022 the annual growth rate is fluctuation trend. The highest growth rate (30.98 %) was found during 2022 with 2059 publications followed by (12.76%) with

1025 publications during 2015. This fluctuation in the AGR indicates that there is no constant upward trend growth in the research output of IIT, Roorkee.



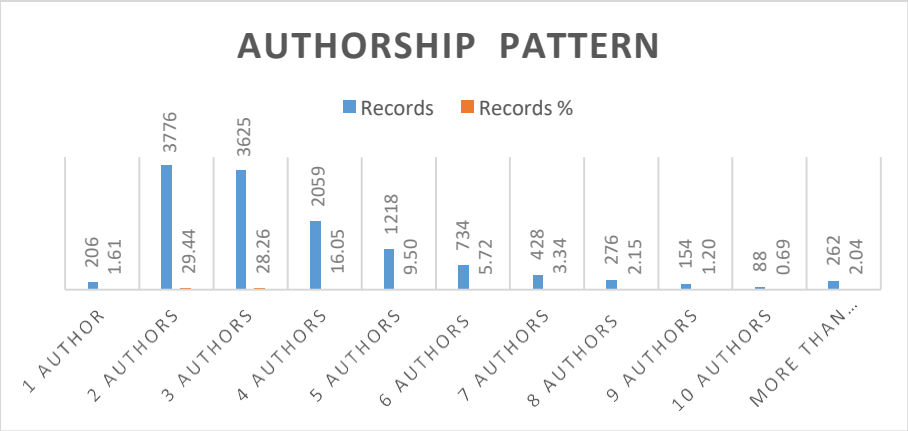
graph-6

5.7 AUTHORSHIP PATTERN

Sl. No.	Pattern	Records	Records %
1	1 Author	206	1.61
2	2 Authors	3776	29.44
3	3 Authors	3625	28.26
4	4 Authors	2059	16.05
5	5 Authors	1218	9.50
6	6 Authors	734	5.72
7	7 Authors	428	3.34
8	8 Authors	276	2.15
9	9 Authors	154	1.20
10	10 Authors	88	0.69
11	More than 10 Authors	262	2.04
Grand Total		**12826**	**100**

table-7

Table depicts a linear order of the categories of number of authors; grouping in a contribution. The authorship pattern of these institution research publications is ranked from single author to more than ten authors. The category of two author paper ranked first forming 29.44% of the total output while the category of three authored publications ranked second by 28.26% publication count by the category of four authors publications ranked third by 16.05% count. IIT, Roorkee 98.39% published their research work in grouping.



graph-7

5.8 DEGREE OF COLLABORATION

The degree of collaboration is a measure of the collaborative research pattern; it is defined as the ratio of the number of collaborative research publications to the total number of research publications in the subject within a given period.

Degree of Collaboration (DC) = Nm/ (Nm+ Ns) = 12620/12826=0.9870

(Nm= No. of Multi author Publication ,Ns= No. of Single Author)

5.9 COLLABORATION NETWORK

Table-9 represent the collaboration network of IITR authors with others, author Kumar, A Maximum network node with 276.25 betweenness and his page rank is maximum among all with 0.1024 unit. IITR authors establish a broader network of authors writing in group.

Table-9 Collaboration Network

Node	*Cluster*	*Betweenness*	*Closeness*	*PageRank*
kumar d	1	11.18779586	0.01333333	0.019875616
poluri km	1	1.778494952	0.01149425	0.014420574
gupta p	1	3.927344631	0.0125	0.013423258
pruthi v	1	3.81163174	0.01204819	0.0149475
kumar a	2	276.2564513	0.01923077	0.1024126
kumar m	2	14.40818039	0.01449275	0.025496969
sharmasc	2	0.014314568	0.01098901	0.009317675
chandra r	2	2.074029668	0.01282051	0.018865923
singhgk	2	0.241844954	0.01075269	0.016751198
pandey a	2	1.124272919	0.01176471	0.010996061

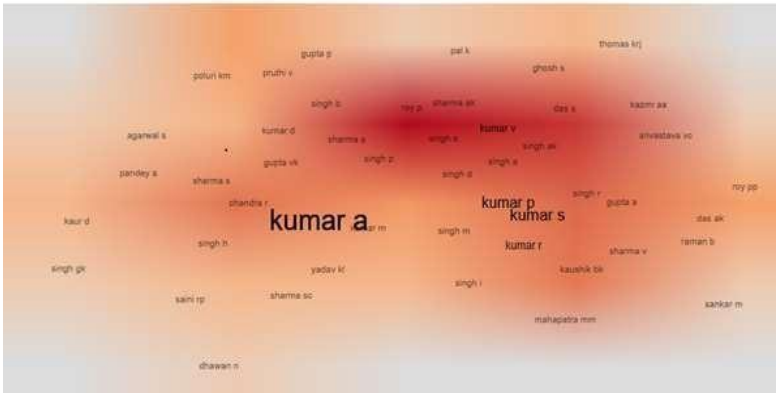


Fig. 1

5.10 YEAR-WISE CO-AUTHOR INDEX

YEAR	1	CAI	2	CAI	3	CAI	4	CAI	Grand Total
2013	21	162.02	177	74.50	301	131.97	308	93.80	807
2014	11	75.34	209	78.10	347	135.07	342	92.46	909
2015	21	127.56	278	92.13	343	118.40	383	91.83	1025
2016	9	47.01	350	99.74	354	105.08	479	98.76	1192
2017	10	50.62	433	119.58	364	104.71	423	84.52	1230
2018	16	80.27	411	112.49	337	96.08	477	94.46	1241
2019	18	84.46	429	109.81	349	93.05	531	98.34	1327
2020	32	136.09	489	113.46	351	84.83	592	99.38	1464
2021	32	126.74	435	93.99	388	87.33	717	112.09	1572
2022	36	108.86	565	93.21	491	84.37	967	115.42	2059
Grand Total	**206**		**3776**		**3625**		**5219**		**12826**

table-10

table-10 indicates the year-wise Co-Authorship Index of IIT, Roorkee publications from 2013 to 2022. For this analysis, the CAI values for publications have a single author, two authors, three authors, and more than three authors. There are five years above the Co-authorship Index found in the single author. In the two authors, four years are found above the Co-authorship Index. The years from 2012 to 2017 are above the Co-Authorship Index found in third authors. In more than three authors, eight years from 2013 to 2020 are lesser than CAI.

5.11 DEPARTMENT WISE PUBLICATIONS

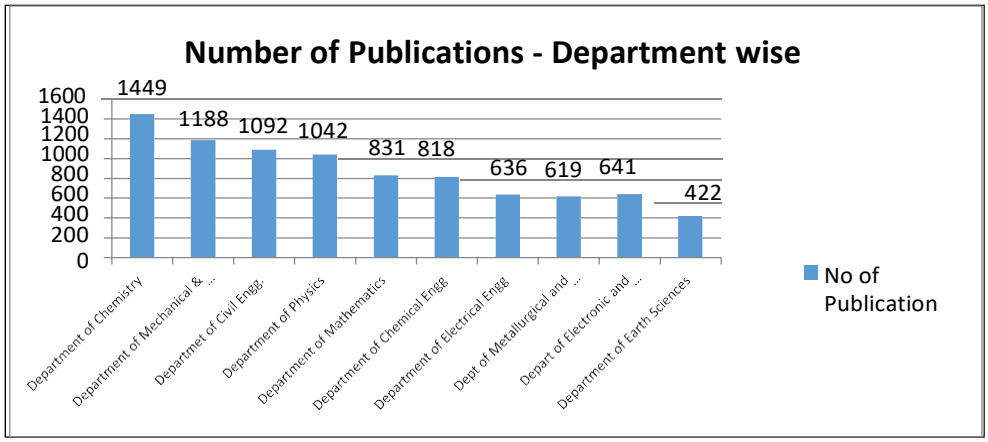


table-11

5.12 MOST USED KEYWORDS AND TREND TOPIC

Fig.2 is the visualization of most used words in publications by IIT Roorkee during 2013-2022. Behaviour, performance, model, mechanical- properties are most used words.

Fig. 2 (Most used keywords)

year	*performance*	*Behavior*	*model*	*design*	*mechanical-properties*	*optimization*	*temperature*	*Nano particles*
2013	36	33	27	28	16	18	24	12
2014	81	79	57	54	40	38	54	41
2015	124	123	94	88	56	61	79	78
2016	192	182	152	130	88	105	110	116
2017	257	245	211	180	153	152	145	144
2018	332	322	282	229	221	185	188	177
2019	416	387	354	283	272	223	227	216
2020	528	480	421	343	333	269	270	253
2021	632	565	498	405	379	313	318	281
2022	778	671	602	491	436	374	366	329

table-12 (Trend Topics – Year wise)

6 MAJOR FINDINGS AND CONCLUSION

The major findings of the study are;

- Nearly 97% of the research is published in the form of Article.
- The research productivity of IIT Roorkee has grown significantly with annual average growth rate of 11.26%. In year 2016, it was maximum with 16.29% increase.
- Department of Chemistry, Mechanical and Industrial Engg, Civil Engg. and Physics published more than 1000 papers during 2013 to 2022.
- 29.44% of the total output was contributed by two authors while the category of three authored publications ranked second by 28.26% publication count by the category of four authors publications ranked third by 16.05% count. IIT, Roorkee 98.39% published their research work in collaboration.
- Degree of Collaboration is 0.9870, shows that the evidence of collaborative efforts of IITR researchers with national and international co authors.

- 5658 articles received 11-50 citations, for more than 100 citations received by 199 articles, more than 200 citations received by 33 articles. There are only 50 documents that received more than 300 citations.526 articles received zero citations which is nearly 5% of total publications.
- Mean DT and RGR are 19.10 and 1.32 respectively.
- The predicted value of the IIT, Roorkee research output for 2030 is 2525, 2035 is 3002, and 2040 is 3480 using time series analysis. There is a positive growth in the research output of IIT, Roorkee publications.

This study is an attempt to advance the other Scientometric studies on research output of IIT Roorkee in terms of publications. The study reveals that IIT Roorkee annual paper output has been substantially increasing, especially the publications in high quality journals.

Some departments are lagging behind in contributing to academic publications; although they may be well involved in field or laboratory research activities. The study shows that IITR authors did not contribute in writing books or book chapters. They should also write books and book chapters in their field so that their expertise can be widely publicized and is available in the library forever. The study will help the researcher to find the area of research and available literature in their selected field. The finding of the study may useful to the funding agencies to determine the factors for allocating the budget to sponsor the research project.

REFERENCES

1. Abdullah, K. H., & Sofyan, D. (2023). Machine learning in safety and health research: a scientometric analysis. *International Journal of Information Science and Management (IJISM)*, *21*(1), 17-37.

2. B. Jeyapragash, & T. Rajkumar. (2019). An Analysis of Research Productivity of Indian Institute of Technology's (IITs) with Special Reference to ResearchGate. *Indian Journal of Information Sources and Services, 9*(2), 58–62.

3. Banshal, S. K., Singh, V. K., Basu, A., &Muhuri, P. K. (2017). Research performance of indian institutes of technology. *Current Science*, 923-932.

4. Bhattacharjee, K. K. (2019, December). Research output on the usage of artificial intelligence in Indian higher education-A scientometric study. In *2019 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM)* (pp. 916-919). IEEE.

5. Bid, S. (2016). Indian Institute of Technology, Kharagpur: A scientometric study of research output. *SSARSC International Journal of Library Information Network and Knowledge*, *1*(1), 1-15.

6. Borgohain, D. J., Bhardwaj, R. K., & Verma, M. K. (2024). Mapping the literature on the application of artificial intelligence in libraries (AAIL): a scientometric analysis. *Library Hi Tech*, *42*(1), 149-179.

7. Ghosh, T. K. (2021). Bibliometric Investigation on Research Productivity in Physics, Chemistry and Mathematics in the Indian Institute of Technology (IIT) Kharagpur during 2001 -2020. *Indian Journal of Information Sources and Services*, *11*(1), 47–57

8. Gupta, B. M., & Dhawan, S. M. (2018). Artificial Intelligence Research in India: A Scientometric Assessment of Publications Output during 2007-16. *DESIDOC Journal of Library & Information Technology*, *38*(6).

9. Kastrin, A., &Hristovski, D. (2021). Scientometric analysis and knowledge mapping of literature-based discovery (1986–2020). *Scientometrics*, *126*(2), 1415-1451.

10. Kumar, S. (2020). Scientometric analysis of research productivity of IIT (ISM) Dhanbad. *Library Philosophy and Practice*, 1-18.

11. Maharaj, N., Parmar, R., & Tandel, R. (2021). Webpage Analysis of Indian Institute of Management (IIM) and Indian Institute of Technology (IIT): A Webometric Study. *Library Philosophy and Practice (e-Journal), 6219*, 1-28.

12. Mohanty, R., & Jena, P. (2020). Mapping of Civil Engineering Research Output at IIT Bombay during 2006-2016. *Library Philosophy and Practice*, 1-20.

13. Yadav, P. R., & Mallikarjuna, C. (2023). IIT Hyderabad's Research Triumph: Unraveling the Impact and Output of Scholarly Publications (2008-2022). *International Journal of Research in Library Science (IJRLS)*, *9*(3), 102-119.

14. https://www.webofscience.com/wos/ accessed on 26.08.2024
15. www.iitr.ac.in accessed on 15.09.2024