

## **WEB PAGE ANALYSIS OF INDIAN INSTITUTE OF TECHNOLOGIES' (IITs) WEBSITES: A WEBOMETRIC STUDY**

By

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### **ABSTRACT:**

The exponential growth of information on the www and public awareness of the net as a critical infrastructure in the 1990's as spurred millions of people to browse and search for information on the web everyday. The internet and www have demonstrated that the scholars, students and general public have a boundless appetite for information. Millions use the web as primary source of information as an inventive medium for communicating and sharing knowledge, enabling new relationship, collaborations and intellectual committees. This study analysis the web pages of Indian Institute of Technology websites retrieved by commercial search engine and tested by Histogram, Scatter Plot and the Line of Best Fit for its reliability and then by Regression Analysis with the help of SPSS 17.0 package and it is found that External Link Web pages provides more than other link pages.

### **INTRODUCTION**

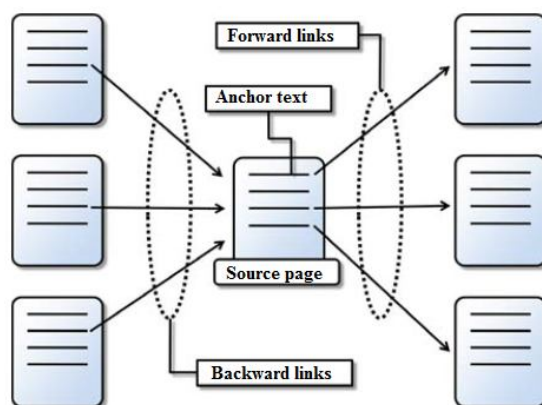
The World Wide Web (WWW) is a system of interlinked hypertext documents accessed via the Internet. With a web browser, one can view web pages that may contain text, images, videos and other multimedia, and navigate between them via hyperlinks (Webopedia). It is a system of Internet servers that support specially formatted documents. The documents are formatted in a markup language called HTML (Hyper Text Markup Language) that supports links to other documents, as well as graphics, audio, and video files. This means one can jump from one document to another simply by clicking on hot spots.

Webometrics covers research of all networking activities based on informetric and other quantitative measures. It is evident that informetric methods using word counts and similar techniques can be applied to the WWW. The webpages are the entities of information

on the, with hyperlinks from them acting as citations. When applying the informetric methodologies to the internet, Search engine plays important role i.e., if the search engine is weak and affected by commercial interests, then searching for the perfect algorithm; matching the perfect user's perfectly well defined need of information (Fugl (2001))<sup>1</sup>.

### WEB MINING BASED METHOD

The hyperlinks form the basis for differences between the ordinary text quantities with web quantity. As they possess valuable information having two types of links "forward links" (out –going hyperlink from a webpage) and the "backward links" (incoming links to the webpage). Google's Page Rank, Kleinberg's HITS emphasizes the importance of backward links in giving information about a particular site. "Anchor Text" is a text part of the link of webpage, which provide valuable information. It is used for Web page categorization, closely related to the content of the linked page (Ito and Nakayama (2011))<sup>2</sup>.



**Figure 1 : Various Information on hyperlinks**

The effect of following a hyperlink may vary with the hypertext system and may sometimes depend on the link itself. On the World Wide Web, most hyperlinks cause the target document to replace the document being displayed, but some are marked to cause the target document to open in a new window. Another possibility is transclusion, for which the link target is a document fragment that replaces the link anchor within the source document (Wikipedia).

### FREQUENCY DISTRIBUTION OF WEBPAGE

The samples of web pages are apportioned with respect to size, number of hyperlinks and the size per link ratio for the sample web pages is called link density. These parameters were also classified by type and discipline in order to observe whether this distribution can show anything useful or characteristic about web pages (Almind and Ingwersen (1998))<sup>3</sup>.

Hyperlinks are important for search engine to algorithms and web mining. Filippo Menczer (Lexical and Semantic Clustering by Web Links) uses two different approaches to examine the common assumption that links between pages imply similar content. Most Webometrics studies use data that comes, directly or indirectly, from a web crawler. Two types of crawling by Viv Cothey (Web Crawling Reliability) are content crawling and link

crawling. The difference between the two is that the aim of content crawling is to get all distinct pages from area crawled whilst rejecting duplicates, whereas a link crawl ignores all content duplication issues, because it is only concerned with topological structure (Thelwall and Vaughan (2004))<sup>4</sup>.

### SCOPE OF WEBOMETRICS

The Webometrics mainly consists on four main areas such as Webpage content analysis, Web link structure analysis, Web usage analysis and Web technology analysis.

- ❖ Webpage Content Analysis is the automatic categorization of webpages and texts by various search engines and tools for analysis.
- ❖ Web link structure Analysis is the study of hyperlinks of a particular website, patterns of linking like inlinks, self-links external links etc.
- ❖ Web usage Analysis deals with the log files of users' searching and browsing behavior.
- ❖ Web technology Analysis relating to the search engine performance closely associated with the information retrieval and supports to webometric analysis.

### OBJECTIVES

- To know the URL of IITs in India.
- To find out the Number of Web Pages of IITs websites in India..
- To find the number of Link Web pages, Self link Web pages, External Link Web pages and Inlink Web pages.
- To know whether the NWP plays a predominant role of all web pages.
- To know the contributions of all links to NWP is identical or not.
- To find out the influence level of each independent variable with the dependent variable.

### BACKGROUND OF THE STUDY

IITs are a group of autonomous public engineering institutes of higher education. There are sixteen institutions listed by The Institute of Technology (Amendment Act 2012) have common admission process for Under Graduate admission by IIT-JEE and the Graduate level programme like M.Tech is administered by the older IITs and admission decisions are made on the basis of GATE.

**Table 1: IITs with the Year of Establishment**

Sl.No	Year of Establishment	No. of IITs
1	Between 1951 -1960	4
2	Between 1961-1970	1
3	Between 1971- 1980	0
4	Between 1981- 1990	0
5	Between 1991 -2000	1
6	Between 2001-2010	9
7	After 2010	1
Total		16

From the above table it is noted that IITs in India are established after 1950s. Among the total 16 IITs, 9 institutions were established between 2001 and 2010. All the IITs domain name uniformly used .ac.in.

### REVIEW OF RELATED LITERATURE

Shukla and Poluru (2012)<sup>5</sup> analyzed the web presence of 173 Indian State Universities. This study shows that some state universities have more visibility compared with their counterparts. The degrees of correlation exist between the WISER and NAAC ranking of universities has also been found. The tools like blogs, social networking sites for scholarly and scientific communication of universities emerge the increase of use of websites has been recommended. Maintaining Institutional Repositories, Open Access, and Collaboration with Other universities, Online Communication etc. help to increase the visibility of the particular website have indicated.

Islam and Alam (2011)<sup>6</sup> examines 44 private university websites in Bangladesh and identifies the number of webpages and link pages, and calculates the overall Web Impact Factor and Absolute Web Impact Factor by using Altavista search engine. This study reveals some private universities have higher number but their link pages are very small in number thus the website fall behind in ranking. The information update and information in both English and local language facilitate more access by users has specified.

Ramesh Babu , Jeyshankar and Nageswara Rao (2010)<sup>7</sup> studied the web pages and Web Impact Factor of 41 central universities in India. The study states about the domains of university websites and the link network diagram of such websites in addition to the status of NWP, LWP, SLWP, ELWP, ILWP and the WIF of each website of central universities.

Jeyshankar and Ramesh Babu (2009)<sup>8</sup> explore the websites of 45 universities in Tamil Nadu through a webometric study. The study reflects that some universities in Tamil Nadu have higher number of web pages but correspondingly their link pages are very small in number and websites fall behind in their simple, self link and external link web impact factor.

Payne and Thelwall (2008)<sup>9</sup> examined the relationship between university inlinks and research productivity over time and identify reasons for individual universities experiencing significant increases and decreases in inlinks over the last six years. There is an evidence of a level of stability over time for university site inlinks when measured against research productivity. Surprisingly, however, inlink counts can vary significantly from year to year for individual, for reasons unrelated to research which undermines their use in webometrics studies.

Ortega and Aguillo (2007)<sup>10</sup> studied the link relationships in the Nordic academic web space comprised of 23 Finish, 11 Danish and 28 Swedish web domains with the European one. Results show that the Nordic network is a cohesive network, set up by three well-defined sub-networks and it rests on the Finnish and Swedish sub-networks. They conclude that the Danish network has less visibility than other Nordic countries. The Swedish one is the principal Nordic sub-network and the Finland network is a slightly isolated from Europe, with the exception of the University of Helsinki.

Thelwall (2006)<sup>11</sup> explained that the order of the links in a search results page is often decided upon by an algorithm that takes into account the number and quality of links to all matching pages. The results indicate that around 66 percent of websites do carry external links, most of which are targeted as a specific purpose, but that about 17 percent publish general links, with implications for those designing and marketing websites.

Park (2004)<sup>12</sup> traced the South Korean Web pages hyperlinking pages hosted in Taiwan, using a search engine. The context in which Taiwan appears in South Korean pages was also examined. Specifically, the structure of hyperlink connectivity from South Korea and Taiwan was analyzed. It was found that the hyperlink network was very sparsely connected in terms of the number of South Korean Webpages hyperlinking to the pages of the other country.

## METHODOLOGY

The study enlists with links of particular website by the following commands:

- Domain: Extract the number of Web Pages at the website.
- Linkdomain: Reveals the number of link Webpages linking to the website. It is called hyperlink pages.
- Linkdomain: AND domain: It provides a complete report of number of Webpages which provides hyperlinks; it is called self –link pages (link from the same website).
- Linkdomain: AND NOT domain:– It provides the report of number of pages not under the particular website. It is called external –link pages.
- Linkdomain: NOT domain: Reveals the number of links incoming from other websites. It is called inlink pages.

The command 'domain' indicates the website address which plays an important role in this study, as it extracts the number of web pages of each websites. The studies of Webometrics make use of the Number of Webpages (NWP) as vital part in calculating WIF, so the same have been taken as Dependent variable and others like LWP, SLWP, ELWP and ILWP has been treated as independent variables. This study analyses the relationship of independent variables with dependent variable by Regression Analysis.

## ANALYSIS AND DISCUSSION

The data are collected from the search engine Google because of its wide coverage and convenient use of Boolean Operators like AND, OR and NOT. Microsoft Excel and SPSS package are used for data analysis.

Table 1: Distribution of Webpages of IITs in India

Sl.no	Name of the Institute (IITs)	NWP	%	LWP	%	SLWP	%	ELWP	%	ILWP	%
1.	IIT Kharagpur	149,000	12.58	171,000	19.97	117,000	12.76	141,000	18.49	144,000	14.75
2.	IIT Bombay	200,000	16.88	107,000	12.50	166,000	18.10	130,000	17.05	130,000	13.32
3.	IIT Madras	123,000	10.38	33,000	3.85	58,000	6.32	80,000	10.49	92,000	9.43
4.	IIT Kanpur	29,000	2.45	23,000	2.69	22,000	2.40	42,000	5.51	54,000	5.53



5.	IIT Delhi	54,000	4.56	43,000	5.02	40,000	4.36	29,000	3.80	27,000	2.77
6.	IIT Guwahati	80,000	6.75	60,000	7.01	40,000	4.36	30,000	3.93	40,000	4.10
7.	IIT Roorkee	54,000	4.56	43,000	5.02	50,000	5.45	33,000	4.33	70,000	7.17
8.	IIT Ropar	43,800	3.70	17,850	2.08	15,510	1.69	17,750	2.33	14,440	1.48
9.	IIT Bhubaneswar	28,500	2.41	35,400	4.13	33,100	3.61	33,100	4.34	32,300	3.31
10.	IIT Hyderabad	54,000	4.56	15,000	1.75	7,500	0.82	14,000	1.84	65,700	6.73
11.	IIT Gandhinagar	94,700	7.99	73,000	8.53	62,300	6.79	42,700	5.60	34,920	3.58
12.	IIT Patna	51,000	4.31	76,000	8.88	81,600	8.90	46,000	6.03	66,600	6.82
13.	IIT Rajasthan	24,600	2.08	36,000	4.20	78,100	8.52	47,000	6.16	82,000	8.40
14.	IIT Mandi	81,000	6.84	20,900	2.44	20,900	2.28	20,900	2.74	18,400	1.89
15.	IIT Indore	54,000	4.56	69,000	8.06	35,000	3.82	52,000	6.82	22,000	2.25
16.	IIT Varanasi	64,000	5.40	33,000	3.85	90,000	9.81	4,000	0.52	82,700	8.47
Total		1,184,600	100.00	856,150	100.00	917,010	100.00	762,450	100.00	976,060	100.00

Source: Google date: September 2012

The following inferences have been drawn from table 1.

NWP is the Number of Web Pages of IITs in India. It is observed, IIT Bombay has been ranked first with (200000) 16.88% of total Number of Web Pages. The least number has been noted as (24600) 2.08% against IIT Rajasthan.

LWP is the Link Web Pages of IITs in India. It is witnessed from the table that IIT Kharagpur has been ranked first with (171000) 19.97% of total number of Link Web Pages. The least number has been noted as (15000) 1.75% against IIT Hyderabad.

SLWP is the Self – Link Web Pages of IITs in India. It is perceived from the table that IIT Bombay has been ranked first with (166000) 18.10% of total number of Self – Link Web Pages. The minimum number has been noticed as (7500) 0.82% for IIT Hyderabad.

ELWP is the External Link Web Pages of IITs in India. It is explained from the table that IIT Kharagpur has been ranked first with (141000) 14.75% of total number of External Link Web Pages. The minimum number has been noticed as (14440) 0.52% for IIT Varanasi.

ILWP is the In Link Web Pages of IITs in India. It is enlightened from the table that IIT Kharagpur has been ranked first with (144000) 14.75% of total number of In Link Web Pages. The minimum number has been noticed as (14440) 1.48% for IIT Varanasi.

**Table 3: Web Impact Factor of IITs**

Sl.no	Name of IITs	NWP (A)	LWP (B)	SWIF (B/A)	SLWP (C)	SLWIF (C/A)	ELWP (D)	ELWIF (D/A)	ILWP (E)	RWIF (E/A)
1.	IIT Kharagpur	149,000	171,000	1.15	117,000	0.79	141,000	0.95	144,000	0.97
2.	IIT Bombay	200,000	107,000	0.54	166,000	0.83	130,000	0.65	130,000	0.65
3.	IIT Madras	123,000	33,000	0.27	58,000	0.47	80,000	0.65	92,000	0.75
4.	IIT Kanpur	29,000	23,000	0.79	22,000	0.76	42,000	1.45	54,000	1.86
5.	IIT Delhi	54,000	43,000	0.80	40,000	0.74	29,000	0.54	27,000	0.50
6.	IIT Guwahati	80,000	60,000	0.75	40,000	0.50	30,000	0.38	40,000	0.50
7.	IIT Roorkee	54,000	43,000	0.80	50,000	0.93	33,000	0.61	70,000	1.30

8.	IIT Ropar	43,800	17,850	0.41	15,510	0.35	17,750	0.41	14,440	0.33
9.	IIT Bhubaneswar	28,500	35,400	1.24	33,100	1.16	33,100	1.16	32,300	1.13
10.	IIT Hyderabad	54,000	15,000	0.28	7,500	0.14	14,000	0.26	65,700	1.22
11.	IIT Gandhinagar	94,700	73,000	0.77	62,300	0.66	42,700	0.45	34,920	0.37
12.	IIT Patna	51,000	76,000	1.49	81,600	1.60	46,000	0.90	66,600	1.31
13.	IIT Rajasthan	24,600	36,000	1.46	78,100	3.17	47,000	1.91	82,000	3.33
14.	IIT Mandi	81,000	20,900	0.26	20,900	0.26	20,900	0.26	18,400	0.23
15.	IIT Indore	54,000	69,000	1.28	35,000	0.65	52,000	0.96	22,000	0.41
16.	IIT Varanasi	64,000	33,000	0.52	90,000	1.41	4,000	0.06	82,700	1.29

The inferences from the Table 3 are as follows:

SWIF or Simple Web Impact Factor is the ratio of all links to the number of pages. IIT Patna has first place with 1.49% of SWIF. IIT Mandi is the last with 0.26% among all IITs by SWIF.

SLWIF is the ratio of self links to the number of pages. IIT Rajasthan occupied first with 3.17% and IIT Hyderabad has 0.14% as least among all IITs by SLWIF.

ELWIF is the ratio of external links to the number of pages. IIT Rajasthan with 1.91% has first place and IIT Varanasi has 0.06% of all IITs by their ELWIF.

RWIF is the ratio of Inlinks to the number of pages. IIT Rajasthan occupied with 3.33% has first place and IIT Mandi has 0.23% of all IITs by their RWIF.

#### Regression Analysis of Variance

Definition: Regression Analysis is a mathematical measure to the average relationship between two or more variables in terms of original units of the data.

The relation between Number of Web Pages (dependent variable) and LWP, SLWP, ELWP & ILWP (independent variables) has been analyzed by using the method of Regression Analysis. Fitness of data can be studied by Histogram and Scatter Plot and the Line of Best Fit for the Regression Analysis.

#### Histogram

In Histogram, a study about the normal curve shaped like a bell that peaks in the middle is expected and is said perfectly symmetrical of the data.

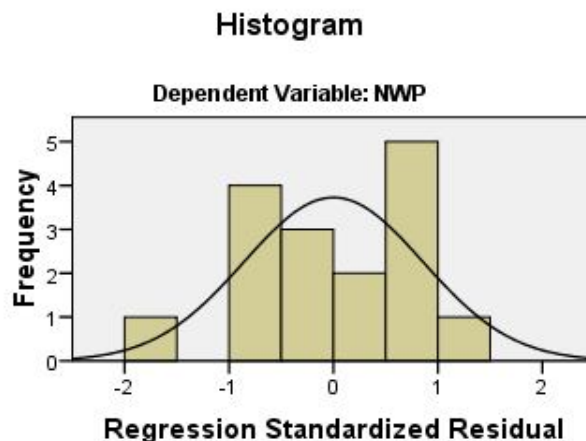


Figure 2: Fitness of Data of IITs by Histogram

The Histogram with bell shaped curve shows our data has normality assumption.

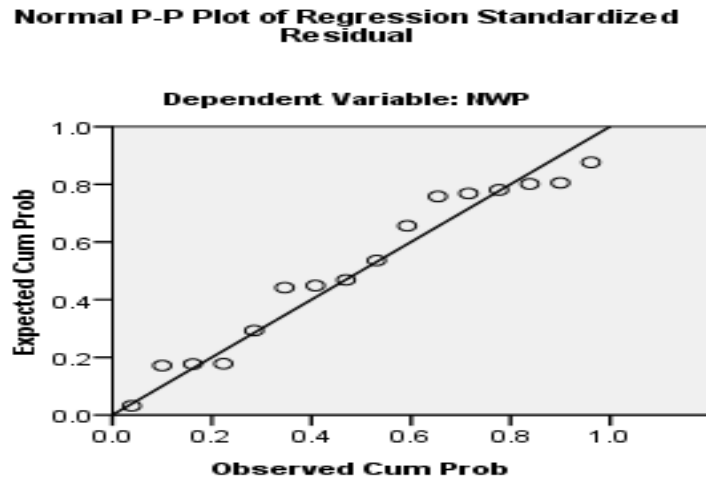


Figure 3: Fitness of Data of IITs by Scatter Plot and the Line of Best Fit

In Scatter Plot and the Line of Best Fit, the data appear as scatter points, each point representing a pair of X (independent variables such as LWP, SLWP, ELWP & ILWP) and Y (dependent variable such as NWP) values. Thus the data appear as scatter plot. This gives the spread of variables showing the nature of relationship.

From the Scatter Plot and the Line of Best Fit, it is known that our data is linearly related with the independent variables.

**REGRESSION RESULT AND INTERPRETATION**

The Websites with all its pages are entered into SPSS Package and the command for Regression Analysis has yield the following outcome and are interpreted according to the statistical rule.

ANOVA <sup>b</sup> (IIT)						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.351E10	4	5.877E9	6.107	.008 <sup>a</sup>
	Residual	1.059E10	11	9.623E8		
	Total	3.409E10	15			
a. Predictors: (Constant), ILWP, LWP, SLWP, ELWP						
b. Dependent Variable: NWP						

Sig .008 (as it is <.01) specifies that 99% confidence in the ability of model to explain the dependent variable by the independent variables. So the decision about the F-test is statistically significant. It specifies the probability of insignificant level is .8% only. (Sig F i.e, p value indicates whether the model as a whole is significant. It tests whether R-square is significantly different from zero).



Model Summary <sup>b</sup> (IIT)				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.830 <sup>a</sup>	.689	.577	31021.477
a. Predictors: (Constant), ILWP, LWP, SLWP, ELWP				
b. Dependent Variable: NWP				

The correlation coefficient (R) for the relationship between the independent variable and the dependent variable is 0.830, which can be characterized as a very strong relationship. (The rule thumb: a correlation less than or equal to 0.20 is characterized as very weak; >0.20 but  $\leq$  0.40 is weak; >0.40 but  $\leq$  0.60 is moderate; >0.60 but  $\leq$  0.80 is strong and >0.80 is very strong).

- The column R Square (between 0 and 1, a higher value is better) explains the proportion of deviation in the dependent variable by the regression model. It is understood that 68% of the variation has been explained. That is the independent variables together account for 68.9% of variation in the dependent variable – NWP.

Coefficients <sup>a</sup> (IIT)						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	23360.518	15534.680		1.504	.161
	LWP	-.132	.387	-.112	-.342	.739
	SLWP	.448	.375	.391	1.192	.258
	ELWP	.846	.455	.685	1.859	.090
	ILWP	-.134	.400	-.109	-.336	.743

a. Dependent Variable: NWP

- It is stated that the p-value (in the column "Sig.") must be low. (If  $p < .05$ , the independent variable is significantly related to the dependent variable).
- The figure .161 indicates that the dependent variable is unreliable for 16%
- The significant level of the variable ELWP is .090 (is  $< .1$ ) has the lowest level of unreliability among all.
- It is known from the column B of Unstandardized coefficients (In the column 'Unstandardized Coefficient' (B) explains the direction of the relationship between independent variable and the dependent variable).
- one unit increase of NWP is due to
- 13% contribution made by LWP but inversely.
- 44% contribution from SLWP.
- 84% contribution from ELWP and
- 13% contribution from ILWP but inversely.

The independent variable ELWP contributes more to the dependent variable NWP amongst all links of IITs.

## CONCLUSION

Websites offering convenient services enable users to economize on time – saving travel time to a physical location and providing access to information whenever and wherever needed are pronounced benefits that have been reported in e-commerce website studies. Webometrics is an unexplored area concerned with webpages, contents of web pages, link structure of web sites and so on. The institutions without its website are unimaginable at present. The web pages play a powerful role for the parent institution as it is an important communication tool. The 'Number of Web pages' is taken as dependent variable in Regression Analysis because, the other web pages like LWP, SLWP, ELWP & ILWP we retrieved using Google from the part of NWP can be recognized by the previous study in this area. Moreover, the calculation of Web Impact Factor has given weightage to NWP among all links. Different algorithms may be used by Google to provide the web pages, but the reliability can be tested by Histogram and by Scatter Plot and Line of Best Fit. After getting the normality assumption of our data, we go further study through Regression Analysis. The result of the study shows that among the four web pages (LWP, SLWP, ELWP & ILWP) of IIT websites, the external link pages stand-in important to increase the number of webpages.

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## APPENDIX - LIST OF IITs WEBSITES &amp; THEIR URLs

SI .No	Name of the Institutes of IITs	Year of Establishment	URL
1	IIT Kharagpur	1951	www.iitkgp.ac.in
2	IIT Bombay	1958	www.iitb.ac.in
3	IIT Madras	1959	www.iitm.ac.in
4	IIT Kanpur	1959	www.iitk.ac.in
5	IIT Delhi	1961 (1963)*	www.iitd.ac.in
6	IIT Guwahati	1994	www.iitg.ac.in
7	IIT Roorkee	1847 (2001)*	www.iitr.ac.in
8	IIT Ropar	2008	www.iitrpr.ac.in
9	IIT Bhubaneswar	2008	www.iitbbs.ac.in
10	IIT Hyderabad	2008	www.iith.ac.in
11	IIT Gandhinagar	2008	www.iitgn.ac.in
12	IIT Patna	2008	www.iitp.ac.in
13	IIT Rajasthan	2008	www.iitj.ac.in
14	IIT Mandi	2009	www.iitmandi.ac.in
15	IIT Indore	2009	www.iiti.ac.in
16	IIT Varanasi	1916 (2011)*	www.itbhu.ac.in

- Already established institutes were given the status of IIT in the year mentioned within the parenthesis.