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Overview of trends in Indian Optics Research (2008 – 2018)

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Abstract

The present study deals with the assessment of Indian optics research output as reflected in Web of Science (WOS) database for the period 2008 to 2018 for identifying the research output in the field of optics literature. It also provides a comparative evaluation and performance of different types of scientometric indicators, such as number of publications, number of citations and collaboration from India. The Indian optics research has increased exponentially over the last decade.

Keywords: Scientometrics, Optics Research, India, Collaborative research, Web of Science

1. Introduction

Optics is that the branch of physics that studies the behaviour and properties of light, including its interactions with matter and the construction of instruments that use or detect it.

Optics usually describes the behaviour of visible, ultraviolet, and infrared light.The field of optics usually describes the behavior of visible, infrared, and ultraviolet light; however because light is

an electromagnetic radiation, analogous phenomena occur in X-rays, microwaves, radio waves, and other sorts of electromagnetic wave. The pure science aspects of the sector are often called optical science or optical physics. Applied optical sciences are often called optical engineering. Applications of optical engineering related specifically to illumination systems are called illumination engineering. Each of those disciplines tends to be quite different in its applications, technical skills, focus and professional affiliations. More recent innovations in optical engineering are often categorized as photonics or optoelectronics.

Scientometrics is the branch science of science that describes the output traits in terms of organizational research structure,resource inputs and outputs, develops benchmarks to evaluate the quality of information output. Scientometric research publications are a quantitative measure for the basic research activity in a country.Scientometrics indicators can be classified to the number of scientometrics sets they represent and the application of reference standards. Scientometrics indicators referring to the measure of a single scientometrics aspect of scientometrics system represented by a single scientometrics set with a single hierarchical level are termed gross indicators. Those indicators which consist of several gross or complex indicators, preferably with weighting factors and each representing a special aspect of a scientometrics system are composite or compound indexes (Chaman, Dharani & Biradar, 2017).

2. Review of the Study

This study describes and explores the factual picture of research interests within mechanical engineering by analyzing the literature. Bibliometrics has established itself as a viable and distinctive research technique for studying the science of science based on bibliographical and citation data (Gupta & Gupta,2004). There has been an increasing interest in using scientometric information for assessing or monitoring research activities for the past few decades. The discipline

devoted to the quantitative study and evaluation of the scientific literature is called scientometrics or bibliometrics. Bibliometrics has been applied to the evaluation of scientific disciplines, national scientific production, and bibliographic databases, and it provides valuable tools to describe scientific activity in the past and to orient future research (Schoepflin & Glanzel 2001). The aim of scientometrics is to provide quantitative characterizations of scientific activity. Because of the particular importance of publications in scientific communities, it largely overlaps with bibliometrics, which is quantitative analysis of media in any written form (Chaman, Dharani & Biradar, 2017). Kim(2002) compared the citation patterns of researchers from physics and mechanical engineering domains in Korea and, found m that m the type of publication source and type of authorship were found to influence the choice of sources cited by them. Noteworthy is that articles in physics journals from Japan are more frequently cited in papers written with purely Korean authorship than those with international co-authorship.In addition, articles in Korean journals are more highly cited in nationally authored papers than in internationally co-authored papers, in both fields. Ravichandra Rao and Suma (1999) analysed the Indian engineering literature and found that the engineers in India publish in a few selected journals and only a few of the institutions are concentrated in engineering research.

3. Hypothesis of the Study

The following hypothesis is formulated on the basis of the study of related literature and objectives framed above;

1. The research in optics gradually increased year by year.
2. There is an increasing trend (growth) in the optics;
3. The share of international collaborative papers in the field of optics have increased over the years;
4. The researchers of Indian optics have preferred foreign journals rather than Indian journals.

4. Methods and Materials

For this study, the literature on Indian optics downloaded from online multidiscipline database "Web of Science" science citation database which is an international indexing and abstracting database. We searched for the term 'Optics' in 'Topic' field for the period 2008 – 2018. Totally 101,415 world research papers were retrived, in that after again refinning, India in Countries/Regions, we got 3862 research papers on 21st November, 2019. The collected data has been classified using Microsoft Excel for the purpose of analysis. Statistical tools such as frequency distribution, percentage analysis were used for the study. Analysis on year wise distribution, subject coverage and organisations which contributed papers was covered.

5. Objectives of the study

1. To examine the growth of Indian engineering during the period 2008 – 2018
2. To identify the document type of the publications in Indian optics.
3. To examine the Language wise distribution of records in the Indian optics.
4. To identify the organisations conducting the research in Indian optics.
5. To identify and analyse the research contribution in the subject field of optics.
6. To identify the top source titles those, carry the research productions in optics.
7. To identify the top prolific authors in the Indian optics Research.
8. To identify the top 25 collobrative coutries.

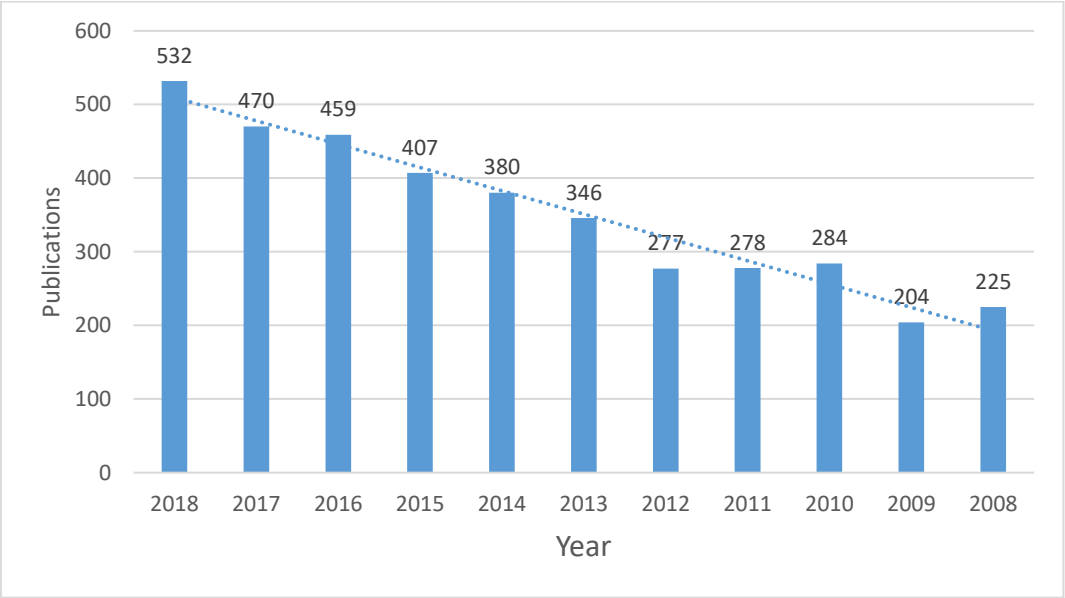
6. Results and Discussion

6.1. Year wise growth rate of publications.

This section provides the results after application of scientometric tools to analyze the outcome. Table 1 indicates the year-wise productivity of optics research in India, The optics research has increased from 407 in 2015 to 532 in 2018.

Table: 1 Year wise growth rate of publications

Publication Years	Publication	Citations	% of 3862	ACP	h - Index
2018	532	1506	13.775	2.83	14
2017	470	3049	12.17	6.49	23
2016	459	3867	11.885	8.42	24
2015	407	4575	10.539	11.24	28
2014	380	4163	9.839	10.96	28
2013	346	4966	8.959	14.35	32
2012	277	4392	7.172	15.86	33
2011	278	4171	7.198	15	32
2010	284	4828	7.354	17	31
2009	204	3625	5.282	17.77	29
2008	225	4663	5.826	20.72	30



Graph: 1 Year wise growth rate of publications

It could be clearly observed from the table 1 and Graph 1 shows that the research output of India and average citations per papers of India. India has produced 3862 papers, and received 430805 citations during the period 2008-2018. In the year of 2018 were produced with 532 articles with 1506 citations (2.83%) of average citations per paper and h-index is 14 followed by year of 2017 produced 470 papers and received 4575 citations with an average of 6.49 and his h-index is 23,in the year of 2008 published 225 publication, 4663 citations with h – Index is 30, The table show that India has contributed total number of publications on optics as per Web of Science database 2008 – 2018. Highest citations (4575) were recived in 2015 and lowest publications (204) were published in the year of 2009.

6.2.Distribution of Publications Based On Document Types

The publications in Indian optics publications were contributed in different bibliographical forms such as Research article, Reviews, Conference Proceedings papers Editorials Materials, Book Review, Book Chapter, News Item, Letter etc and the same is shown in Table 2.

Table: 2 Document type growth rate of publications

Document Types	**Publication**	**% of 3862**
Article	3563	92.258
Review	144	3.729
Proceedings Paper	98	2.538
Letter	56	1.45
Editorial Material	47	1.217
Meeting Abstract	44	1.139
Correction	7	0.181
Retracted Publication	3	0.078
Biographical Item	1	0.026
Book Chapter	1	0.026

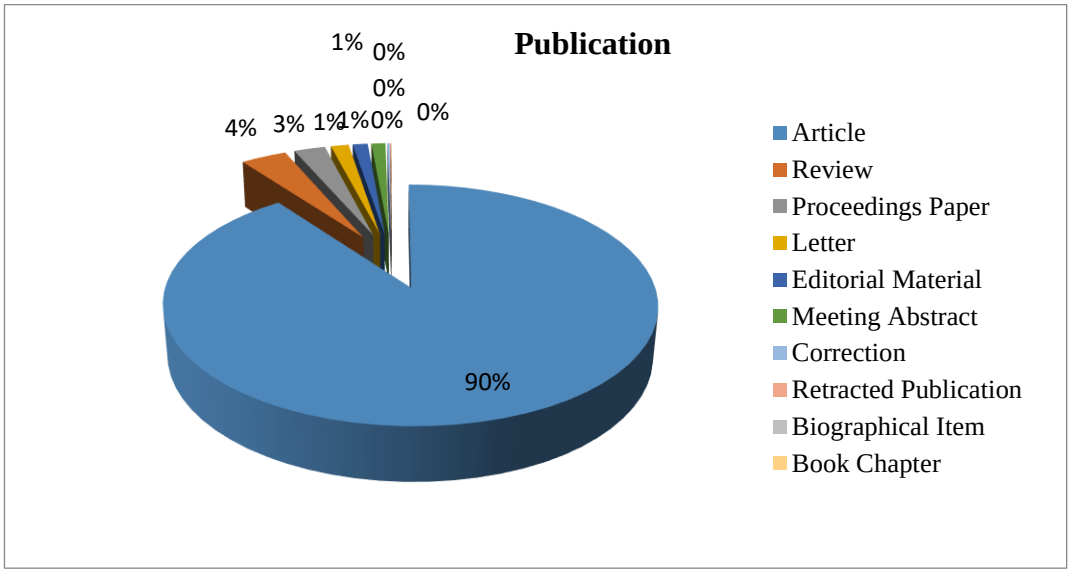


Table: 2 Document type growth rate of publications

Table 2 show that maximum number of papers are published in the form of articles i.e. 3563 (92.258%) are published in journals. This followed by Reviews papers 144 (3.729%) are published, Proceding papers 98 (2.538%) are published, Latters 56 (1.45%) are published, Editorial Materials 47 (1.217%) are published, Meeting abstracts 44 (1.139%) are published, Corrections 7 (0.181%) are published Retreacted publications 3 (0.078%) are published. It could be noted that only 1 (0.00%) publication is available in Biographical Item and Book Chapter.

6.3.Language based distribution of publications

Language is significant medium to disseminate the scientific productivity in any subject area. Therefore, researcher tried to know the language in which author preferred to publish study. All 3862 (100%) publications are printed in english language only.

Table 3 – Language based distribution of publications

Sl No	Languages	Records	% of 3862
1	ENGLISH	3862	100.000

6.4.Research output of major Research Institutions and Universities in India

Table 4 reveals the ranking list of top 25 highly productive Research Institutions in India based on their highest publications, citations, average citations per publication and h-index. According to the web of science database Indian Institute of Technology System ((IIT)s), Delhi contributed the highest publications to the field of Engineering i.e. 666 (17.245%) publications, followed by Indian Institute Of Technology (IIT) Delhi published i.e. 228 (5.904%), Council Of Scientific Industrial Research (CSIR) India published 217 (5.619%), Department Of Science Technology India published 170 (4.402%), All India Institute Of Medical Sciences (AIIMS) New Delhi published 132 (3.418%), Indian Institute Of Science (IISc) Bangalore published 104 (2.693%) articles, L V Prasad Eye Institute produced 101 (2.615%), Dr Rajendra Prasad Centre For Ophthalmic Sciences produced 97 (2.512%), Raja Ramanna Centre For Advanced Technology published 97 (2.512%), Raja Ramanna Centre For Advanced Technology published 94 (2.34%), Defiance Research Development Organization (DRDO) produced 87 (2.253%) papers Indian Institute Of Technology (IIT) Madras produced 84 (2.253%) papers and Anna University published 75 papers (1.942%). The study has identified most active selective 25 institutions only.

Table 4 – Research output of major Research Institutions and Universities in India

Rank	Records	% of 3862	Organizations-Enhanced
1	666	17.245	Indian Institute Of Technology System (IIT) System
2	228	5.904	Indian Institute Of Technology (IIT) Delhi
3	217	5.619	Council Of Scientific Industrial Research (CSIR) India
4	170	4.402	Department Of Science Technology India
5	132	3.418	All India Institute Of Medical Sciences (AIIMS) New
6	104	2.693	Indian Institute Of Science (IISc) Bangalore
7	101	2.615	L V Prasad Eye Institute
8	97	2.512	Dr Rajendra Prasad Centre For Ophthalmic Sciences
9	94	2.434	Raja Ramanna Centre For Advanced Technology
10	87	2.253	Defence Research Development Organisation (DRDO)
11	84	2.175	Indian Institute Of Technology (IIT) Madras
12	75	1.942	Anna University

13	75	1.942	Indian Institute Of Technology (IIT) Bombay
14	75	1.942	Indian Institute Of Technology (IIT) Kanpur
15	69	1.787	Vellore Institute Of Technology
16	68	1.761	(CSIR) National Physical Laboratory (NPL)
17	65	1.683	National Institute Technology Tiruchirappalli
18	63	1.631	University Of Hyderabad
19	62	1.605	Bhabha Atomic Research Center (BARC)
20	60	1.554	Pgimer Chandigarh
21	60	1.554	Sankara Nethralaya
22	59	1.528	Raman Research Institute
23	58	1.502	University Of Delhi
24	57	1.476	Anna University Chennai
25	57	1.476	Indian Institute Of Technology (IIT)Kharagpur

6.5.Most prolific authors in Indian Optics research

Table 5 – Most Prolific authors in Indian Optics research

Authors	Publications	% of 3862
Kumar A	86	2.227
Gupta BD	85	2.201
Kumar S	66	1.709
Ghosh S	50	1.295
Gupta A	46	1.191
Mukhopadhyay S	42	1.088
Sharma A	42	1.088
Panicker CY	41	1.062
Kumar P	40	1.036
Rao HI	39	1.01
Kumar R	38	0.984
Mishra SK	37	0.958
Gupta V	32	0.829
Kumar V	32	0.829
Sharma S	32	0.829
Ramasamy P	31	0.803
Van Alsenoy C	31	0.803
Das S	30	0.777
Sastikumar D	30	0.777
Varghese HT	30	0.777
Agarwal A	29	0.751
Mary YS	29	0.751
Bhagavannarayana G	27	0.699

Raina KK	27	0.699
Singh S	27	0.699

According to study highest publications are by Kumar, A, occupies first rank with 86 articles (2.227%) followed by Gupta BD published 85 (2.201%) papers, Kumar S published 66 papers (1.709%), Ghosh S 50 papers (1.295%), Gupta A produced 46 papers (1.191%), Mukhopadhyay Sand Sharma Apublished 42 articles (1.088%), Panicker CYpublished 41 (1.062%) papers, Kumar P published 40 (1.036%) papers, Rao HI published 39 (1.01%) papers, Kumar R published 38 (0.984%) papers, Mishra SK published 37 (0.958%) papers, Gupta V, Kumar Vand Sharma S published 32 (0.829%) papers, Ramasamy Pand Van Alsenoy C published 31 (0.803%) papers showes in the table – 5.

6.6.Sources wise distribution of Indian Optics Research in India during 2008 – 2018

The data collected for the sudy indicate that from the 3862 publications of the source from various most preferred journals in the field of Indian Optics Research over the 11 years period.

Table 6 – Research output of major Research Institutions and Universities in India

Source Titles	Publication	% of 3862
OPTIK	203	5.256
Indian Journal Of Ophthalmology	171	4.428
Optics Communications	102	2.641
Spectrochimica Acta Part A Molecular And Biomolecular	84	2.175
Journal Of Crystal Growth	83	2.149
Applied Optics	62	1.605
Sensors And Actuators B Chemical	51	1.321
Optical Materials	50	1.295
Journal Of Applied Physics	49	1.269
Optics And Laser Technology	47	1.217
Journal Of Optics	43	1.113
Optical Engineering	43	1.113
IEEE Sensors Journal	38	0.984

Journal Of Modern Optics	38	0.984
Optical And Quantum Electronics	38	0.984
Pramana Journal Of Physics	37	0.958
Journal Of Glaucoma	35	0.906
Journal Of Molecular Structure	35	0.906
Journal Of Lightwave Technology	34	0.88
Liquid Crystals	33	0.854
Physical Review A	32	0.829
Investigative Ophthalmology Visual Science	30	0.777
Annals Of Indian Academy Of Neurology	29	0.751
Review Of Scientific Instruments	28	0.725
Neurology India	27	0.699

Table 6 showes that the total Indian publications ourput in optics research 95.987 % appeared in Journals. The top 25 most productive journals accounted for the ten years. Based on the publications the *OPTIK* published the highest publications i.e. 203 (5.256%) articles, followed by *Indian Journal Of Ophthalmology* published 171 (4.428%,) articles , *Optics Communications* published 102 (2.641%) articles, *Spectro chimica Acta Part A Molecular And Biomolecular Spectroscopy* 84 (2.175%) articles *Journal Of Crystal Growth* 83 (2.149%) articles, *Applied Optics* published 62 (1.605%) papers, *Sensors And Actuators B Chemical* published 51 (10321%) papers, *Optical Materials* published 50 (1.295%) papers, *Journal Of Applied Physics* published49 (1.269%) papers, *Optics And Laser Technology* published 47 (1.217%) papers, *Journal Of Optics* and *Optical Engineering* published 43 (1.113%) papers, *IEEE Sensors Journal*, *Journal Of Modern Optics* and *Optical And Quantum Electronics* published 38 (0.84%) papers etc. during 2008 – 2018.

6.7.International Collaboration

Due to the interdisciplinary growth of subject, the universe of knowledge is ever dynamic and is ever-growing. More and more specialization in the subjects is achieved by the scientists, which is a result of increased participation of group of researchers from different dicipline. It has been found from earlier studies that collaboration in research varies from discipline to discipline and for the same discipline from time to time and from one country to country.Collaborative research has become a well established feature in the field of chemical science. It is observed that there is consistently increasing trend towards collaboration among various branches of chemical science which leads to collaborative authorship in literature (Chaman, Dharani & Biradar, 2017).

Table 7 – Research output of International Collaboration

Countries/Regions	Publications	% of 3862
India	3862	100
USA	299	7.742
Germany	110	2.848
England	108	2.796
France	76	1.968
Japan	74	1.916
Peoples R China	63	1.631
Canada	53	1.372
South Korea	53	1.372
Australia	48	1.243
Malaysia	48	1.243
Belgium	47	1.217
Italy	47	1.217
Saudi Arabia	43	1.113
Poland	42	1.088
Spain	40	1.036
Czech Republic	37	0.958
Singapore	35	0.906
Netherlands	32	0.829
Brazil	31	0.803

Switzerland	30	0.777
Scotland	26	0.673
Taiwan	26	0.673
Israel	24	0.621

Table 7 depicts the international collaborative papers of India with top 25 countries during 2008-2018. The largest number of collaborative publications (3862) of India in optics research , followed by USA contributed 299 papers with 7.742% of total share, Germany published 110 (2.848%) papers, England produced 108 (2.796%) papers, France published 76 (1.968%) articles, Japan contributes 74 (1.916%) papers, Pepoles R China published 63 (1.631%) papers and Canada and South Koriea has contributed 53 (1.372%) papers, Australia and Malaysia contributed 48 (1.243%) papers, Belgium and Italy produced 47 (1.217%) papers, Soudi Arabia published 43 (1.113%) papers, Poland produced 42 (1.088%) papers, Spain published 40 (1.036%) papers, Czech Repablic published 37 (0.958%) papaers, Singapore published 35 (0.906%) papers, Netherlands published 32 (0.829%) papers, Brazil produced 31 (0.803%) papers, Switzerland published 30 (0.777%) papers, Scotland and Taiwan published 26 (0.673%) papers and Israel published 24 (0.621%) papers etc,. Many countries are contributed with below 10% share with India in optics research during 2008 to 2018.

6.8.Subject-Wise Productivity of Indian Optics Research

Table 8 indicates the subject-wise productivity of Optics research in India. Optics with 1079 (27.939%) publications, Physicswith 1055 (27.317%) publications, Materials Science 609 (15.769%) publications, Ophthalmology 504 (15.769%) publications, Engineering 484 (12.532%) publications, Chemistry 427 (11.056%) publications, Science Technology Other Topics 242 (6.266%), Instruments Instrumentation 222 publications (5.748%) publications, Neurosciences

Neurology 185 (4.79%) publications, Crystallography 149 (43.858%), Telecommunications 117 (3.03%) Spectroscopy 113 (2.926%) publications, Surgery 100 (2.926%) publications, Electrochemistry 69 (2.712%) publications, Astronomy Astrophysicsand Computer Science 61 (1.579%) Radiology Nuclear Medicine Medical Imaging 58 (1.502%) publications, Pediatrics 57 (1.476%) publications, Biochemistry Molecular Biology 53 (1.372%) publications, Genetics Hereditыand Nuclear Science Technology 34 (0.88%) publications, Metallurgy Metallurgical Engineering 29 (0.751%) publications, Oncology 28 (0.725%) publications, Research Experimental Medicine 25 (0.647%) publications and Biophysics 23 (0.596%) publications.

Table 8- Subject-Wise Productivity of Indian Optics Research

Research Areas	Publications	% of 3862
Optics	1079	27.939
Physics	1055	27.317
Materials Science	609	15.769
Ophthalmology	504	13.05
Engineering	484	12.532
Chemistry	427	11.056
Science Technology Other Topics	242	6.266
Instruments Instrumentation	222	5.748
Neurosciences Neurology	185	4.79
Crystallography	149	3.858
Telecommunications	117	3.03
Spectroscopy	113	2.926
Surgery	100	2.589
Electrochemistry	69	1.787
Astronomy Astrophysics	61	1.579
Computer Science	61	1.579
Radiology Nuclear Medicine Medical Imaging	58	1.502
Pediatrics	57	1.476
Biochemistry Molecular Biology	53	1.372
Genetics Heredity	34	0.88
Nuclear Science Technology	34	0.88
Metallurgy Metallurgical Engineering	29	0.751

Oncology	28	0.725
Research Experimental Medicine	25	0.647
Biophysics	23	0.596

7. Conclusion

The study analyses India's performance in the field of optics, using publications data and different quantitative and qualitative measures. Its focuses on India's global publication share, growth rate, citation quality, international collaborative publications, its publication share and distribution in sub-fields using 11 years data from the Web of Science database. The study suggests the need to increase the pace of Indian optics research and also improve its quality. Scientometric analysis is additionally extremely essential to plan appropriate measures to be taken to upgrade the research activities. A detail Scientometric analysis of optics research of India and its comparison with other countries is extremely important to get a transparent picture and to require necessary measures to upgrade the research performance. It is important to evaluate the research performance of major optics research institutes of the country and to compare their performance among themselves and similar institutes of other countries. The growth in literature has become a major concern for the scientists, scholars, and library professional as they try to keep themselves abreast with new advances in their subject, and information professionals try to organize this knowledge. India has produced 3862 papers, and received 430805 citations during the period 2008-2018. Maximum number of papers are published in the form of articles i.e. 3563 (92.258%) are published in journals. It is observed that there is a consistently increasing trend towards collaboration among various branches of marketing which leads to collaborative authorship in literature.

References

1. Bhattacharya, S., Shilpa, & Bhati, M. (2012). China and India: The two new players in the nanotechnology race. *Scientometrics, 93*(1), 59-87. Retrieved from http://link.springer.com/10.1007/s11192-012-06517.

2. Chaman Sab, M., Dharani Kumar, P., & Biradar, B. S. (2017). Assessment of Chemical Science Research output Using Scientometric Indicators. *Asian Journal of Chemistry and Pharmaceutical Sciences, 2*(2), 10 -15.

3. Chaman Sab, M., Dharani Kumar, P., & Biradar, B. S. (2017). Scientometric Dimensions of Chemical engineering research in india with reference to web of science citation database. *Review Of Research, 6*(4), 1-8. Retrieved from www.lsrj.in

4. Elango, B., & Rajendran, P. (2015). Global tribology research output (1998 2012): A macro level scientometric study. *Journal of Information Science Theory and Practice, 3*(4), 35-48.

5. Gupta, B. M., Kshitij, A., & Verma, C. (2011). Mapping of Indian computer science research output, 1999-2008. *Scientometrics, 86*(2), 261-283.

6. Gupta, B.M., & Gupta, P. (2004). Analysis of India's S&T research capabilities and international collaborative strength, particularly in context of India-German collaboration, New Delhi: DFG India.

7. Hadagali, G. S., & Anandhalli, G. (2015). Modeling the growth of neurology literature. *Journal of Information Science Theory and Practice, 3*(3), 45-63.

8. Hosamani, M. S. C., & Bagalkoti, V. T. (2014). Scientometric Analysis of Indian Engineering Literature during 1999-2013. *International Journal of Scientific & Engineering Research, 5*(5).

9. Kim, M. J. (2002). Citation patterns of Korean physicists and mechanical engineers: Difference by type of publication source and type of authorship. *Scientometrics, 55*(3), 421 – 436.

10. Liu, F., Lin, A., Wang, H., Peng, Y., & Hong, S. (2016). Global research trends of geographical information system from 1961 to 2010: A bibliometric analysis. *Scientometrics, 106*(2), 751-768.

11. Nobre, G. C., & Tavares, E. (2017). Scientific literature analysis on big data and internet of things applications on circular economy: A bibliometric study. *Scientometrics, 111*(1), 463-492.

12. Ravichandra Rao, I. K., & Suma, M. P. (1999). A quantitative study of Indian engineering literature. *Scientometrics, 46*(3), 605-619.

13. Sangam, S. L., Keshava, & Agadi, A. B. (2010). Growth pattern of marine engineering literature. *Information Studies, 16*(2), 113-120.

14. Schoepflin, U., & Glanzel, W. (2001). Two decades of "Scientometrics". An interdisciplinary field represented by its leading journal. *Scientometrics, 50*(2), 301-312.

15. Singhal, K., Banshal, S. K., Uddin, A., & Singh, V. K. (2015). A Scientometric analysis of computer science research in India. In 2015 Eighth International Conference on Contemporary Computing (IC3) (pp. 177-182).

16. Zou, Y., & Laubichler, M. D. (2017). Measuring the contributions of Chinese scholars to the research field of systems Biology from 2005 to 2013. Scientometrics, 110(3), 1615-1631.