About the Authors

Dr. Rupinder Tewari is the founder & professor in the Department of Microbial Biotechnology, and Chief-Coordinator, DST-Centre for Policy Research at Panjab University, Chandigarh, with a rich experience of 39 years in the domains of academics and research. After graduation, post-graduation and PhD from the Dept. of Microbiology (Hons. School), Panjab University, he went on to receive a second PhD (Microbiology) from University of London, London (UK) and a Post-Doctorate from Washington University, Saint Louis, USA. He is a recipient of the prestigious *Rockefeller Biotechnology Fellowship (USA)* and *Commonwealth Academic Staff Scholarship (UK)*. He has to his credit over 100 research publications in international journals and four books in the field of Microbiology and Biotechnology. His recent book, '*Industry-Academia R&D Ecosystem in India.....an evidence based study*', has been highly appreciated by the policy makers, ministries and funding agencies of Government of India. Prof. Tewari has vast administrative experience and held eminent positions at Panjab University, such as Dean (Faculty of Sciences); Chairperson, Department of Biotechnology; Founder & Chief-Coordinator, Centre for Innovation Cluster (Biotechnology); Director (Hony.), Centre for Industry-Institute Partnership Programme. In addition, Prof. Tewari has been the Founder of *Association of Microbiologists of India (Chandigarh Unit);* Co-Founder, *Chandigarh Region Innovation & Knowledge Cluster (CRIKC);* and Member, Board of Directors, Venus Remedies Pvt. Ltd., Panchkula (Haryana).

Ms. Mamta Bhardwaj is working as a Sr. Scientist-C with DST-Centre for Policy Research at Panjab University, Chandigarh since 2015. She has been working in the domain of Intellectual Property Rights (IPRs) of India and other countries. She is a graduate in Engineering with specialization in Electronics and Communication from Institution of Electronics and Telecommunication Engineers (IETE), New Delhi and a postgraduate in the same field from Guru Gobind Singh Indraprastha University, New Delhi. She also has certifications in various IPR courses offered by World Intellectual Property Organization (WIPO). She is credited with 5 research publications in national and international journals and co-author of a book related to industry-academia interactions. She has been actively involved in organizing various industry-academia meets/symposia and delivered talks on the same theme in various forums.

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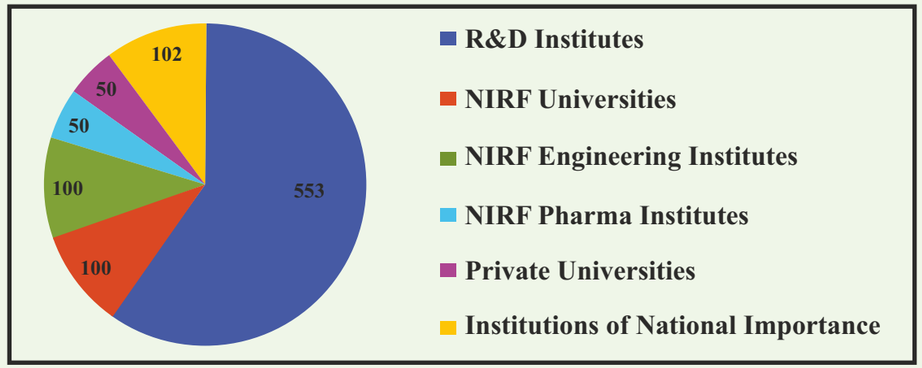

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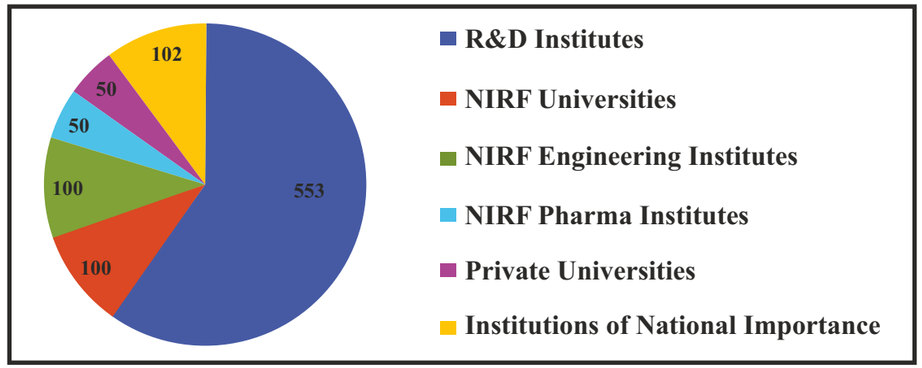

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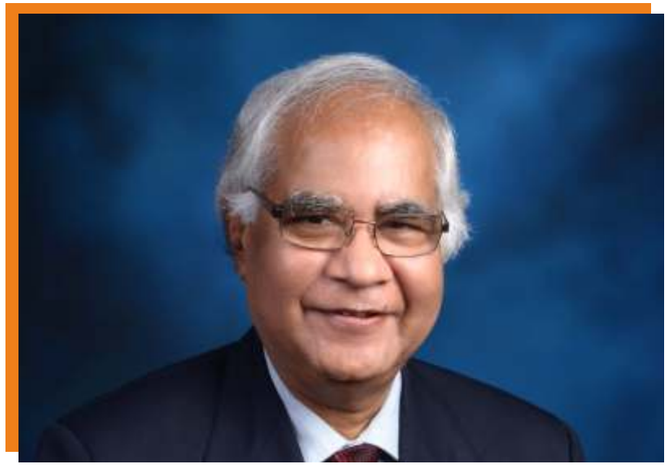
This Book is Dedicated

to



(9th April, 1947 – 6th January, 2018)

Dr. Baldev Raj

FTWAS, FNAE, FNA, FASC, FNASC

(Former Chairman, DST- Centres for Policy Research)

'An eminent nuclear scientist, academician par excellence, thought leader and a mentor to thousands of scientists and students'

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MESSAGE

In the current era, innovation has become a buzzword, and rightly so, as the economic and societal growth of a nation has been linked to its innovation index. The commercial exploitation of innovations, by countries such as USA, Germany, France, UK, Japan and South Korea have contributed in a great manner towards their financial stability. In developed countries, innovations have not only improved the quality of living of their countrymen but also consolidated their positions in world power order. To extract maximum financial benefits of scientific innovations, Intellectual Property (IP) is of paramount importance.

India is globally ranked 5th in the world for producing 'Number of Scientific Publications (Scimago Journal & Country Rank, 2016), but global ranking nosedives to 45th rank in the indicator of Intellectual Property Rights (IPR) as reported in International Property Rights Index (IPRI) Report, 2017. These two rankings reflect the inability of Indian researchers to convert their academic excellence into technologies/products/patents. In order to address this issue and achieving respectful global ranking in IPR, STIP-2013 laid down strong emphasis on developing an IPR policy, which subsequently came into existence as National IPR Policy-2016. The policy provides guidelines for increasing awareness about IPR and generating more IPs in higher education institutes and national research laboratories of India.

The Government has set up a DST-Centre for Policy Research at Panjab University, for 'Adopting evidence-based Approaches for Identifying and Promoting Areas for Generation of IPs'. This book is a right step in this direction. The scientists of the Centre have identified universities and research laboratories, which have potential in generating IPs and have made recommendations for boosting patent system in India. I wish DST-CPR good luck in their endeavours for promoting IP in India.

(Harsh Vardhan)

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प्रो. आशुतोष शर्मा
Prof. Ashutosh Sharma

Secretary
Government of India
Ministry of Science and Technology
Department of Science and Technology

MESSAGE

The old proverb 'Necessity is the Mother of Invention' holds true even in the current era of knowledge economy. The Indian government has realized the importance of Innovations for boosting not only the economic growth but also addressing the societal problems of the nation. The inclusion of the word 'Innovation' in the latest science policy of India i.e. STIP-2013 clearly shows the importance India is giving to Innovations.

For innovation to happen through R&D activity, the great emphasis should be laid on establishing robust infrastructure for such activities, enthusing researchers, funding technical institutions and national research laboratories adequately. Further, true value of intellectual property (IP) is realized when the commercial worth of the product or technology is explored. In India, many patentable inventions are not being commercialized, not because they do not work; but the inventor was unable to exploit it commercially primarily due to lack in enhancing mechanisms. Hence, there is a need for an inclusive IP mechanisms in the country. The focus of many of our Indian researchers is more on publishing their research work which needs a paradigm shift. There is a need and responsibility lies on all of us for making researchers aware about patent filing and advantages of collaboration with the industrial sector for commercializing their innovations.

I hope the study undertaken by DST-Centre for Policy Research at Panjab University, Chandigarh will help in identifying the gaps in the current patent regime and provide viable suggestions to make it more effective.

(Ashutosh Sharma)

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आई.ए.एस.
संयुक्त सचिव

Rajiv Aggarwal
I.A.S
Joint Secretary

MESSAGE

At the outset, I extend my heartiest congratulations to DST-Centre for Policy Research, Panjab University, Chandigarh for coming out with this extremely well- researched book entitled: **"Mapping Patents and Research Publications of Higher Education Institutes and National Research laboratories of India"**.

In today's knowledge driven economy, protection and promotion of intellectual Property (IP) is of paramount importance. To strengthen the IPR regime in India, the National IPR Policy-2016 was adopted by the Government of India on 12th May, 2016. To fulfil the objectives laid therein, a professional body namely Cell for IPR Promotion & Management (CIPAM) has been established. A nation-wide campaign has been launched for furthering IPR awareness in educational institutions and industry, along with training programmes for police, customs officials and the judiciary. There has been significant augmentation of manpower in the IP offices across the nation, resulting in direct impact on the pendency of IP applications. For instance, time taken for Trademark examination has already been brought down from the erstwhile 13 months to just one month, while Trademarks Registration has recorded an increase of almost 5 times in 2017-18 to 3,00,913 vis-a-vis 2015-16. Examination of patent application in F.Y. 2017-18 has almost quadrupled to 60,330 compared to F.Y. 2015-16, while the shortest time taken to grant a patent recently has been just 113 days from the filing of the request for examination.

Given the Government of India's resolve to strengthen the IP ecosystem of India, I am sure this book will help foster a heightened awareness amongst industry and research institutions to protect and safeguard their IPs.

I wish you good luck in your future endeavours.

(Rajiv Aggarwal)

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Dr. Jatinder Kaur Arora
Executive Director

MESSAGE

In the current era of knowledge economy, Intellectual Property Rights (IPRs) holds an important place, as it reflects the innovation ecosystem and patent regime of a nation.

In India, the inclination continues to be on publishing the research findings rather than filing patent. Further presently, the time taken for the grant of a patent in India is longer than in most of the developed countries. The government is taking a number of initiatives to address the issues. The National IPR Policy was released on 12th May 2016. The policy emphasizes on several issues including promotion of IPR generation, commercialization and creating public awareness about the economic, social and cultural benefits of IPRs among all sections of society. Department of Industrial Policy and Promotion (DIPP) has created a dedicated cell namely Cell for IPR Promotion & Management (CIPAM) to implement objectives laid down in National IPR Policy. The Govt. of India is also working towards reducing the patent-granting period by modifying various stages of scrutiny and examination including application filing, screening classification and request for examination. DST, GoI sponsored Patent Information Centres (PICs) are also actively engaged in supporting innovations in their respective states.

The book entitled, **"Mapping Patents and Research Publications of Higher Education Institutes and National Research Laboratories of India"** authored by the scientific staff of DST-Centre for Policy Research, Panjab University, Chandigarh is a positive step in identifying the patents (filed/granted) of nearly 900 instituions. The outcome of this data will lead to identify potential institutes which can be strengthened for generation of patents. I congratulate DST-CPR for this accomplishment and wish good luck in their future endeavours.

(Jatinder Kaur Arora)

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MESSAGE

In the knowledge economy era, it is well-acknowledged fact that science and technology are the prominent parameters for the growth of a country. However, in the recent years, Intellectual Property Rights (IPR) has attained equal importance for the scientific development of a nation. In view of this, Department of Science and Technology (DST) has set up five Centres for policy research in various distinguished higher education institutions in India. DST-Centre for Policy Research (CPR), Panjab University is one of the Centres, which has been mandated with the objective "Adopt evidence-based approaches for identifying and promoting areas for generation of intellectual properties".

DST-CPR, Chandigarh has been actively engaged in understanding the impact of IPR in the innovation system, the contributions of Higher Education Institutes (HEIs) and National R&D labs and making recommendations for strengthening patent system in the country. The Centre has been organising workshops, seminars and brainstorming sessions for achieving valuable outcomes. It has also conducted an exhaustive study on Indian HEIs and national research institutions based on research articles publications and patents (granted) to these institutions.

I, appreciate the efforts made by the Centre for compiling the book **"Mapping Patents and Research Publications of Higher Education Institutes and National R&D Laboratories of India",** which also contains chapters authored by eminent experts in IPR from IPO, New Delhi; TIFAC, New Delhi, CIPAM (DIPP), New Delhi, NRDC, New Delhi and TISC (PSCST), Chandigarh, highlighting the strengths and programmes launched by respective government organizations. I believe DST-CPR at Panjab University has done good work in achieving its mandate given to them and, is on the right track and will soon come out with valuable recommendations for enhancing IPR regime in India.

With best wishes,

(Neeraj Sharma)

PANJAB UNIVERSITY
CHANDIGARH, INDIA 160 014

Professor Arun K. Grover
Vice Chancellor

FOREWORD

Research publications and patents are two important indicators for judging the Science, Technology and Innovation (STI) ecosystem of a nation. India enjoys an impressive global ranking of number five in the indicator of research publications (SJR-Scimago Journal & Country Rank, 2016). However, its patent application filing (45,057) is not as competent as of other countries, such as China, Japan and S. Korea which filed 13,38,503, 3,18,381 and 2,08,830 patent applications, respectively in the year 2016 (World Intellectual Property Indicator, 2017). The Government of India is aware of this fact and desirous of bridging the gap in the coming years.

To beef up the innovation-ecosystem of India, Department of Science and Technology (DST), GoI floated *Expression of Interest* (EoI) in 2013, for establishing 'DST-Centres for Policy Research' in Higher Education Institutes (HEIs). Over 30 HEIs, comprising of Universities (Central & State, Public & Private) and Institutes of National Importance (IITs, NITs etc.) submitted EoIs. After two rounds of stiff competition, DST narrowed down to establish and fund five Centres for Policy Research (CPR) namely, IISc-Bangalore, IIT-Delhi, Entrepreneur Development Institute of India-Gandhinagar, Babasaheb Bhimrao Ambedkar University-Lucknow and Panjab Universty (PU)-Chandigarh. The broad mandate assigned to DST- CPR at PU, Chandigarh was to promote 'Industry-Academia interactions' and 'Adopt evidence-based approaches for identifying and promoting areas for generation of intellectual properties'. Since its inception in 2014, this Centre is working enthusiastically to fulfil the objectives, as laid down by DST, GoI.

Last year, DST-CPR at PU, Chandigarh published a book entitled, 'Industry-Academia R&D Ecosystem in India....an evidence based study' which was highly appreciated by the policy makers, parliamentary body (Science &Technology) and a couple of ministries of Government of India.

The present book entitled, 'Mapping Patents and Research Publications of Higher Education Institutes and National R&D Laboratories of India' is yet another endeavour of the scientific team at DST-CPR, PU, Chandigarh. The book is a compendium of the initiatives taken by the Government of India for stimulating patent regime in the country. It has comprehensively described various organizations/bodies involved in the

governance, promotion, funding and filing of patents in India. The book has dedicated chapters on IPR Policy-2016 and International Patent Code (IPC) of Indian patents. The main content of the book is the extensive study carried out by DST-CPR at PU, Chandigarh for mapping nearly 1000 institutes for their research publications and patent profile for the period 2010-16. The study has identified institutes competent in number of research publications as well as patents (granted). Such institutes can act as role models for strengthening the patent ecosystem of institutes having creditability in research publications but low on patents. In addition, increase in number of patents will help build the image of any University and also contribute towards the financial kitty (of the University), by way of licensing out patents to the private sector, especially industries. The book also has a chapter on case-studies carried out on institutes generating large number of patents. The robust patent-ecosystem (IP Cell, IP Policy, IP Chair, Technology Transfer Cell, etc.) prevailing in these institutes may be adopted by other institutions for enhancing their patent profile. The last chapter of the book entails a list of 'Recommendations' for strengthening the patent regime in India. Some of the recommendations e.g., setting up 'IPR Academies' in the universities, setting up of dedicated 'IP Fund' by MHRD, GoI and creating 'IP Chairs' in Higher Education Institutes are worthy of serious consideration.

I congratulate and wish the very best to Team-CPR in their pursuit of promoting intellectual property regime in India.

(Arun K. Grover)

DST-Centre for Policy Research,
Panjab University, Chandigarh

सत्यमेव जयते
Department of
Science & Technology
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Prof. Rupinder Tewari
Coordinator
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PREFACE

In the 21st century, Science, Technology and Innovation (STI) are considered to be the key drivers of the economic development of nations, including India. Research publications and patent generation are two critical indicators for assessing the quality of scientific endeavours of a nation. As per global indicators, India is ranked amongst the top 5 countries in terms of number of research publications (Scimago Journal & Country Rank, 2016). However, its global ranking slips down heavily in the indicator of Intellectual Property Rights (IPRs) (International Property Rights Index Report, 2017). As per Annual Report 2016-17 of Controller General of Patents, Designs, Trade Marks and Geographical Indications (CGPDTM), GoI, 45, 444 patent applications were filed in India, out of which only one-fourth applications were filed by Indians, rest by the foreign applicants. Barring CSIR Labs, IITs, and IISc-Bangalore, other institutes do not have much credibility in the regime of patents.

To give impetus to patents and other fields such as trademarks, copyright, designs etc., Department of Industrial Policy and Promotion (DIPP), GoI released 'National IPR Policy' on 12 May 2016. This policy has laid strong emphasis on patent awareness in the educational and research institutes, and generation of patents for societal/economical benefits for the nation. The conversion of academic knowledge into commercial gains by licensing out patents to the private sector will help the universities in enriching their financial kitty, which is at premium in nearly all the higher educational institutes.

To improve the patent ecosystem of universities, autonomous institutes and national research laboratories, DST, GoI, established a DST-Centre for Policy Research (CPR) at Panjab University, Chandigarh in 2014. One of the studies undertaken by the Centre was to understand the patent regime of India. The data collected was published in the form of a chapter in a book entitled, '**Industry-Academia Ecosystem in India.....*an evidence-based study'***, authored by yours truly and the team of scientists at DST-CPR.

The second task undertaken by the Centre was to map the number of research publications and patents (granted) of educational and research institutes. It elaborates an exhaustive study of patents granted and

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research publications of 904 institutes comprising of 351 universities and institutes and 553 NRLs. The study has been carried out in two parts a) Composite Analysis b) Sector wise Analysis (Institutions of National Importance, Top 100 NIRF Universities, Top 100 NIRF Engineering Institutes, Top 50 Private Universities, Top 50 Pharma Institutes and National Research laboratories).

The first chapter of the book describes the patent regime of India. It includes the patents data taken from the annual reports of Indian Patent Office (IPO) for the year 2016-17. This chapter also describes various bodies of GoI involved in dissemination of knowledge about IPRs and agencies providing financial assistance for patent filing. The second chapter briefly mentions the salient points of National IPR policy 2016. The following chapter discusses the most important and globally recognized patent organization known as World Intellectual Property Organization (WIPO), which promotes the protection of intellectual property throughout the world. This chapter is followed by the 4th chapter namely "Indian Web-portals (Patents and Technologies" in which existing web portals on patents and technologies in India have been mentioned.

The Centre also conducted a study to understand the patent regime of select institutes (universities and autonomous institutes of national importance). The data collected revealed that institutes having creditable number of patents (granted) possess institute specific IPR Policy, IPR cell and Technology Transfer Offices (TTOs). These observations are presented in chapter 6.

Each patent (granted) is given a specific code by International Patent Classification (IPC), as designed by WIPO. The IPC code assists the industry as well as researchers to ascertain the category (agriculture, medical, electrical and so on) to which the patent belongs. In chapter 7 patents have been coded based on IPC system. The authors feel that it is for the first time that this type of exercise has been undertaken.

The last chapter comprises of 'Recommendations' for the promotion and strengthening of patent ecosystem in India. These recommendations have been drawn out of the various meetings/ symposia/ seminars conducted by DST-CPR.

The authors hope that the data presented in this study will help the policy makers to devise better guidelines to stimulate the patent regime in India.

Prof. Rupinder Tewari
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Acknowledgements

The authors wish to place on record sincere gratitude towards Department of Science and Technology (DST), GoI, New Delhi for making available financial and moral support for the publication of this book. We are grateful to scientists of DST, especially Dr. Neeraj Sharma (Head, PRC), Dr. Anita Aggarwal (Scientist-E) and Dr. Akhilesh Mishra (Scientist-D) for their continuous guidance and support for the work published in this book.

We wish to express our gratefulness towards Prof. Arun K Grover, Vice Chancellor, Panjab University, Chandigarh. Prof. Grover has been a source of inspiration and always appreciated the activities undertaken by DST-CPR. The kind and timely assistance provided by Prof. Sudhir Kumar (Honorary Director, Publication Bureau, Panjab University, Chandigarh) for the publication of this book is also highly appreciated.

Additionally, we would like to acknowledge the contributions of scientific organizations of Government of India such as, Council for Scientific and Industrial Research (CSIR), Department of Biotechnology (DBT), Department of Atomic Energy (DAE), Indian Council of Medical Research (ICMR) and Indian Council of Agricultural Research (ICAR) for furnishing patent related information.

Special thanks are due towards our colleagues namely, Dr. Radhika Trikha, Dr. Mansimran Khokhar, Dr. Ajit Singh Naosekpam, Dr. Navkiran Kaur, Ms. Kanwal Puneet Kaur, Ms. Sukriti Paliwal, Mr. Ashok Gupta (former colleague) and Mr. Rohan Raghubir for their constant support during compilation of data and publication of the book. The authors would also like to acknowledge the contribution of Mr. Pradeep Kumar towards data compilation in chapter 4.

The authors convey their apologies to those, whose names have been missed inadvertently.

Disclaimer

INDEX

Chapter-1: IPR Regime of India

The ingenuity of the mind used for creation of a commercial entity or societal use is considered as the Intellectual Property (IP) of the concerned person i.e. inventor. The inventor has a legal right over these properties or inventions, which are termed as Intellectual Property Rights (IPRs). The IP protection is critical to foster innovation. Currently, IPRs cover patents, copyrights, trademarks, industrial designs, geographical indications (GI), layout designs, trade secrets and new plant varieties. Without protection of ideas, individuals as well as businesses would not reap the full benefits of their inventions and thus would focus less on R&D.

Patents occupy a prominent position as global indicators for ranking of the world economies. In general, there is direct relation between the economy and the patent regime of a nation. Patent is an exclusive and territorial right granted by regional or national government. Once granted, it remains valid for a maximum period of 20 years from the date of filing of application, provided the periodic maintenance fees are duly paid during this period and the patent is not revoked or declared invalid by the court. The three mandatory conditions required for protection of an invention are: *i) It must be novel ii) It must involve an inventive step i.e. non-obvious to a person skilled in the related field of the technology and iii) It must be capable of industrial application.* The amendments in the Indian Patent Act, 1970, which were brought in 2005, have spurred tremendous growth in the patenting activities because before 2005, only process patents were granted and after the amendment, product patents are also granted.

1.1 Patent Regime in India

In India, the patent system is administered by the office of the Controller General of Patents, Designs and Trademarks (CGPDTM) under the Department of Industrial Policy and Promotion (DIPP), Ministry of Commerce and Industry (figure 1). The jurisdiction of Indian patent system is divided geographically into four regions i.e. Northern Region (Patent Office, Delhi), Western Region (Patent Office, Mumbai), Southern Region (Patent Office, Chennai) and Eastern Region (Patent Office, Kolkata).

For the promotion, development and funding of patent related matters, Government of India has created many bodies e.g. National Research Development Corporation (NRDC), an enterprise of Department of Scientific and Industrial Research (DSIR); Technology Information, Forecasting and Assessment Council (TIFAC), which is under the aegis of DST; Patent Information Centres (PICs) set up by TIFAC in 20 states of India and Cell for IPR Promotion and Management (CIPAM), a professional body under DIPP.

PICs (http://tifac.org.in/index.php/admin-finance/patent) have set up IPR Cells in various institutions of higher education. For example, PIC set up for the state of Punjab has established 14 IPR Cells in various places including Panjab University, Chandigarh and Punjabi University, Patiala.

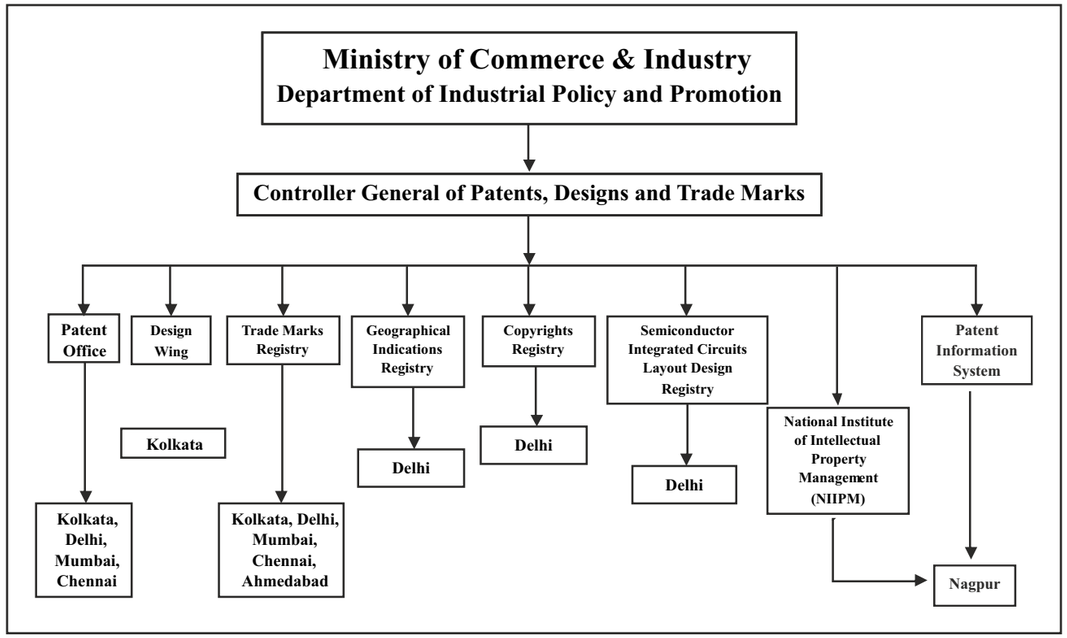

Figure 1: Organizational Structure of Patent Regime of India

1.2 Patent Regime in India Based on IPO Indicators

Trends in Patent Applications: Table 1 throws light on the trends of patents filed/granted/examined/ disposed in India in the last five years (2012-17). In all the aforesaid categories, a gradual increase in the number of patents (filed/granted/examined) was observed in the last five years. Comparing the data of 2012 and 2017, an increase of 3.90%, 57.65%, 58.10% and 70.17% was observed in the categories of patents filed, granted, examined and disposal of patents respectively. A significant increase in the number of patents examined and disposed off is attributed to the increase in the requisite staff for examining the patent applications. However, the patent examining agencies still need more skilled-staff as it takes more than 3 years for granting a patent in India vis a vis other countries like USA, U.K. and Japan, where patents are granted within 12-18 months.

Table 1: Trend in Patent Applications

Category \ Year	2012-13	2013-14	2014-15	2015-16	2016-17
Filed	43,674	42,951	42,763	46,904	45,444
Examined	12,268	18,615	22,631	16,851	28,967
Granted	4,126	4,227	5,978	6,326	9,847
Disposal of request for examination (Granted + Refused + Abandoned)	9,027	11,411	14,316	21,987	30,271

***Source**: IPO Annual Reports 2012-17*

Applications Filed by Indian Applicants: Figures 2 & 3 depict the number of patents filed and granted in India in various fields of industrial sectors. Mechanical sector leads the list with 10,715 filed-patents, amounting to 23.57% of the total filed-patents. The second rank is held by Computers/Electronics (6,443) followed by Chemical (5,911), Electrical (4,141), Drugs (2,122), General Engineering (1,225), Biotechnology (876) and Food (283) sectors.

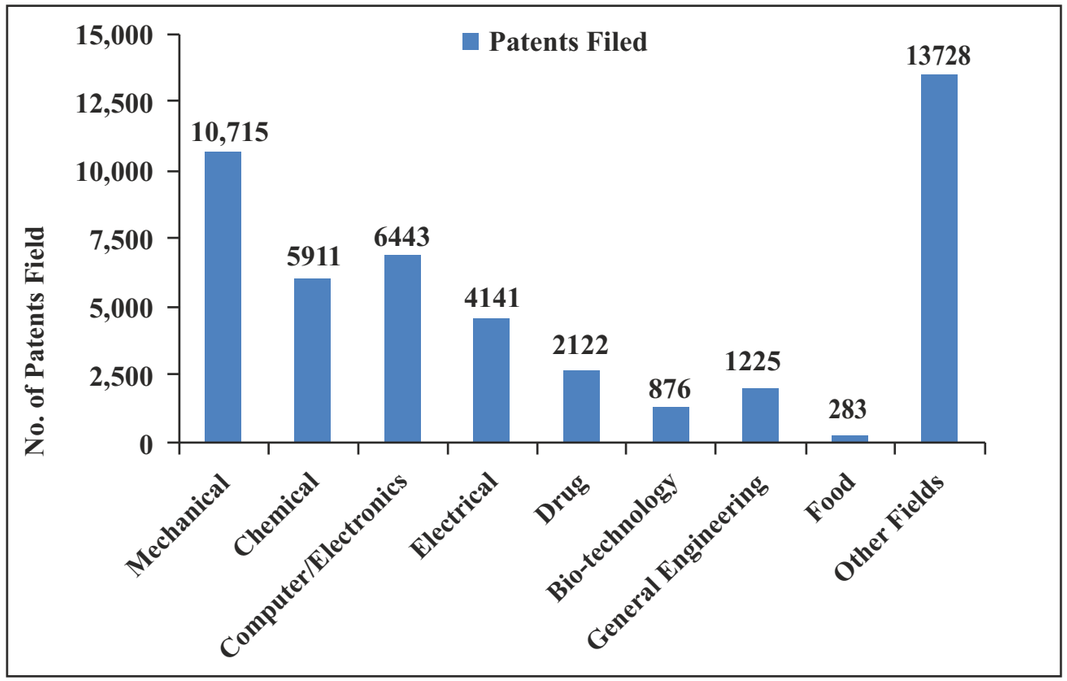

Figure 2: Number of Patent Applications Filed in 2016-17 under Major Fields of Inventions
***Source**: IPO Annual Report 2016-17*

Note: Other Fields – Biomedical, Biochemistry, Communication, Physics, Civil, Textiles, Metallurgy/Material Science, Agriculture Engineering, Polymer Science/Technology, Microbiology, Agrochemical, Traditional Knowledge.

In the patent-granted category (Figure 3), Chemical sector (2673) has replaced Mechanical sector (1,939) as the leader in industrial sector. Third position has been claimed by Computer/Electronics (1,049) followed by Electrical (579), Drugs (551), and Biotechnology (333), General Engineering (228) and Food (71) sectors.

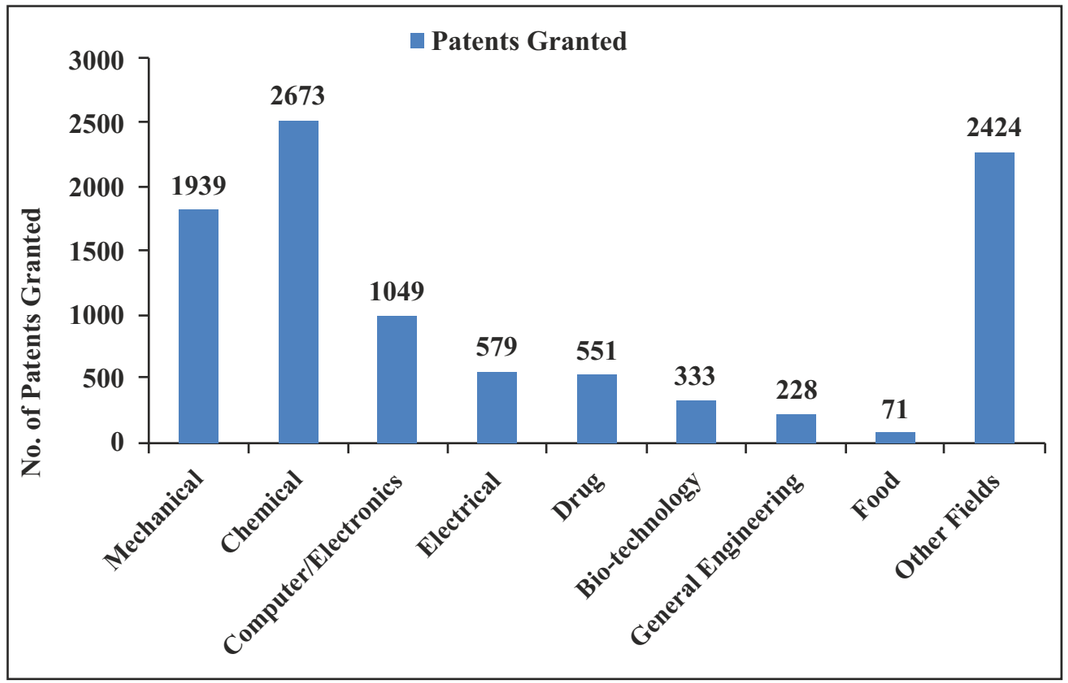

Figure 3: Number of Patents Granted in 2016-17 under Major Fields of Inventions
***Source**: IPO Annual Report 2016-17*

Note: Other Fields – Biomedical, Biochemistry, Communication, Physics, Civil, Textiles, Metallurgy/Material Science, Agriculture Engineering, Polymer Science/Technology, Microbiology, Agrochemical

Analysing data based on state-wise categorization of ordinary patents-filed (figure 4 & table 2), Maharashtra (3,513) occupies first position followed by Tamil Nadu (2,003), Karnataka (1,764) and Delhi (1,066). These four states account for 63.75% of the total ordinary patents filed with IPO. As per IPO data of 2016-17, out of a total of 45,444 patents filed, only 13,219 patent applications (ordinary, convention and PCT) were filed by Indians, and 32,225 were filed by foreign applicants. In other words, 70.8% applications were filed by foreign applicants and only 29.2% by Indian applicants.

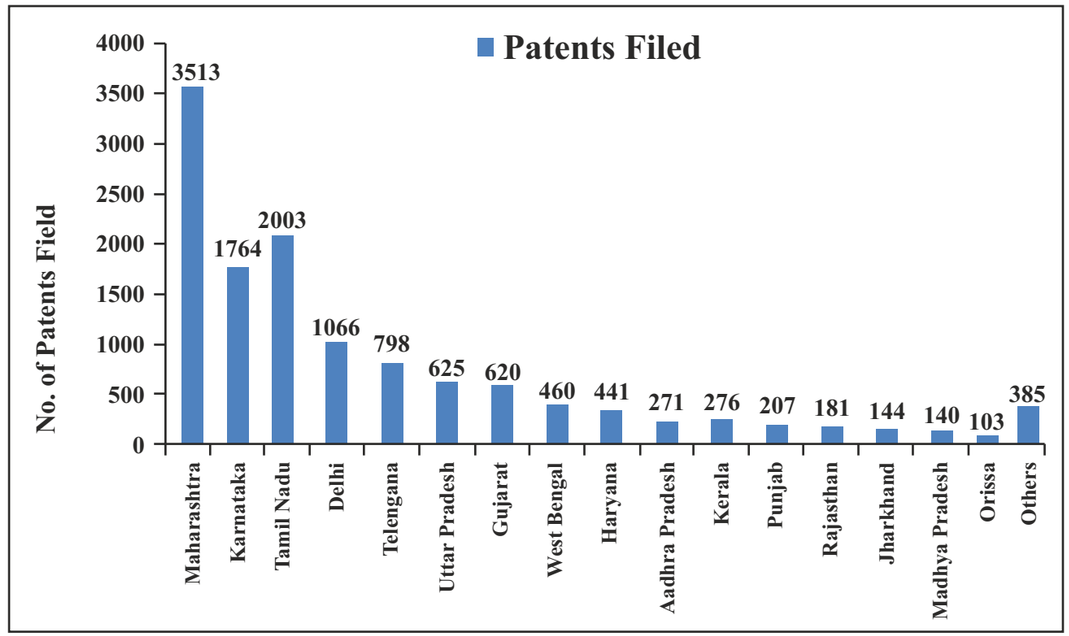

Figure 4: Patents Filed (Ordinary) in the Year 2016-17 (>100 Applications Filed)
***Source**: IPO Annual Report 2016-17*

Table 2: Other States (Number of Patent Applications Filed < 100)

S. No.	State/Union Territory	Ordinary* (2016-17)	S. No.	State/Union Territory	Ordinary (2016-17)
1.	Assam	**68**	11.	Arunachal Pradesh	**6**
2.	Uttaranchal	**64**	12.	Mizoram	**3**
3.	Jammu & Kashmir	**49**	13.	Dadra & Nagar Haveli	**3**
4.	Himachal Pradesh	**40**	14.	Andaman & Nicobar	**2**
5.	Chandigarh	**35**	15.	Manipur	**2**
6.	Goa	**29**	16.	Nagaland	**1**
7.	Pondicherry	**27**	17.	Meghalaya	**0**
8.	Bihar	**26**	18.	Daman & Diu	**0**
9.	Chhattisgarh	**22**	19.	Sikkim	**0**
10.	Tripura	**7**			

***Source**: IPO Annual Report 2016-17*

***Ordinary Patent**- An application for patent filed in the Patent Office without claiming any priority either in a convention country or without any reference to any other earlier application under process in the office. Such type of application is known an ordinary application (www.ipindia.nic.in/.../Final_FREQUENTLY_ASKED_QUESTIONS_-PATENT.pdf).*

In the domain of scientific and R&D organizations (table 3), first ten organizations filed 499 patents in 2016-17, with Council of Scientific & Industrial Research (CSIR) filing maximum number of patents (230), followed by Defence Research & Development Organisation (DRDO) filing 58 patent applications.

Of the top ten organizations, four belong to the public sector and the remaining six fall in the category of private sector (table 3). These are, G.H.R Labs and Research Centre (50), a multidisciplinary research organization; Hetero Research Foundation (23), an organization working in areas of diverse specializations; Allinov Research & Development Pvt. Ltd. (20), a product research and innovation training entity; MSN Research & Development Centre (19), a research-based pharmaceutical company; L&T Technology Services Ltd. (18), a multidisciplinary services company; Sun Pharma Advanced Research Company Ltd. (14), a bio-pharmaceutical company and GSP Crop Science Pvt. Ltd. (13), an agro chemicals and fertilizers manufacturing company.

Table 3: Top 10 Indian Applicants for Patents from Scientific and Research & Development Organizations

S. No.	Name of Scientific and Research & Development Organization	Applications Filed
1.	CSIR, New Delhi	230
2.	DRDO, New Delhi	58
3.	G.H.R Labs and Research Centre, Nagpur	50
4.	ICAR, New Delhi	41
5.	Hetero Research Foundation, Hyderabad	23
6.	Allinov Research & Development Pvt. Ltd., Krishnagiri	20
7.	MSN Research & Development Centre, Hyderabad	19
8.	L&T Technology Services Ltd., Vadodra	18
9.	Sun Pharma Advanced Research Company Limited (SPARC Ltd), Mumbai	14
10.	ISRO, Bengaluru	13
	GSP Crop Science Pvt. Ltd., Ahmedabad	

***Source**: IPO Annual Report 2016-17*

Blue: Public sector organization
Red: Private sector organization

Table 4 lists the top ten Higher Education Institutes (HEIs) of India in the area of patent filing for the year 2016-17. The IITs (collective) continue to occupy the first position with 400 patent applications. Second best institute is Amity University, Noida with 106 patent applications filed. Interestingly, only 3 public institutes (IITs, IISc-Bangalore and NITs) figure in the top ten applicants.

Table 4: Top 10 Indian Applicants for Patents from Institutes and Universities

S. No.	Name of Institute/University	Applications Filed
1.	IITs (Collective)	400
2.	Amity University, Noida	106
3.	Indian Institute of Science, Bangalore	54
4.	Vel Tech Dr. RR & Dr. SR Technical University, Chennai	50
5.	G.H. Raisoni College of Engineering, Nagpur	49
6.	Bharath University, Chennai	45
7.	Chandigarh Group of Colleges, Chandigarh	30
8.	Chitkara University, Rajpura	29
9.	Hindustan Institute of Technology & Science, Chennai	28
10.	National Institutes of Technology (Collective)	26

***Source**: IPO Annual Report 2016-17*

Blue: Public sector organization
Red: Private sector organization

Amongst the top 5 Indian Patentees (table 5), three belong to public sector i.e. CSIR (104), DRDO (80), and IITs (55) occupying first, second and fifth rankings. The third and fourth ranks are shared by private companies i.e. Samsung R&D Institute India Bangalore Private Limited, Bengaluru (64), a R&D centre of Samsung Electronics and Hindustan Unilever Ltd., Mumbai (62), which is a consumer goods company.

Table 5: Top 5 Indian Patentees

S. No.	Name of Organization	Patents Granted
1.	CSIR, New Delhi	104
2.	DRDO, New Delhi	80
3.	Samsung R&D Institute India Bangalore Private Ltd., Bengaluru	64
4.	Hindustan Unilever Ltd., Mumbai	62
5.	IITs (Collective)	55

***Source**: IPO Annual Report 2016-17*

Blue: Public sector organization
Red: Private sector organization

The top 5 foreign resident patentees are listed in table 6. A brief about these companies is mentioned as follows. Qualcomm Incorporated is an USA based semiconductor and telecommunications equipment company; GM Global Technology Operations INC, a US company providing services for engineering and construction industries; Koninklijke Philips Electronics N. V., is a Netherlands based company, which focuses in light, health care and electronics; LG Electronics is a consumer electronics South Korean company and Honda Motor Company Ltd. is a Japanese company, which manufacturers automobiles, aircraft, motorcycles, and power equipment.

Table 6: Top 5 Foreign Resident Patentees

S. No.	Name of Applicant	Patents Granted
1.	Qualcomm Incorporated, U.S.A	383
2.	GM Global Technology Operations Inc, U.S.A	209
3.	Koninklijke Philips Electronics N. V., Netherlands	159
4.	LG Electronics, S. Korea	108
5.	Honda Motor Company Ltd., Japan	90

***Source**: IPO Annual Report 2016-17*

In the field of Information Technology (IT) (table 7), Wipro Ltd. (190), occupies the first position. It is followed by Tata Consultancy Services Limited (159), IITs (Collective) (43), HCL Technologies Ltd. (35) and Huawei Technologies India Pvt. Ltd., (29).

Table 7: Top 5 Indian Applicants for Patents in the Field of Information Technology

S. No.	Name of Company	Applications Filed
1.	Wipro Ltd., Bengaluru	190
2.	Tata Consultancy Services Ltd., Mumbai	159
3.	IITs (Collective)	43
4.	HCL Technologies Ltd., Noida	35
5.	Huawei Technologies India Pvt. Ltd., Bengaluru	29

***Source**: IPO Annual Report 2016-17*

1.3 Patent Cooperation Treaty (PCT): National Phase Applications

Majority of foreign patent applications filed in India were through the PCT national phase route. The number of such applications filed during 2016-17 was 26,645, which is 6% less as compared to the filing of previous year i.e. 28,248. The top five countries filing patents, through PCT national phase route are USA (8,981), Japan (3,399), Republic of China (2,256), Germany (2,186) and Netherlands (1,295) (figure 5).

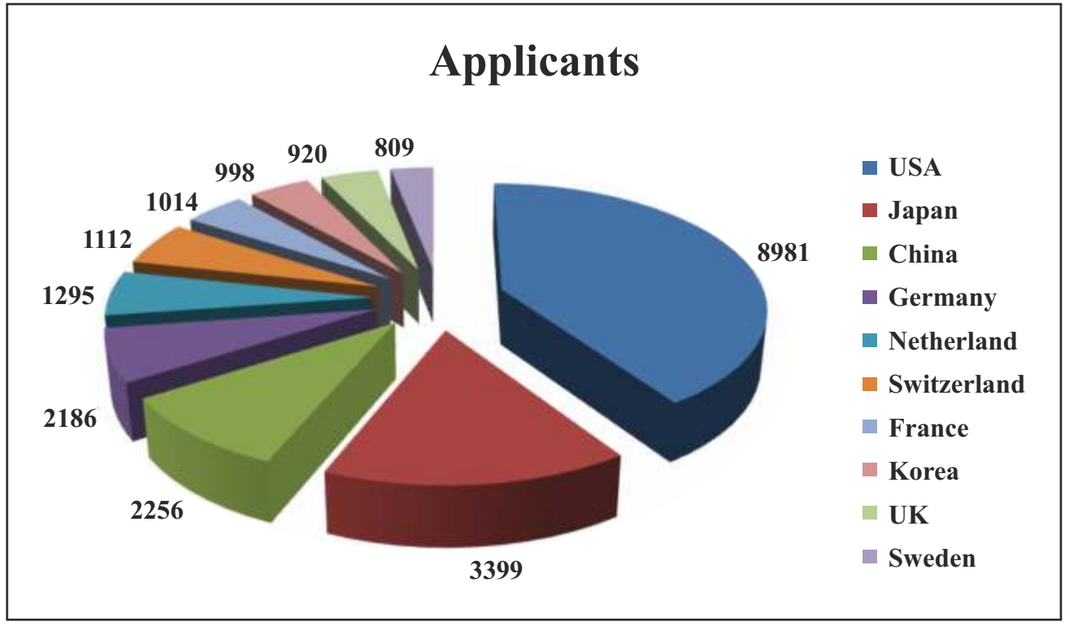

Figure 5: Top Ten Applicants for PCT National Phase (Country-Wise)
***Source**: IPO Annual Report 2016-17*

1.4 Top 10 Foreign Resident Applicants

Table 8 provides a list of top 10 foreign resident applicants, who filed patent applications during 2016-17. It is observed that Qualcomm Incorporated continues to top the list with 1,840 applications. It is followed by Samsung Electronics Co. Ltd. (706) and Huawei Technologies Company Ltd. (625) at the second and third positions respectively.

Table 8: Top 10 Foreign Resident Applicants

S. No.	Name of Organisation	Number ofApplications
1.	Qualcomm Incorporated, USA	1,840
2.	Samsung Electronics Co. Ltd., Korea	706
3.	Huawei Technologies Company Ltd., China	625
4.	Microsoft Technology Licensing LLC, USA	589
5.	Koninklijke Philips N.V., Netherlands	557
6.	General Electric Company, USA	520
7.	Telefonaktiebolaget LM Ericsson (Publ), Sweden	470
8.	Philips Lighting Holding B.V., Netherlands	307
9.	Mitsubishi Electric Corporation, Japan	218
10.	BASF SE, Germany	216

***Source**: IPO Annual Report 2016-17*

1.5 Revenue Generated and Expenses Incurred

The trends of revenue-generated and non-planned expenses incurred have been shown in the form of bar diagrams in figures 6 &7.

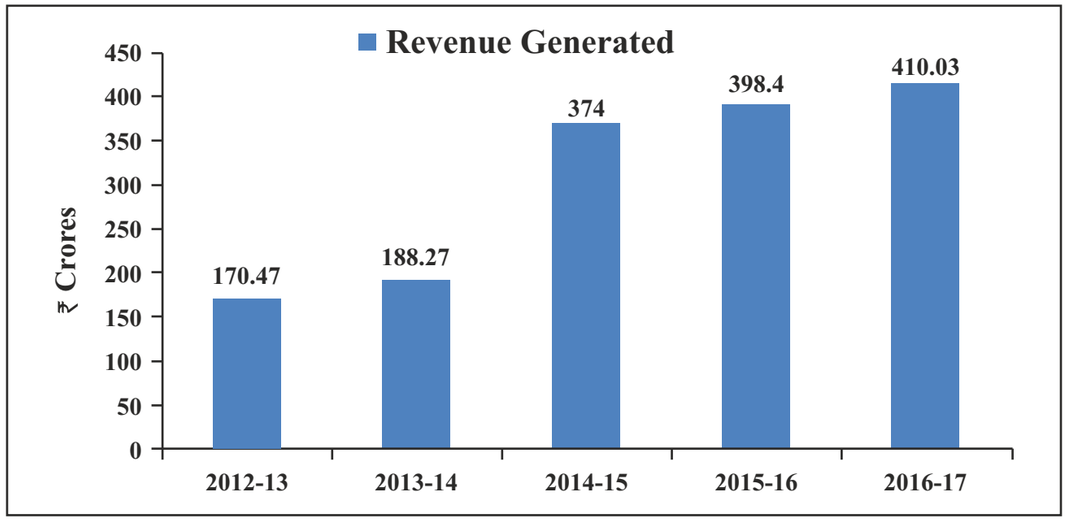

Figure 6: Revenue Generated by Indian Patent Office
Source: *IPO Annual Reports 2012-17*

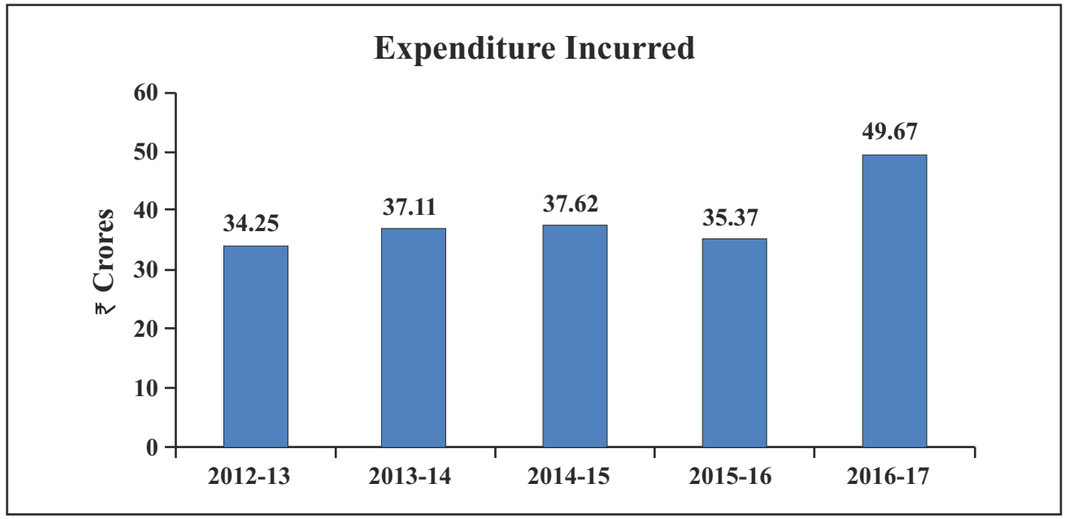

Figure 7: Expenditure by Indian Patent Office
Source: *IPO Annual Reports 2012-17*

1.1 Patent Facilitating Centre of Technology Information Forecasting and Assessment Council

Mr. Yashawant Dev Panwar
Scientist- E, TIFAC, DST, GoI, New Delhi.-110016
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Patent Facilitating Centre (PFC) was set up at Technology Information Forecasting and Assessment Council (TIFAC) by Department of Science and Technology (DST), Govt. of India (GoI), in the year 1995 with a motto to respond to challenges experienced by the scientific community, which were envisaged after India became a part of WTO. PFC was setup with four fold objectives as mentioned below:

a. Introducing patent information as a vital input in the process of promotion of R&D programmes.

b. Providing patenting facilities to scientists and technologists in the country for Indian and foreign patents on a sustained basis.

c. Keeping a watch on development in the area of Intellectual Property Rights and making important issues known to policymakers, scientists, industry, etc.

d. Creating awareness and understanding related to patents and the challenges and opportunities in this area including arranging workshops, seminars, conferences etc.

In the prevailing techno-legal environment, protection and enforcement of intellectual property rights (IPRs) are inevitable technology management processes. With each passing day, since we became a member of WTO, the importance of knowledge about IPR has been rising steeply in India. Management of IPRs requires information, skills, knowledge and experience. PFC has been harnessing the creativity of the Indian knowledge generators (scientists and technologists) in order to make India a major intellectual prowess for better presence in global trade and commerce. PFC aims at new heights through its uniqueness residing in its motto of service 'May I help you' and being a source of comprehensive information – a single window outlet, and remaining innovative in the competitive era. For the last 22 years, PFC has been working to develop an IPR ecosystem in India as per its mandated role.

Facilitation of IP Protection: PFC provides technical, financial and legal support for obtaining patents and also for post patent actions w.r.t. patentable inventions emanating from research funded by

- Department of Science and Technology
- An Indian university/educational institution
- Any other central/state government department/agency

For patentable inventions funded by a university/ educational institution, applications for patents will be filed in the name of the university/educational institution with the concerned scientist/s as inventor/s. Applicants for patents will be decided by the term and conditions mutually agreed between the funding agency and the research agency. Requests for patent search are entertained from scientists, universities/

educational institutions, government, industry, attorneys and PSUs, with a levy of nominal charge.

Scientists or their institutions, requesting PFC's help in patenting or patent search should send a list of key words, a brief technical description of the invention and names and addresses (if possible) of agencies and scientists engaged in similar R&D work. This would ensure more extensive data search and would also save time. Scientists and their institutions are expected to keep track of developments in areas related to patented inventions and inform PFC about possible exploitation and also violation of their patents. Information so furnished by inventors will be kept confidential. Queries on IPRs from individuals, government, university, industry, PSUs, R&D institutions and other agencies would be quickly responded to.

Requests for the above facilitation services are routed through patent information centres (PICs) in the states and are also being received directly from applicants. PFC evaluates these requests by conducting detailed patent search and patentability assessment. A possibility of protecting the same under other forms of IP rights such as industrial designs, copyrights, plant variety protection, etc. is also explored and protected suitably.

PFC has facilitated filing of about 1500 patents in India and abroad. About 250 patents have already been granted.

1. Awareness creation

PFC in its endeavour to create awareness has organized about 450 IPR/patent awareness workshops in different parts of the country sensitizing more than 70,000 scientists, technologists, academicians, industrialists and policy makers. These workshops are spread all over the country, and are open to all R&D institutions, industry, academic institutions, government departments, NGOs and individuals.

2. Patent Information Centres (PICs)

PFC opened 20 patent information centers (PIC) in 20 states. The PICs are playing the role of a 'Consultant and Guide' w.r.t. IPRs specially for patents at the state level, by providing guidance in filing of patent application, extending the patent search services and also assisting PFC in conducting workshops in their respective states. In addition to this, PICs are working on registration of potential items such as Geographical Indications (GIs), inclusion of IPR in course curriculum, supporting IPR Cells in Universities etc. and any other matter relating to IPR.

3. Registering Geographical Indications

PFC has taken initiatives to protect many exclusive items of traditional excellence localized to a specific geographical area under 'The Geographical Indication of Goods (Registration and Protection) Act'. Recently registration certificates were issued for six GIs namely Kangra Tea, Kullu Shawls (by PIC-Himachal Pradesh), Muga Silk (by PIC-Assam) and three GIs relating to Malda mangoes (by PIC-West Bengal). Now PICs are independently handling the GI related work in states.

4. IPR Cells in Universities

PFC has successfully set up IPR Cells in Universities (IPCU) with the help of PICs and Vice Chancellors of the respective universities. There are 65 IPCUs in existence in 12 states. IPCUs have been created with the aim of guiding university academicians in matters related to IPR like patent searches, IP audit of universities and protecting inventions, through PICs, which in turn approach PFC for filing and processing patent applications and maintaining granted patents. The ownership rests with the universities. The aim was to have IP cell in each University within few years. Now it is being directly handled by DST and PICs at state level.

5. Training programmes

PFC has conducted a number of IPR related advanced training programmes on topics like patent drafting, patent searches, etc. from time to time. It has collaborated with various agencies in India and abroad such as DRDO, DAE, UNIDO, Indo-US S&T Forum (IUSSTF), National Institute of Health (NIH), USA etc. for conducting these trainings.

6. Women Scientist Scholarship Scheme (WOS-C)-KIRAN IPR

A large number of women in India are highly qualified in science. Many of them are not able to pursue career in science due to domestic and social reasons. India cannot afford to miss out on the skills and talent of such highly educated women. If she aspires to remain competitive in the knowledge society, S&T as a development indicator cannot be identified only with laboratory research. Many lateral and vertical issues need to be addressed for it to become truly a development indicator. The Women Scientists Scheme (WOS-C) has been evolved by DST for providing opportunities to women scientists who desire to return to mainstream science and work in the area of IPRs. WOS-C scheme aims to train women having qualifications in science/ engineering / medicine or allied areas in the area of IPR and their management for a period of one year. The training will allow them to work from their homes and thus maintain a good balance between professional and domestic demands. The scheme is being implemented by TIFAC on behalf of DST. About 500 women have already been trained under this scheme, out of which 200 have cleared the Patent Agent Examination conducted by the Patent Office of India. Sixty percent of these women are pursuing their career in the area of IPR. Some of them are self employed and have become entrepreneurs.

The objectives of the scheme are:

i. Empower talented and skilled women who have studied science, engineering, medicine and allied areas to contribute effectively in the advancement of science and technology in the country.

ii. Develop a pool of women scientists geared up for creating, protecting and managing intellectual property (IP) in India.

iii. Train talented and meritorious women in laws related to protection of IP, management of IPR, determination of novelty and originality of IP, ascertaining patentability of an invention, searches of databases related to patents and allied databases and other aspects of IPR; enabling them to seek specialized employment or be self employed.

iv. Develop a core of professionals for preparing specialized reports based on IPR such as technology scan and freedom to operate reports.

` PFC is the nodal office having overall responsibility of implementing the scheme throughout the country including training of selected candidates. It has set up three more coordination centres apart from PFC, namely, Centre for International Cooperation in Science (CICS), Chennai; Indian Institute of Technology (IIT), Kharagpur and CSIR-Unit for Research & Development of Information Products (URDIP), Pune for facilitating training of candidates.

Selection of the candidates for this scheme is through an all India online examination followed by interviews. TIFAC was also conferred the Nari Shakti Puruskar 2015 by Hon'ble President of India.

7. Database on Indian Patents

PFC pioneered three CD-ROM databases on Indian patents; one on patent applications filed in India entitled **Ekaswa-A** and another on patents accepted by the Indian Patent Office entitled **Ekaswa-B,** which were brought out during 98-99. This met a very important need in the country as this was the only digital database on Indian inventions during this period which was available in public domain. The databases cover data as published in the Gazette of India from January 1, 1995 to December 2004. Later on PFC developed a new database named **Ekaswa-C** for patent applications published in Official Journal of Patent Office from January 2005 till June 2008. The databases are now available online through the PFC website www.indianpatents.org.in free of cost. These databases are also available on CD RoM at nominal charges.

8. Counselling and Advisory Role

PFC has been instrumental in preparing guidelines of Ministry of Science and Technology for handling intellectual property emanating from projects funded by DST.

PFC has become a national referral point for industry, universities, government agencies, NGOs, foreign embassies, individual scientists, innovators and consultants, for information and advice on IPR related matters, especially updated patent information. PFC was instrumental in generating critical inputs including conceptual frame work, actual patent data, analysis, etc. for decision making, policy formulation and future planning at the national level in the area of IPR and related matters.

1.2 Intellectual Property Protection and Commercialization - Role of NRDC

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NRDC a Bridge between Laboratories and Start-ups

National Research Development Corporation (NRDC), an enterprise of Ministry of Science & Technology, Department of Scientific & Industrial Research (DSIR), Govt. of India was set up in 1953 with a mandate to develop, promote and transfer/commercialize Intellectual Property Rights (IPRs)/ technologies emanating from various national R&D institutions/universities/Public Sector Undertakings (PSUs) in the country to Entrepreneurs, Start-ups and Micro, Small and Medium Enterprises (MSMEs). NRDC acts as an effective catalyst in translating innovative research into marketable industrial products/processes and services in areas like Pharmaceuticals, Biotechnology, Chemicals, Energy, Agro & Food processing.

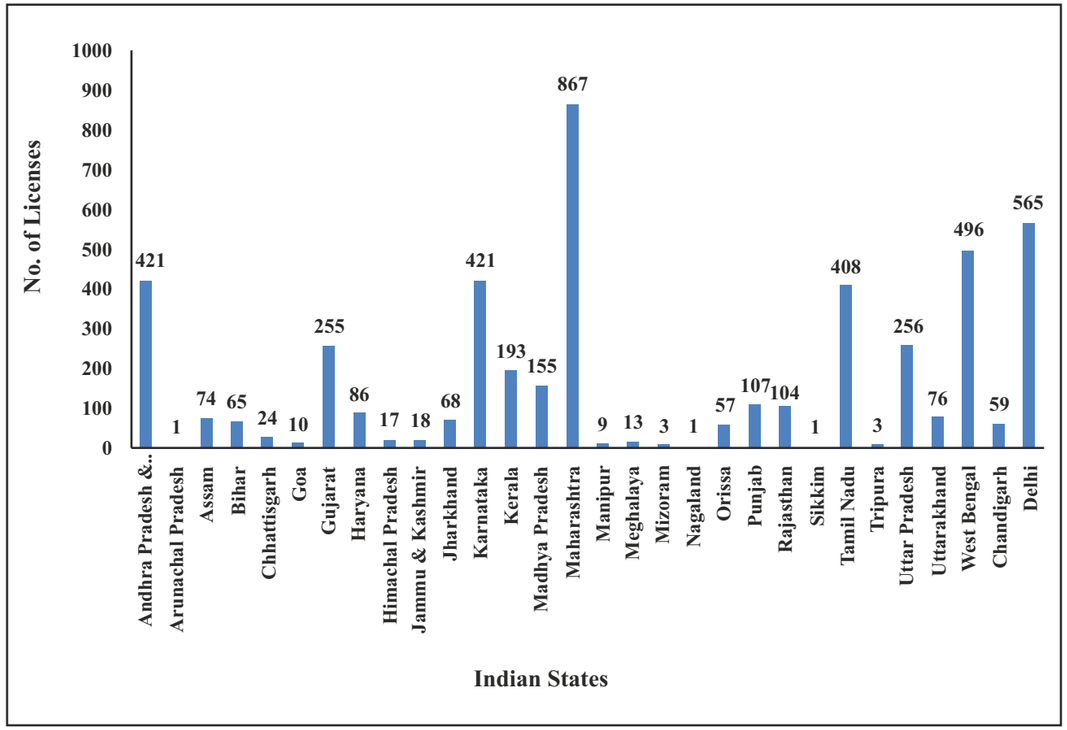

Figure 11: Number of Technologies Licensed by NRDC to Start-ups/SME's in Various States of India

NRDC has a repository of 2500 Indian technologies, filed about 1700 patents and transferred about 5000 technologies in different states in India, till date (Figure 11). These technologies were developed by laboratories of Council of Scientific and Industrial Research (CSIR), Indian Council of Agricultural Research (ICAR), Indian Council of Medical Research (ICMR), Defence Research and Development Organization (DRDO), Department of Science & Technology (DST), Department of Biotechnology (DBT); institutes of higher learning including Indian Institutes of Technology (IITs)/Universities, PSUs etc. (Figure 12). It also has a rich experience in Intellectual Property (IP) management, technology transfer and commercialisation. It may be pertinent to mention here that NRDC shared about Rs 400 crores as license premia and royalty with its technology partner laboratories and created millions of jobs since it came into existence. Besides technology transfer NRDC provides angel funding, extensive services in IPR protection and skill development programmes to entrepreneurs/MSMEs.

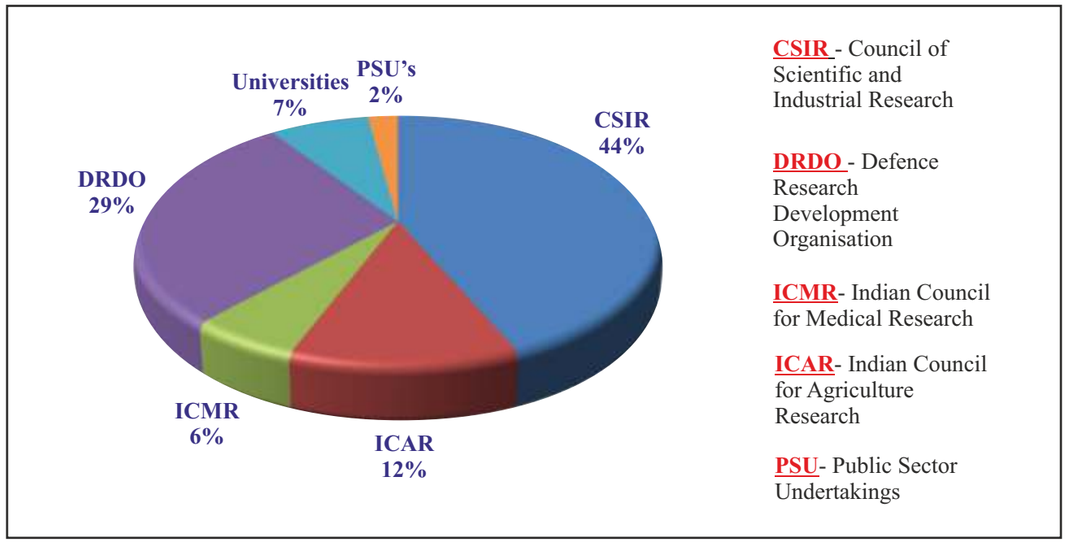

Figure 12: Technology Sources for NRDC

During 2010-17, NRDC has assigned a total 509 technologies and licensed 335 technologies to various industrial units for commercialization (NRDC Annual Report, 2016-17). In 2017, NRDC achieved great success and managed to assign/license 144 technologies (Figure 13).

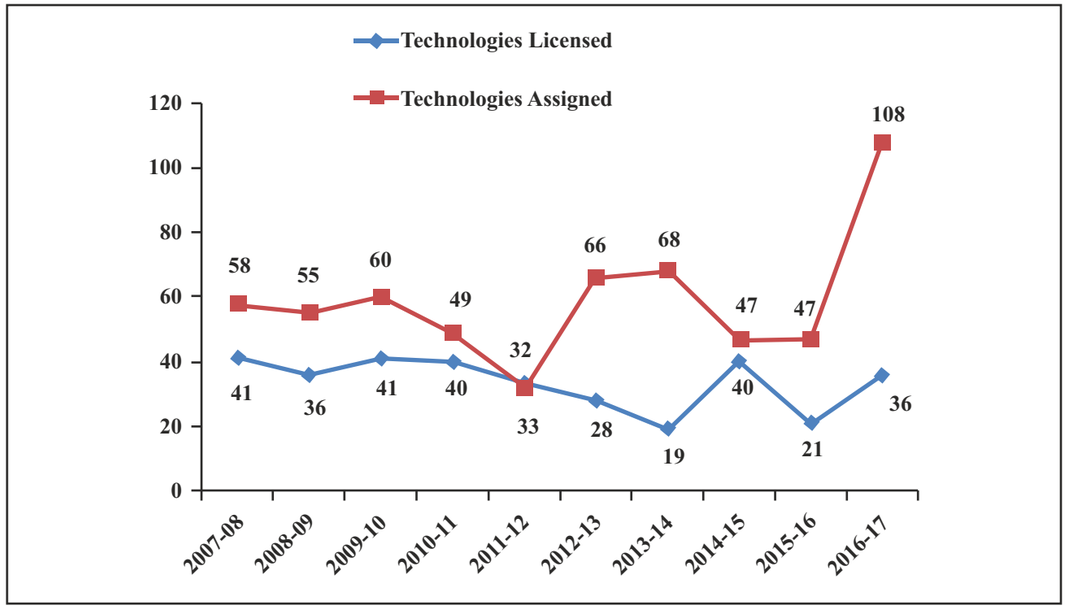

Figure 13: Number of Technologies Licensed and Assigned by NRDC (2007-17)

IPR Awareness

In the 21st century knowledge economy, IP is a business asset for organizations. To spread awareness about IPRs and its protection & management, NRDC organizes awareness seminars/workshops on IPR issues pertaining to commercialisation of technology, protection of IP and prior art searching techniques, for establishing novelty of invention, various avenues for protecting inventions abroad, IP issues in technology transfer and its impact on R&D work. It also intends to promote IP for the benefit of researchers, students, academicians, inventors, innovators, entrepreneurs and others to make them aware about the importance and advantages of IP protection in the present economy.

Promoting Start-ups

NRDC has been promoting IP, Innovation, Incubation and Entrepreneurship and working for the Start-ups. NRDC also has a major role in Start-up India Action Plan and assists Dept. of Industrial Policy & Promotion (DIPP) in assessing the innovation content in the start-up proposals and recommends the eligible start-ups for start-up recognition and tax benefits to DIPP. NRDC has also partnered with Indian Oil Corporation for monitoring, evaluating and reviewing the progress of implementation of the selected Start-ups under Indian Oil's Start-up Scheme.

Facilitation Centres for the Management of IP

NRDC has established 2 IP Facilitation Centres at Bengaluru and Vishakhapatnam to assist MSMEs in processing their IP applications with the financial assistance from Ministry of MSME, GoI. In addition to these centres, NRDC on behalf of DSIR under its Programme for Inspiring Inventors and Innovators (PIII) has also set up 6 university innovation facilitation centres at:

- Gujarat Technological University, Ahmedabad, Gujarat
- IIT, Kanpur, Uttar Pradesh
- All India Institute of Medical Sciences, New Delhi
- Amity University, Noida, Uttar Pradesh
- National Institute of Technology, Silchar, Assam
- Indian Institute of Engineering Science & Technology, Shibpur, Howrah, West Bengal

The main mandate of innovation facilitation centres is to sensitize the students, research scientists and faculty members about the effective management of IP, technology transfer and commercialization related matters by organizing seminars and workshops.

Indian Technology Databank

To bridge the gap between inventors and industry, NRDC has developed a portal for both technology providers and technology seekers of the country for transfer or commercialization of innovative products and processes (Figure 14). This searchable portal gives complete information about the invention/technology, its inventor/manufacturers details along with a form to express interest in it for further commercialization.

Figure 14: Indian Technology Databank Developed by NRDC (http://fccollc.com/nrdclive/)

Recommendations

There is a need to enhance the IPR awareness and patent filings in India. A greater coordination is required between all the stakeholders and adequate funding is required from Govt. to increase the Indian patent filings to position India as a leader in innovation space.

1.3 Adoption of Technology Innovation Support Centre (TISC) Network of WIPO in India

Jatinder Kaur Arora, Gurharminder Singh* & Divya Kaushik
TISC/PIC, Punjab State Council for Science & Technology, Chandigarh
*Corresponding Author (harminder1978@gmail.com)

The existing ecosystem for supporting innovation needs to be strengthened on priority as innovation is the key driver of socio-economic development in today's context. It plays a critical role in terms of competitiveness of the enterprises. Realizing the importance of innovation as the principle source of economic growth and competitive business advantage, international and national agencies are focussing on making technical information accessible to the innovators at the local level to harness their creativity for need based research.

World Intellectual Property Organization (WIPO), a specialized organization of the United Nations, based in Geneva, aims to assist the innovators exploit their innovative potential and help create, protect and manage their Intellectual Property Rights (IPRs) through its Technology Innovation Support Centre (TISC) program. It also intends to provide innovators in developing countries with easy access to locally based, high quality technology information and related services. Till date, WIPO has established more than 600 TISC Centers in 71 countries, with majority of them being in Asia (162).

Govt. of India (GoI) has also released National Intellectual Property Rights (IPR) Policy in 2016 in line with its agenda of sustainable entrepreneurship through national missions like “Make in India”, “Startup India” and “Standup India”. The IPR Policy, 2016 aims to push IPRs as a marketable financial asset, promoting innovation and entrepreneurship, while protecting public interest. Special thrust is laid on awareness generation and effective enforcement of IPRs, besides encouragement of IP commercialisation. Cell for IP Promotion and Management (CIPAM) under the Department of Industrial Policy & Promotion (DIPP), Ministry of Commerce & Industry (GoI) has been setup as a professional body for implementation of the National IPR Policy, 2016.

India adopted the TISC network of WIPO as envisaged in WIPO-India Action Plan 2015-16 to foster creativity and innovation for promotion of entrepreneurship and enhancing social & economic development. The adoption of TISC network is also aligned with the core objectives of the National IPR Policy, 2016. A 'Service Level Agreement' was signed between WIPO and GoI in May 2017 to set up TISC network in India. CIPAM was nominated as the ‘National Focal Point’ for setting up of TISCs in India in a phased manner. A rigorous scrutiny of existing agencies providing regional IPR services were assessed by the National Focal Point on the basis of their expertise and activities undertaken in the past for setting up of TISCs centres across the country.

Punjab State Council for Science & Technology (PSCST) had been rendering various services to academia & industry of Punjab and Chandigarh for IPRs promotion and protection from last 15 years through its Category 1 Patent Information Centre (PIC) setup with the support of Dept. of Science & Technology (DST), GoI and Intellectual Property Facilitation Centre for MSMEs setup by Ministry of

MSMEs, GoI. Based on the expertise, infrastructure and activity profile of PSCST in all aspects of IPRs & innovations, CIPAM under the aegis of WIPO has set up the 1st TISC of India in PIC, PSCST. The formal agreement for setting up TISC at PSCST was signed between Govt. of Punjab and GoI on 13th July, 2017 at Udyog Bhawan, New Delhi. The Centre was jointly inaugurated on 4th December, 2017 by Principal Secretary (Department of Science, Technology & Environment, Govt. of Punjab), Head, Technology & Innovation Support Division (WIPO) and Assistant Vice-President (CIPAM). Subsequently, DIPP has also setup two other TISC at Anna University, Chennai, Tamil Nadu and National Research Development Corporation, Visakhapatnam. Presently, there are only three TISCs in India.

TISC, PSCST is presently rendering the following services to innovators, industry and startups of Punjab & Chandigarh region:

- Facilitating access of International standard IP facilities to the innovators of the region in terms of database access for ascertaining the novelty & inventiveness
- Filing of Patents, Designs, Trademarks and Copyrights
- Training & Capacity building & IP Technology Scan Reports
- Information on global in-force/off patent industrial inventions & Government initiatives for promoting innovations & IPRs
- Sharing of Case studies/best practices of other countries
- Experience sharing platform
- IP commercialization, technology transfer & licensing
- Encouraging publications on innovations of local industry, expert inputs on innovation management, information on global in-force/off patent industrial inventions to keep the industry abreast of technological development and Government initiatives for promoting innovative enterprises, etc.
- Institution of Punjab State Industrial Innovations Awards to recognize and award high impact technological and commercialized innovations of local industry

Activities of TISC, PSCST:

Since its inception, TISC-PSCST has carried out following activities in the areas of awareness generation, IP filings and commercialization.

IP Filing Facilitations:

37 international patent searches were conducted for institutions and 3 for individual inventors, out of which, two patent applications have been successfully filed through Technology, Information, & Forecasting Council (TIFAC), Dept. of Science & Technology (DST), GoI in the Indian Patent Office after conducting thorough evaluation w.r.t. patentability of these inventions.

Awareness Generation:

WIPO sponsored hands-on training workshop on "Access to Technology for Innovation and Establishing a TISC Network" was organized on 4th & 5th December, 2017 at Chandigarh. The workshop was organized with the support of CIPAM, wherein experts from WIPO provided training to coordinators of IPR Cells set up by PSCST in various universities/institutions in Punjab as well as from six other neighboring states, on conducting patent searches by using various International & National IP online databases of WIPO, European Patent Office and India Patent Office. Around 70 participants from seven Northern states of India namely, Punjab, Haryana, Himachal, Uttrakhand, Uttar Pradesh, Rajashtan, Delhi and Jammu & Kashmir, dealing with promotion & management of IPRs, attended the workshop. This was first of its kind program held in India by WIPO to emphasize on the value of IP information viz-a-viz developing new technologies & innovations to overcome present day challenges especially in agriculture & health sectors.

IP Commercialization:

Apart from awareness generation and IP filing facilitation, TISC-PSCST has successfully facilitated transfer of two technologies.

- The centre facilitated transfer of two fermentation technologies developed by Department of Microbiology, Punjab Agricultural University (PAU), Ludhiana, Punjab to Unati Cooperative, Talwara, Punjab. TISC provided valuable inputs to Unati Cooperative w.r.t finalization of technology transfer agreement and technical knowhow, tangible materials & protocols and reports to be sought from Technology Provider i.e PAU. A non exclusive technology transfer MoA was signed between Department of Microbiology, PAU and Unati Cooperative Marketing-cum-Processing Society Ltd. at PAU Campus for 2 fermentation technologies for the preparation of naturally fermented beverages and probiotic drinks from different fruits and vegetables as health supplement. The agreement has been signed for transfer of following two technologies:

  i. Probiotic beverages from black carrots.

  ii. Naturally fermented fruit & vegetable juices.

  The demand of fermented beverages is on rise in international market like fermented tea *Kambucha*. 'The Unati' has also planned to scale up the final product developed by PAU under its own brand. TISC will provide IPR filings facilitation to Unati during the scaling up & marketing of these technologies for process optimization/improvement interventions and designing of product packaging & branding, etc.

- Further, TISC also helped in development of an in-house technology. Discussions were initiated with engineers of Industrial Consultancy Division, PSCST, who had an expertise of developing and demonstrating state-specific technologies for the brick kilns for further improvement in brick manufacturing processes. Patent information & non-patent literature was provided to them

on available kiln technologies. Based on technologies available in the prior art and disadvantages therein, the team successfully invented the "Hybrid Kiln Technology" overcoming the limitations in the available technologies. The technology provided 10-15% increase in first quality brick output with lower Specific Energy consumption & reduction in air pollutants emission. The developed hybrid technology is also compliant with new National Brick Emission Standards of 250 gm/$Nm^{3.}$

A patent in the name of PSCST, Chandigarh was filed over the technology by TISC, PSCST through PFC, TIFAC, DST-GoI on 5th October, 2017 vide application No. 201711035308. Further, Punjab Pollution Control Board (PPCB), which is a state level monitoring & regulatory body was approached by PSCST for facilitation in adoption of technology throughout the state keeping in view of its benefits. After an extensive consultation with the brick kiln associations/owners of the state and addressing their concerns, the technology was approved by PPCB for replication in the state on priority in a phased manner. Out of a total of about 35000 kilns nationwide, the state of Punjab alone has approx. 3000 kilns, which have the scope of adoption of the novel technology.

Transfer of patented technology of PSCST to the brick kiln owners/associations of the state as well as in other parts of the country has been approved at following rates:

- ✓ To kilns situated in Punjab: @Rs.25000/- per kiln
- ✓ To kilns in other parts of India: @Rs.50000/- per kiln

TISC also drafted Non Disclosure Agreement (NDA) which is to be signed by PSCST with each technology seeker. Till 27th February 2018, PSCST has successfully transferred the technology to 196 Kiln units in Punjab, 3 Kiln units of Haryana and 1 Kiln unit of Uttarakhand.

Special project on "Assessment of IP needs and development of IP management strategies of Sports Cluster of Punjab":

TISC, PSCST is implementing a special project on "Assessment of IP needs and development of IP management strategies of Sports Cluster of Punjab for enhancing their business competitiveness". The main objectives of this project are to provide specific Off-Patents and enforced patent data/ freedom to operate advice/ legal status and validity advice to various units of sports cluster for technology upgradation/licensing and expansion of business opportunities.

A steering committee comprising representatives of 5 major Industrial Associations of Jalandhar Sports Cluster namely Sports and Toys Exporters Association, Sports Goods Manufacturers and Exporters Association, Sports Forum, Association of Indian Manufacturers of Sports Goods and Khel Udyog Sangh has been formed for monitoring the effective implementation of the project.

Special Assignment of UNIDO through TIFAC, DST, GoI:

TISC/PIC, PSCST was given a special assignment of preparing an IP technology scan report on

"Patenting trends in the bicycle sector in the last decade" by PFC-TIFAC, DST, GoI on behalf of UNIDO, New Delhi. TISC team analysed approx 54,000 patent documents related to bicycles filed worldwide in the last 10 years and compared filing trends in top countries i.e China, Taiwan, US, Korea and India. The report highlights the shift in focus of innovations in the sector from structure based innovations, to current need based innovations like foldable bicycles & geared bicycles. Recent technologies in the sector were also reported to present the wide scope of innovation in this sector and features that can be expected in future bicycles.

Recommendations for further strengthening the IP ecosystem of India

Presently, government initiatives have provided a huge impetus on building an effective IPR ecosystem nationwide. However, there is still a scope for improvement at the grass root levels. Central or regional systems that provide single window system for filing of IPRs on behalf of MSMEs need to be devised to encourage them, especially micro & small units, for filing IPRs. IPFCs can take a lead in this. Special projects/pilot studies for different MSME clusters should be carried out to assess current IP status and potential needs of the cluster to enhance their IP portfolio. The District Industries Centres (DIC) can play a significant role in facilitating innovators from industrial sectors, start-ups and individual inventors for their IP related queries. The DIC staff can be trained in handling IP queries and act as nodal agency for implementation of various innovations supporting schemes of DIPP, MSME, Textile ministries etc and also routing the entrepreneurs/innovators to avail services of TISC, PIC, IPFC etc.

For promotion of innovation in academia, exposure of IP at school level will definitely help in inculcating scientific and creative temper during the development years which can be facilitated by introduction of IPRs in school curriculum. Further, in higher education, submission of patent prior art search results along with review of literature can be made mandatory to take up a research.

In addition to ongoing awareness & capacity building activities, extensive and regular training of police officers and judiciary on IP laws also needs to be taken up to help keep them abreast with latest development in the IPR regime of India & worldwide.

1.4 CIPAM-A Window for IPR Activities

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India has a well-established legislative, administrative and judicial framework to safeguard Intellectual Property Rights (IPRs), which meet its international obligations while utilizing the flexibilities provided in the international regime to address its developmental concerns. India has a Trade Related Aspects of Intellectual Property Rights (TRIPS) compliant, robust, equitable and dynamic IPR regime. India has set global standards in the IPR scenario.

Recognizing the importance of IPRs as crucial drivers of social and economic growth by encouraging creativity and innovation, the **National IPR Policy** was approved by the Union Cabinet on 12th May 2016.

The objectives of the Policy are:

- IPR Awareness: Outreach and Promotion - To create public awareness about the economic, social and cultural benefits of IPRs among all sections of society.
- Generation of IPRs - To stimulate the generation of IPRs.
- Legal and Legislative Framework- To have strong and effective IPR laws, which balance the interests of rights owners with larger public interest.
- Administration and Management- To modernize and strengthen service-oriented IPR administration.
- Commercialization of IPRs - Get value for IPRs through commercialization.
- Enforcement and Adjudication - To strengthen the enforcement and adjudicatory mechanisms for combating IPR infringements.
- Human Capital Development- To strengthen and expand human resources, institutions and capacities for teaching, training, research and skill building in IPRs.

Initiatives Undertaken

- The Patent Rules, 2003 have been amended to streamline processes and make them more user friendly.
- Expedited Examination of patents is now permitted on certain grounds. In fact, the shortest time taken to grant a patent recently has been just 113 days from the filing of the request for examination. As on 31st December 2017, 225 of the 323 expedited applications received had already been examined and 45 Patents granted; of these, 9 have been granted to startups.
- The Trade Marks Rules, 2002 have been revamped and The Trade Marks Rules, 2017 were notified on 6th March, 2017.
- The administration of Copyright Act, 1957 and Semiconductor Integrated Circuits Layout-Design Act, 2000 has been transferred to DIPP. This has enabled an integrated approach and synergy between different IP offices and Acts.
- Subsequently, under the Finance Act 2017, the Copyright Board has also been merged with the Intellectual Property Appellate Board (IPAB).

- A Scheme for facilitating Start-ups Intellectual Property Protection (SIPP) has been launched for encouraging innovation and creativity of Start-ups. 80% rebate is provided to Start-ups on patent filing fees and 50% rebate for trademark filing.
- 459 new technically competent Patent Examiners in various fields of technology have been appointed on regular basis in addition to the existing 130. Also, 27 posts of Deputy Controllers and 49 posts of Assistant Controllers in Patent Office have been filled up through promotion. This exponential increase is already bringing down the pendency.
- 4 Senior Trademark Examiners and 55 Trademark Examiners have been engaged in addition to existing 63. Apart from this, services of 84 Trademark Examiners are being utilized on contractual basis. This has already cut down the examination time drastically from 13 months to just 1 month.
- To promote ease of doing business, the office of Controller General of Patents, Designs, Trade Marks and GIs (CGPDTM) has introduced automatic issuance of electronically generated patent certificate and trademark certificate.
- An Intellectual Property Office Feedback mechanism has been implemented from 1st March 2017 to receive Suggestions/ Feedbacks from Stakeholders.
- An SMS service has been implemented for patent applications, which facilitates Applicants in getting information/updates pertaining to filings, issuance of examination reports, scheduled hearings, disposals, oppositions and other critical events.
- The IP Office has also developed a mobile application`, which has been launched.

Cell for IPR Promotion & Management (CIPAM)

The Cell for IPR Promotion & Management (CIPAM), a professional body under the aegis of Department of Industrial Policy & Promotion (DIPP), Ministry of Commerce & Industry (MOCI) was created to address the above objectives to ensure focused action on issues related to IPRs, assist in simplifying and streamlining of IP processes, apart from undertaking steps for furthering IPR awareness, commercialization and enforcement.

(a) Awareness

- CIPAM in partnership with industry associations has conducted 19 IPR awareness road-shows in 18 states in the year 2016.
- The IPR Awareness Campaign in schools was launched in collaboration with the International Trademark Association (INTA). IPR Awareness programs have been conducted in 100 schools till now, reaching over 7500 students. The campaign uses presentations and creatively illustrated posters and pamphlets which cover the basics on IPRs and the need to protect IPRs.
- A special 'Training of Trainers' was conducted in two batches in collaboration with TIFAC and Agastya International Foundation. These certified trainers will in turn conduct the awareness workshops in schools, colleges and industries.
- CIPAM launched a social media campaign - “LetsTalkIP” which received an overwhelming response from the IPR fraternity and has helped in the organic growth of followers on Twitter, Facebook and You Tube.
- CIPAM also launched a social media campaign on 'Geographical Indications' (GIs) to promote India's GIs and thereby provide a platform to showcase the works of our weavers, farmers,

artisans, craftsmen and rural communities of the country. A logo design and tagline contest for GIs had been launched on MyGov website for identifying a common tag for all Indian GIs irrespective of their categories.

- Content on IPR is being included in the NCERT curriculum of Commerce for Class XII.
- Also, a chapter on 'IPR, Innovation & Creative Works' is being included in NCERT's "Handbook on Entrepreneurship for Northeast Region (NER)".

(b) Enforcement

- In association with IP experts from law firms and the industry, 28 trainings have been organized for police officials in the states of Andhra Pradesh, Uttar Pradesh, West Bengal, Madhya Pradesh, Telangana, Haryana, Rajasthan, Jharkhand with two rounds of trainings in the North-East Police Academy and three in National Police Academy, Hyderabad.
- An advisory has been issued by the Ministry of Home Affairs to all State Police Academies to incorporate IPR in their training curriculum for both regular and in-service police officers.
- The training of Judges on IP Enforcement and adjudication has also been undertaken.
- Two colloquiums on commercial laws for High Court Judges were held at National Judicial Academy of Bhopal. Further, training programs are being planned in conjunction with National Judicial Academy and various State Judicial Academies.
- CIPAM in association with Federation of Indian Chambers of Commerce & Industry (FICCI) has made an IPR Enforcement Toolkit for Police, which was launched by Commerce and Industry Minister. This Toolkit will aid police officials in dealing with IP Crimes, in particular, Trademark counterfeiting and Copyright piracy.
- CIPAM, DIPP organized a three day "National Workshop on Enforcement of Intellectual Property Rights" in August 2017 for state police officials, public prosecutors and representatives from industry and academia. The workshop was inaugurated by Hon'ble Union Minister of Home Affairs.
- CIPAM launched an Anti-Piracy Video Campaign in collaboration with Viacom 18 Media Pvt. Limited using the popular cartoon characters –Motu and Patlu, to raise awareness in kids on piracy.

(c) Commercialization

- A Service Level Agreement (SLA) has been signed between DIPP and WIPO for establishing Technology and Innovation Support Centre (TISC) network in India.
- Three TISCs have been established; the first one at Patent Information Centre (PIC), Punjab, the second one at Anna University, Chennai and the third one in NRDC-IPFC, Visakhapatnam. First round of training on has been conducted at the two TISCs.
- TISC, PIC-PSCST facilitated the following 2 technology transfers of Probiotic beverages from black carrots and Naturally fermented fruit & vegetable juices.
- More than 50 IPR cells have been established in Universities and Colleges in state of Punjab, Rajasthan, Gujarat and Uttar Pradesh. Training of Trainers has been conducted at Jaipur for establishing IPR cells.

1.5 Overview of Utility Models Protection

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The protection of small innovations specially those which have practical utility and unable to meet strong inventiveness criteria but short commercial life, many countries across the world, probably over 100 countries have established a system either as a part of their patent law or a *sui-generis* (independent) system enabling the right holders to commercialize the products of such innovations at early stage of development of technology which is generally known as utility model. The system is said to be useful for the Small and Medium Sized Enterprises (SMEs) to protect their small and incremental innovations particularly in developing countries. The Utility models are generally protected for the inventions relating to devices or articles having practical utility application but are protected for short duration without any substantive examination as quickly as possible, so as to enable the right holders to commercialize the products of such innovations at early stage of development of technology. This system is mostly used by domestic applicants or innovators thereby promoting the local innovations.

Utility models, similar to patent are designed to protect new technical inventions based on functional usefulness through granting a limited exclusive right to prevent others from commercially exploiting the protected inventions without consents of the right holders. It is not easy to define a utility model, as it varies from one country to another. In general, utility models are considered particularly suited for protecting inventions that make small improvements to, and adaptations of, existing products or those have a short commercial life.

These utility models are also known as innovation patents/ utility innovations/ petty patent in countries like Australia, Malaysia, and Indonesia. In contrast, some countries like Hong Kong, Ireland and Slovenia have in place a short-term patent that is equivalent to a utility model[1].

Historical Development of Utility Model Law:

The Utility Model protection was first established in Germany in 1891to protect the inventions, which had lower level of inventive ingenuity or inventiveness, which could not be protected under patent law or under design law. The introduction of utility model encouraged the innovators to protect the utility oriented inventions, particularly domestic innovators as about 85% applications are filed by them. Germany has made tremendous growth in the technological development utilizing the system successfully. While the law requires utility models to meet the same requirements as patents in terms of novelty, inventive step and utility, the there is a lower threshold for inventive step[2]. Processes and biotechnological inventions were also excluded from the purview of utility models.

In Japan, the utility model protection system was established in 1905, which was originally based on the utility model law of Germany. It has been amended several times since then and is now restricted to the protection of devices only. Japanese utility law now encourages devices by promoting the protection and

[1]http://www.wipo.int/patents/en/topics/utility_models.html
Understanding Industrial Property, WIPO publication No 859(E),pp-8.
[2]Section 1(1) of German Utility Model Law

utilization of devices relating to shape or construction of articles or a combination of articles, so as to contribute to the development of industry[3]. The utility model protection system has played a very important role in the economic and technological development of Japan. More than 85% applications are being filed by domestic applicants.

Similarly in Australia, the small innovations having incremental improvements are protected by innovation patents, which are equivalent to utility models but have not exclusion for processes like Germany. However, biological processes including the product thereof are excluded from protection. Other criteria as to the scope of protection are similar to standard patent such as manner of manufacture and novelty standard. In case of innovation patent, the inventive threshold is also lower than required for standard patent. The innovation patent system has replaced the earlier petty patent system in 2001 on the recommendation of Advisory Council on Intellectual Property (ACIP).In Australia, system has been exploited more by the domestic applicants rather than foreign applicants as about 80% of the applications are filed by the domestic applicants. This allows domestic innovators to exploit the products of their small or incremental innovations at the early stage and therefore promoting the technological development by early introduction of new products in the market

The European Commission also realized the importance of community utility models particularly for SMEs, whose minor technological innovations often have only a short lifetime and the protection is considerable economic importance within the internal market. Therefore, Commission also submitted proposals in 1997 to European Parliament and Council Directive for the legal arrangements for creating Community Utility Models after having wide range of discussion and consultations on the Green Paper in 1995, in order to protect the technical inventions involving specific level of inventiveness for promoting a better exploitation of the industrial potential of innovation, research and technological development policies, particularly by small and medium sized firms since the existing system in the member states of European Union differ widely with regard to level of inventiveness and therefore do not have a uniform system for protecting such incremental inventions. However, countries like United Kingdom, Sweden and Luxemburg still do not have such system.

In China, the patent law governs the grant of invention patents, utility models and industrial designs since 1984 when the law was enacted first time and came into force from 1985. However, since then the law has been amended twice in 1992 and 2000. The invention patent and utility model both are commonly referred as patent. China has successfully utilized the utility model system for promoting the technological development like Japan. In fact the number of applications filed for utility models have always been more than invention patent and industrial designs. The review of Chinese system also indicated that the system has been utilized more by the domestic innovators than foreigners.

South Korea, although introduced the utility model protection system in 1908, the first separate legislation for utility model was enacted in 1961. This law has been amended in 1998 and lastly in 2002 with an aim to encourage small and medium sized enterprises by providing quick protection to their inventions by adopting non-examination system. The review of Korean system also indicated that the system has been utilized more by the domestic innovators.

[3]Section 1of Japanese Utility Model law

Brazil also has a long history of utility model system since 1923. The current law is in force since 1996 which was enacted with a view to promote social interest, the technological and economic development of the country. Although, the Brazilian utility model system does not appear to be attractive as the system requires substantive examination and also mandatory filing of request of such substantive examination as in the case of patent, but it has been observed that the system has been utilized more by the domestic innovators as compared for foreigners.

Apart from China and South Korea, some other developing countries from Asia such as Taiwan China, Mongolia, Vietnam, Malaysia, Thailand, Indonesia and Philippines have also adopted the utility model system for promoting the innovation activities of the innovators, particularly local innovators including SMEs in one form or other. The requirements for registration of utility models are more or less same or rather similar in all countries but each country has provided its own definition to utility models or innovation patents suiting to their industrial development. This system is said to be good for SMEs sector, as it is cost effective, quick for registration in order to protect incremental and improved inventions.

At present, there are about 50 odd countries and 2 Inter-Governmental Organizations, which have utility model protection system. They are namely, Australia, Argentina, Armenia, Austria, ARIPO, Belarus, Belgium, Brazil, Bulgaria, China, Colombia, Costa Rica, Czech Republic, Denmark, Estonia, Ethiopia, Finland, France, Georgia, Germany, Greece, Guatemala, Hungary, Ireland, Italy, Japan, Kazakhstan, Kenya, Kyrgyzstan, Malaysia, Mexico, Netherlands, OAPI, Peru, Philippines, Poland, Portugal, Republic of Korea, Republic of Moldova, Russian Federation, Slovakia, Spain, Tajikistan, Trinidad & Tobago, Turkey, Ukraine, Uruguay and Uzbekistan[4].

However, according to another research study conducted in 2004 by a Japanese researcher, there are about 130 countries who have introduced the utility model system as a system to supplement the patent law[5]. The utility models are considered generally good for the developing countries for following reasons, namely, (a) they enable the artisans to secure protection for innovations which are unable to meet the strict novelty and inventive step requirement of patent law, (b) they increase the role of small scale innovators and artisans in economic development and help them to stay in the business in the face of new technology, (c) they act as a spur to enhanced levels of innovation,(d)they are cheaper to acquire than patent and finally (e) they become a source of data on innovative activity and experience in technological management[6].

International development in Utility Model System:

a) **Paris Convention**: The importance of protection of intellectual property, particularly the industrial property was first recognized in the Paris Convention for the protection of Industrial Property, which was established more than 120 years ago in 1883 and revised many times since then but lastly amended on September 28, 1979, provides for the protection of utility models. This is one of the first important international treaties for the promotion and protection of industrial property by the nationals of contracting member countries in other member countries. At present, there are about

[4]See at http://www.wipo.int/sme/en/ip_business/utility_models/where.htm
[5]This research was conducted by Mr.Takeyuki Iwai, a senior researcher in Institute of Intellectual Property, Tokyo, Japan and published in IIP Bulletin,2004,pp38-48
[6]Uma Suthersanen-Utility Models and Innovation in developing Countries, February 2006-UNCTAD-ICTSD Project on IPRs and Sustainable Development, Issue paper No.13, available at http://www.unctad.org/en/docs/iteipc20066_en.pdf

more than 170 members to this convention. India joined the Paris Convention on December 8, 1998 and became bound to the provisions of this convention. This has in its scope and objects, apart from patents, industrial designs and trademarks, utility models, service marks, trade names, indications of source or appellations of origin and the repression of unfair competition[7]. Although, the convention is silent as to its definition and scope of the utility model but provides for National treatment and a right of priority for the purpose of filing of application in other member countries within certain period of time[8]. This period could be between six months to twelve months depending upon the kind of industrial property. For instance, a period of twelve months for patents and utility models and six months for industrial designs and trademarks from the date of filing of the first application. Furthermore, it is permissible to file a utility model application in country by virtue of a right of priority based on the filing of a patent application and vice versa[9]. Under the provisions of the Convention, the applicant can also divide his patent application into patent application or utility model either *suo-motto* or on the receipt of the examination report that application discloses more than one invention. The provisions of importation and compulsory licences, failure to work or insufficient working in respect of patents are also applicable, mutatis mutandis, to utility models[10].

b) **Patent Cooperation Treaty:** Similarly, there is another international system, which mainly provides a simplified procedure for filing of an application for the grant of patent to the invention in each of its contracting member countries by filing an international application. This system is known as Patent Cooperation Treaty and popularly known as 'PCT'. This treaty was concluded in 1970 and entered into force on January 21, 1978 but modified several times. There are about more than 135 members to this treaty. India became member to this treaty with effect from December, 8, 1998. Although this treaty mainly provides for unified procedure for international patent application in respect of filing, international search for novelty purpose, international publication and optionally for international examination before entering the national phase of individual member country, but encourages and protects utility models procedurally. The provisions of this treaty enable the inventors or the applicants filing of an international application for the grant of patent claiming priority based on the utility model application[11]. The provisions of this treaty also construe the reference of patent, unless expressly stated otherwise, as patents for inventions, inventors' certificates, utility certificates, utility models, patents or certificates of addition, inventors' certificate of addition and utility certificates of addition[12]. Accordingly, PCT also permits to file Utility Model application through National phase utilizing the priority date and flexibilities provided therein as applicable for patent. Therefore, the utility model is one of the important forms of the intellectual property, which is not only recognized world over but also in the international treaties and conventions.

c) **TRIPS Agreement:** Perhaps the last international agreement in respect of intellectual property is the agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), which came into existence from January, 1, 1995. This agreement provides for standards concerning the availability, scope and use of intellectual property in respect of Copyright and Related Rights, Trademarks, Geographical Indications, Industrial Designs, Patents, Layout Designs (Topographies) of Integrated Circuits, Protection of Undisclosed Information and Control of Anti-competitive Practices in Contractual Licences[13]. It does not provide for establishment of utility model system by member country but has reference to the provisions of Paris Convention through the provisions of Article 2,3 and 4 of this agreement (Part-I). Since TRIPS provides for only minimum standards for the protection of intellectual property rights, there is nothing which prevents any member country to adopt utility model system to promote IP protection among the small innovators particularly in the SMEs.

[7]Article 1.1 of Paris Convention
[8]Article.4
[9]Article 4E(2)
[10]Article 5,
[11]Article 2(i) of the Patent Cooperation Treaty defines 'application' means an application for the protection of an invention; references to an application shall be construed as references to applications for patents for inventions, inventors' certificates, utility certificates, utility models, patents or certificates of addition, inventors' certificate of addition and utility certificate of addition.
[12]Article 2(ii) of PCT

Global trend of Utility Model Applications: The global trend of utility model applications filed in various countries, who have successfully implemented the system, is given below.

(a) Japan: The trend of utility model applications filed as compared to Patent and Designs applications from 2007 to 2016 in Japan is given below. It is seen that the trend of utility model applications was almost constant till 2014 and thereafter it started declining. However, the number of utility model applications filed by Nationals is much more (about 80%) than the Foreign Nationals.

Table 9: Trend of Applications from 2007 to 2016

Year	Patents	Industrial Designs	Utility Models
2007	508,263	102,665	10,750
2008	509,990	107,108	9,936
2009	463,601	86,406	9,917
2010	468,417	102,977	9,385
2011	475,051	127,795	9,634
2012	490,271	120,761	10,902
2013	473,141	112,225	10,919
2014	465,971	112,295	10,404
2015	457,952	105,746	9,947
2016	456,467	119,141	8,910

Source: http://www.wipo.int/ipstats/en/statistics/country_profile/profile.jsp?code=JP

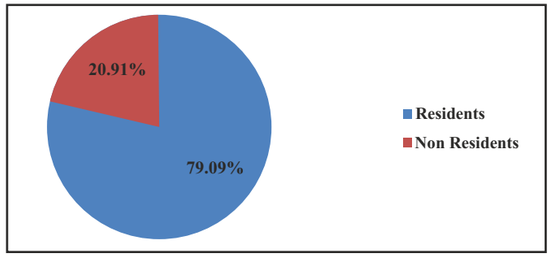

Figure 15: Utility Model Applications Residents vs Non-Residents

[13]Part-II,section1-8 of the TRIPS Agreement

(b) Germany: A substantive number of applications for utility model applications were filed in Germany from 2007 to 2016. The utility model applications as compared to patents and industrial design filed in Germany is given below. It is observed that the domestic applicants filed substantive number of applications (Figure 16).

Table 10: Trend of Applications from 2007 to 2016

Year	Patents	Industrial Designs	Utility Models
2007	1,63,779	5,61,169	18,431
2008	1,71,835	5,86,673	17,459
2009	1,62,332	5,30,833	17,798
2010	1,73,619	5,56,584	17,488
2011	1,75,606	5,64,082	16,675
2012	1,83,048	6,18,289	16,316
2013	1,84,493	6,21,807	16,475
2014	1,79,506	6,48,210	15,919
2015	1,75,423	5,73,271	15,282
2016	1,77,073	6,36,395	15,035

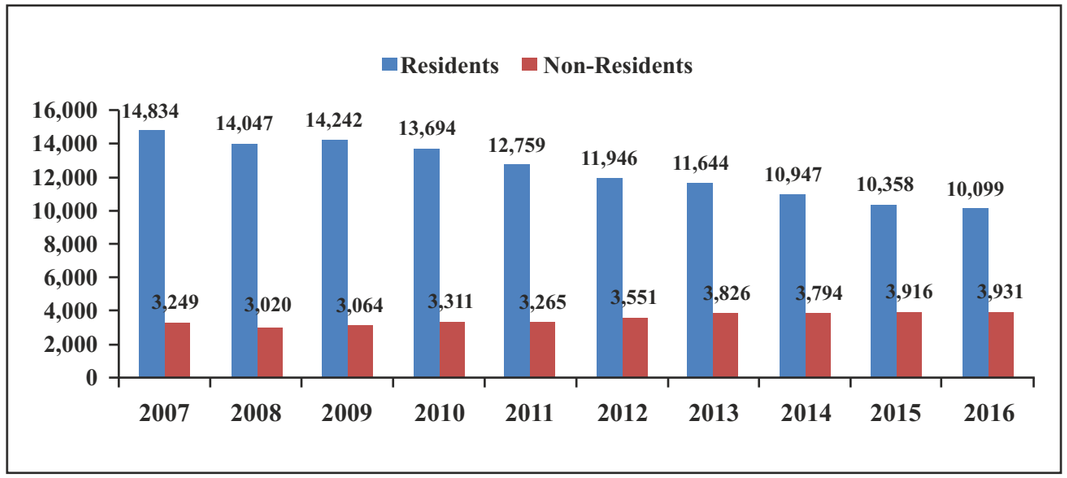

Figure 16: Utility Patents Filed by Residents and Non Residents

c) China: The trend of utility model applications filed in China indicates the tremendous growth in this sector. It is observed that morethan 1.5 lac utility model applications are being filed per year. The China is one those countries where utility model system is most successful and being increasingly utilized mostly by domestic applicants. However, it is surprising that in the year 2009 more than 3 lacs utility model applications were filed, which are equal to patent applications as well as designs applications.

Table 11: Applications for Three Kinds of Patents Received from Home and Abroad, 2007-16

Year	Patents	Industrial Designs	Utility Models
2007	1,61,308	2,74,689	1,81,626
2008	2,04,268	3,28,075	2,26,120
2009	2,41,434	3,69,593	3,11,395
2010	3,08,326	4,48,121	4,10,588
2011	4,36,170	5,63,532	5,86,316
2012	5,61,408	7,17,863	7,41,409
2013	7,34,096	7,61,027	8,93,749
2014	8,37,817	6,73,538	8,69,956
2015	1,010,615	7,29,551	11,29,160
2016	1,257,439	7,91,338	14,77,686

Source: http://www.wipo.int/ipstats/en/statistics/country_profile/profile.jsp?code=CN

Table 12: Applications for Three kinds of Patents Received from January 2017-December 2017

2017	Total	Invention	Utility Model	Design
No. of applications	36,97,845	13,81,594	16,87,593	6,28,658

(d) S. Korea (Korea Intellectual Property Office): The trend of utility model applications filed in Republic of Korea is given below. Utility model applications show clear declining trend from 2007 to 2016.

Table 13: Trend of Applications from 2007 to 2016

Year	Patents	Industrial Designs	Utility Models
2007	1,76,336	76,893	21,269
2008	1,73,496	78,576	17,621
2009	1,70,233	77,201	17,333
2010	1,78,654	85,853	13,957
2011	1,87,747	86,397	12,165
2012	2,03,836	1,13,250	12,853
2013	2,23,527	1,54,148	11,300
2014	2,30,553	1,27,828	9,606
2015	2,38,185	1,35,438	9,512
2016	2,33,786	1,33,598	8,739

Source: http://www.kipo.go.kr/

(e) Taiwan Province of China: The trend of utility model applications filed in Taiwan Province of China also indicates that the system is very successful. The trend of Utility model and invention patents are slightly declining, while trend of Industrial designs slightly increased between 2007 to 2016.

Table 14: Trend of Applications from 2007 to 2016

Year	Patents	Industrial Designs	Utility Models
2007	51,569	7,442	22,717
2008	51,831	7,751	23,952
2009	46,582	6,738	25,032
2010	47,327	7,220	25,833
2011	49,919	7,735	25,170
2012	51,189	8,248	25,637
2013	49,217	8,969	25,025
2014	46,379	8,148	23,488
2015	44,415	7,808	21,404
2016	43,836	8,445	20,161

Source: https://www.tipo.gov.tw/ct.asp?xItem=640384&ctNode=6830&mp=2

(f) Australia: The trend of innovation patent applications (similar to utility model applications) filed in Australia from 2007 to 2016 is given below. Number of Patent and Industrial model applications remained constant, while Utility model applications increased over the years.

Table 15: Trend of Applications from 2007 to 2016

Year	Patents	Industrial Designs	Utility Models
2007	11,992	11,884	1,266
2008	12,152	11,227	1,297
2009	10,656	10,943	1,365
2010	11,559	12,315	1,535
2011	11,536	16,709	1,763
2012	11,719	21,132	1,930
2013	12,515	17,955	1,744
2014	11,903	16,480	1,622
2015	11,239	12,672	1,924
2016	11,735	12,000	1,973

Source: http://www.wipo.int/ipstats/en/statistics/country_profile/profile.jsp?code=AU

(g) Brazil: The trend of utility model applications filed in Brazil from 2007 – 2016 is given below. It is again observed that domestic applicants mostly file such applications.

Table 16: Trend of Applications from 2007 to 2016

Year	Patents	Industrial Designs	Utility Models
2007	5,393	5,832	3,073
2008	5,521	9,621	3,408
2009	5,420	9,401	3,402
2010	5,735	7,139	3,037
2011	6,359	11,723	3,125
2012	6,603	10,517	3,023
2013	6,848	9,176	3,065
2014	6,712	9,895	2,772
2015	6,570	9,463	2,749
2016	7,223	8,735	2,980

Source: http://www.wipo.int/ipstats/en/statistics/country_profile/profile.jsp?code=BR

Advantage of Utility model: Since the utility model is *sui-generis* legislation in most of the countries, it has several advantages. Some of them are enumerated below:

a) Utility model protection is not within the purview of TRIPS Agreement therefore each country has freedom to limit the scope of protection to be covered. It has been seen that in most countries the protection is limited to the engineering products such as devices, articles, which have practical utility application made by improvements in such products, and chemical and pharmaceutical products are not covered as utility models.

b) The protection is granted to those for incremental inventions, which have very less threshold of inventive step and are unable to meet the patentability criteria under patent law due to strong inventiveness requirement.

c) The protection is granted very quickly as the registration procedure is very simple and there is no substantive examination required. The registration in most countries is granted based on formal examination of the application. This also reduces the administrative burden on IP Offices.

d) The system is very economical and inexpensive since there is very less filing fee in all countries and there is no examination fee in most countries except in one or two countries. Brazil has prescribed examination fee also.

e) Since the technology becomes obsolete quickly, the commercialization of utility model protected products is also very quick due to its faster procedure for registration.

f) It has been observed that it encourages and protects, especially, domestic innovators and still very much effective and important.

g) It is found useful specially for SMEs sector and individual innovators in most of the countries

h) Utility model system is supplementary to other IP Laws and therefore provides more option to innovators to elect from.

I) Conversion from patent application to UM application or vice-versa in many countries is allowed and therefore where the invention is not patentable under patent law the applicant gets the opportunity to protect the invention as Utility model or in case the applicant finds the inventive threshold of his invention is very strong he can convert his Utility model application into patent application. However, the law ensures that no dual protection (patent and utility model) is granted to the invention.

j) The applicant of utility model is entitled for priority right under Paris Convention as well as under PCT.

k) The utility model rights can be licensed or mortgaged to third party as in case of patent.

Disadvantage of Utility Model: In spite of above mentioned advantages, the utility model has several disadvantages. Some of the disadvantages are mentioned below:

a) It has been observed from the filing trend of utility model applications that the system is slowly loosing the interest and becoming unpopular in many of the developed countries.

b) However, it is very popular in China, South Korea, Taiwan China and other Asian countries except Japan.

c) Since there is no substantive examination being done before the grant of patent, the protection is being considered as weak.

d) The legal enforceability of the protected right is also very weak due to lack legal authority. In case of any infringement of the rights the right holder is required to obtain the technical report from the patent office about its register ability on the basis of a search conducted by the examiner in the prior art documents.

Chapter-2: National IPR Policy, 2016

2.1 Introduction: India is home to abundant creative and innovative potential. It is the birthplace of medicine and wellness systems such as Ayurveda, Unani, Siddha and Yoga, and has a well-established handicraft and textile industry owing to its rich culture. It has made its journey beyond the Moon with a robust Space programme and has been the global contributor of affordable medicines due to a strong Pharmaceutical sector. But even with such a high innovation quotient, India lacks a consolidated Intellectual Property (IP) regime. Hence, the Indian government took up the task to frame a policy that would not only instrument awareness but also the enforcement and commercialization of IP laws in the country. The first draft of the National IPR policy was released on 19 December 2014. An approved National Intellectual Property Rights (IPR) policy was passed by the Union Cabinet on 12th May 2016, for its holistic development in India.

2.2 Vision Statement: An India where creativity and innovations are stimulated by IP for the benefit of all; an India where IP promotes advancement in science and technology, arts and culture, traditional knowledge and biodiversity resources; an India where knowledge is the main driver of development, and knowledge owned is transformed into knowledge shared.

2.3 Mission Statement: Stimulate a dynamic, vibrant and balanced IPR system in India to:

- Foster creativity and innovation and thereby, promote entrepreneurship and enhance socio-economic and cultural development.
- Focus on enhancing access to healthcare, food security and environmental protection, among other sectors of vital social, economic and technological importance.

2.4 Objectives: The Policy lays down seven objectives, which are elaborated with steps to be undertaken by the identified nodal Ministry/Department. The implementing or Nodal Ministry/Department shall coordinate with all other concerned stakeholders, including other Ministries/Departments, towards attaining the objectives.

Objective 1: Outreach and Promotion: *To create public awareness about the economic, social and cultural benefits of IPRs among all sections of society.* The steps to be taken towards attaining this objective are outlined below:

1.1. Adopt the national slogan "Creative India; Innovative India" and launch an associated campaign on electronic, print and social media, including by linking the campaign with other national initiatives such as "Make in India", "Digital India", "Skill India", "Start Up India", "Smart Cities" and other new initiatives in the future.

1.2. Create a systematic campaign for promotion of India's IP strengths by conveying to all stakeholders the value and benefits of IP.

1.3. Create awareness programs specifically targeting industry and R&D entities, both private and public

1.4. Create well-publicized events and ongoing programs to emphasize the importance of IP

1.5. Create suitable course materials

1.6. Engage with the media to sensitize them regarding IP related issues.

Objective 2: Generation of IPRS: *To stimulate the generation of IPRs:* The steps to be taken towards attaining this objective are outlined below:

2.1. Use the campaign "Creative India; Innovative India" to propagate the value of creativity and innovation, and the resultant benefit to the public; to create a mindset and culture that encourages knowledge generation and its application through IP.

2.2. Carry out a comprehensive IP audit or base line survey in various sectors in cooperation with stakeholders to assess and evaluate areas of strength and potential, prioritize target groups of inventors and creators, develop specific programs to address their needs, provide resources to enable them to create IP assets and utilize them for their own and social benefit.

2.3. Undertake studies to assess the contribution of IP content in different industries on the economy, employment, exports and technology transfer.

2.4. Focus on improving IPR output of national research laboratories, universities, technology institutions and other researchers by encouraging and facilitating the acquisition of IPR by them.

2.5. Encourage researchers in public funded academic and R&D institutions in IPR creation by linking it with research funding & career progression.

2.6. Encourage researchers in public funded academic and R&D institutions by having uniform guidelines for division of royalties between the organizations and individual researchers and innovators.

2.7. Include IP creation as a key performance metric for public funded R&D entities as well as Technology Institutions, and gradually extend such evaluation from Tier-1 to Tier-2 institutions.

2.8. Provide guidance to researchers and innovators about national priority areas to focus on, for instance in energy and food security, healthcare and agriculture, as well as specific sectors such as biotechnology, data analytics, nanotechnology, new materials and Information and Communication Technology (ICT).

2.9. Encourage public funded R&D institutes and industry to develop affordable drugs relating to neglected diseases.

2.10. Encourage R&D including open source based research such as Open Source Drug Discovery (OSDD) by the Council of Scientific and Industrial Research (CSIR) for new inventions for prevention, diagnosis and treatment of diseases, especially those that are life threatening and those that have high incidence in India.

2.11. Establish and strengthen IP facilitation centers as nodal points especially in industrial and innovation university clusters.

2.12. Create an industry-academia interface for encouraging cross-fertilization of ideas and IPR-driven research and innovation in jointly identified areas.

2.13. Stimulate large corporations, both Indian and foreign, that have R&D operations, to create, protect and utilize IPRs in India.

2.14. Improve awareness of the value of copyright for creators, the importance of their economic and moral rights.

2.15. Introduce support systems for MSMEs, start-ups and grass root innovators to reduce transaction costs linked to IP creation for the entire value chain from IPR generation to commercialization, including schemes to facilitate domestic IPR filings.

2.16. Consider incentives to promote R&D

2.17. Promote 'infusion of funds to public R&D units' as a part of Corporate Social Responsibility (CSR) to foster a culture of open innovation.

2.18. Provide special incentives for creation of IPRs in green technologies and manufacture of energy efficient equipment.

2.19. The ambit of Traditional Knowledge Digital Library (TKDL) should also be expanded to include other fields besides Ayurveda, Yoga, Unani and Siddha.

2.20. Public research institutions should be allowed access to TKDL for further R&D, while the possibility of using TKDL for further R&D by private sector may also be explored, provided necessary safeguards are in place to prevent misappropriation.

2.21. Document oral traditional knowledge, taking care that the integrity of the said knowledge is preserved and traditional ways of life of communities are not compromised.

2.22. Introduce IPRs as part of academic curriculum in educational institutions, especially universities, law and technical institutions.

2.23. Increase awareness of international mechanisms and treaties (Patent Cooperation Treaty, Madrid and Hague) to encourage creation and protection of IPRs by Indian individual and entities in global markets.

2.24. Encourage and incentivize IP generation and utilization among students at all levels, use awareness programs and educational materials to inculcate an appreciation for the value of IP.

2.25. Encourage innovations in the agriculture and pisciculture sector through application of IP for higher sustainable agricultural production.

2.26. Encourage the registration of Geographical Indications (GIs) through support institutions; assist GI producers to define and maintain acceptable quality standards, and providing better marketability.

2.27. Encourage creation of design related IP rights by identifying, nurturing and promoting the aspects of innovation protectable under the design law and educating designers to utilize and benefit from their designs; involve the NIDs, NIFTs and other institutions in sensitization campaigns.

2.28. IPR generation for ICT technologies, including those relating to cyber security for India, will be encouraged.

2.29. Take steps to increase domestic filings of patent applications.

2.30. Promote India's rich heritage of traditional knowledge with the effective involvement and participation of the holders of such knowledge. Traditional knowledge holders will be provided necessary support and incentives for furthering the knowledge systems that they have nurtured from the dawn of our civilization.

Objective 3: Legal and Legislative Framework: *To have strong and effective IPR laws, which balance the interests of rights owners with larger public interest.* The steps to be taken towards attaining this objective are outlined below:

3.1. Review existing IP laws, where necessary, to update and improve them or to remove anomalies and inconsistencies, if any, in consultation with stakeholders.

3.2. Engage constructively in the negotiation of international treaties and agreements in consultation with stakeholders; examine accession to some multilateral treaties which are in India's interest; and, become signatory to those treaties which India has de facto implemented to enable it to participate in their decision making process.

3.3. Continue to engage actively and constructively in the deliberations at various international fora to develop legally binding international instrument(s) to protect Traditional Knowledge (TK), Genetic Resources (GR) and Traditional Cultural Expressions (TCE).

3.4. Pursue transfer of clean technology and know-how from developed countries to India, as per the provisions of Article 4 of the United Nations Framework Convention on Climate Change (UNFCCC), in order to meet the objectives of reducing anthropogenic emissions of Green House Gases (GHGs) and support activities of climate change adaptation.

3.5. Review and update IP related rules, guidelines, procedures and practices for clarity, simplification, streamlining, transparency and time bound processes in administration and enforcement of IP rights.

3.6. Undertake an in-depth study to determine the appropriateness and extent of applying the existing laws to protecting TK, GR and TCE, and to propose changes required, if any.

3.7. Indian Cinematography Act, 1952 may be suitably amended to provide for penal provisions for illegal duplication of films.

3.8. Identify important areas of study and research for future policy development.

3.9. Examine the issues of technology transfer, know-how and licensing relating to Standard Essential Patents (SEPs) on fair and reasonable terms and provide a suitable legal framework to address these issues, as may be required.

Objective 4: Administration and Management: *To modernize and strengthen service-oriented IPR administration.* The steps to be taken towards attaining this objective are outlined below:

4.1. The administration of the Copyright Act, 1957 along with the office of the Registrar of Copyrights, under the Department of Higher Education, is being transferred to the Department of Industrial Policy and Promotion.

4.2. The administration of the Semiconductor Integrated Circuits Layout-Design Act, 2000 along with the office of the Semiconductor Integrated Circuits Layout-Design Registry (SICLDR), under the Department of Electronics and Information Technology, is being transferred to the Department of Industrial Policy and Promotion (DIPP).

4.3. Restructure, upgrade and modernize IPOs taking into account the rapid growth and diversity of IP users and services, higher responsibilities and increased workload.

4.4. Augment manpower after analyzing projected workload, speedy liquidation of backlog, requirements of global protection systems and productivity parameters.

4.5. Study and review the organizational and cadre structure, processes of recruitment, training, career development, performance based incentives to attract and retain the best talent to enhance efficiency and productivity.

4.6. Modernize further the physical and ICT infrastructure taking into account the expanding needs of the IPOs and to accelerate e-filings, e-processing and other e-services.

4.7. Promote interaction between various IP offices and public R&D institutions for sensitization of personnel and scientists.

4.8. Collaborate with various R&D Institutions, Universities, Funding Agencies, Chambers of Industry and Commerce in providing advisory services to improve IP creation, management and utilization.

4.9. Make efforts to include TKDL as a part of PCT minimum documentation.

4.10. Establish close cooperation between IPOs and create a common web portal for ease of access to statutes, regulations and guidelines for better coordination.

4.11. Promote cooperation with IP offices in other countries in areas of Capacity Building, Human Resource Development, Training, Access to Databases, Best Practices in search and examinations, use of ICT and user oriented services.

4.12. Introduce approaches and mechanisms so that benefits of the IP system reach all inventors including MSMEs, informal innovators and holders of traditional knowledge.

4.13. Create a Cell for IPR Promotion and Management (CIPAM) under the aegis of DIPP to facilitate promotion, creation and commercialization of IP assets.

4.14. Explore the possibility of expedited examination of patent applications to promote manufacturing in India.

4.15. Enhance international and bilateral cooperation and coordinate with Indian Missions abroad to follow IP developments and advice on IP related matters.

4.16. Office of the Controller General of Patents Designs and Trademarks (CGPDTM), which administers patents, designs, trademarks and GIs, has undergone a sea change in the past few years, in up gradation and use of ICT.

4.17. Office of Registrar of Copyrights

4.18. The Protection of Plant Varieties and Farmers' Rights Authority- The Protection of Plant Varieties and Farmers' Rights Authority

4.19. Registrar of Semiconductor Integrated Circuits Layout Design

4.20. National Biodiversity Authority (NBA)

4.21. Re-designate the institution of the Controller General of Patents, Designs and Trademarks as Controller General of Intellectual Property Rights to reflect its mandate in view of the proposed change in its scope of responsibilities.

Objective 5: Commercialization of IPRS: *Get value for IPRs through commercialization.* The steps to be taken towards attaining this objective are outlined below:

CIPAM shall also undertake the following Tasks:

5.1. Promote licensing and technology transfer for IPRs; devising suitable contractual and licensing guidelines to enable commercialization of IPRs; promote patent pooling and cross licensing to create IPR based products and services.

5.2. Provide support for MSMEs, Individual Inventors and Innovators from the informal sectors with enablers like facilitation centers for single window services to help them commercialize their IPRs.

5.3. Incentivize Indian inventors, MSMEs and start-ups to acquire and commercialize IPRs in other countries also.

5.4. Examine availability of SEPs on Fair, Reasonable and Non Discriminatory (FRAND) terms.

5.5. Identify opportunities for marketing Indian IPR-based products, especially GIs, and services to a global audience.

5.6. Promote collaborative IP generation and commercialization efforts between R&D institutions, Industry, Academia and Funding Agencies.

5.7. Ensure enhanced access to affordable medicines and other healthcare solutions by (a) Encouraging cross-sector partnerships between public sector, private sector, universities and NGOs; (b) promoting novel licensing models, and (c) developing novel technology platforms.

5.8. Streamline regulatory processes to ensure timely approval for manufacturing and marketing of drugs while maintaining safety and efficacy standards.

5.9. Make efforts to reduce dependency on active pharmaceutical ingredients (API) imports, including incentivizing manufacture of APIs in India and revitalizing public sector undertakings in health care sector.

5.10. Support the financial aspects of IPR Commercialization

5.11. Promote use of Free and Open Source Software along with adoption of open standards; possibility of creating Indian standard operating environments will be examined.

5.12. Promote going-to-market activities

Objective 6: Enforcement and Adjudication: *To strengthen the enforcement and adjudicatory mechanisms for combating IPR infringements.* The steps to be taken towards attaining this objective are outlined below:

6.1. Create awareness of the value of IP and respect for IP culture.

6.2. Take strong measures against attempts to treat generic drugs as spurious or counterfeit.

6.3. Undertake stringent measures to curb manufacture and sale of misbranded, adulterated and spurious drugs.

6.4. Public awareness as also legal and enforcement mechanisms, including technology based measures, will be reinforced to combat offline and online piracy.

6.5. Small technology firms will be supported in safeguarding their IP rights; for instance, support for IPR in ICT focus areas will be provided through easy to-use portals.

6.6. Assistance to smaller firms for protection of their IPRs internationally will be enhanced, such as DeitY's Support for International Patent Protection in Electronics and IT (SIPEIT).

6.7. Pursue incidents of misappropriation of TK, GR and TCE in other countries vigorously.

6.8. Strengthen the enforcement mechanisms for better protection of IP rights.

6.9. Licensing practices or conditions that may have an adverse effect on competition will be addressed through appropriate measures, including regulation of anticompetitive conduct in the market by the Competition Commission of India.

6.10. Facilitate effective adjudication of IP disputes through different measures.

Objective 7: Human Capital Development: *To strengthen and expand human resources, institutions and capacities for teaching, training, research and skill building in IPRs.* The steps to be taken towards attaining this objective are outlined below:

7.1. Strengthen and empower Rajiv Gandhi National Institute of Intellectual Property Management (RGNIIPM), Nagpur to conduct training for IPR administrators and managers in industry and business, academicians, R&D institutions; IP professionals; inventors and civil society; train the trainers and develop training modules; develop links with other similar entities at the international level; provide legal training for examiners.

7.2. Strengthen IP Chairs in educational institutes of higher learning to provide quality teaching and research; develop teaching capacity and curricula and evaluate their work on performance based criteria.

7.3. Introduce multi-disciplinary IP courses/ modules in all major training institutes such as Judicial Academies, National Academy of Administration, Police and Customs Academies, Institute for Foreign Service Training and Forest Training Institutes.

7.4. Making IPR an integral part of the curriculum in all legal, technical, medical and management educational institutions, NIFTs, NIDs, AYUSH Educational Institutes, Agricultural Universities, centres of skill development and the like.

7.5. Strengthen existing and create new IPR cells and technology development and management units in NIDs, NIFTs, Agricultural Universities, Technology and Management Institutes and

centres of skill development.

7.6. Encourage formulation of institutional IP Policy/ Strategy in Government Departments, Higher Education, Research and Technical Institutions.

7.7. Progressively introduce IP teaching in Schools, Colleges and other Educational Institutions and centres of skill development.

7.8. Facilitate Industry Associations, Inventor and Creators Associations and IP Support Institutions to raise awareness of IP issues and for Teaching, Training and Skill Building.

7.9. Develop distance learning and on-line courses on IP for all categories of users; strengthen IP teaching in open universities and centres of skill development.

7.10. Strengthen IP Teaching, Research and Training in collaboration with WIPO, WTO, other International Organizations and reputed Foreign Universities.

7.11. Encourage and support capacity building among Women Creators, Innovators, Entrepreneurs, Practitioners, Teachers and Trainers.

2.5 Implementation: IP in India is regulated by several laws, rules and regulations under the jurisdiction of different Ministries/ Departments. A number of authorities and offices administer the laws. The legal provisions need to be implemented harmoniously so as to avoid conflict, overlap or inconsistencies among them. It is necessary that the authorities concerned administer the laws in coordination with each other in the interest of efficient administration and user satisfaction. Legal, technological, economic and socio-cultural issues arise in different fields of IP which intersect with each other and need to be addressed and resolved by consensus in the best public interest. International, regional and bilateral negotiations require developing a common national position in consultation with different Ministries, authorities and stakeholders.

The present IP Policy aims to integrate IP as a policy and strategic tool in national development plans. It foresees a coordinated and integrated development of IP system in India and the need for a holistic approach to be taken on IP legal, administrative, institutional and enforcement related matters.

Thus, DIPP shall be the nodal point to coordinate, guide and oversee implementation and future development of IPRs in India. The responsibility for actual implementation of the plans of action will remain with the Ministries/ Departments concerned in their assigned sphere of work. Public and private sector institutions and other stakeholders, including State governments, will also be involved in the implementation process.

Chapter-3: World Intellectual Property Organization

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3.1 Introduction: Ingenuity of the mind, used for the creation of a commercial entity or societal use is considered as the intellectual property (IP) of the concerned person i.e. the inventor. The inventor has a legal right over these properties or inventions, which are termed as Intellectual Property Rights (IPRs). The protection of IP is critical for fostering innovation. Currently, IPRs cover patents, copyrights, trademarks, industrial designs, geographical indicators (GI), layout designs, trade secrets and new plant varieties. Without protection of ideas, individuals as well as businesses would not reap the full benefits of their inventive ideas and thus, would focus less on R&D.

The World Intellectual Property Organization (WIPO) is a specialized agency of the United Nations (UN) special agency, which acts as the global forum for IP policy, services, information and cooperation. Over the past five decades, WIPO has taken a lead role in promoting and strengthening of IPRs, as well as their use and enforcement. WIPO is the administrator of 26 international IP treaties[1] and supports the modernisation of IP systems in developing countries. WIPO also serves as a medium for intergovernmental negotiations on new legal instruments. Additionally, WIPO provides a set of international rules, which balances the interests of those who produce and consume the fruits of innovation and creativity.

3.2 Origin: The origin of WIPO dates back to the '1883 Paris Convention' for the Protection of Industrial Property[2] and the '1886 Berne Convention' for the Protection of Literary and Artistic Works[3], which together laid the foundations for existing international IP system. Both the conventions provided for the establishment of an 'International Bureau' to provide administrative support to their respective State Parties. The two bureaux combined in 1893 to form the United International Bureaux for the Protection of Intellectual Property. As a consequence of further conventions, on specialised aspects of IP such as on trademarks, industrial designs and appellations of origin, the Unions, which were created as a result of several of these treaties were also integrated into United International Bureaux (i.e. the Madrid, Hague, Nice, and Lisbon Unions)[4].

Following a convention in 1967 (the WIPO Convention) for the establishment of an international umbrella organization for the administration of IP issues, United International Bureaux was replaced by WIPO in 1970. In 1974, an agreement with UN established WIPO[5] as a specialized agency for the promotion of creative intellectual activity and for facilitating the transfer of technology related to industrial property to the developing countries in order to accelerate economic, social and cultural development through a balanced and effective international IP system[5]. In 2007, WIPO member states adopted the WIPO development agenda, which included 45 recommendations that together aim to make the organisation and its various activities more focused on the needs of its developing country member states[6]. As of 2018, WIPO has 191 Member States, of which 132 are developing countries including India[7]. Together, these Member States are responsible for determining the direction, budget and activities related to IPRs on the global level.

3.3 WIPO's Main Activities

- **Legal Negotiations and Policy Discussions:** WIPO provides a forum for Member States to pursue legal negotiations and policy discussions that shape international rules and practices on IP, and which occur through its various committees, supported by the WIPO Secretariat. The agency hosts intergovernmental committees tasked with different aspects of global IP law and policy. These include committees charged with oversight of existing WIPO treaties and negotiation of new treaties and soft law instruments (such as guidelines), as well as committees focused on issues ranging from IP enforcement to the relationship of IP and development[7,8].

- **Administration of Inter-governmental IP Treaties:** WIPO's Secretariat provides a range of services to its Member States, other stakeholders and the public. The Secretariat administers 25 inter-governmental IP treaties (plus the WIPO Convention) and their financial arrangements. These treaties fall into 3 main categories: 15 IP protection treaties which define international substantive standards on IP; 4 classification treaties (which aim to organise information concerning inventions, trademarks and industrial designs through an indexed classification system) and 6 global protection system treaties (which establish procedural rules mainly aimed at ensuring that one international registration or filing of an industrial property will have effect in all the countries signatory to the relevant treaties[1]. In addition, WIPO provides administrative and financial services to the International Union for the Protection of New Varieties of Plants (UPOV), an independent intergovernmental organisation established by the International Convention for the Protection of New Varieties of Plants, and the Director General of WIPO simultaneously serves as UPOV's Secretary-General[9]. The Rome[10], Phonograms (Geneva)[11] and Satellites (Brussels)[12] Conventions are co-administered by WIPO, UNESCO and the International Labour Organization (ILO). List of treaties administered by WIPO and its signatories are summarized in Table 3.1.

Table 3.1: List of WIPO Administered Treaties

Titles	Purpose	Total Contracting Parties
WIPO Convention (1967)[4]	Establishing the World Intellectual Property Organization (WIPO)	191 (including India)
IP Protection Treaties		
Paris Convention (1883)[2]	Concerning protection of industrial property, including patents, marks, industrial designs, utility models, trade names, and the repression of unfair competition	177 (including India)
Berne Convention (1886)[3]	Concerning the protection of literary and artistic work	175 (including India)
Madrid Agreement (Source) (1891)[13]	For the repression of false or deceptive indications of the source of goods	36
Rome Convention (1961)[10]	Concerning protection of performances of performers, producers of phonograms and broadcasts of broadcasting organisations	93 (including India)
Phonograms Convention (1971)[11]	Concerning the protection of phonograms	79 (including India)
Brussels Convention (1974)[12]	Relating to the distribution of programme-carrying signals transmitted by satellite	37
Nairobi Treaty (1981)[14]	Concerning the protection of the Olympic symbol	52 (including India)
Washington Treaty (1989)[15]	Concerning intellectual property in respect of integrated circuits	Treaty not yet in force
Trademark Law Treaty (1994)[16]	Establishing more user-friendly national and regional trademark registration systems	54
WIPO Copyright Treaty (1996)[17]	Introducing new international rules and clarifying the interpretation of certain existing rules in order to respond to the impact of information and communication technologies on the creation and use of literary and artistic works	96
WIPO Performances and Phonograms Treaty (1996)[18]	Introducing new international rules responding to the impacts of information and communication technologies on the production and use of performances and phonograms	96
Patent Law Treaty (2000)[19]	Harmonising and streamlining formal procedures in respect of national and regional patent applications and patents to make such procedures more user-friendly	39
Singapore Treaty (2006)[20]	Regarding laws pertaining trademarks	46
Beijing Audiovisual Treaty (2012)[21]	Protecting the rights of audiovisual performers	Treaty not yet in force
Marrakesh Treaty (2013)[22]	Facilitating access to published works for persons who are blind, visually impaired or otherwise print disabled	34 (including India)
Classification Treaties		
Nice Agreement (1957)[23]	Concerning the international classification of goods and services for the purpose of the registration of marks	84
Locarno Agreement (1968)[24]	Establishing a system of classification for industrial designs	54
Strasbourg Agreement (1971)[25]	Establishing the International Patent Classification (IPC) system	62
Vienna Agreement (1973)[26]	Establishing a system of classification for marks	32

Global Protection System Treaties		
Madrid Agreement (Marks)	Concerning the international registration of marks	55
Hague Agreement (1925) (including the Geneva Act of 1999) [28]	Concerning the international registration of industrial designs	67
Lisbon Agreement (1958) (including the Geneva Act of 2015)[29]	Concerning the protection of appellations of origin and their international registration	28
Patent Cooperation Treaty (PCT) (1970)[30]	Enabling applicants to file an 'international' patent application seeking protection in many countries	152 (including India)
Budapest Treaty (1977)[31]	Concerning the international recognition of the deposit of microorganisms for the purposes of patent procedure	80 (including India)
Madrid Protocol (on Registration of Marks) (1989)[32]	Rendering the Madrid system more flexible and more compatible with the domestic legislations of certain countries that had not been able to accede to the Agreement	100 (including India)

- **International IP Filing and Examination Services:** WIPO offers treaty-related services that help applicants and holders of IP rights to protect their IP across borders. It enables applicants to seek patent protection and to register trademarks and appellations of origin in multiple countries by filing one international application through the organisation. It also facilitates registration of industrial designs in multiple countries with minimum formalities and expense. In addition, WIPO's Arbitration and Mediation Centre offers Alternative Dispute Resolution (ADR) procedures to help businesses, associations and their legal counsels to resolve IP disputes outside courts[33], most prominently relating to abusive registration and use of internet domain names (or 'cybersquatting')[34].

  WIPO supports global infrastructure for the IP system through services to patent offices and copyright agencies, such as systems that enable patent offices to share documents, including search and examination documentation, to facilitate a more efficient international examination process for patent applications[35]. It also provides systems for the modernisation of offices such as WIPO's Industrial Property Automation System (IPAS)[36] and the WIPO Copyright Management System (WIPOCOS)[37].

- **IP Information, Advisory and Training Services:** WIPO provides information services through a series of global databases of patent documents (Patent Scope)[38], brands (Global Brands Database)[39], industrial designs (Hague Express Database)[40] and laws and treaties (WIPO Lex)[41], as well as statistics and economic research on IP and innovation[42]. WIPO provides assistance to developing countries, including legal assistance on IP legislation, policy advice and training and institutional support for national and regional IP offices. In 1995, WIPO and WTO sealed an agreement, wherein

WIPO undertook to provide assistance to developing countries for the implementation of the TRIPS Agreement[43].

WIPO also hosts a number of multi-stakeholder platforms and public–private partnerships (PPPs), such as WIPO Green (an online marketplace that promotes innovation and diffusion of green technologies by connecting technology and service providers)[44], WIPO Re:Search (a consortium of public and private sector organisations that aims to share IP and expertise with the global health research community to promote the development of new drugs, vaccines and diagnostics)[45] and the Accessible Books Consortium (ABC) (a partnership of WIPO, organisations serving people with print disabilities and organisations of publishers and authors, that aim to increase the number and availability of books in accessible formats for people who are blind or visually impaired)[46], as well as initiatives to improve Access to Research for Development and Innovation (ARDI)[47] and Access to Specialised Patent Information (ASPI)[48] in developing countries. International IP filing systems and WIPO's databases are summarized in Table 3.2.

Table 3.2: Summary of International IP Filing Systems and WIPO's Databases

<table>
<tr><th></th><th>PCT system</th><th>Madrid system</th><th>Hague system</th><th>Alternative Dispute Resolution (ADR) Procedures</th><th>Databases</th></tr>
<tr><td>About the system</td><td>A system for seeking patent protection in multiple countries by filing one international application.</td><td>A system for protecting trademarks in multiple countries by filing one international application.</td><td>A system for registering industrial designs in multiple members with minimum formalities and expense.</td><td>Fast, flexible and cost-effective services for settling IP and technology disputes outside the courts.</td><td>Databases that give access to information on intellectual property.</td></tr>
<tr><td>Users</td><td colspan="5">Anyone, including major corporations, research institutions and universities as well as small and medium-sized enterprises and individuals, from developing and developed countries.</td></tr>
<tr><td>Overview</td><td rowspan="2">Replaces multiple national patent applications with a single international application, saving time and money. Provides preliminary, non-binding reports on patentability.</td><td colspan="2">Replaces multiple registrations with just one, saving time and money.</td><td rowspan="2">ADR options including mediation, arbitration, expert determination and domain name dispute resolution to enable private parties to efficiently settle their domestic or cross-border commercial disputes.</td><td rowspan="2">Three of the key databases are
-PATENTSCOPE global patent search system
-Global Brand Database of trademarks, appellations of origin and official emblems
-Hague Express Database of industrial designs</td></tr>
<tr><td>Enables you to manage and renew your marks through one centralized system.</td><td>Lets you register up to 100 industrial designs with one form. Makes management of your registered designs easier-record changes or renewals through a single step.</td></tr>
</table>

<table>
<tr><td>Key Elements</td><td>Filing, formal examination, international search, international publication, preliminary and non-binding reports on patentability.</td><td>Filing and formal examination.</td><td>Filing, formal examination and post-registration management.</td><td>Global, single neutral procedure, specialized in IP and technology; confidential and flexible.</td><td>Global search, multi-lingual search (PATENTSCOPE), image search (Global Brand Database).</td></tr>
<tr><td rowspan="2">Advantages</td><td colspan="3">Harmonized formality requirements, binding on all signatory countries.</td><td rowspan="2">Expeditious, cost-effective solutions; private and flexible procedures; mediators, arbitrators and experts skilled in IP and ADR; international enforcement.</td><td rowspan="2">Free and accessible technology information, facilitating identification of networks, competitors and owners.</td></tr>
<tr><td>Postpones the major costs associated with international patent protection. Provides applicants and patent offices with a strong basis for patenting decisions.</td><td>Registration and subsequent management in all signatory countries is achieved through a single application.</td><td>Design registration in many countries can be achieved through a single application as well as subsequent management.</td></tr>
</table>

3.4 Role of India in International IP Systems

- **Access to International IP Filing Systems:** India is an active participant in WIPO and is signatory to 10 out of 26 IP treaties governed by WIPO including the treaties governing the international IP filing systems i.e. PCT (for patents); Madrid (for trademarks) and Hague (for industrial designs) systems (Tables 3.1 & 3.2). The PCT system provides a cost-effective process for seeking patent protection in multiple countries, which has numerous benefits for applicants. With just one PCT application, an applicant can seek patent protection in up to 152 countries[48] instead of filing a separate application directly in each different country. Similarly, the Madrid & Hague Systems also provides a cost effective process for obtaining and maintaining trademark and industrial designs protection, respectively, in multiple jurisdictions. With a single international application, applicant can indicate all the territories and can have an international registration with effect in all those territories – up to 116 countries[49] for trademarks and 67 countries[50] for industrial designs. The subsequent management of international registration of trademarks and designs is also easier; with one request, an applicant can record changes in name or address or changes in ownership, with effect for all the countries covered by international registration. Applicants can renew their international registration directly with WIPO, and this renewal will have effect in the countries concerned.
- **Protection of Traditional Knowledge (TK):** The WIPO Intergovernmental Committee on Intellectual Property and Genetic Resources, TK and Folklore, established in 2000 is a forum

where WIPO member states discuss the intellectual property issues that arise in the context of access to genetic resources and benefit sharing as well as the protection of TK and Traditional Cultural Expressions (TCEs). The IGC holds formal negotiations with the objective of reaching agreement on one or more international legal instruments that would ensure the effective protection of genetic resources, traditional knowledge and traditional cultural expressions. Such an instrument or instruments could range from a recommendation to WIPO members to a formal treaty that would bind countries choosing to ratify it[51].

After fighting successfully for the revocation of turmeric and basmati patents granted by United States Patent and Trademark Office (USPTO) and neem patent granted by European Patent Office (EPO), India initiated its project for the creation of a Traditional Knowledge Digital Library (TKDL)[52] in 2001. This model is well accepted by international community and a very good mechanism for saving traditional knowledge from patents by foreign individuals. It stimulated the IGC process and increased recognition of TK within the patent system. In 2002, certain TK journals were included in the minimum documentation for applications under WIPO's Patent Cooperation Treaty, and TK classification tools were integrated within the International Patent Classification in 2004[53].

- **Technology and Innovation Support Centres:** The WIPO Technology and Innovation Support Center (TISC) program provides innovators in developing countries with access to locally based, high quality technology information and related services, helping them to exploit their innovative potential and to create, protect, and manage their IP rights. Till date, WIPO has established 638 TISCs in 48 countries worldwide[54]. Out of these 48 countries, 9 are Asian countries including Russia, Philippines, Jordan, Malaysia, Bangladesh, India, Oman, Sri Lanka and Vietnam. Services offered by TISCs may include:
  - ✓ Access to online patent and non-patent (scientific and technical) resources and IP-related publications;
  - ✓ Assistance in searching and retrieving technology information;
  - ✓ Training in database search;
  - ✓ On-demand searches (novelty, state-of-the-art and infringement);
  - ✓ Monitoring technology and competitors;
  - ✓ Basic information on industrial property laws, management and strategy, and technology commercialization and marketing

  In 2017, the Department of Industrial Policy and Promotion (DIPP), Govt. of India in collaboration with WIPO established two TISCs in India at Chandigarh and Chennai[55]. It will stimulate a dynamic, vibrant and balanced IP system in India to foster creativity and innovation, thereby promoting entrepreneurship and enhancing social, economic and cultural development by establishing a network of TISCs in India.
- **Access to International Microorganism Deposit System:** Adopted in 1977, the Budapest Treaty concerns a specific topic in the international patent process i.e. inventions involving microorganisms. All states party to the Treaty are obliged to recognize microorganisms deposited as a part of the patent disclosure procedure with an International Depositary

Authority (IDA), irrespective of where the depository authority is located. In practice this means that the requirement to submit microorganisms to each and every national authority in which patent protection is sought no longer exists. India is also a signatory to this Treaty[56]. There are 46 IDAs worldwide[57]. In India, 2 IDAs are working under the Budapest Treaty, first is the Microbial Culture Collection (MCC) at National Centre for Cell Science (NCCS), Pune[58] and the second is Microbial Type Culture Collection and Gene Bank (MTCC) at Institute of Microbial Technology (IMTECH), Chandigarh[59].

3.5 International IP Filing Systems: Major Users (2016)

- **PCT System:** In 2016, a record number of patent applications were filed worldwide i.e. more than 3 million from 154 patent offices. These include applications filed directly with national and regional offices and applications entering offices through the PCT national phase. Around 233,000 PCT applications were filed in 2016. Applicants based in the United States (US) filed the largest number of PCT applications (56,590), followed by applicants from Japan (45,214), China (43,094), Germany (18,305) and the Republic of Korea (15,552). India stands at 15th position with 1,529 PCT applications[60](Fig. 3.1).

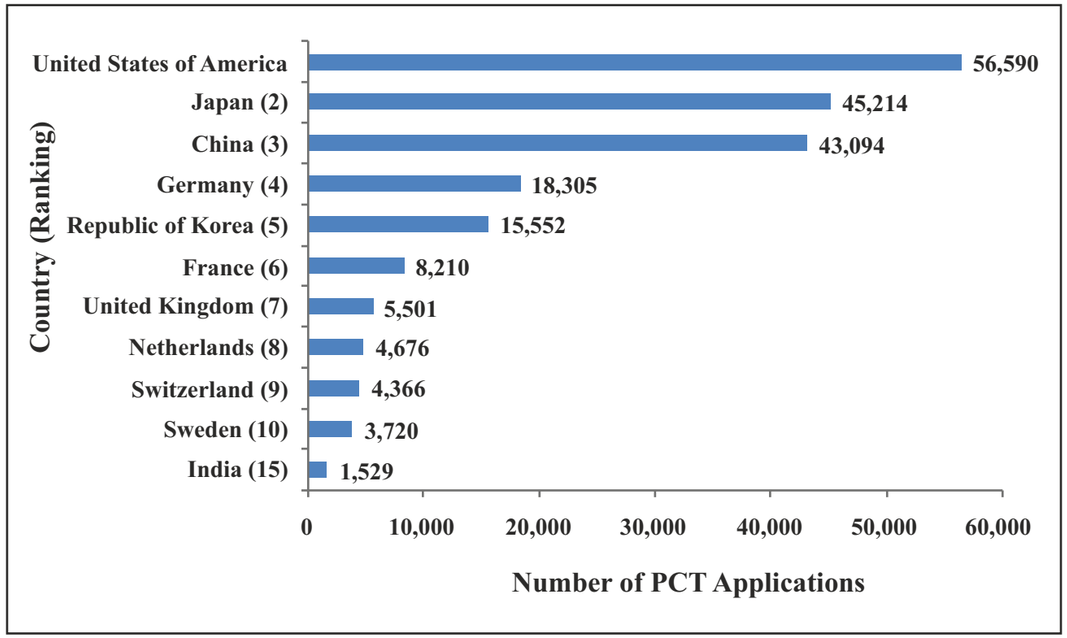

Figure 3.1: Top 10 PCT Filing Countries in 2016

- **Madrid System:** An estimated 7 million trademark applications were filed worldwide in 2016. To obtain trademark protection in multiple countries or jurisdictions, applicants can either file their applications directly at each individual office – known as the "Paris Route" – or file an application for international registration through the Madrid System: the "Madrid Route". As per WIPO's statistics database, international applications totalled 53,493 in 2016 through the Madrid System, which offered trademark holders the ability to obtain protection for their branded products and services in an area covering a total of 114 countries[56]. US was the largest user of Madrid System (7,730) followed by applications from Germany (7,544), France (4,124) and China (3,820) (Fig. 3.2)[60]. India was at 32nd position with 175 trademark applications filed through Madrid System[61].

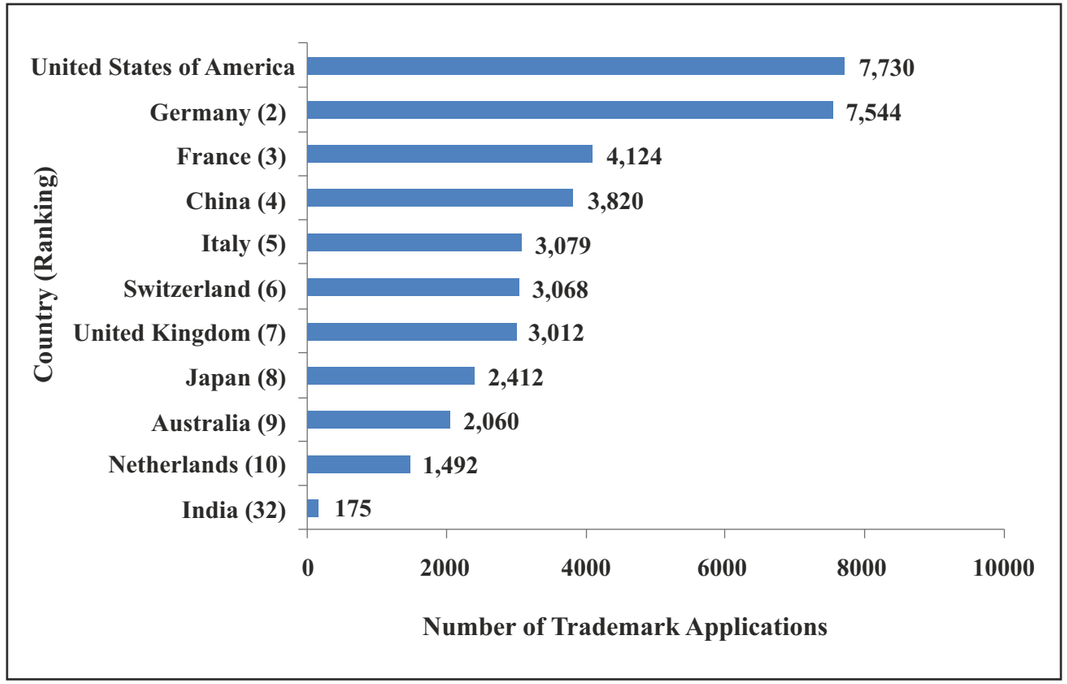

Figure 3.2: Top 10 Users of Madrid System in 2016

- **Hague System:** Through the Hague System, applicants can seek industrial design protection internationally. In 2016, the Hague System received 5,562 international applications containing 18,716 designs. Applicants residing in Germany remained the largest users of the Hague System with 3,917 designs in applications. They were followed by those residing in Switzerland (2,555), Republic of Korea (1,882), US (1,410) and Netherlands (1,317). Combined, these five origins accounted for nearly 60% of the total. Top 10 users of Hague system are depicted in figure 3.3[60]. In 2016, there was no industrial design application reported from Indian residents through Hague system[61].

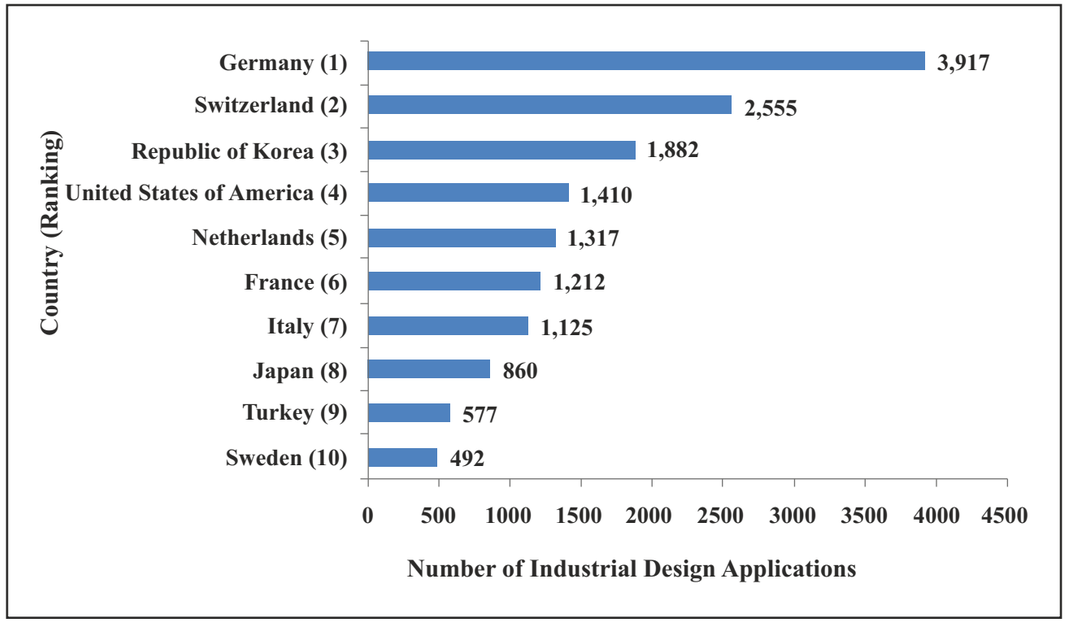

Figure 3.3: Top users of Hague system in 2016

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Chapter- 4: Indian Web-Portals (Patents and Technologies)

Information about patents, technologies and innovations is of great significance, especially for the scientists and potential licensors. The information, when compiled in an organized way, can be an important indicator of the research output of a nation. The policy makers can also make use of the patent related information to identify the strong and weak areas of the nation's research ecosystem, and thus design policies accordingly.

India does not have an holistic web portal displaying comprehensive patent related data of the country. However, many organizations like CSIR, ICMR, ICAR, NRDC, BIRAC etc. have dedicated patent web portals displaying the patent profile of the respective organizations. This chapter mentions important web portals developed by the various government and private bodies in India and also lists their strengths and weaknesses.

Indian Patents and Technologies - Web portals

S. No.	Patents and Technologies-Web Portal and URL	Strengths	Limitations
1.	**CSIR Technology Portal and Patent Database** URL: http://techindiacsir.anusandhan.net Patent Database URL: http://www.patestate.com	• Showcases the technologies available with CSIR. • Lists and segregates patents as per the technology domains (25) • Provides active patent list and technologies available for transfer. • Provides link (URL: http://www.patestate.com) for patent portfolio access and easy browsing of patents based on type of industrial application area or by CSIR- Laboratories. • Coverage: >8000 patents, across 38 CSIR laboratories distributed in 25 Subject Domains. • Search option is available for Patent number, Title, Application, Applicant, Inventor, IPC classification code, abstract and country. • Two or more fields can be combined by "AND" or "OR" operators. • Data can be filtered for a date range, industrial application name or CSIR laboratory wise.	• Provides detail of only CSIR patents and technologies. • Provides narrow coverage of patents filed in India. • Does not provide information about funding of the projects leading to the patents. • Does not illustrate the trends in patent data.

2.	**National Research Development Corporation (NRDC) Web Portal** URL: http://fccollc.com/nrdclive/	• Aims to develop and commercialize the innovative technologies from R & D institutes. • Web Portal has a sector wise (13 sectors) list of technologies available with NRDC.	• Provides narrow sample of patents filed in India. • Patent related details are not directly accessible to public. • Search filtering options are not available.
3.	**Asian and Pacific Centre for Transfer of Technology (APCTT) Web portal** URL: http://apctt.org/technology-offer	• Provides sector wise list of technologies offered by inventors. • Covers wide range of technology sectors • Provides link for various global technology databases.	• Limited number of technologies available. • Details of patent area absent. • Data filter options not provided.
4.	**Industry Academia CRIKC Web portal** URL: http://iacrikc.dstcpr.in/	• Provides list of filed and granted national and international patents. • Provides area wise sorted list of patents. • Includes bibliographic information of patents.	• Information is limited to CRIKC member institutions only. • Patent information available is limited. • Available bibliographic information of patents covers only Title, Application number, Status of patent, Date of filing, Institute name, and Inventor contact details.
5.	**TIME IS (Technology Innovation Management & Entrepreneurship Information Service)** URL: http://www.techno-preneur.net	• Provides list of technologies which are commercialization-ready. • Lists and segregates patents as per the technology domains. • Wide range of technology sectors is covered. • Provides information of new studies and innovations in major technology sectors and technology trends. • Provides compiled project profile details.	• Does not provide details of patents related to technologies. • Coverage in terms of number is not wide. • Does not provide searching and filtering

6.	**BIRAC technology portal** URL: http://birac.nic.in/technologyportal.php	• Portal provides list of patents sorted and segregated into different technology domains along with information about the inventors. • Displays list of technologies according to different stages of development (Products in the market, Products ready to enter in the market, Products ready for licensing and technology transfer, Under validation, Early stage technologies etc.) • Keyword based search option. • Search results contain information about the technology and it's unique property.	• Portal is focused to technologies available with BIRAC only. • Portal does not provide details about patent related data to concerned technologies.
7.	**Techpedia** URL: http://techpedia.sristi.org	• Provides industry defined project wise list of technologies. • Provides list of assistive technologies for differently abled persons.	• Coverage is very small in terms of technology sectors and numbers. • Patent related details are absent. • Searching and filtering options are not provided.
8.	**DST-The National Innovation Foundation (NIF) Technology catalogue** URL: http://nif.org.in/technology-catalogue/28 **DST-Intellectual Property Management (IPM) web page** URL:http://nif.org.in/ipr	• Lists sustainable technologies and grassroots innovations. • Provides sector wise list of innovations. • Displays inventor detail, Innovation description, IPR status (patent app. No./ Patent No.), Technical specification and Features details. • Except patents other IPR details such as design and protection of plant varieties (PPV) and farmers rights (FR) are also available in IPR management page. • Patent details cover many bibliographic fields (Innovator's Name, Innovation Title, State From, Application Number, Priority Date and Current Status)	• Technology catalogue covers only awarded/ selected technologies by NIF. • Covers only a few sectors of technologies. • Limited number technologies are listed.
9.	**Indian Council of Medical research (ICMR)**	• Provides list of technologies available for collaboration.	• Lists only ICMR technologies.

	Technology listing web page URL: http://www.icmr.nic.in/ipr/icmr_technology_available_for_collaboration_%2828%29.htm	• Provides details of technologies and stage of development of technologies.	• No details of patent. • Search option is not available. • Only a few technologies available.
10.	**Defense Research and Development Organization (DRDO) Technology web page** URL: http://www.drdo.gov.in/drdo/English/index.jsp?pg=homebody.jsp	• Lists the technologies sorted according to different research areas of DRDO. • Provides details of technologies developed.	• Only DRDO technologies are listed. • Patent/ IPR details are not available. • Search option is not available. • Only a few technologies are available.
11.	**Indian Space Research Organisation (ISRO) Technology Transfer page** URL: https://www.isro.gov.in/isro-technology-transfer/patent	• Web page provides list of IPR portfolio of ISRO. • The 'Patent tab' on the website lists all the patents granted (270) to ISRO. • Title, application No., and Patent number details are available.	• Patent list provided is limited to ISRO owned patents. • List contains only granted patents. • Search option not provided. • Limited number of patents available.
12.	**The Department of Atomic Energy (DAE) patent web page** URL: http://www.dae.nic.in/?q=node/954	• Provides the list of patents filed by DAE. • Bibliographic details of patents (Title, Application no., Date of filing, Patent no., and Type of application) are available.	• Provide the list of patents owned by the DAE. • Search option is not available. • Patents are not sorted by technology area. • Limited number of patents available.

13.	**Indian Council of Agricultural Research(ICAR)** **ICAR-IARI** URL: http://iari.res.in **ICAR-NDRI** URL: http://ndri.res.in **ICAR-IVRI** URL: http://ivri.nic.in	• Does not have any composite web portal for technology/patents. However patent information can be obtained from websites of individual institutes.	• Only Title of Patent, Inventor Name and Application number is available.
14.	**Technology Information, Forecasting and Assessment Council (TIFAC)** Patent Facilitating Centre (PFC) URL: http://www.pfc.org.in/db/db.htm	• Provides bibliographic information of patents. • Have information of granted Indian patents from 1995 to 2005 and published Indian patent applications from 2005 to 2008 in Ekaswa-A, Ekaswa-B and Ekaswa-C databases.	• Database is not updated after 2008. • After 2005 details of published patent applications is available but details of granted patents is not available.

Chapter-5: Research Publications and Patenting Profile of Higher Education Institutes and R&D Laboratories of India

5.1Composite Analysis

The economy of a nation is directly linked to its level of scientific temperament, research articles publications and patents. Research articles reflect the academic excellence, whereas, patents reflect the ability to translate fundamental research into a product/technology for commercial or societal benefits. India is among the top 5 countries (5th rank) in the indicator of Number of Publications (Scimago Journal & Country Rank, *(http://www.scimagojr.com/countryrank.php?year=2016)*, but its global ranking hovers in forties (45th rank) in the indicator of Intellectual Property Rights (IPR) according to the International Property Rights Index (IPRI) Report-2017 (https://internationalpropertyrightsindex.org/countries). The rankings in both parameters (research articles & IPRs) reflect the reluctance of Indian researchers to convert their academic excellence into technologies/products/patents.

India's dream of becoming a strong and developed nation cannot be fulfilled unless India improves its ranking in the domain of patents and technology transfer. In order to achieve this, it is imperative that we understand the ecosystem of Research and Development (R&D) of Higher Education institutes (HEIs) and R&D labs in India. Keeping this in mind, Department of Science & Technology (DST)-Centre for Policy Research (CPR) at Panjab University, Chandigarh undertook a study to analyse the research publications and patenting profile of more than 900 institutes of India comprising of top HEIs (351) and all national R&D institutions (553). The HEIs comprise of Institutions of National Importance (INIs), universities, engineering institutes, pharma institutes and private universities based on the national rankings released in 2016. The national R&D labs, included in this study, have been established under 27 ministries of Govt. of India and 2 independent departments under Prime Minister of India**.** The breakup of 904 institutes, considered in this study, is depicted in figure 1.

Objectives

i) Identify institutes good in research publications as well as in generation of patents.

ii) Identify institutes good in research publications , but low on generation of patents.

iii) Understand the ecosystem for the generation of patents by the institutes.

Expected Outcome

Strengthening the ecosystem for generation of patents in the institutes displaying limited number of patents, but high on research publications.

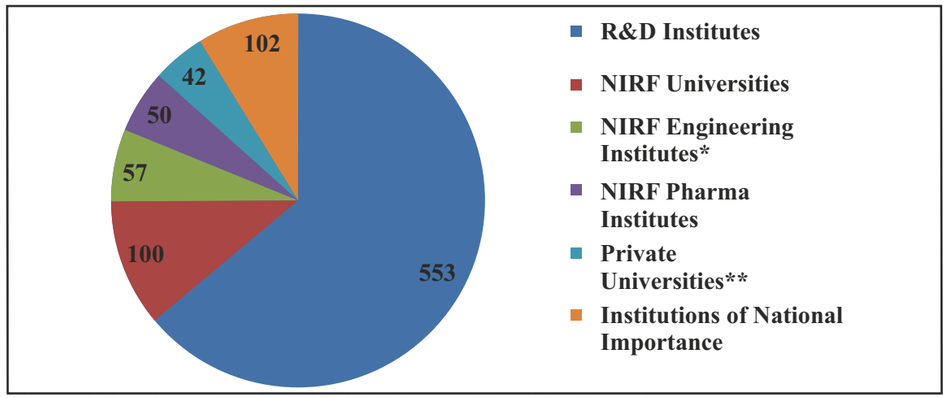

Figure 1: Break up of HEIs and R&D Labs considered for the study

**43 institutes from NIRF Engg. Institutes are included in INIs*

***8 Private Universities are included in the list of top 100 NIRF universities*

Data Collection and Methodology

A. **R&D Labs:** The list of R&D labs was retrieved from the official websites of respective ministries of GoI and Directory for R&D Institutes, published by National Science and Technology Management Information System (NSTMIS) of DST, GoI (http://nstmis-dst.org/PDF/directory-of-r-and-d-institutions-2015.pdf).

B. **NIRF Institutions:** The National Institutional Ranking Framework (NIRF) was launched on 29th September 2015. This framework outlines a broad methodology to rank institutions across the country based on various parameters (https://www.nirfindia.org/Ranking).

C. **INIs:** INI is a status conferred to a premier government education institute in India by an Act of Parliament, INI 'serves as a pivotal player in developing highly skilled personnel within the specified region of the country/state'. For this study the data was collected from (http://mhrd.gov.in/institutions-national-importance).

D. **Private Universities:** A private university is a university established through a State/Central Act by a sponsoring body. For this study, data was gathered from CAREERS 360 *(*https://university.careers360.com/colleges/ranking?page=3*)*.

E. **Publications:** The research article publication data for HEIs and R&D labs was retrieved from Scopus owned by Elsevier (https://www.scopus.com/). Scopus is a largest abstract and citation database of peer-reviewed literature, scientific research articles, books and conference proceedings. For this study, we have considered only research article publications.

F. **Patents:** The raw data for patents (published & granted) of INIs was procured from a well-reputed private firm, Talwar & Talwar (TT) Consultants (http://ttconsultants.com/xlpat-patent-search-tool.php) located in Mohali, Punjab, India. Search tools used for extracting the relevant data were as follows:

- XLPAT owned by TT Consultants (http://ttconsultants.com/xlpat-patent-search-tool.php)
- InPASS of Govt. of India (http://ipindiaservices.gov.in/publicsearch)
- Orbit owned by Questel (https://www.questel.com/)
- Dervent Innovation owned by Clarivate Analytics (https://clarivate.com/products/derwent-innovation/)

The patent search tools used for data extraction provide 80-90% accuracy. It is pertinent to mention that the patent data was collected based on 'Name of the Applicant', which, in general, is either an institute or a scientist/s belonging to an institute. However, in case of national R&D laboratories, the 'Applicant' is usually the parent organization such as CSIR, ICMR, DRDO, etc. In such scenario, parent organizations were requested to provide the list of patents originating from different research laboratories of respective organizations. The research laboratory, from which patent/s originated, was considered as an 'Applicant' for our study. The patents data was then classified according to different fields (Engineering, Medical Sciences, Biotechnology, etc.) based on the code assigned to each patent by IPO.

For the current study, only granted-patents were considered. The data pertaining to filed-patents was not taken into account, as many institutes are resorting to submission of patents without getting proper evaluation of the patent-application, based on the patentability criteria (novelty, industrial application and non-obviousness to a person skilled in the related field of the technology). The patentability chances of such patent-applications are very low and ultimately get rejected by the competent authorities.

The data collected was analysed as 'Composite Analysis' and 'Sector-wise Analysis'. For 'Composite Analysis' all the 904 institutes were taken into consideration for rankings based on research publications and patents. For 'Sector-wise Analysis' rankings, have been carried out based on following sectors i.e. national R&D labs (553), INIs (102), top 100 NIRF universities, top 100 NIRF engineering institutes, top 50 private universities and top 50 NIRF Pharma institutes. The study was further extended to identify institutes showing creditable performances in the field of Chemical Engineering, Physics, Engineering, Biotechnology/Food/Agriculture, Medical Sciences and Pharma/Drugs. As already mentioned, the sources of data extraction for research articles and patents are different, and the field wise classification criteria of both the sources are diverse. The scientific staff of DST-CPR at PU, Chandigarh has tried to make most appropriate combinations (Table 1) to justify the comparison of both the parameters (research articles & patents).

Table 1: Matching of Various Fields Mentioned in the Categories of Patents and Research Publications

S. No.	Fields in which patents have been categorized		Fields in which research publications have been categorized
1.	Physics		Physics & Astronomy
2.	Pharma/Drugs		Pharmacology, Toxicology and Pharmaceutics
3.	Medical Sciences		· Medicine · Health Profession · Dentistry · Neuroscience
4.	Engineering	· Mechanical Engineering · ECE · Electrical Engineering	· Engineering · Computer Science
5.	Chemical Engineering		· Chemical Engineering · Material Science · Chemistry
6.	Biotech/Food/ Agriculture	· Biotechnology/Biological Science · Food/Agriculture	· Agricultural and Biological Sciences · Biochemistry and Genetics and Molecular Biology · Immunology & Microbiology · Environmental Sciences

Time Span for the Study: For the purpose of this study, data for research articles' publications and patents (filed and granted) was collected for the period 2010-16. The time span of 7 years is considered enough to analyse trends on parameters of articles' publications and patents of the institutes.

Results and Analyses

- **Composite Analysis of 904 Institutions**
- **Sector Wise Analysis of 904 Institutions**
  - *I. Institutions of National Importance (102)*
  - *ii. Top 100 NIRF Engineering Institutes*
  - *iii. Top 100 NIRF Universities*
  - *iv. Top 50 Private Universities*
  - *v. Top 50 NIRF Pharma Institutes*
  - *vi. National R&D Laboratories (553)*

5.1.1 Composite Analysis of 904 Institutions : In this catagory all institutions comprising of HEIs (351) and national rearch labs (553) were mapped for total number of research publications and patents filed and granted for the period 2010-16. The list of top 50 ranked institutions based on number of research publications is mentioned in table 2.

Table 2: Rankings of Top 50 Institutions Based on Research Publications (2010-16)

Rankings	Institutions	Number of Research Publications	Number of Patents (Granted)	Status
1.	DU, New Delhi	15052	26	CU
2.	IISc., Bangalore	10852	174	CU
3.	IIT, Kharagpur	8724	10	INI
4.	BHU, Varanasi	8140	3	CU
5.	BARC, Mumbai	7887	16	DAE
6.	UoH, Hyderabad	7649	5	CU
7.	AIIMS, New Delhi	7634	31	INI
8.	IIT, New Delhi	7148	56	INI
9.	IIT, Madras	6440	48	INI
10.	IIT, Bombay	6300	100	INI
11.	VIT University, Vellore	6267	3	PrU
12.	IIT, Roorkee	6028	1	INI
13.	IIT, Kanpur	5622	44	INI
14.	Annamalai University, Chidambram	5400	1	SU
15.	IIT, Hyderabad	5398	2	INI
16.	PGIMER, Chandigarh	5380	1	MHFW
17.	Gujarat University, Ahmedabad	4871	0	SU
18.	PU, Chandigarh	4733	2	SU

19.	AMU, Aligarh	4588	2	CU
20.	IICT, Hyderabad	4534	76	CSIR
21.	Manipal University, Manipal	4444	13	PrU
22.	IIT, Guwahati	4205	0	INI
23.	IARI, New Delhi	3934	4	ICAR
24.	S.R.M Institute of Science & Technology, Chennai	3509	4	PrU
25.	TIFR, Mumbai	3494	4	DAE
26.	NCL, Pune	3232	114	CSIR
27.	Sathyabama University, Chennai	3211	0	PrU
28.	Indian Association for the Cultivation of Science, Kolkata	2961	2	DST
29.	Bharathiar University, Coimbatore	2948	0	SU
30.	JNU, New Delhi	2739	6	CU
31.	ICT, Mumbai	2671	39	SU
32.	Saha Institute of Nuclear Physics, Kolkata	2543	1	DAE
33.	Jammu University, Tawi	2524	0	SU
34.	Osmania University, Hyderabad	2467	0	SU
35.	NPL, New Delhi	2378	25	CSIR
36.	Sri Venkateswara University, Tirupati	2344	0	SU
37.	IIT, Dhanbad	2323	3	INI
38.	Jamia Millia Islamia, New Delhi	2320	0	CU
39.	NIT, Rourkela	2275	0	INI
40.	Thapar University, Patiala	2269	0	PrU
41.	IGCAR, Tamil Nadu	2250	9	DAE
42.	IVRI, Izatnagar	2242	6	ICAR
43.	GNDU, Amritsar	2177	1	SU
44.	Pondicherry University, Puducherry	2151	1	CU
45.	CDRI, Lucknow	2125	42	CSIR
46.	UoA, Allahabad	2109	0	CU
47.	Bharath University, Chennai	2082	0	PrU
48.	Shivaji University, Kohlapur	2063	0	SU
49.	ISI, Kolkata	1886	13	INI
50.	Coimbatore Institute of Technology, Coimbatore	1854	0	SU

Blue - Good in number of patents-granted (>25)
Black – Average in number of patents-granted (10-25)
Red – Low or Nil in number of patents-granted (<10)
CU – Central University, SU – State University, PrU – Private University, INI – Institution of National Importance
Note: Full forms of abbreviations for institutions is mentioned in Annexure -1

Figures 2 and 3 reflect top 10 ranked institutions based on research publications and patents (granted) respectively.

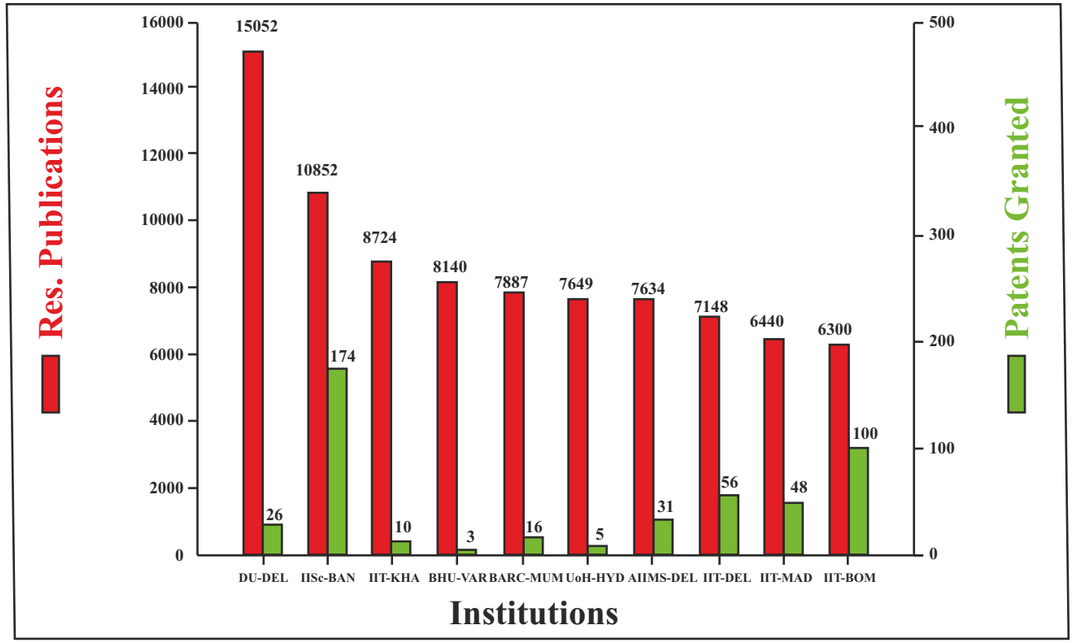

Figure 2: Top 10 Ranked Institutions Based on Number of Research Publications (2010-16)

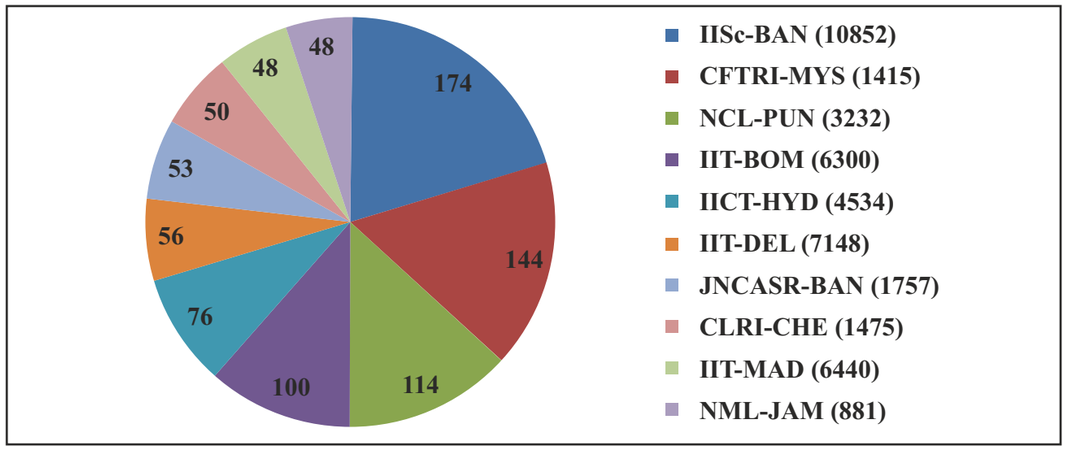

Figure 3: Top Ranked 10 Institutions Based on Number of Patents Granted (2010-16)
Note: Numbers in brackets represents number of research publications

5.1.2: Field Wise Analysis of 904 Institutions

Table 3: Rankings of Top 50 Institutions Based on Research Publications in the Field of **Physics** (2010-16)

Rankings	Institutions	Number of Research Publications	Number of Patents (Granted)	Status
1.	BARC, Mumbai	3583	1	DAE
2.	IISc., Bangalore	3527	26	CU
3.	DU, New Delhi	2850	0	CU
4.	TIFR, Mumbai	2499	3	DAE
5.	IIT, Kharagpur	2141	1	INI
6.	IIT, Madras	2010	9	INI
7.	IIT, Kanpur	1983	3	INI
8.	Saha Institute of Nuclear Physics, Kolkata	1926	0	DAE
9.	PU, Chandigarh	1783	0	SU
10.	IIT, New Delhi	1762	3	INI
11.	IIT, Bombay	1698	9	INI
12.	BHU, Varanasi	1605	0	CU
13.	UoH, Hyderabad	1386	0	CU
14.	IIT, Roorkee	1301	0	INI
15.	Indian Association for the Cultivation of Science, Kolkata	1242	1	DST
16.	NPL, New Delhi	1219	1	CSIR
17.	IIT, Guwahati	1209	0	INI
18.	Indira Gandhi Centre for Atomic Research, Kalpakkam	1078	1	DAE
19.	Institute for Plasma Research, Gandhinagar	866	1	DAE
20.	Annamalai University, Chidambram	809	0	SU
21.	Institute of Physics, Bhubaneswar	778	0	DAE
22.	AMU, Aligarh	759	0	CU
23.	Variable Energy Cyclotron Centre, Kolkata	727	0	DAE
24.	VIT University, Vellore	717	0	PrU
25.	S.N. Bose National Centre for Basic Sciences, Kolkata	714	4	DST
26.	Thapar University, Patiala	700	0	PrU
27.	Physical Research Laboratory, Ahmedabad	687	0	CSIR
28.	Raja Ramanna Centre for Advanced Technology, Indore	681	0	DAE
29.	Raman Research Institute, Bangalore	669	12	DST
30.	Visva-Bharati University, Shantiniketan	613	0	CU
31.	Indian Institute of Astrophysics, Bangalore	608	0	DST
32.	Gujarat University, Ahmedabad	597	0	SU
33.	JNCASR, Bangalore	591	15	DST
34.	IIT, Hyderabad	589	0	INI
35.	Harish Chandra Research Institute, Allahabad	587	0	DAE
36.	Jamia Millia Islamia, New Delhi	575	0	CU
37.	Bharathiar University, Coimbatore	568	0	PrU
38.	Jammu University, Tawi	568	0	SU
39.	Sri Venkateswara University, Tripura	533	0	SU
40.	CGCR, Kolkata	530	0	CSIR
41.	IIT (ISM), Dhanbad	523	0	INI
42.	NCL, Pune	515	0	CSIR
43.	Shivaji University, Kolhapur	512	0	SU
44.	GNDU, Amritsar	482	0	SU
45.	Cochin University of Science and Technology, Cochin	480	0	SU
46.	The Institute of Mathematical Sciences, Chennai	463	0	DAE
47.	IISER, Pune	455	0	INI
48.	Pondicherry University, Puducherry	453	0	CU
49.	S.R.M Institute of Science and Technology University, Chennai	446	0	PrU
50.	Tezpur University, Tezpur	442	0	CU

Blue - Good in number of patents-granted (>25)
Black – Average in number of patents-granted (10-25)
Red – Low or Nil in number of patents-granted (<10)
CU – Central University, SU – State University, PrU – Private University, INI – Institution of National Importance
Note: Full forms of abbreviations for institutions is mentioned in Annexure -1

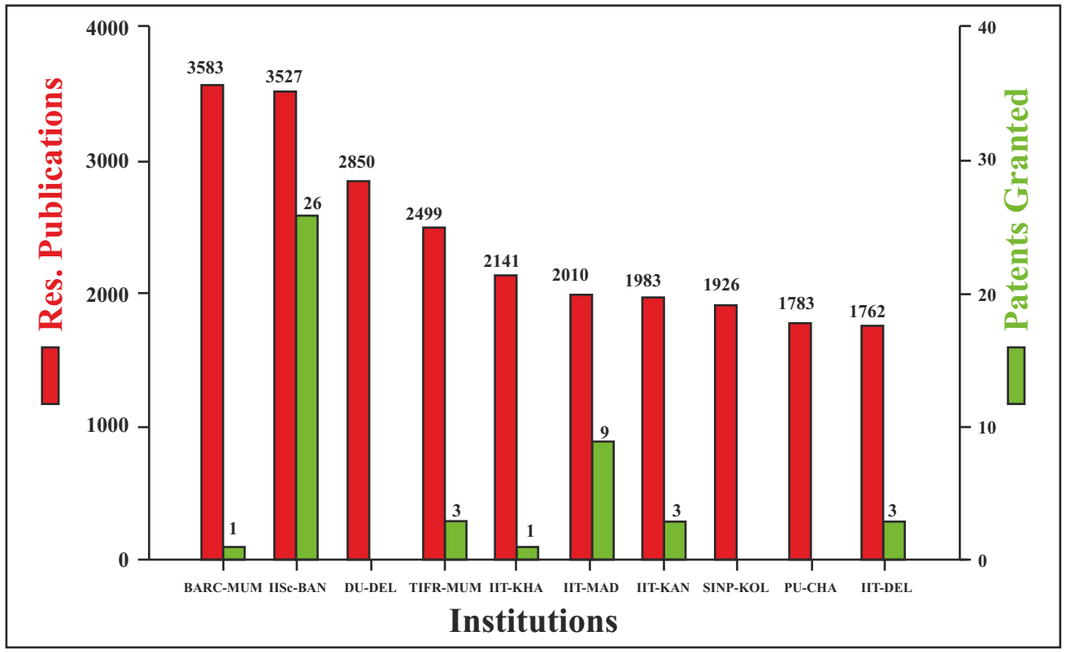

Figure 4: Top 10 Ranked Institutions Based on Number of Research Publications in the Field of **Physics** (2010-16)

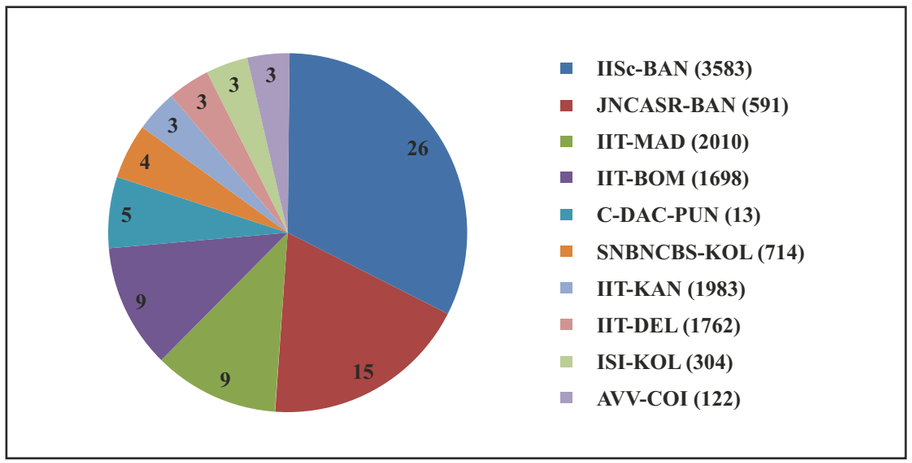

Figure 5: Top 10 Ranked Institutions Based on Number of Patents Granted in the Field of **Physics** (2010-16)
Note: Numbers in brackets represents number of research publications

Table 4: Rankings of Top 50 Institutions Based on Research Publications in the Field of **Pharma/ Drugs** (2010-16)

Rankings	Institutions	Number of Research Publications	Number of Patents (Granted)	Status
1.	DU, New Delhi	1403	7	CU
2.	IIT, Hyderabad	1295	0	INI
3.	IICT, Hyderabad	1271	28	CSIR
4.	Gujarat University, Ahmedabad	1173	0	SU
5.	UoH, Hyderabad	1066	0	CU
6.	VIT University, Vellore	982	0	PrU
7.	Annamalai University, Chidambram	965	1	SU
8.	Bharath University, Chennai	833	0	PrU
9.	Manipal University, Manipal	832	0	PrU
10.	Jamia Hamdard, New Delhi	829	6	Public (Deemed)
11.	CDRI, Lucknow	802	24	CSIR
12.	BHU, Varanasi	761	1	CU
13.	Sathyabama Institute of Science and Technology, Chennai	723	0	PrU
14.	S.R.M Institute of Science And Technology, Chennai	602	1	PrU
15.	PU, Chandigarh	591	2	SU
16.	Jawaharlal Nehru Technological University, Hyderabad	476	0	SU
17.	Osmania University, Hyderabad	472	0	SU
18.	Sri Venkateswara University, Tirupati	418	0	SU
19.	Manipal College of Pharmaceutical Sciences, Manipal	389	0	PrU
20.	UIPS (PU), Chandigarh	385	0	SU
21.	Indian Institute of Integrative Medicine, Jammu	346	4	CSIR
22.	Bharati Vidyapeeth, Pune	330	0	PrU
23.	Bharathiar University, Coimbatore	329	0	SU
24.	IITR, Lucknow	327	0	CSIR
25.	BITS, Pilani	322	0	PrU

26.	AIIMS, New Delhi	320	9	MHFW
27.	Birla Institute of Technology, Ranchi	308	0	PrU
28.	Karpagam University, Coimbatore	305	0	PrU
29.	Poona College of Pharmacy Pune, Erandwane	298	0	PrU
30.	AMU, Aligarh	286	0	CU
31.	JSS University, Mysore	271	0	PrU
32.	National Chemical Laboratory, Pune	263	10	CSIR
33.	GNDU, Amritsar	263	1	SU
34.	Indian Institute of Chemical Biology, Kolkata	257	4	CSIR
35.	IISc, Bangalore	256	18	CU
36.	Periyar University, Salem	254	0	SU
37.	University College of Pharmaceutical Sciences, Warangal (Kakatiya University)	226	0	SU
38.	Department of Pharmaceutical Sciences, Dibrugarh (Dibrugarh University)	226	0	SU
39.	UoA, Allahabad	218	0	CU
40.	S.R.M Institute of Science and Technology, Chennai	217	1	PrU
41.	PGIMER, Chandigarh	208	0	MHFW
42.	CIMAP, Lucknow	204	5	CSIR
43.	Pondicherry University, Puducherry	201	0	CU
44.	IIT, Kharagpur	200	0	INI
45.	NIPER, Mohali	195	10	INI
46.	BARC, Mumbai	195	0	DAE
47.	Nirma University, Ahmedabad	191	0	PrU
48.	Jamia Millia Islamia, New Delhi	185	0	CU
49.	INMAS, New Delhi	177	0	DRDO
50.	Guru Jambeshwar University of Science And Technology, Hisar	172	0	SU

Blue - Good in number of patents-granted (>25)
Black – Average in number of patents-granted (10-25)
Red – Low or Nil in number of patents-granted (<10)
CU – Central University, SU – State University, PrU – Private University, INI – Institution of National Importance
Note: Full forms of abbreviations for institutions is mentioned in Annexure -1

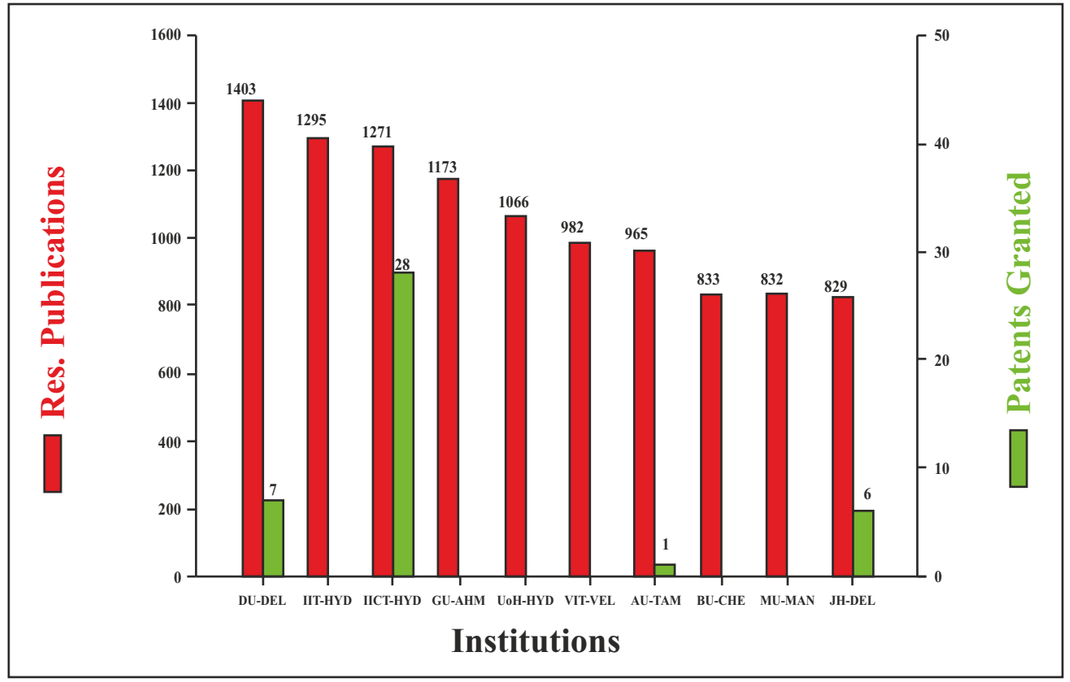

Figure 6: Top 10 Ranked Institutions Based on Number of Research Publications in the Field of **Pharma/Drugs** (2010-16)

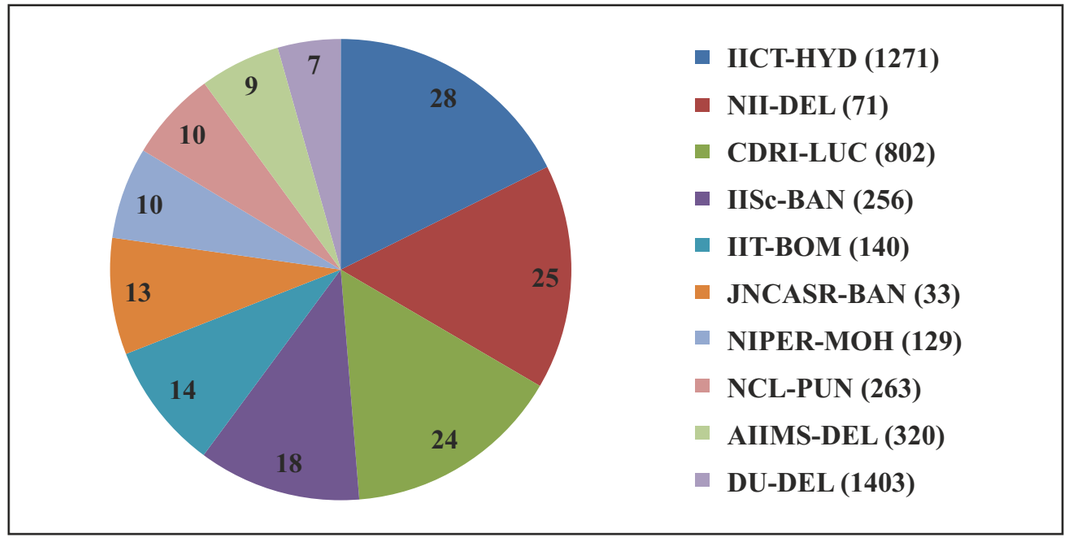

Figure 7: Top 10 Ranked Institutions Based on Number of Patents Granted in the Field of **Pharma/Drugs** (2010-16)

Note: Numbers in brackets represents number of research publications

Table 5: Rankings of Top 50 Institutions Based on Research Publications in the Field of **Medical Sciences** (2010-16)

Rankings	Institutions	Number of Research Publications	Number of Patents (Granted)	Status
1.	AIIMS, New Delhi	6521	2	MHFW
2.	PGIMER, Chandigarh	5046	1	MHFW
3.	DU, New Delhi	3715	0	CU
4.	Manipal University, Manipal	2909	0	CU
5.	BHU, Varanasi	2051	0	CU
6.	NIMHANS, Bangalore	1850	0	MHFW
7.	UoH, Hyderabad	1289	0	CU
8.	IISc., Bangalore	1171	2	CU
9.	BARC, Mumbai	1080	1	DAE
10.	AMU, Aligarh	1024	0	CU
11.	PU, Chandigarh	952	0	SU
12.	King George's Medical University Lucknow	912	0	SU
13.	Annamalai University, Chidambaram	901	0	SU
14.	CDRI, Lucknow	882	0	CSIR
15.	Sree Chitra Tirunal Institute for Medical Sciences and Technology Thiruvananthapuram	832	1	INI
16.	Gujarat University, Ahmedabad	716	0	SU
17.	VIT University, Vellore	671	0	PrU
18.	Jamia Hamdard, New Delhi	654	0	Public (Deemed)
19.	JNU, New Delhi	640	0	CU
20.	IIT, Kharagpur	575	0	INI
21.	IGIB, New Delhi	558	0	CSIR
22.	IICB, Kolkata	544	0	CSIR
23.	AFMC, Pune	498	0	MoD
24.	CCMB, Hyderabad	492	0	CSIR
25.	IVRI, Izatnagar	489	0	ICAR
26.	IIT, Hyderabad	486	0	INI
27.	Bharathiar University, Coimbatore	483	0	PrU
28.	Osmania University, Hyderabad	467	0	SU
29.	Institute of Post Graduate Medical Education and Research, Kolkata	450	0	MHFW
30.	S.R.M Institute of Science and Technology, Chennai	448	2	PrU
31.	IIT, New Delhi	444	1	INI
32.	Bharati Vidyapeeth, Pune	438	0	PrU
33.	IICT, Hyderabad	435	0	CSIR
34.	IIT, Madras	433	1	INI
35.	Jamia Millia Islamia, New Delhi	426	0	CU
36.	IITR, Lucknow	386	0	CSIR
37.	Bose Institute, Kolkata	373	0	DST
38.	GNDU, Amritsar	358	0	SU
39.	Institute of Nuclear Medicine & Allied Sciences, New Delhi	343	0	DRDO
40.	IIT, Bombay	339	3	INI
41.	IIT, Kanpur	336	1	INI
42	IIT, Guwahati	334	0	INI
43.	IIT, Roorkee	332	0	INI
44.	JSS University, Mysore	331	0	PrU
45.	CFTRI, Mysore	319	0	CSIR
46.	NII, New Delhi	313	3	DBT
47.	Jammu University, Tawi	311	0	SU
48.	UoA, Allahabad	302	0	CU
49.	NCL, Pune	295	0	CSIR
50.	Regional Institute of Medical Sciences, Imphal	293	0	MHFW

Blue - Good in number of patents-granted (>25)
Black – Average in number of patents-granted (10-25)
Red – Low or Nil in number of patents-granted (<10)

CU – Central University, SU – State University, PrU – Private University, INI – Institution of National Importance

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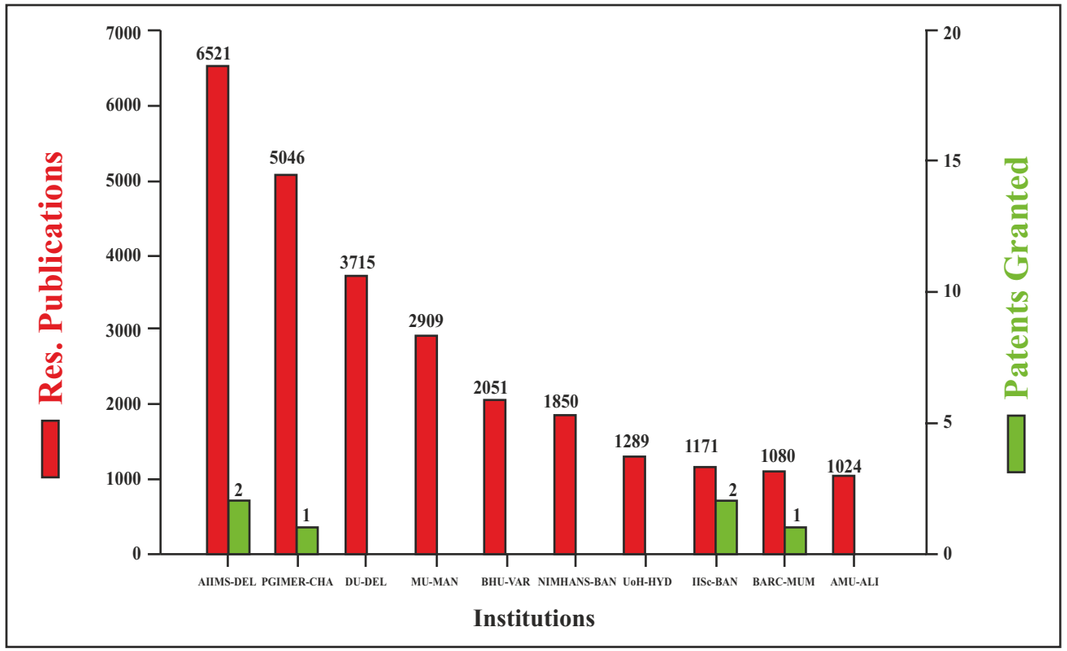

Figure 8: Top 10 Ranked Institutions Based on Number of Research Publications in the Field of **Medical Sciences** (2010-16)

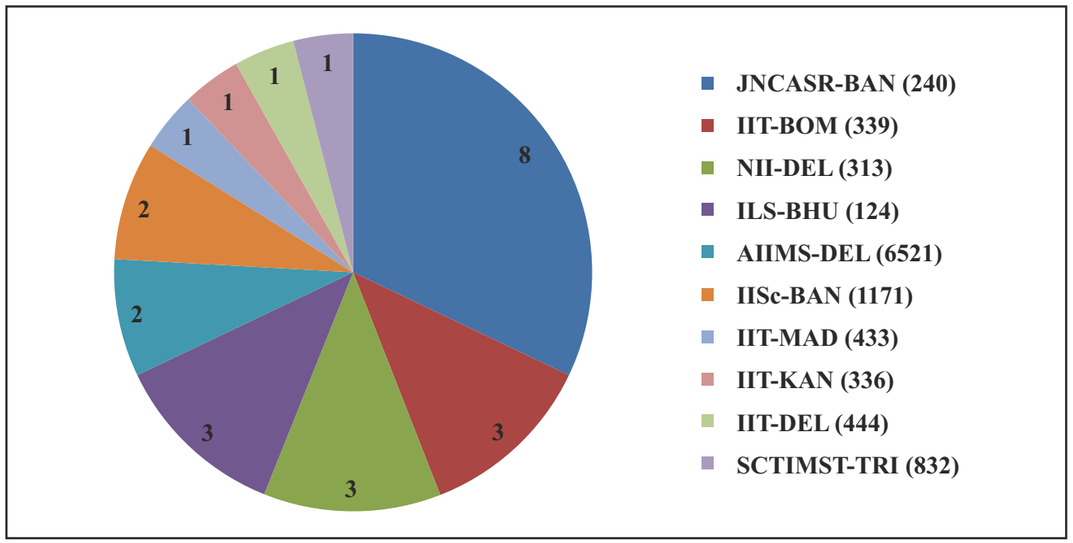

Figure 9: Top 10 Ranked Institutions Based on Number of Patents Granted in the Field of **Medical Sciences** (2010-16)

Note: Numbers in brackets represents number of research publications

Table 6: Rankings of Top 50 Institutions Based on Research Publications in the Field of **Engineering** (2010-16)

Rankings	Institutions	Number of Research Publications	Number of Patents (Granted)	Status
1.	IIT, Kharagpur	4211	9	INI
2.	IISc., Bangalore	3442	97	CU
3.	IIT, New Delhi	3143	14	INI
4.	IIT, Madras	3040	21	INI
5.	IIT, Roorkee	2871	0	INI
6.	VIT University, Vellore	2737	3	PrU
7.	DU, New Delhi	2483	0	CU
8.	IIT, Bombay	2481	46	INI
9.	IIT, Kanpur	2190	19	INI
10.	Sathyabama Institute of Science and Technology, Chennai	1670	0	PrU
11.	S.R.M Institute of Science And Technology, Chennai	1545	2	PrU
12.	IIT, Guwahati	1501	0	INI
13.	BARC, Mumbai	1379	3	DAE
14.	Coimbatore Institute of Technology, Coimbatore (Anna University)	1344	0	Public (SU)
15.	NIT, Rourkela	1298	0	INI
16.	Thapar University, Patiala	128	0	PrU
17.	UoH, Hyderabad	5123	0	CU
18.	Annamalai University, Chidambram	51233	0	SU
19.	BHU, Varanasi	1225	0	CU
20.	IIT (ISM), Dhanbad	1055	1	INI
21.	PSG College of Technology, Coimbatore	980	1	PrU
22.	Amrita Viswa Vidyapeetham, Amrita Nagar	920	2	PrU
23.	Bharathiar University, Coimbatore	870	0	SU
24.	Indira Gandhi Centre for Atomic Research, Kalpakkam	869	0	DAE
25.	S.R.M Institute of Science and Technology Chennai	860	2	PrU

26.	Indian Statistical Institute, Kolkata	824	9	INI
27.	NIT, Durgapur	794	0	INI
28.	Thiagarajar College of Engineering, Madurai (Annu University)	767	5	SU
29.	IIT, Hyderabad	744	2	INI
30.	NIT, Karnataka	705	0	INI
31.	Jamia Millia Islamia, New Delhi	703	0	CU
32.	NPL, New Delhi	662	6	CSIR
33.	PU, Chandigarh	647	0	SU
34.	AMU, Aligarh	633	0	CU
35.	NIT, Calicut	596	0	INI
36.	MNIT, Allahabad	596	0	INI
37.	Birla Institute of Technology, Ranchi	582	3	PrU
38.	ICT, Mumbai	576	1	SU
39.	Shivaji University, Kolhapur	575	0	SU
40.	IIT (BHU), Varanasi	563	0	INI
41.	NIT, Warangal	557	0	INI
42.	Gujarat University, Ahmedabad	555	0	SU
43.	BITS, Pilani	533	0	PrU
44.	Sri Venkateswara University, Tripura	512	0	SU
45.	Karunya University, Coimbatore	510	0	PrU
46.	NIT, Kurukshetra	498	0	INI
47.	Bharath University, Chennai	498	0	PrU
48.	College of Engineering, Pune	497	0	Public
49.	DMRL, Hyderabad	484	0	DRDO
50.	Cochin University of Science and Technology, Cochin	473	0	SU

Blue - Good in number of patents-granted (>25)

Black – Average in number of patents-granted (10-25)

Red – Low or Nil in number of patents-granted (<10)

CU – Central University, SU – State University, PrU – Private University, INI – Institution of National Importance

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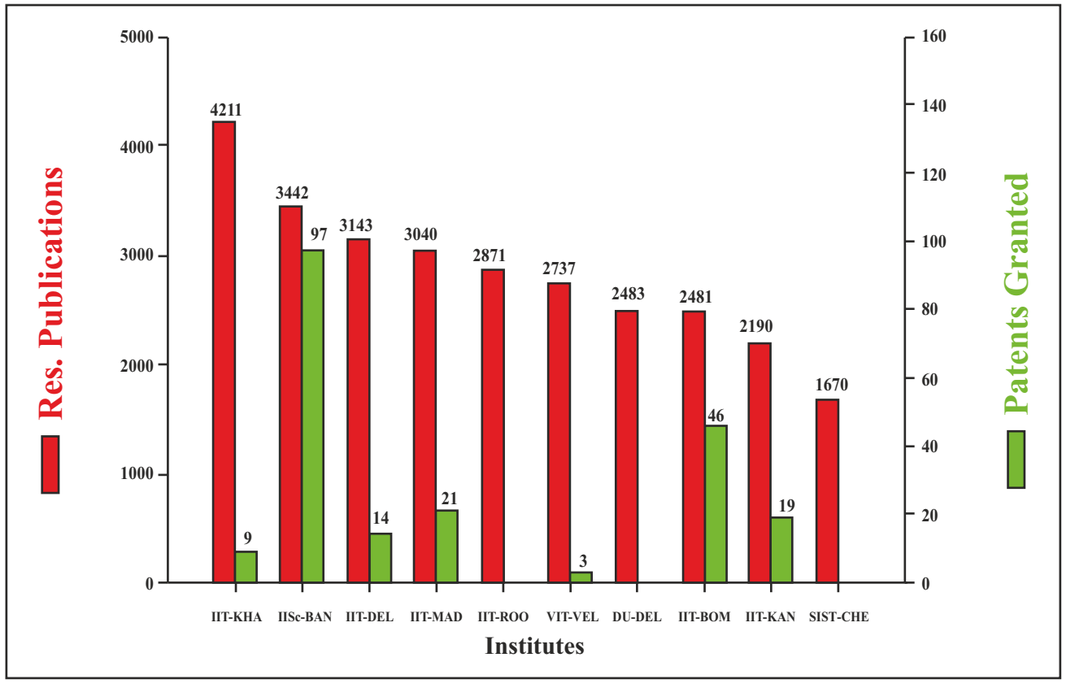

Figure 10: Top 10 Ranked Institutions Based on Number of Research Publications in the Field of **Engineering** (2010-16)

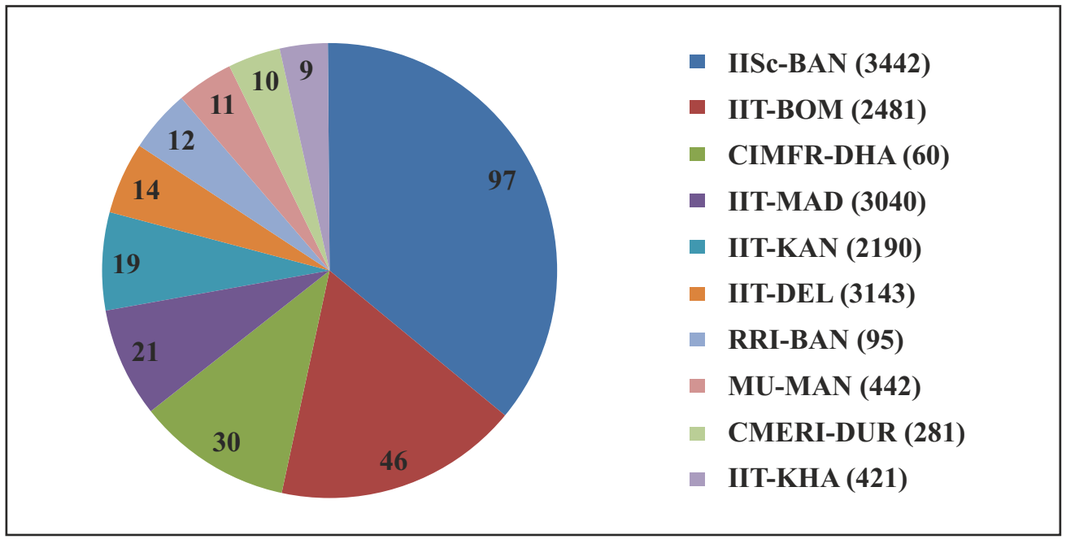

Figure 11: Top 10 Ranked Institutions Based on Number of Patents Granted in the Field of **Engineering** (2010-16)

Note: Numbers in brackets represents number of research publications

Table 7: Rankings of Top 50 Institutions Based on Research Publications in the Field of **Chemical Engineering** (2010-16)

Rankings	Institutions	Number of Research Publications	Number of Patents (Granted)	Status
1.	IISc., Bangalore	6974	19	CU
2.	BARC, Mumbai	5987	7	DAE
3.	IIT, Kharagpur	5890	0	INI
4.	IIT, Hyderabad	5860	0	INI
5.	DU, New Delhi	5613	3	CU
6.	IICT, Hyderabad	5246	44	CSIR
7.	IIT, Madras	4514	22	INI
8.	UoH, Hyderabad	4418	4	CU
9.	IIT, New Delhi	4256	17	INI
10.	IIT, Bombay	4132	29	INI
11.	IIT, Kanpur	4060	17	INI
12.	NCL, Pune	4045	97	CSIR
13.	BHU, Varanasi	3863	1	CU
14.	IIT, Roorkee	3612	1	INI
15.	Indian Association for the Cultivation of Science, Kolkata	3532	1	DST
16.	IIT, Guwahati	3067	0	INI
17.	ICT, Mumbai	2917	20	SU
18.	VIT University, Vellore	2712	2	PrU
19.	Gujarat University, Ahmedabad	2680	0	SU
20.	Annamalai University, Chidambram	2380	0	SU
21.	NPL, New Delhi	2293	17	CSIR
22.	Indira Gandhi Centre for Atomic Research, Kalpakkam	2083	8	DAE
23.	AMU, Aligarh	1974	2	CU
24.	CLRI, Chennai	1754	32	CSIR
25.	Shivaji University, Kolhapur	1749	0	SU
26.	PU, Chandigarh	1690	0	SU
27.	Bharathiar University, Coimbatore	1651	0	PrU
28.	Central Electro Chemical Research Institute, Karaikudi	1636	24	CSIR
29.	Central Salt Marine Chemicals Research Institute, Bhavnagar	1584	33	CSIR
30.	GNDU, Amritsar	1558	0	SU
31.	JNCASR, Bangalore	1539	24	DST
32.	National Institute For Interdisciplinary Science and Technology , Thiruvananthapuram	1463	21	CSIR
33.	Sri Venkateswara University, Tirupati	1448	0	SU
34.	NIT, Rourkela	1361	0	INI
35.	S.R.M Institute of Science and Technology, Chennai	1356	1	PrU
36.	Tezpur University, Tezpur	1345	0	CU
37.	Thapar University, Patiala	1326	0	PrU
38.	Jamia Millia Islamia , New Delhi	1260	0	CU
39.	IIT (ISM), Dhanbad	1247	0	INI
40.	Osmania University, Hyderabad	1216	0	SU
41.	Alagappa University, Karaikudi	1197	0	SU
42.	Central Glass Ceramic Research Institute, Kolkata	1174	35	CSIR
43.	CDRI, Lucknow	1156	17	CSIR
44.	Pondicherry University, Puducherry	1153	1	CU
45.	IIT (BHU), Varanasi	1146	0	INI
46.	NIT, Karnataka	1131	0	INI
47.	IISER, Kolkata	1095	0	INI
48.	Kalyani University, Kalyani	1074	0	SU
49.	BITS, Pilani	1064	0	PrU
50.	Cochin University of Science and Technology, Cochin	1015	0	SU

Blue - Good in number of patents-granted (>25)

Black – Average in number of patents-granted (10-25)

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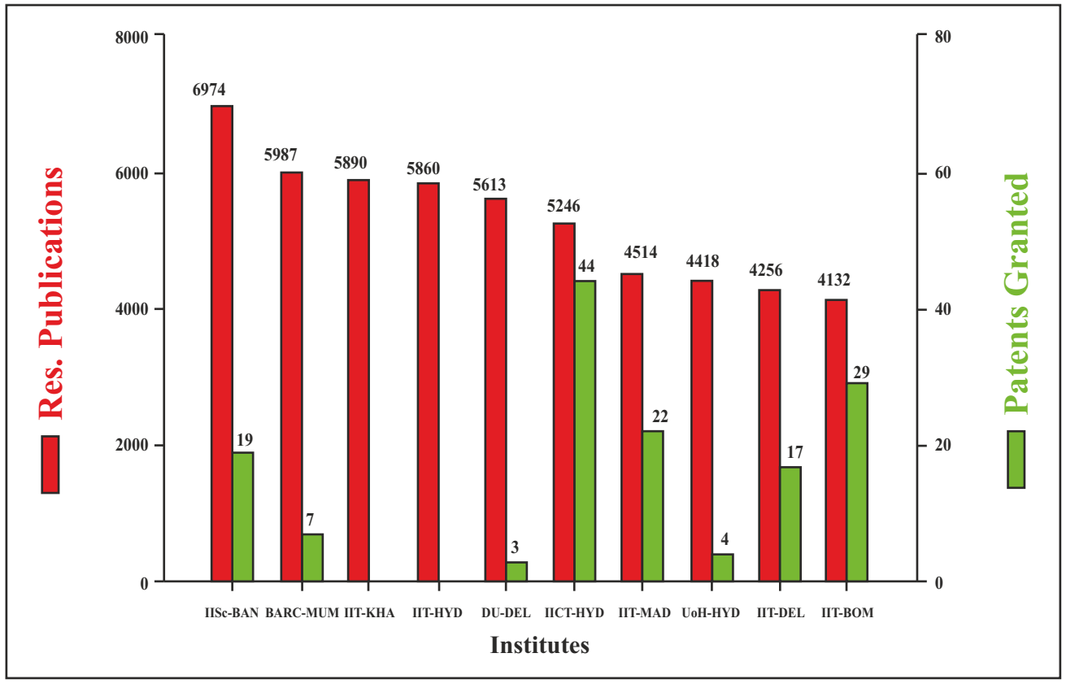

Figure 12: Top 10 Ranked Institutions Based on Number of Research Publications in the Field of **Chemical Engineering** (2010-16)

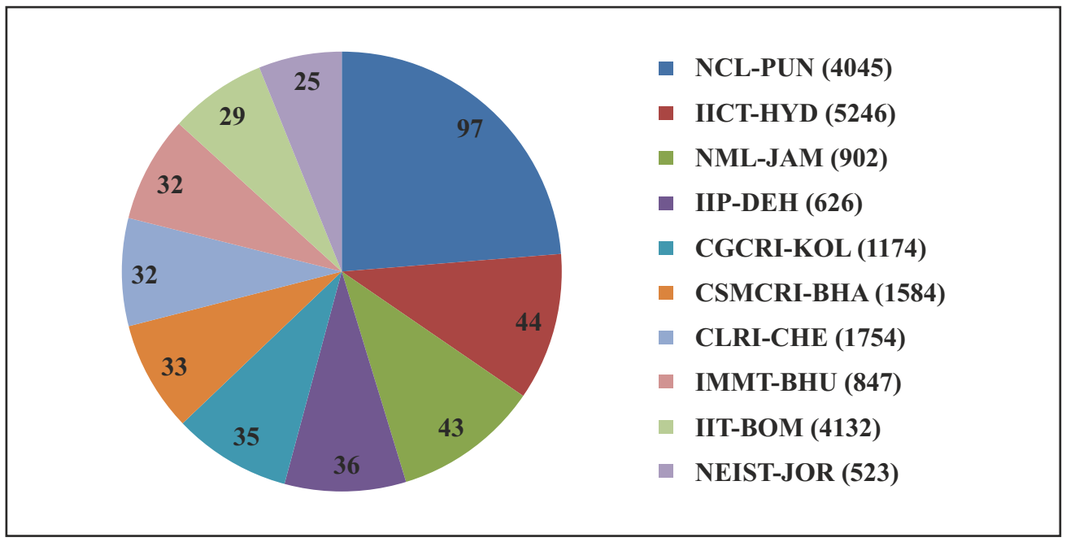

Figure 13: Top 10 Ranked Institutions Based on Number of Patents Granted in the Field of **Chemical Engineering** (2010-16)

Note: Numbers in brackets represents number of research publications

Table 8: Rankings of Top 50 Institutions Based on Research Publications in the Field of **Biotech/Food/Agriculture** (2010-16)

Rankings	Institutions	Number of Research Publications	Number of Patents (Granted)	Status
1.	DU, New DelhiI	6225	24	CU
2.	ARI, New Delhi	4536	0	ICAR
3.	BHU, Varanasi	3920	1	CU
4.	UoH, Hyderabad	3138	2	CU
5.	IISc., Bangalore	2977	25	CU
6.	Annamalai University, Chidambaram	2257	0	SU
7.	Gujarat University, Ahmedabad	2255	0	SU
8.	IIT, Hyderabad	2182	0	INI
9.	BARC, Mumbai	2175	4	DAE
10.	IIT, Kharagpur	2105	0	INI
11.	IICT, Hyderabad	2066	3	CSIR
12.	IIT, New Delhi	2029	5	INI
13.	IVRI, Izatnagar	1929	6	ICAR
14.	AMU, Aligarh	1908	1	CU
15.	VIT University, Vellore	1868	0	PrU
16.	AIIMS, New Delhi	1784	20	MHFW
17.	Manipal University, Manipal	1666	0	PrU
18.	JNU, New Delhi	1625	5	CU
19.	IIT, Roorkee	1492	0	INI
20.	PU, Chandigarh	1472	0	SU
21.	CDRI, Lucknow	1442	1	CSIR
22.	CFTRI, Mysore	1436	121	CSIR
23.	NDRI, Karnal	1422	7	ICAR
24.	IIT, Bombay	1357	9	INI
25.	Jammu University, Tawi	1352	0	SU
26.	IIT, Guwahati	1294	0	INI
27.	NCL, Pune	1220	4	CSIR

28.	IIT, Chennai	1161	5	INI
29.	PGIMER, Chandigarh	1118	0	MHFW
30.	Osmania University, Hyderabad	1113	0	SU
31.	Bharathiar University, Coimbatore	1098	0	PrU
32.	IGIB, New DelhiI	1079	10	CSIR
33.	CT, Mumbai	1053	12	SU
34.	CCMB, Hyderabad	1030	3	CSIR
35.	NBRI, Lucknow	1025	7	CSIR
36.	S.R.M Institute of Science and Technology, Chennai	1018	0	PrU
37.	Sathyabama Institute of Science and Technology, Chennai	1004	0	PrU
38.	IICB, Kolkata	955	1	CSIR
39.	Pondicherry University, Puducherry	927	0	CU
40.	Jamia Hamdard, New Delhi	924	0	Public (Deemed)
41.	UoA, Allahabad	924	0	CU
42.	Bose Institute, Kolkata	909	4	DST
43.	Sri Venkateswara University, Tripura	899	0	SU
44.	IMTECH, Chandigarh	888	9	CSIR
45.	IIT, Kanpur	881	4	INI
46.	Shivaji University, Kolhapur	877	0	SU
47.	GNDU, Amritsar	872	0	SU
48.	CIMAP, Lucknow	848	4	CSIR
49.	Jamia Millia Islamia, New Delhi	847	0	CU
50.	Kalyani University, Kalyani	746	0	SU

Blue - Good in number of patents-granted (>25)

Black – Average in number of patents-granted (10-25)

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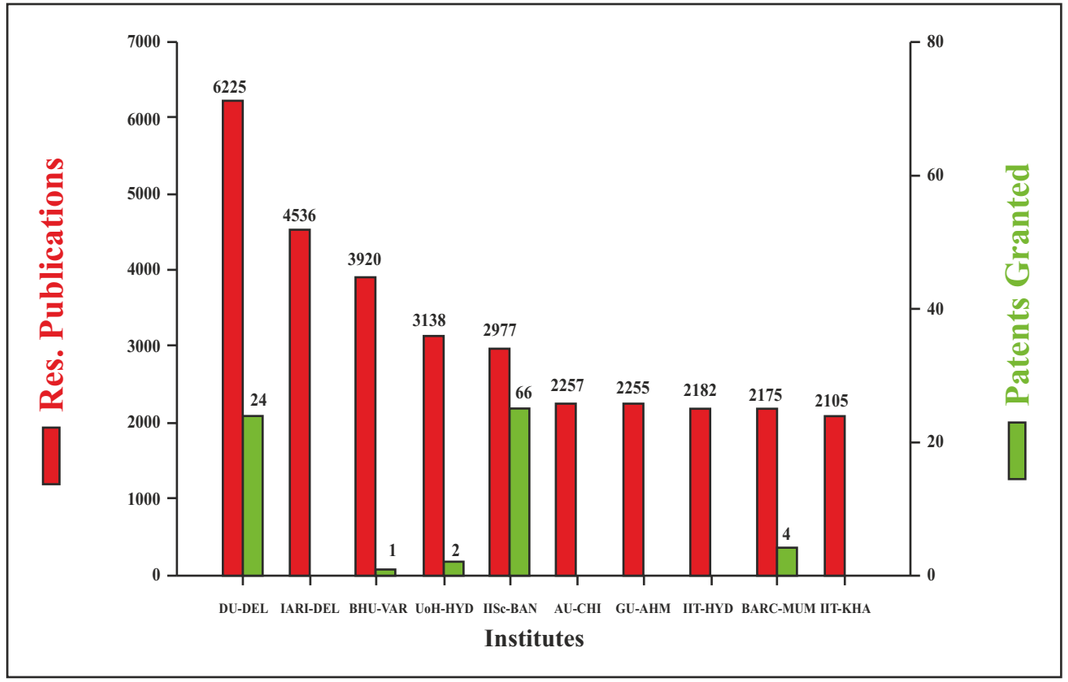


Figure 14: Top 10 Ranked Institutions Based on Number of Research Publications in the Field of **Biotech/Food/Agriculture** (2010-16)

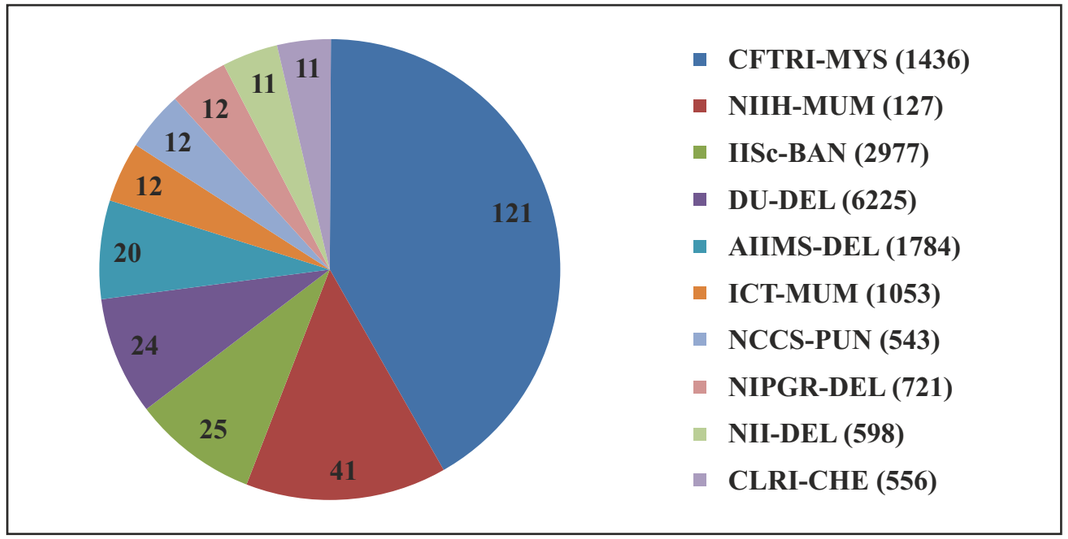


Figure 15: Top 10 Ranked Institutions Based on Number of Patents Granted in the Field of **Biotech/Food/Agriculture** (2010-16)

Note: Numbers in brackets represents number of research publications

Conclusions

1. During the period 2010-16, total number of research publications produced by top 50 ranked institutions ranged between 1,854-15,052. The breakup of top 50 institutions is as follows:
   a) INIs-12 (IITs-9, AIIMS-1, ISI-1, NIT-1)
   b) Universities-26 (Central-9; State-11; Private-6)
   c) National Research Labs-12 (CSIR-4; DAE-4; ICAR-2, MHFW-1, DST-1)

2. Amongst the top 50 institutions, ranked on the basis of research publications, only 11 institutes generated > 25 patents (granted) led by IISc-Bangalore (174) and CFTRI-Mysore (144). Fourteen institutions had no patent (granted) and 17 had patents (granted) in the range of 1-5.

3. Based on field wise analysis of the data of 904 institutions for the period 2010-16, following institutions are leading in the category of patents (granted).
   a) Biotech/Food/Agriculture: CFTRI-Mysore (121); NIIH-Mumbai (41); IISc-Bangalore (26)
   b) Chemical Engineering: NCL-Pune (97); IICT-Hyderabad (44); NML-Jamshedpur (43)
   c) Engineering: IISc-Bangalore (97); IIT-Bombay (46); CIMFR-Dhanbad (30)
   d) Pharma/Drugs: IICT-Hyderabad (28); NII-Delhi (25); CDRI-Lucknow
   e) Physics: IISc-Bangalore (26); JNCASR-Bangalore (15)
   f) Medical Sciences: JNCASR-Bangalore (8); IIT-Bombay (3)

4. The patent ecosystem of institutions, which are good in research publications, but low in patents, as mentioned in tables 2-8, need to be strengthened by understanding the patent ecosystem of institutions generating creditable number of patents (granted) on regular basis.

Sector wise Analysis: All 904 Institutions have been analysed on the basis of various sectors, which are explained in the further sections.

5.2 Institutions of National Importance (INI)

INI is a status conferred to a premier government education institute in India by an Act of Parliament, and 'serves as a pivotal player in developing highly skilled personnel within the specified region of the country/state'. Only a chosen few institutes make it to this coveted list and are usually supported by the Government of India (GoI). Institutes under the gambit of INI in India are mentioned in figure 16.

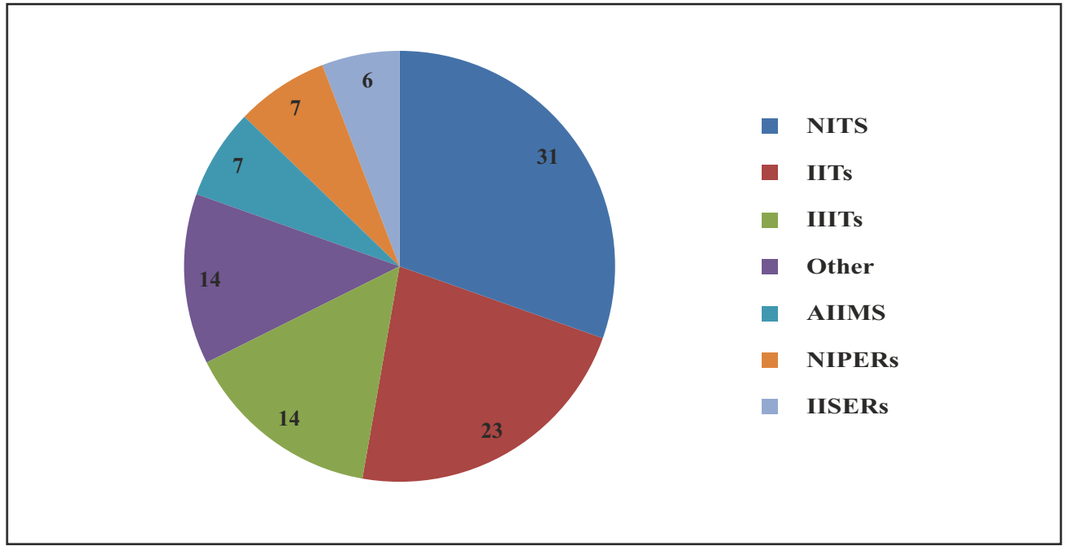


Figure 16: Breakup of Institutions of National Importance

The present study has been specifically carried out on the profile of INIs with respect to research publications and patents, in order to identify the institutions possessing a good research and patenting profile.

Indian Institutes of Technology (IITs): IITs are autonomous public institutes of higher education and are governed by the Institutes of Technology Act, 1961, which declares them as institutions of national importance and lays down their powers, duties, and framework for governance etc. IITs have contributed to the nation's growth and are also recognised worldwide as a leader in the field of engineering education and research. Reputed for the outstanding calibre of students graduating from its undergraduate and postgraduate programmes, the institutes attract the best students from all parts of India.

So far, GoI has established 23 IITs, which can be categorized as first, second and third generation IITs, based on their year of establishment. Their profile according to total number of research publications and patents granted/published is depicted in table 9.

Table 9: Research Publications and Patent Profile of IITs in India (2010-2016)

S. No.	Institute	Year of Establishment	Research Articles	Patents Granted/ Published
	First Generation IITs			
1.	IIT, Kharagpur (IIT-KHA) (www.iitkgp.ac.in)	1950	8724	10 / 171
2.	IIT, Delhi (IIT-DEL) (www.iitd.ac.in)	1961	7148	56 / 208
3.	IIT, Madras (IIT-MAD) (www.iitm.ac.in)	1959	6440	48 / 376
4.	IIT, Bombay (IIT-BOM) (www.iitb.ac.in)	1958	6300	100 / 441
5.	IIT, Roorkee (IIT-ROO) (www.iitr.ernet.in)	1846 (2001)	6028	1 / 25
6.	IIT, Kanpur (IIT-KAN) (www.iitk.ac.in)	1959	5622	44 / 252
	Second Generation IITs			
7.	IIT, Hyderabad (IIT-HYD) (www.iith.ac.in)IIT,	2009	5398	2 / 26
8.	Guwahati (IIT-GUW) (www.iitg.ernet.in)	1994	4205	0 / 23
9.	IIT (Indian School of Mines), Dhanbad (IIT-DHA) (www.iitism.ac.in)	1926 (2016)	2323	3 / 4
10.	IIT (BHU), Varanasi [IIT(BHU)] (www.iitbhu.ac.in)	1916 (2012)	1432	0 / 1
11.	IIT, Indore (IIT-IND) (www.iiti.ac.in)	2009	902	0 / 10
12.	IIT, Bhubaneswar (IIT-BHU) (www.iitbbs.ac.in)	2009	694	0 / 8
13.	IIT, Ropar (IIT-ROP) (www.iitrpr.ac.in)	2009	627	0 / 2
14.	IIT, Patna (IIT-PAT) (www.iitp.ac.in)	2009	597	0 / 6
15.	IIT, Mandi (IIT-MND) (www.iitmandi.ac.in)	2009	468	0 / 0
16.	IIT Gandhinagar (IIT-GAN) (www.iitgn.ac.in)	2009	460	0 / 4
17.	IIT, Jodhpur (IIT-JOD) (www.iitj.ac.in)	2009	232	0 / 3
	Third Generation IITs			
18.	IIT, Goa (IIT-GOA) (www.iitgoa.ac.in)	2016	29	0 / 0
19.	IIT, Tirupati (IIT-TIR) (www.iittp.ac.in)	2015	6	0 / 0
20.	IIT, Jammu (IIT-JMM) (www.iitjammu.ac.in)	2016	5	0 / 0
21.	IIT, Palakkad (IIT-PAL) (www.iitpkd.ac.in)	2015	5	0 / 0
22.	IIT, Bhilai (IIT-BHI) (www.iitbhilai.ac.in)	2016	0	0 / 0
23.	IIT Dharwad (IIT-DHR) (www.iitdh.ac.in)	2016	0	0 / 0

Blue - Good in number of patents-granted (>25)
Black – Average in number of patents-granted (10-25)
Red – Low or Nil in number of patents-granted (<10)

National Institutes of Technology (NITs): NITs are autonomous public institutes of higher education. They are governed by the National Institutes of Technology Act, 2007, which declared them as institutions of national importance alongside IITs. NITs, earlier known as Regional Engineering Colleges, were established 1959 onwards to meet the growing demand of technology-based industries for highly trained engineering graduates and postgraduates, which IITs alone could not provide. Currently, there are 31 NITs located nearly in all the states of India. The profile of research publications and number of patents granted/published has been listed in table 10.

Table 10: Research Publications and Patent Profile of NITs in India (2010-16)

S. No.	Institute	Year of Establishment	Research Articles	Patents Granted/ Published
1.	NIT, Rourkela (NIT-ROU) (www.nitrkl.ac.in)	2002 (1960)*	2275	0 / 6
2.	NIT, Mangaluru (NIT-MNG) (www.nitk.ac.in)	2002 (1960)*	1377	0 / 0
3.	NIT, Durgapur (NIT-DUR) (www.nitdgp.ac.in)	2003 (1960)*	1281	0 / 1

4.	NIT, Warangal (NIT-WAR) (www.nitw.ac.in)	2002 (1959)*	980	0 / 2
5.	MNNIT, Allahabad (MNNIT-ALL) (www.mnnit.ac.in)	2007 (1961)*	937	0 / 7
6.	NIT, Calicut (NIT-CAL) (www.nitc.ac.in)	2002 (1961)*	908	2 / 12
7.	NIT, Kurukshetra (NIT-KUR) (www.nitkkr.ac.in)	2008 (1963)*	834	0 / 2
8.	NIT, Hamirpur (NIT-HAM) (www.nith.ac.in)	2002 (1986)*	697	0 / 1
9.	VNIT, Nagpur (VNIT-NAG) (www.vnit.ac.in)	2002 (1960)*	685	1 / 3
10.	NIT, Tiruchirapalli (NIT-TRU) (www.nitt.edu)	2003 (1964)*	620	0 / 6
11.	MANIT, Bhopal (MANIT-BHO) (www.manit.ac.in)	2002 (1960)*	541	0 / 3
12.	Dr. B.R. Ambedkar NIT, Jallandhar (NIT-JAL) (www.nitj.ac.in)	2002 (1987)*	532	0 / 3
13.	NIT, Agartala (NIT-AGA) (www.nita.ac.in)	2006 (1965)*	465	0 / 2
14.	NIT, Silchar (NIT-SIL) (www.nits.ac.in)	2002 (1967)*	458	0 / 0
15.	NIT, Raipur (NIT-RAI) (www.nitrr.ac.in)	2005 (1956)*	400	0 / 0
16.	SVNIT, Surat (SVNIT-SUR) (www.svnit.ac.in)	2003 (1961)*	304	0 / 11
17.	NIT, Srinagar (NIT-SRI) (www.nitsri.net)	2003 (1960)*	226	0 / 0
18.	NIT, Tadepalligudam (NIT-TAD) (www.nitandhra.ac.in)	2015	226	0 / 0
19.	NIT, Jamshedpur (NIT-JAM) (www.nitjsr.ac.in)	2002 (1960)*	200	0 / 0
20.	NIT, Delhi (NIT-DEL) (www.nitdelhi.ac.in)	2010	162	0 / 0
21.	NIT, Patna (NIT-PAT) (www.nitp.ac.in)	2004 (1886)*	126	0/ 0
22.	NIT, Meghalaya (NIT-MEG) (www.nitm.ac.in)	2010	97	0 / 0
23.	NIT, Puducherry (NIT-PUD) (www.nitt.edu)	2010	59	0 / 0

24.	MNIT, Jaipur (MNIT-JAI) (www.mnit.ac.in)	2002 (1963)*	45	0 / 12
25.	NIT, Manipur (NIT-MNI) (www.nitmanipur.ac.in)	2010	38	0 / 1
26.	NIT, Goa (NIT-GOA) (www.nitgoa.ac.in)	2010	29	0 / 0
27.	NIT, Nagaland (NIT-NGD) (www.nitnagaland.ac.in)	2010	28	0 / 0
28.	NIT, Arunachal Pradesh (NIT-ARU) (www.nitap.in)	2010	26	0 / 0
29.	NIT, Mizoram (NIT-MIZ) (www.nitmz.ac.in)	2010	20	0 / 0
30.	NIT, Srinagar, Uttarakhand (NIT-SRI-UK) (www.nituk.ac.in)	2010	15	0 / 0
31.	NIT, Sikkim (NIT-SIK) (www.nitsikkim.ac.in)	2010	13	0 / 0

Red – Low or Nil in number of patents-granted (<10)

**These NITs were established during the period (1960-1987) as Regional Engineering Colleges; later on these were upgraded to NITs in the year mentioned in brackets.*

Indian Institutes of Science Education and Research (IISERs): IISERs are a group of premier institutes of fundamental science, education and research and were established by the Govt. of India through the Ministry of Human Resources and Development (MHRD) under the National Institute of Technology Bill, 2010. Till date, 7 IISERs have been established and Table 11 depicts their profile of research publications and patents granted/published.

Table 11: Research Publications and Patent Profile of IISERs in India (2010-16)

S. No.	Institute	Year of Establishment	Research Articles	Patents Granted/ Published
1.	IISER, Pune (IISER-PUN) (www.iiserpune.ac.in)	2006	1234	1 / 21
2.	IISER, Kolkata (IISER-KOL) (www.iiserkol.ac.in)	2006	1194	0 / 0
3.	IISER, Bhopal (IISER-BHO) (www.iiserbhopal.ac.in)	2008	635	0 / 1
4.	IISER, Thiruvananthapuram (IISER-THI) (www.iisertvm.ac.in)	2008	360	0 / 3
5.	IISER, Mohali (IISER-MOH) (www.iisermohali.ac.in)	2007	268	0 / 12
6.	IISER, Tirupati (IISER-TIR) (www.iisertirupati.ac.in)	2015	17	0 / 0

Red – Low or Nil in number of patents-granted (<10)

All India Institutes of Medical Science (AIIMS): AIIMS is a group of autonomous medical colleges of higher education set up by an Act of Parliament. AIIMS-Delhi (AIIMS-DEL) was established in 1956 and six more AIIMS were established in 2012 at Bhubaneswar, Bhopal, Rishikesh, Patna, Jodhpur and Raipur (Table 12). AIIMS-DEL is not only the flag bearer of the medical-research institutes in India but is recognised as a premier institute globally. The following table describes the research publications and patent profile of the AIIMS in India.

Table 12: Research Publications and Patent Profile of AIIMS in India (2010-16)

S. No.	Institute	Year of Establishment	Research Articles	Patents Granted/ Published
1.	AIIMS, New Delhi (AIIMS-DEL) (www.aiims.edu)	1956	6591	31 / 52
2.	AIIMS, Bhubaneswar (AIIMS-BHU) (www.aiimsbhubaneswar.edu.in)	2012	113	0 / 0
3.	AIIMS, Bhopal (AIIMS-BHO) (www.aiimsbhopal.edu.in)	2012	113	0 / 0
4.	AIIMS, Rishikesh (AIIMS-RIS) (www.aiimsrishikesh.edu.in)	2012	71	0 / 0
5.	AIIMS, Patna (AIIMS-PAT) (www.aiimspatna.org)	2012	60	0 / 0
6.	AIIMS, Jodhpur (AIIMS-JOD) (www.aiimsjodhpur.edu.in)	2012	46	0 / 0
7.	AIIMS, Raipur (AIIMS-RAI) (www.aiimsraipur.edu.in)	2012	27	0 / 0

Blue - Good in number of patents-granted (>25)
Red – Low or Nil in number of patents-granted (<10)

National Institutes of Pharmaceutical Education and Research (NIPERs): NIPERs are the national level institutes in pharmaceutical sciences with an enunciated objective of becoming a 'centre of excellence' for advanced studies and research in the pharmaceutical sector. NIPERs were established under the NIPER Act, 1998 and are autonomous bodies under the aegis of Department of Pharmaceuticals, Ministry of Chemicals and Fertilizers, Government of India (GoI). These institutes have been conceived to provide leadership in pharmaceutical sciences and related areas. As of now, a total of 7 NIPERs have been established in the states Punjab, Telangana, Bihar, Assam, West Bengal, Uttar Pradesh and Gujarat (Table 13).

Table 13: Research Publications and Patent Profile of NIPERs in India

S. No.	Institute	Year of Establishment	Research Articles	Patents Granted/ Published
1.	NIPER, Hyderabad (NIPER-HYD) (www.niperhyd.ac.in)	2007	284	0 / 0
2.	NIPER, Mohali (NIPER-MOH) (www.niper.ac.in)	1998	222	21 / 86
3.	NIPER, Hajipur (NIPER-HAJ) (niperhajipur.ac.in)	2007	67	0 / 0
4.	NIPER, Guwahati (NIPER-GUW) (niperguwahati.ac.in)	2008	60	0 / 0
5.	NIPER, Kolkata (NIPER-KOL) (www.niperkolkata.edu.in)	2007	54	0 / 0
6.	NIPER, Raebareli (NIPER-RAE) (www.niperraebareli.edu.in)	2008	53	0 / 0
7.	NIPER, Ahmedabad (NIPER-AHM) (www.niperahm.ac.in)	2007	47	0 / 0

Black – Average in number of patents-granted (10-25)
Red – Low or Nil in number of patents-granted (<10)

Indian Institutes of Information Technology (IIITs) and Other Institutes: As mentioned in the figure 16, the status of INI has also been awarded to all the IIITs (14), which were established under the Act namely "The Indian Institutes of Information Technology Act", 2014. These institutes were previously established as Deemed Universities and later upgraded to IIITs for the advancement of new knowledge and innovation in information technology and allied fields to empower the nation to the forefront in the global context.

Table 14: Research Publications and Patent Profile of IIITs in India

S. No.	Institute	Year of Establishment	Research Articles	Patents Granted/ Published
1.	Indian Institute of Information Technology, Guwahati (IIIT-GUW) (www.iiitg.ac.in)	2013	5	0 / 0
2.	Indian Institute of Information Technology, Vadodara (IIIT-VAD) (www.iiitvadodara.ac.in)	2013	0	0 / 0
3.	Indian Institute of Information Technology, Una (IIIT-UNA) (www.iiitu.ac.in)	2014	0	0 / 0
4.	Indian Institute of Information Technology, Ranchi (IIIT-RAN) (iiitranchi.ac.in)	2016	0	0 / 0

5.	Indian Institute of Information Technology, Dharwad (IIIT-DHR) (www.iiitdwd.ac.in)	2015	0	0 / 0
6.	Indian Institute of Information Technology, Kottayam (IIIT-KOT) (www.iiitkottayam.ac.in)	2015	1	0 / 0
7.	Indian Institute of Information Technology, Nagpur (IIIT-NAG) (iiitn.ac.in)	2016	2	0 / 0
8.	Indian Institute of Information Technology, Pune (IIIT-PUN) (www.iiitp.ac.in)	2016	1	0 / 0
9.	Indian Institute of Information Technology, Senapati (IIIT-SEN) (www.iiitmanipur.ac.in)	2015	0	0 / 0
10.	Indian Institute of Information Technology, Kota (IIIT-KOTA) (www.iiitkota.ac.in)	2013	6	0 / 0
11.	Indian Institute of Information Technology, Tiruchirapalli (IIIT-TRU) (www.iiitt.ac.in)	2013	0	0 / 0
12.	Indian Institute of Information Technology, Lucknow (IIIT-LUC) (iiitl.iiita.ac.in)	2015	2	0 / 0
13.	Indian Institute of Information Technology, Kalyani (IIIT-KAL) (iiitkalyani.ac.in)	2014	4	0 / 0
14.	Indian Institute of Information Technology, Design & Manufacturing, Kurnool (IIIT-KUR) (www.iiitdmkl.ac.in)	2015	0	0 / 0

Red – Low or Nil in number of patents-granted (<10)

Table 15: Research Articles and Patent Profile of Other Institutes (2010-16)

S. No.	Institute	Year of Establishment	Research Articles	Patents Granted/ Published
1.	Indian Statistical Institute, Kolkata (ISI-KOL) (www.isical.ac.in)	1931	1886	13 / 28
2.	Indian Institute of Engineering Science and Technology, Shibpur (IIEST-SHI) (www.iiests.ac.in)	1856	565	0 / 5
3.	Sree Chitra Tirunal Institute for Medical Sciences and Technology, Thiruvananthapuram (SCTIMST-THI) (www.sctimst.ac.in)	1976	354	1 / 71
4.	Academy of Scientific & Innovative Research, Chennai (ASIR-CHE) (www.acsir.res.in)	2010	114	0 / 0

5.	Jawaharlal Institute of Post Graduate Medical Education & Research, Puducherry (JIPGMER-PUD) (jipmer.edu.in)	1823	90	0 / 0
6.	Indian Institute of Information Technology, Design & Manufacturing, Kancheepuram (IIITDM-KAN) (www.iiitdm.ac.in)	2007	87	0 / 0
7.	Rajiv Gandhi Institute of Petroleum Technology, Rae Bareli (RGIPT-RAE) (www.rgipt.ac.in)	2007	62	0 / 3
8.	Pandit Dwarka Prasad Mishra Indian Institute of Information Technology & Manufacturing , Jabalpur (PDPMIIIT-JAB) (www.iiitdmj.ac.in)	2005	30	0 / 0
9.	School of Planning & Architecture, New Delhi (SPA-DEL) (www.spa.ac.in)	1941	12	0 / 0
10.	Atal Bihari Vajpayee Indian Institute of Information Technology and Management, Gwalior ABVIITM-GWA) (www.iiitm.ac.in)	1997	12	0 / 0
11.	School of Planning & Architecture, Bhopal (SPA-BHO) (spabhopal.ac.in)	2008	8	0 / 0
12.	School of Planning & Architecture, Vijaywada (SPA-VIJ) (www.spav.ac.in)	2008	3	0 / 0
13.	Rajiv Gandhi National Instiute of Youth Development, Sriperumbudur (RGNIYD-SPR) (www.rgniyd.gov.in)	1993	1	0 / 0
14.	Dakshina Bharat Hindi Prachar Sabha, Chennai (DBHPS-CHE) (www.dbhpscentral.org)	1918	0	0 / 0

Red – Low or Nil in number of patents-granted (<10)

Analyses: All INIs have been analysed on the basis of research publications and patents granted. Analysis has been further extended to field wise analysis which is mentioned below:

- **Composite Analyses of 102 INIs**
- **Field Wise Analyses of 102 INIs**

5.2.1 Composite Analyses of 102 INIs: Figures 17 & 18 depict the top INIs according to their number of research publications and patents granted to them.

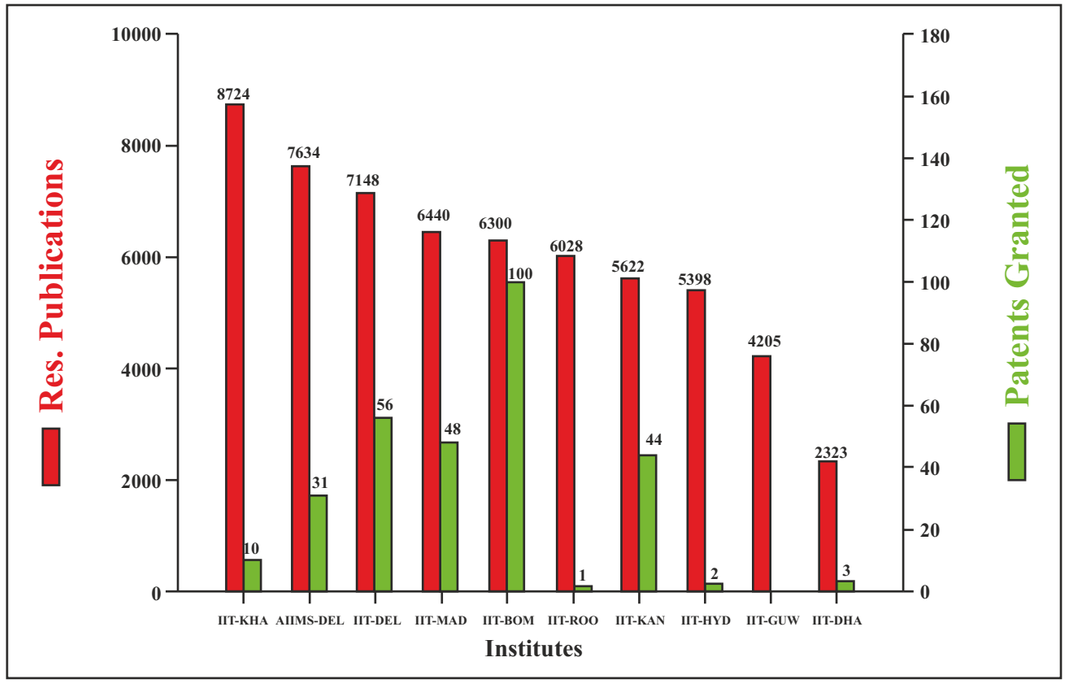


Figure 17: Top 10 Ranked INIs based on Number of Research Publications (2010-16)

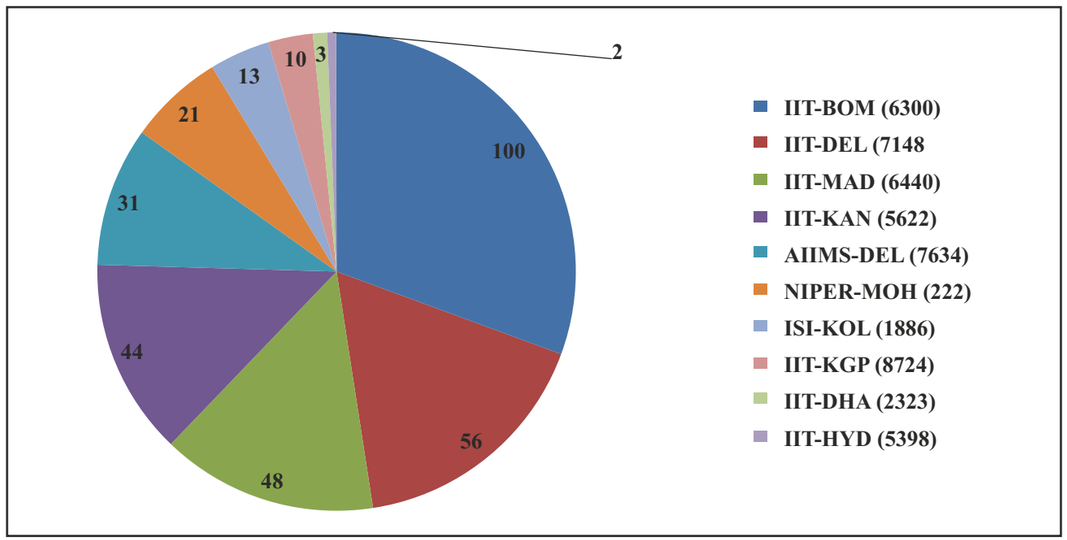


Figure 18: Top 10 Ranked INIs based on Number of Patents Granted (2010-16)

Note: Numbers in brackets represent number of research publications

5.2.2 Field Wise Analyses of 102 INIs:

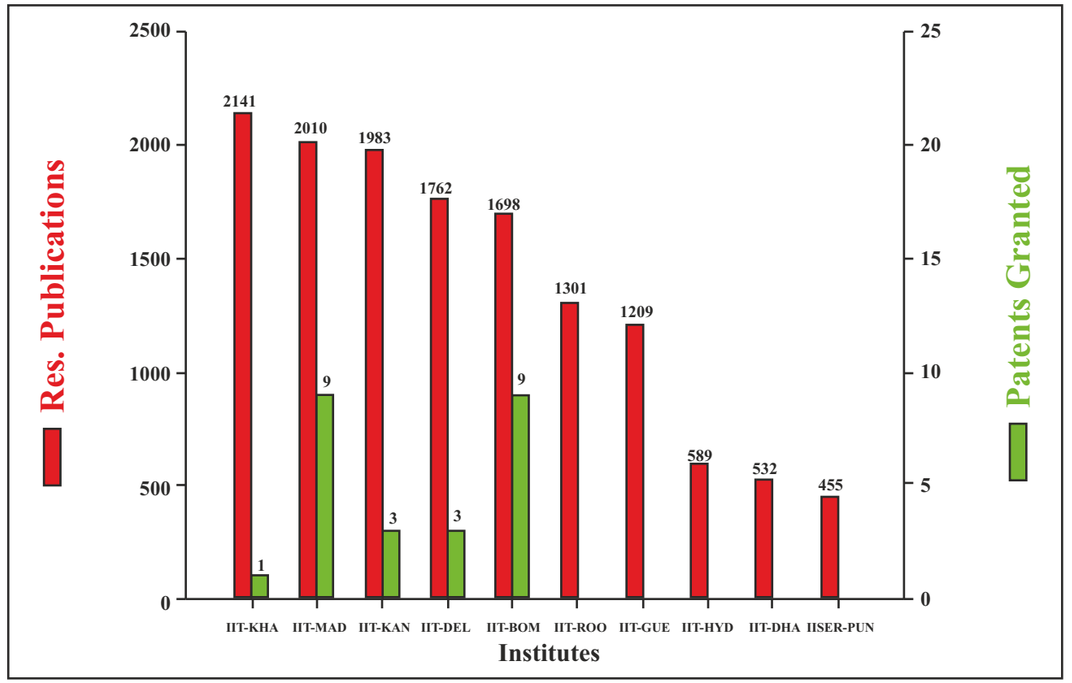


Figure 19: Top 10 Ranked INIs based on Number of Research Publications in the Field of **Physics** (2010-2016)

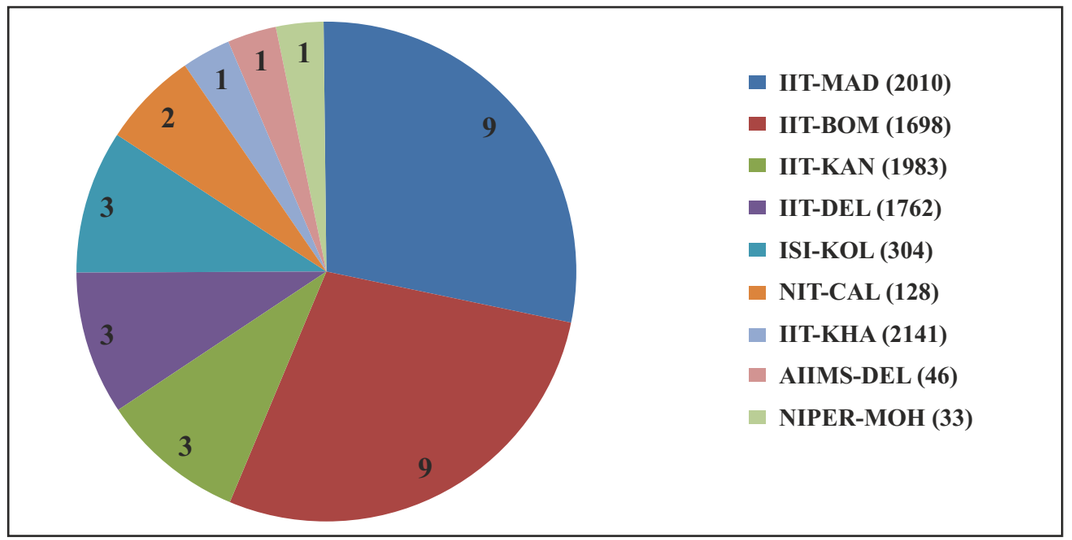


Figure 20: Top 9 Ranked INIs based on Number of Patents Granted in the Field of **Physics** (2010-16)

Note: Numbers in brackets represent number of research publications

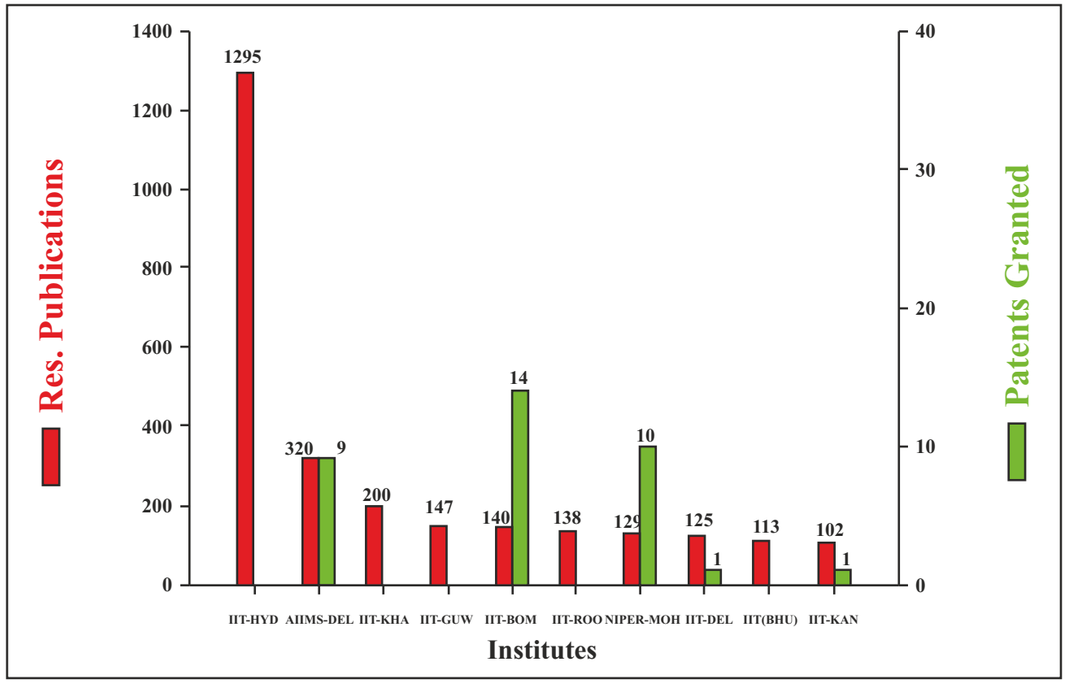


Figure 21: Top 10 Ranked INIs based on Number of Research Publications in the Field of **Pharma/Drugs** (2010-16)

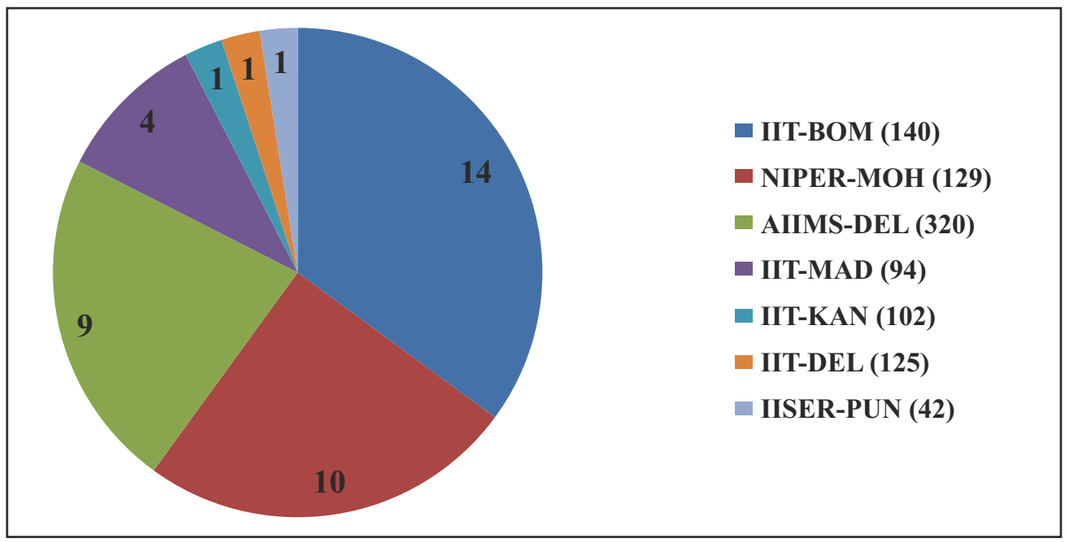


Figure 22: Top 7 Ranked INIs based on Number of Patents Granted in the Field of **Pharma/Drugs** (2010-16)

Note: Numbers in brackets represent number of research publications

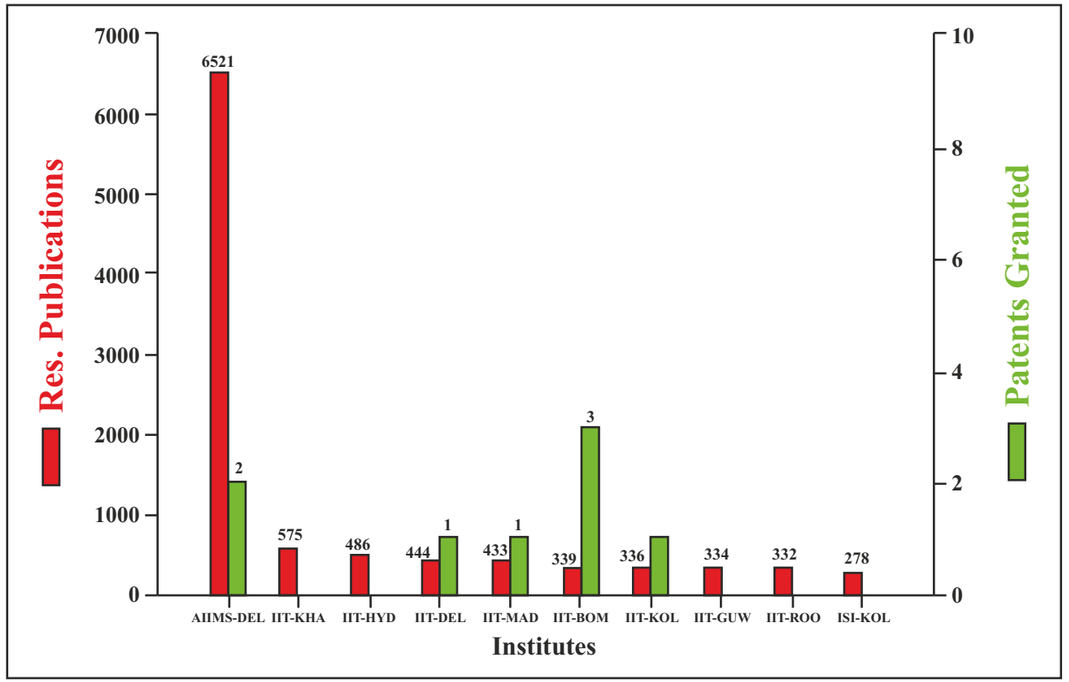


Figure 23: Top 10 Ranked INIs based on Number of Research Publications in the Field of **Medical Sciences** (2010-16)

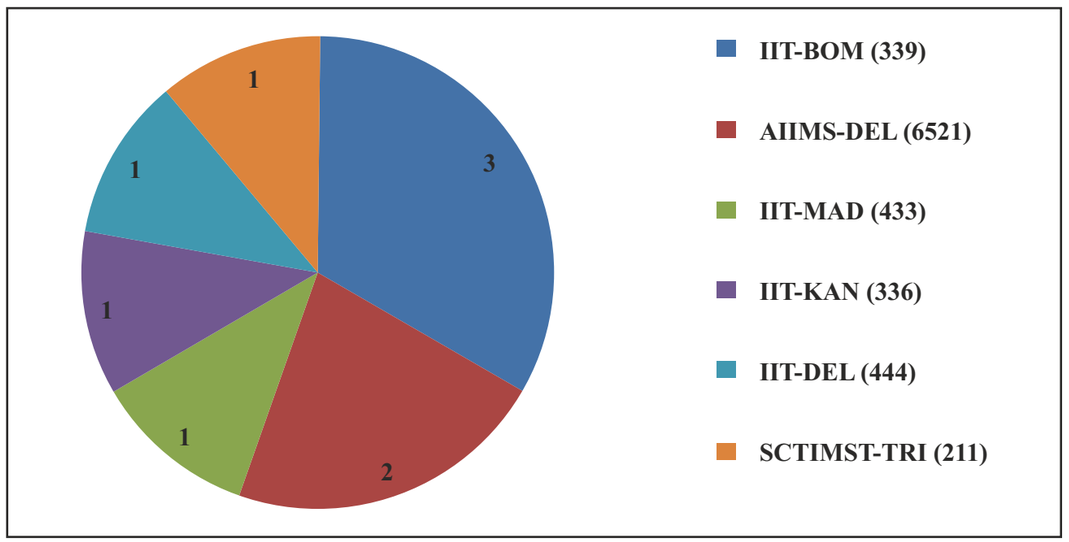


Figure 24: Top 6 Ranked INIs based on Number of Patents Granted in the Field of **Medical Sciences** (2010-16)

Note: Numbers in brackets represent number of research publications

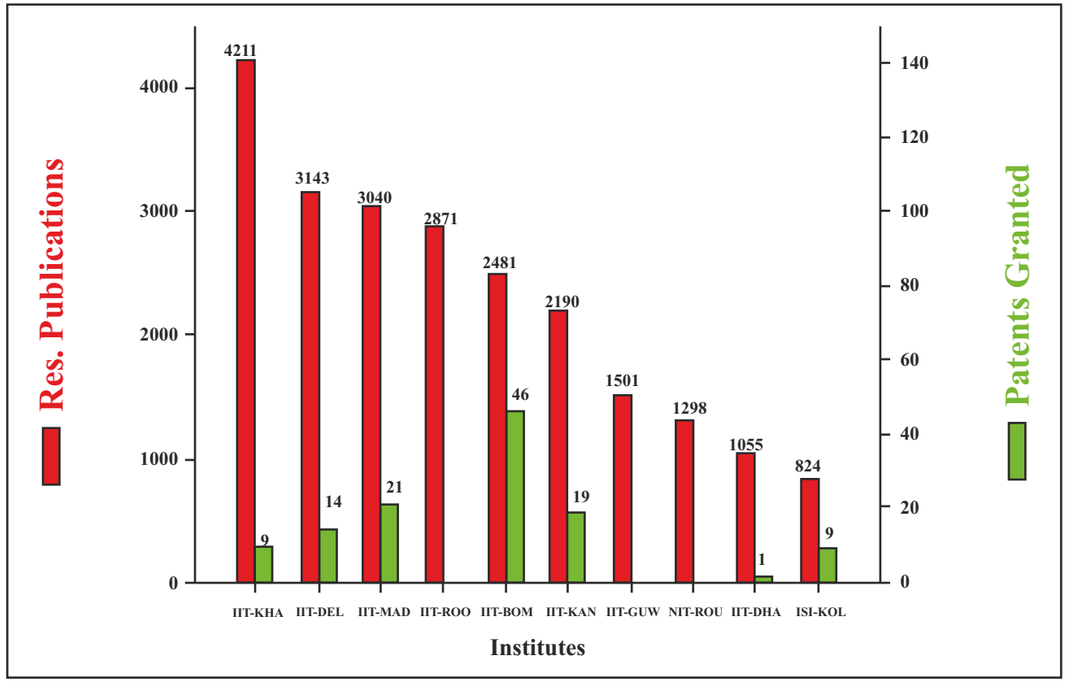


Figure 25: Top 10 Ranked INIs based on Number of Research Publications in the Field of **Engineering** (2010-16)

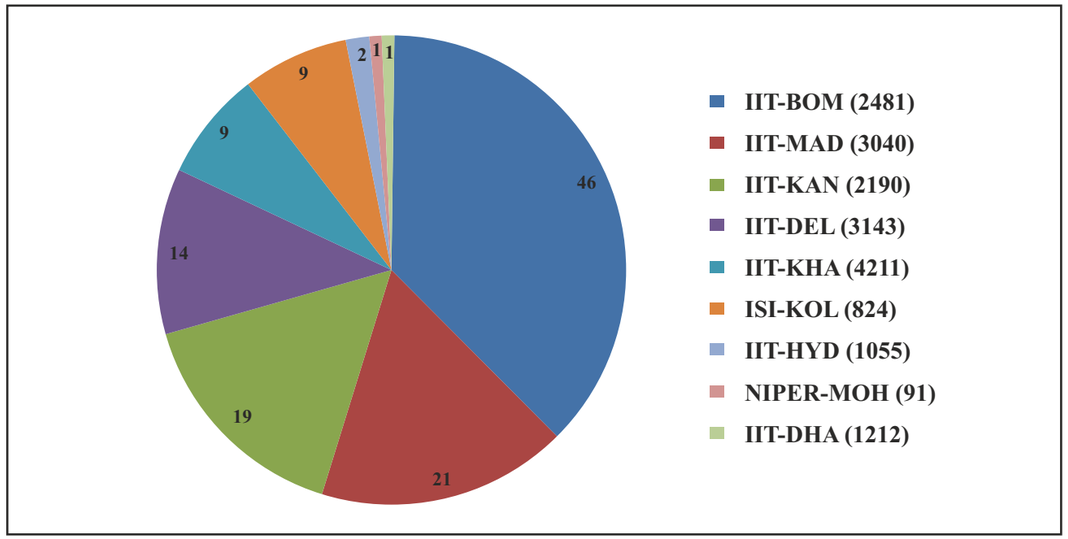


Figure 26: Top 9 Ranked INIs based on Number of Patents Granted in the Field of **Engineering** (2010-16)

Note: Numbers in brackets represent number of research publications

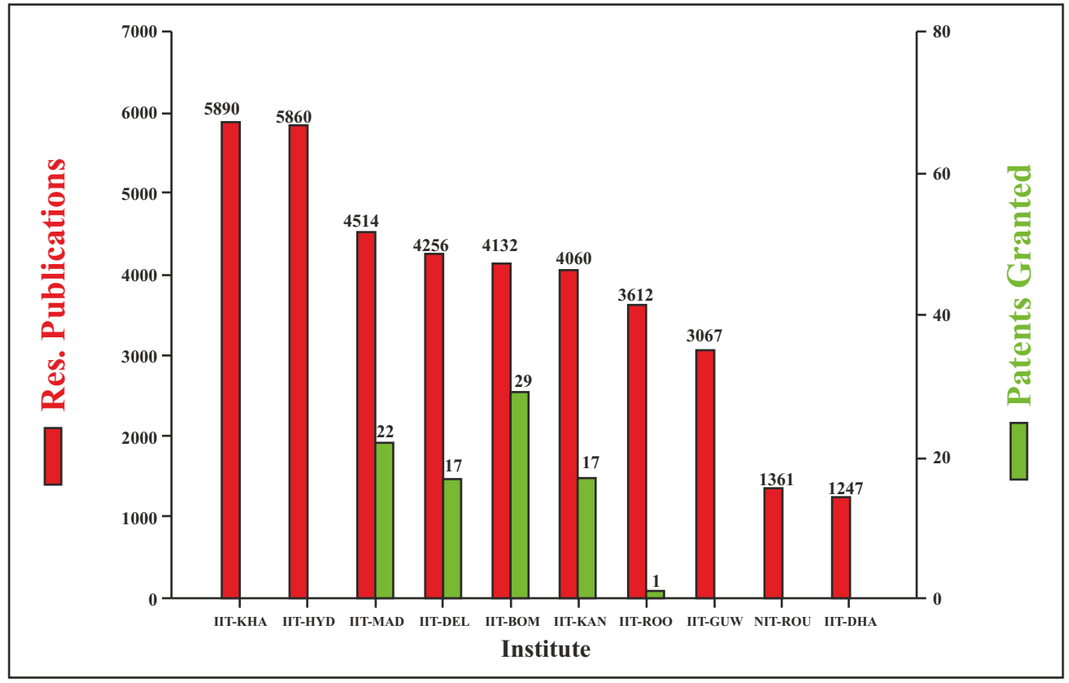


Figure 27: Top 10 Ranked INIs based on Number of Research Publications in the Field of **Chemical Engineering** (2010-16)

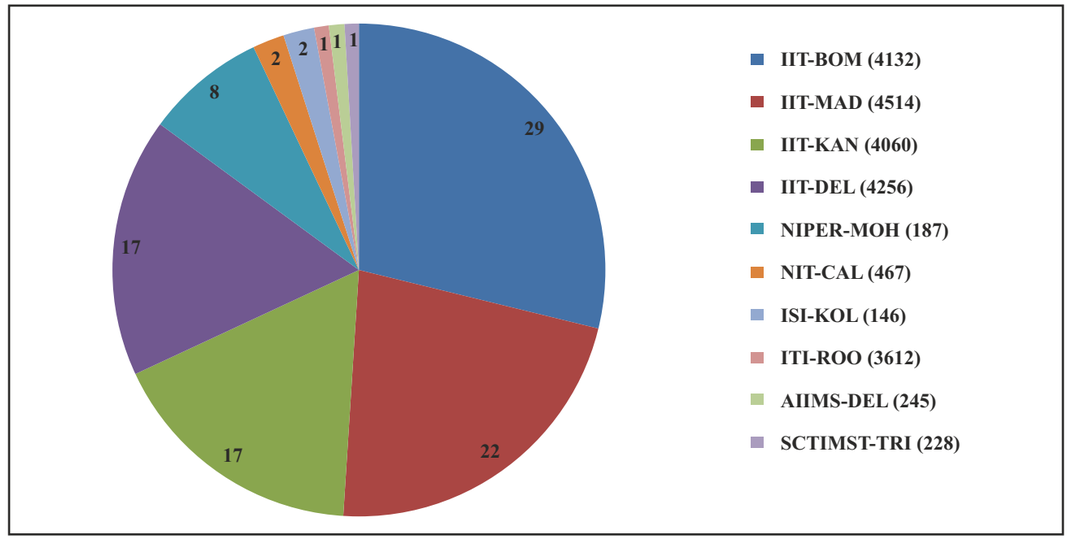


Figure 28: Top 10 Ranked INIs based on Number of Patents Granted in the Field of **Chemical Engineering** (2010-16)

Note: Numbers in brackets represent number of research publications

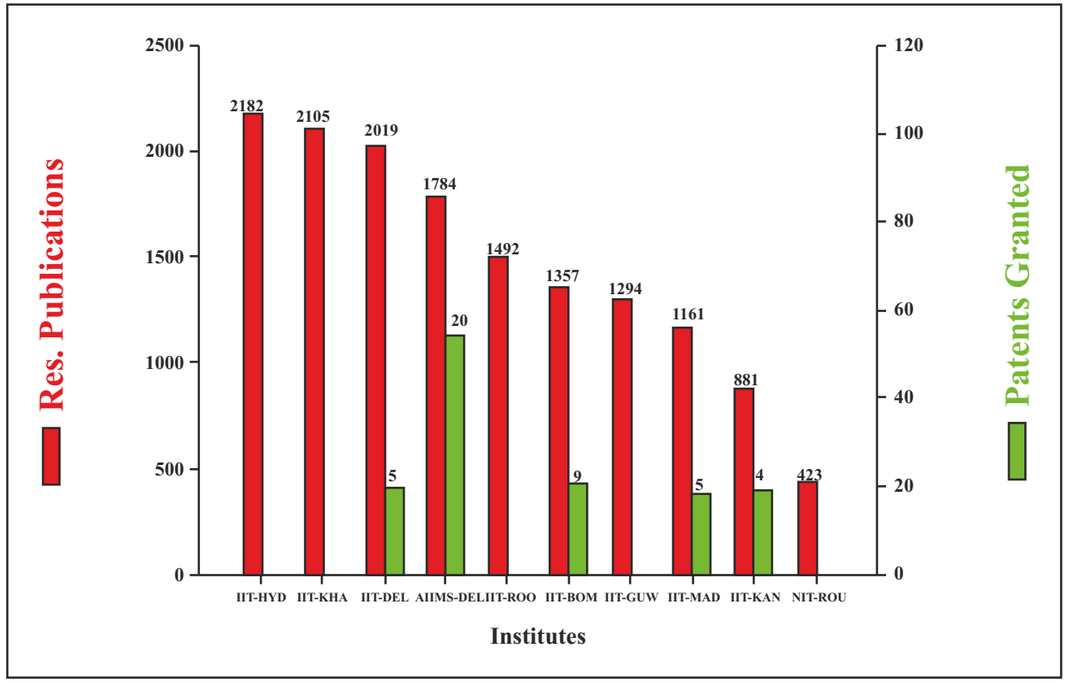


Figure 29: Top 10 Ranked INIs based on Number of Research Publications in the Field of **Biotech/Food/Agri.** (2010-16)

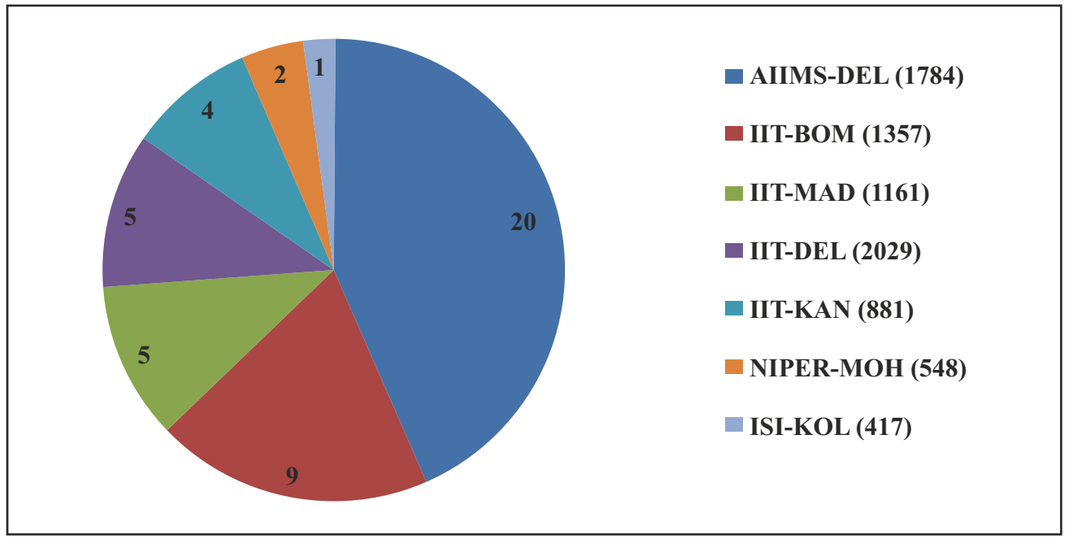


Figure 30: Top 7 Ranked INIs based on Number of Patents Granted in the Field of **Biotech/Food/Agri.** (2010-16)

Note: Numbers in brackets represent number of research publications

Conclusions

1. INIs comprise of engineering institutes (IITs, IIITs, NITs), medical institutes (AIIMS), pharma institutes (NIPERs), basic sciences institutes (IISERs) and a few other institutes.

2. Amongst top ten institutes ranked on the basis of research publications and patents (granted) for the period 2010-16, majority of the positions have been taken up by first generation IITs.

3. Institutes leading in the fields of patents (granted) are as follows:
   a) IIT-Mumbai: Engineering (46), Chemical Engineering (29), Pharma/Drugs (14), Physics (9), Medical Sciences (3)
   b) AIIMS-Delhi: Biotech/Food/Agriculture (20)
   c) IIT-Madras: Physics (9)

4. AIIMS-Delhi and NIPER-Mohali have appreciable number of patents (granted). Other AIIMS and NIPERS along with IIITs and 2nd and 3rd generation IITs are newly established institutes. The faculty of these institutions is of high caliber and publishing research papers. It is only a matter of time they will start generating patents as well.

5. The research publications and patent profile of all NITs is well below expectations, except NIT-Calicut (for patents-granted) and NIT-Rourkela (for research publications).

5.3 Top 100 NIRF Universities

National Institutional Ranking Framework: The National Institutional Ranking Framework (NIRF) was launched on 29th September 2015. This framework outlines a broad methodology to rank institutions across the country. The methodology for ranking universities and institutions has identified five broad parameters. These are:

1. Teaching, Learning and Resources

2. Research and Professional Practices

3. Graduation Outcomes

4. Outreach and Inclusivity

5. Perception

Considering the fact that, universities in India are essentially set up for postgraduate education and research, it was decided to assign higher percentage (40 %) weightage to "Research Productivity, Impact and IPR", 30 % weightage to "Teaching, Learning and Resources", 5% weightage to "Graduation Outcomes", 5 % weightage to "Outreach and Inclusivity" and 10% weightage to "Perception". Weightage assigned for ranking of colleges was suitably modified. These five parameters were further used to generate sub-categories. As mentioned above, each broad category has an overall weight assigned to it, with the sub-categories proportionately weighed further (https://www.nirfindia.org /Ranking).

The data pertaining to research publications and patents (granted) of top 100 NIRF universities was analysed to identify universities with good, moderate or poor performance (Table 16). The study was further extended to analyse universities excelling in the domains of engineering, chemical engineering, physics, biotech/food/agriculture, medical sciences and pharma/drugs.

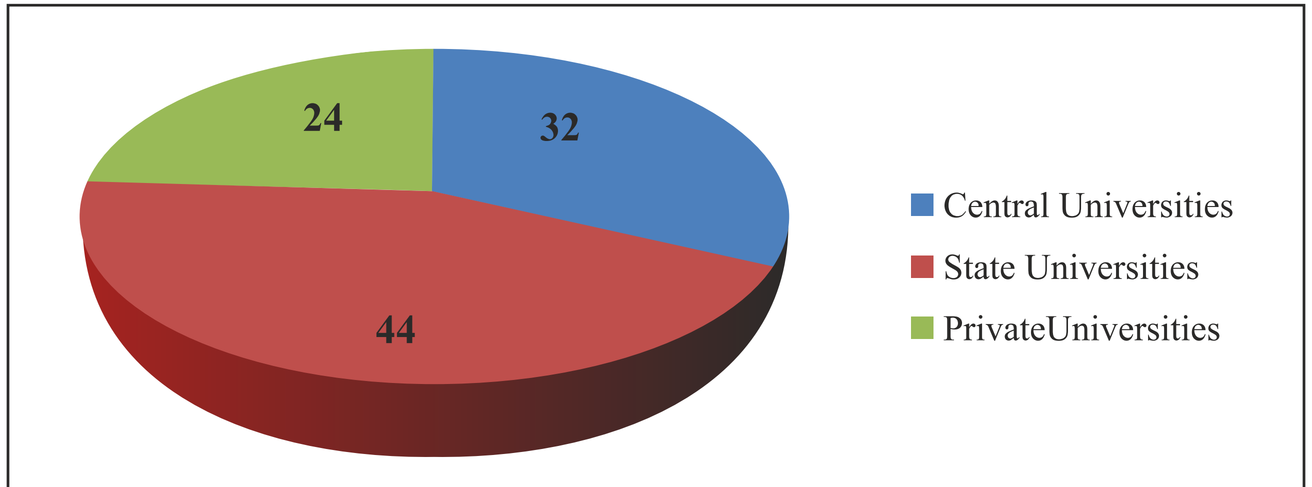


Figure 31: Breakup of Top 100 NIRF Universities Central Universities/ State Universities and Private Universities.

Table 16: Research Articles and Patent Profile of Top NIRF 100 Universities in India

S. No.	Institute	Year of Establishment	Institute Status	Ranking/No. of Res. Publications	Ranking/No. of Patents Granted	Ranking/No. of Patents Published
1.	University of Delhi, New Delhi (http://www.du.ac.in/du/)	1922	CU	1/15052	3/26	3/58
2.	Indian Institute of Science, Bengaluru, Karnataka (http://www.IISc-Bangalore.ac.in/)	1909	CU*	2/10852	1/174	1/359
3.	Banaras Hindu University, Varanasi, Uttar Pradesh (http://www.bhu.ac.in/)	1916	CU	3/8140	8/3	16/9
4.	University of Hyderabad, Hyderabad, Telangana (https://www.uohyd.ac.in/)	1974	CU	4/7649	6/5	12/13
5.	Annamalai University, Annamalai Nagar, Tamil Nadu (http://annamalaiuniversity.ac.in/)	1929	SU	5/5400	10/1	23/2
6.	Gujarat University, Ahmedabad, Gujarat (http://www.gujaratuniversity.ac.in/web/)	1950	SU	6/4871	0	24/1
7.	Panjab University, Chandigarh, UT (http://puchd.ac.in/)	1947	SU	7/4733	9/2	7/35
8.	Aligarh Muslim University, Aligarh, Uttar Pradesh (https://www.amu.ac.in/)	1875	CU	8/4588	9/2	20/5
9.	Manipal Academy of Higher Education, Manipal, Karnataka (https://manipal.edu/mu.html)	1956	PrU	9/4444	0	0
10.	S.R.M Institute of Science and Technology, Chennai, Tamil Nadu (http://www.srmuniv.ac.in/)	1985	PrU	10/3509	7/4	5/41
11.	Sathyabama Institute of Science And Technology, Chennai, Tamil Nadu (http://www.sathyabama.ac.in/)	1987	PrU	11/3494	0	17/8
12.	Bharathiar University, Coimbatore, Tamil Nadu (http://www.b-u.ac.in/)	1982	SU	12/2948	0	24/1
13.	Jawaharlal Nehru University, New Delhi (https://www.JNU-DEL.ac.in/main/)	1969	CU	13/2739	5/6	12/13

14.	Institute of Chemical Technology, Mumbai, Maharashtra (http://www.ictmumbai.edu.in/)	1933	SU	14/2671	2/39	4/48
15.	Jammu University, Tawi, Jammu and Kashmir (http://www.jammuuniversity.in/)	1969	SU	15/2524	0	0
16.	Osmania University, Hyderabad, Telangana (http://www.osmania.ac.in/)	1918	SU	16/2467	0	18/7
17.	Sri Venkateswara University, Tirupati, Andhra Pradesh (https://www.svuniversity.edu.in/)	1954	SU	17/2344	0	24/1
18.	Guru Nanak Dev University, Amritsar, Punjab (http://www.gndu.ac.in/)	1969	SU	18/2177	10/1	22/3
19.	Pondicherry University, Puducherry (http://www.pondiuni.edu.in/)	1985	CU	19/2151	10/1	16/9
20.	Jamia Millia Islamia, New Delhi (http://jmi.ac.in/)	1920	CU	20/2119	0	15/10
21.	University of Allahabad, Allahabad, Uttar Pradesh (http://www.allduniv.ac.in/)	1887	CU	21/2109	0	22/3
22.	Shivaji University, Kolhapur, Maharashtra (http://www.unishivaji.ac.in/)	1962	SU	22/2063	0	0
23.	Birla Institute of Technology & Science, Pilani, Rajasthan (http://www.bits-pilani.ac.in/)	1955	PrU	23/1755	0	13/12
24.	Tezpur University, Sonitpur, Assam (http://www.tezu.ernet.in/)	1994	CU	24/1742	0	19/6
25.	Kalyani University, West Bengal (http://www.klyuniv.ac.in/)	1960	SU	25/1719	0	0
26.	Cochin University of Science & Technology, Kochi, Kerala (http://www.cusat.ac.in/)	1971	SU	26/1656	10/1	18/7
27.	Jamia Hamdard, New Delhi (http://jamiahamdard.edu/)	1989	CU*	27/1650	0	22/3
28.	Jawaharlal Nehru Technological University, Hyderabad, Telangana (http://jntuh.ac.in/)	2008	SU	28/1589	0	0

29.	Amrita Vishwa Vidyapeetham, Coimbatore, Tamil Nadu (https://www.amrita.edu/)	2003	PrU	29/1556	4/9	2/91
30.	Periyar University, Salem, Tamil Nadu (http://www.periyaruniversity.ac.in/)	1998	SU	30/1495	0	0
31.	Alagappa University, Karaikudi, Tamil Nadu (http://alagappauniversity.ac.in/)	1985	SU	31/1485	0	0
32.	Gauhati University, Guwahati, Assam (http://www.gauhati.ac.in/)	1948	SU	32/1306	0	0
33.	Visva Bharati, Bolpur, West Bengal (http://www.visvabharati.ac.in/)	1921	CU	33/1304	0	14/11
34.	North Eastern Hill University, Shillong, Meghalaya (http://www.nehu.ac.in/)	1973	CU	34/1068	0	23/2
35.	King Georges Medical University, Lucknow, Uttar Pradesh (http://kgmu.org/)	1905	SU	35/902	0	17/8
36.	Assam University, Silchar, Assam (http://www.aus.ac.in/)	1994	CU	36/848	0	24/1
37.	Guru Jambeshwar University of Science And Technology, Hisar, Haryana (http://www.gjust.ac.in/)	1995	SU	37/833	0	21/4
38.	National Law University, Jodhpur, Rajasthan (http://www.nlujodhpur.ac.in/index-main.php)	2008	SU	38/823	0	0
39.	North Maharashtra University, Jalgaon, Maharashtra (http://www.nmu.ac.in/)	1991	SU	39/737	7/4	9/21
40.	Dr. Babasaheb Ambedkar Marathwada University, Aurangabad, Maharashtra (http://www.bamu.ac.in/)	1958	SU	40/703	9/2	0
41.	Dibrugarh University, Dibrugarh, Assam (https://www.dibru.ac.in/)	1965	SU	41/694	0	0
42.	Maharaja Sayajirao University of Baroda, Vadodara, Gujarat (http://www.msubaroda.ac.in/)	1949	SU	42/657	0	0

43.	Kalasalingam Academy of Research And Higher Education, Virudhunagar, Tamil Nadu (http://kalasalingam.ac.in/site/)	1984	PrU	43/655	0	0
44.	Goa University, Goa (https://www.unigoa.ac.in/)	1985	SU	44/623	10/1	21/4
45.	University of Kota, Kota, Rajasthan (https://www.uok.ac.in/)	2003	SU	45/551	0	24/1
46.	Pt. Ravishankar Shukla University, Raipur, Chhattisgarh (http://www.prsu.ac.in/)	1964	SU	46/539	0	0
47.	Presidency University, Kolkata, West Bengal (http://www.presiuniv.ac.in/web/)	2010	SU	47/535	0	24/1
48.	Mizoram University, Aizawl, Mizoram (http://www.mzu.edu.in/)	2001	CU	48/508	0	0
49.	Homi Bhabha National Institute, Mumbai, Maharashtra (http://www.hbni.ac.in/)	2005	CU*	49/498	0	0
50.	Jaypee University of Information Technology, Solan, Himachal Pradesh (http://www.juit.ac.in/)	2002	SU	50/487	10/1	14/11
51.	Babasaheb Bhimrao Ambedkar University, Lucknow, Uttar Pradesh (http://www.bbau.ac.in/new/index.aspx)	1996	CU	51/486	0	0
52.	Tripura University, Suryamaninagar, Tripura (http://www.tripurauniv.in/)	1985	CU	52/476	0	0
53.	National Institute of Technology, Agartala, Tripura (http://www.nita.ac.in/)	1965	CU*	53/468	0	23/2
54.	Indian Institute of Space Science and Technology, Thiruvananthapuram, Kerala (https://www.iist.ac.in/)	1956	CU*	54/457	0	0
55.	Guru Gobind Singh Indraprastha Vishwavidyalaya, Delhi(http://www.ipu.ac.in/)	1998	SU	54/457	0	17/8
56.	Mahatma Gandhi Medical College, Sri Balaji Vidyapeeth, Puducherry (http://www.mgmcri.ac.in/)	2001	PrU	55/414	0	0

57.	IK Gujral Punjab Technical University, Kapurthala, Punjab (https://www.ptu.ac.in/)	1997	SU	56/406	0	0
58.	Noorul Islam Centre For Higher Education, Kanyakumari, Tamil Nadu (http://www.niuniv.com/)	1989	PrU	57/388	0	0
59.	Shri Mata Vaishno Devi University, Katra, Jammu and Kashmir (http://www.smvdu.ac.in/)	2004	SU	58/355	0	0
60.	International Institute of Information Technology, Hyderabad, Telangana(https://www.iiit.ac.in/)	1998	CU*	59/353	10/1	15/10
61.	Yogi Vemana University, Andhra Pradesh (http://www.yogivemanauniversity.ac.in/)	2006	SU	60/338	0	0
62.	Central University of Punjab, Bathinda, Punjab (https://www.cup.ac.in/)	2009	CU	61/324	0	23/2
63.	Ambedkar University, Delhi (http://www.aud.ac.in/)	2007	SU	62/315	0	0
64.	Teri School of Advanced Studies, New Delhi (http://www.teriuniversity.ac.in/)	1998	PrU	63/308	0	23/2
65.	Dayalbagh Educational Institute, Agra, Uttar Pradesh (https://www.dei.ac.in/dei/)	1973	SU	64/300	0	22/3
66.	Central University of Rajasthan, Ajmer, Rajasthan (http://www.curaj.ac.in/)	2009	CU	65/272	0	0
67.	Institute of Liver And Biliary Sciences, New Delhi (https://www.ilbs.in/)	2009	SU	66/254	0	0
68.	Sri Ramachandra Medical College And Research Institute, Chennai, Tamil Nadu (http://www.sriramachandra.edu.in/)	1985	PrU	67/241	0	16/9
69.	Sikkim University, Gangtok, Sikkim (http://www.cus.ac.in/index.php/en/)	2007	CU	68/212	0	0
70.	Pandit Deendayal Petroleum University, Gandhinagar, Gujarat (http://www.pdpu.ac.in/)	2007	PrU	69/207	0	0

71.	Rajasthan University of Veterinary & Animal Sciences, Bikaner, Rajasthan (http://rajuvas.org/)	2010	SU	70/174	0	0
72.	Central University of Gujarat, Gandhinagar, Gujarat(http://www.cug.ac.in/)	2009	CU	71/161	0	0
73.	Banasthali Vidyapith, Vanasthali, Rajasthan (http://www.banasthali.org/)	1983	PrU	72/154	10/1	24/1
74.	LNM Institute of Information Technology, Jaipur, Rajasthan (https://www.lnmiit.ac.in/)	2002	SU	73/142	0	0
75.	Central University of Tamil Nadu, Thiruvarur, Tamil Nadu (http://cutn.ac.in/)	2009	CU	74/123	0	0
76.	Indraprastha Institute of Information Technology, New Delhi (https://www.iiitd.ac.in/)	2008	SU	75/101	0	22/3
77.	PES University, Bengaluru, Karnataka (http://pes.edu/)	1972	PrU	76/91	0	22/3
78.	Shoolini University of Biotechnology and Management Sciences, Solan, Himachal Pradesh (http://shooliniuniversity.com/)	2009	PrU	77/88	0	11/15
79.	Jaypee University of Engineering & Technology, Guna, Madhya Pradesh (http://www.juet.ac.in/)	2010	PrU	78/87	0	0
80.	Tamilnadu Agricultural University, Coimbatore, Tamil Nadu (http://www.tnau.ac.in/)	1971	SU	79/84	8/3	6/37
81	Tamilnadu Veterinary & Animal Sciences University, Chennai, Tamil Nadu (http://www.tanuvas.tn.nic.in/)	1990	SU	80/81	10/1	8/25
82.	Maharishi Dayanand University, Rohtak, Haryana (http://www.mduro htak.ac.in/)	1976	SU	81/65	10/1	17/8
83.	National Institute of Food Technology, Entrepreneurship & Management, Sonipat, Haryana(http://www.niftem.ac.in/)	2006	CU*	82/51	0	23/2
84.	Chettinad Academy of Research and Education, Kelambakkam, Tamil Nadu (http://www.chettinadhealthcity.com/care/index.htm)	2005	PrU	83/49	0	0

85.	Kalinga Institute of Industrial Technology, Bhubaneswar, Odisha (http://kiit.ac.in/)	1992	PrU	84/48	0	0
86.	M.S. Ramaiah University of Applied Sciences, Bengaluru, Karnataka (http://www.msruas.ac.in/)	2013	PrU	85/47	0	10/17
87.	Indian Institute of Foreign Trade, New Delhi (http://tedu.iift.ac.in/iift/index.php)	1963	CU*	86/46	0	0
88.	NarseeMonjee Institute of Management Studies, Mumbai, Maharashtra (http://www.nmims.edu/)	1981	PrU	87/45	0	0
89.	U.P. Pandit DeenDayal Upadhyaya PashuChikitsa Vigyan Vishwavidhyalaya Evam Go Anusandhan Sansthan(DUVASU), Mathura, Uttar Pradesh (http://www.upvetuniv.edu.in/)	2001	SU	88/44	0	0
90.	The Northcap University, Gurugram, Haryana (http://www.ncuindia.edu/)	1996	PrU	89/36	0	0
91.	Central University of South Bihar, Patna, Bihar(https://www.cusb.ac.in/)	2009	CU	90/30	0	0
92.	Pt. Bhagwat Dayal Sharma University Of Health Sciences, Rohtak, Haryana (http://uhsr.ac.in/)	2008	SU	91/18	0	0
93.	Karunya Institute of Technology and Sciences, Coimbatore, Tamil Nadu(http://www.karunya.edu/)	1986	PrU	91/18	0	17/8
94.	Jagadguru Sri Shivarathreeshwara University, Mysuru, Karnataka (https://jssuni.edu.in/JSSWeb/WebHome.aspx)	2008	PrU	92/17	0	0
95.	Bidhan Chandra Krishi Vishwavidyalaya, Mohanpur, West Bengal (https://www.bckv.edu.in/)	1974	SU	93/12	0	0
96.	Dr. Harisingh Gour Vishwavidyalaya, Sagar, Madhya Pradesh (http://www.dhsgsu.ac.in/)	1946	CU	94/7	0	0
97.	Shiksha 'O' Anusandhan, Bhubaneswar, Odisha (http://www.soa.ac.in/)	1996	PrU	94/7	0	0
98.	Indian Law Institute, New Delhi (http://www.ili.ac.in/)	1956	CU*	95/3	0	0
99.	Institute of Armament Technology, Pune, Maharashtra (https://www.diat.ac.in/)	1952	CU*	96/2	0	24/1
100.	Sir Padmapat Singhania University, Bhatewar, Rajasthan (https://www.spsu.ac.in/)	2007	PrU	97/1	0	0

***Although institutes have been considered as universities for the purpose of NIRF Ranking, 2016.**

Blue - Good in number of patents-granted (>25)

Red – Low or Nil in number of patents-granted (<10)

Analyses: In this category, NIRF ranked universities were mapped for total number of research publications and patents granted for the period 2010-16. A list of top 100 NIRF ranked universities based on the number of research publications is mentioned in Table 16.

- **Composite Analyses of Top 100 NIRF Universities**
- **Field Wise Analyses of Top 100 NIRF Universities**

5.3.1 Composite Analyses of Top 100 NIRF Universities:

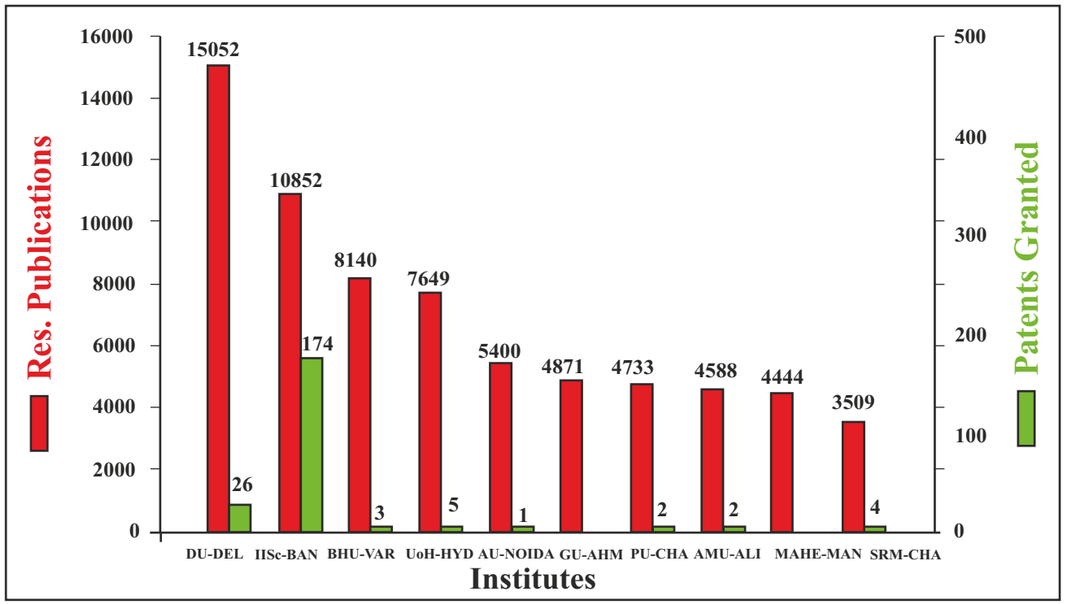


Figure 32: Top 10 Ranked NIRF Universities Based on Number of Research Publications (2010-2016)

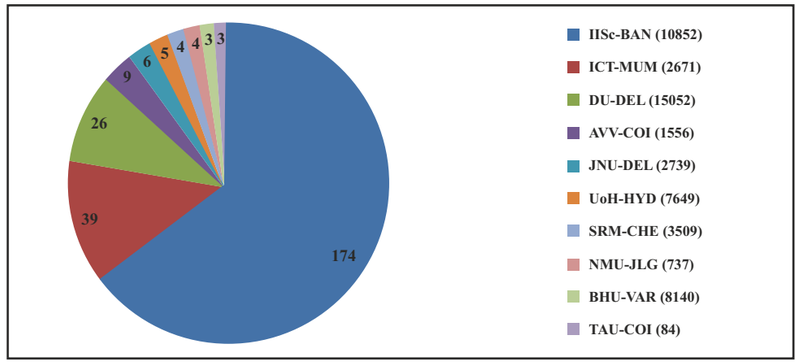


Figure 33: Top 10 Ranked NIRF Universities Based on Number of Patents Granted (2010-16)
Note: Numbers in brackets represents number of research publications

5.3.2 Field Wise Analyses of Top 100 NIRF Universities

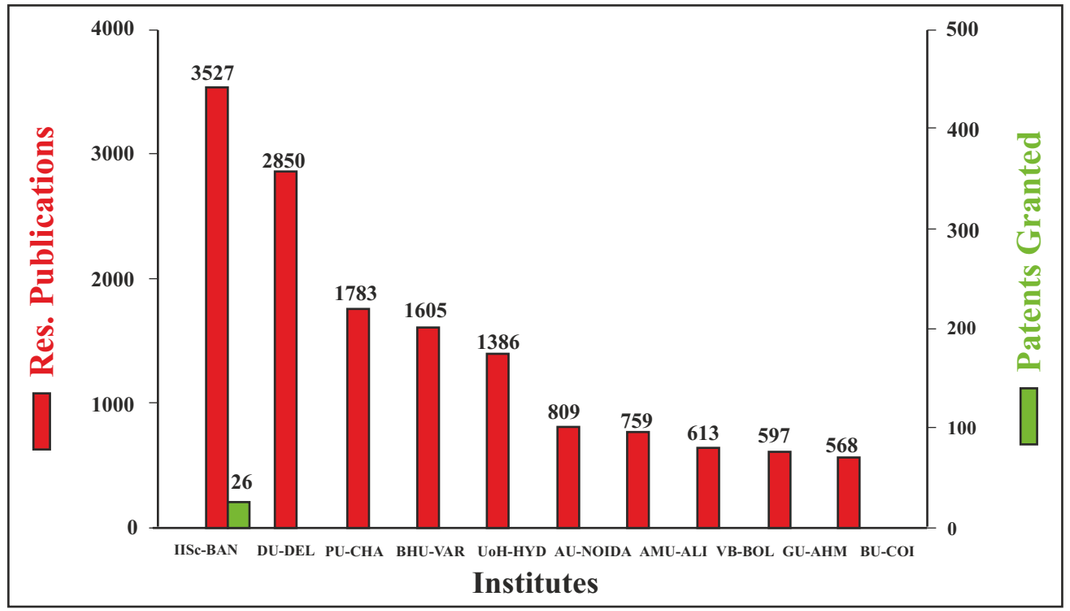


Figure 34: Top 10 Ranked NIRF Universities Based on Number of Research Publications in the Field of **Physics** (2010-2016)

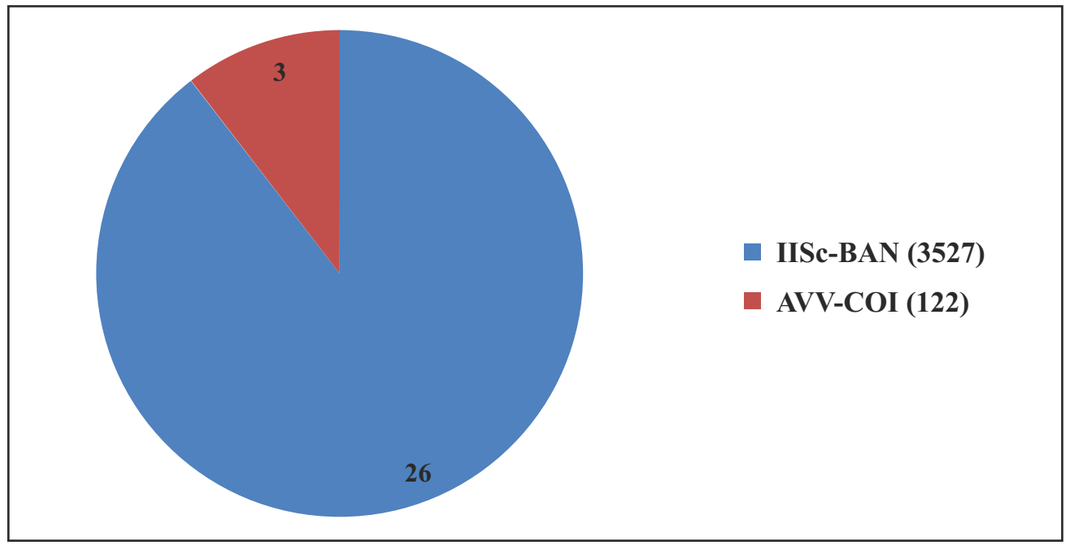


Figure 35: Universities having Patents Granted in the Field of **Physics** (2010-2016)

Note: Numbers in brackets represent number of research publications

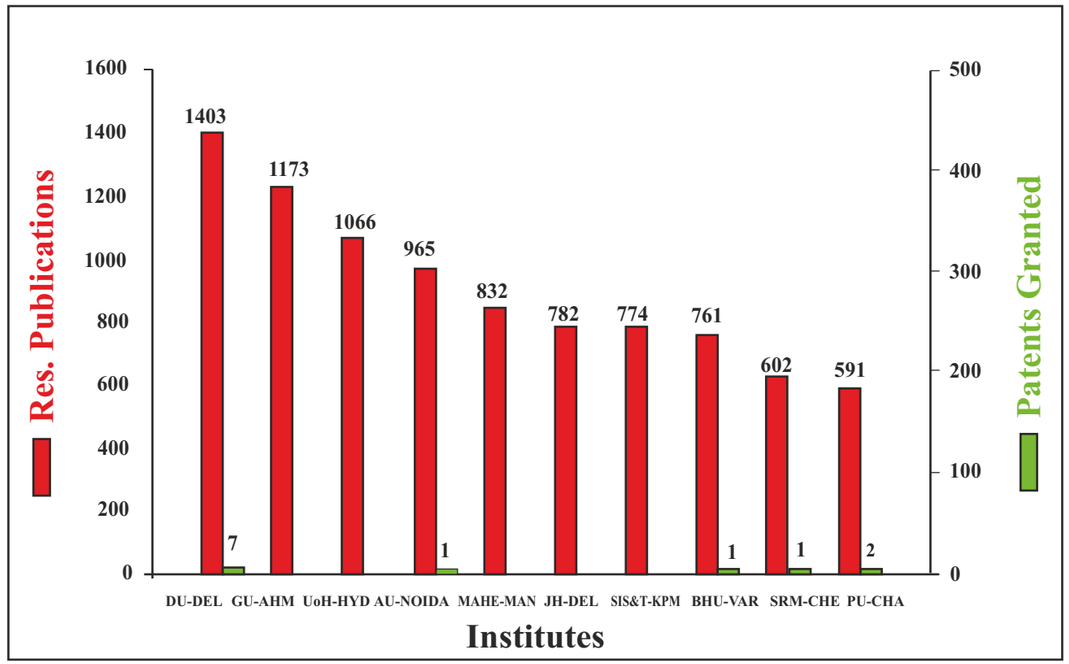


Figure 36: Top 10 Ranked NIRF Universities Based on Number of Research Publications in the Field of **Pharma/Drugs** (2010-2016)

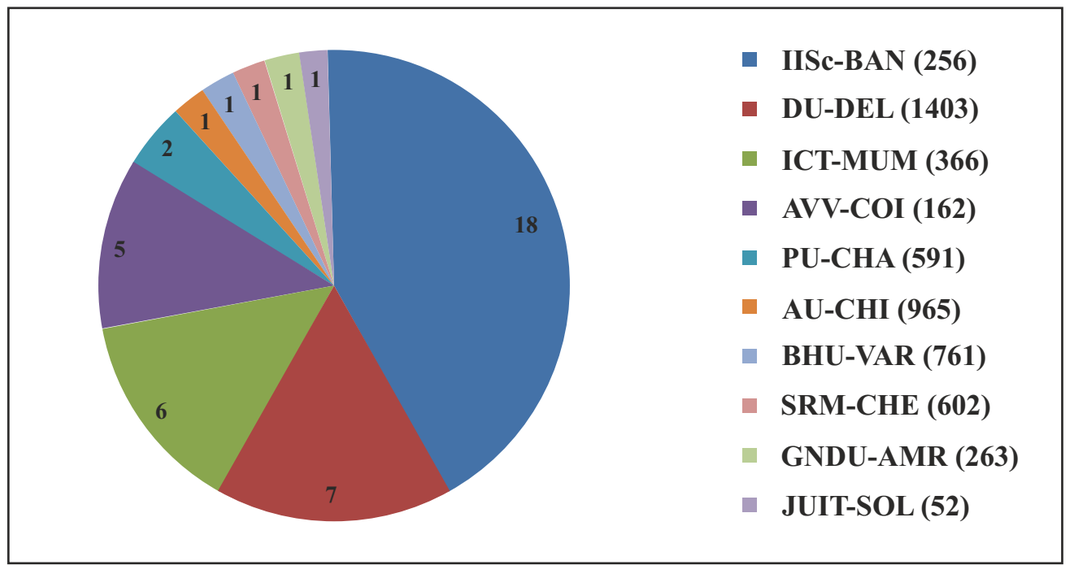


Figure 37: Top 10 Ranked Universities Based on Number of Patents Granted in the Field of **Pharma/Drugs** (2010-2016)

Note: Numbers in brackets represent number of research publications

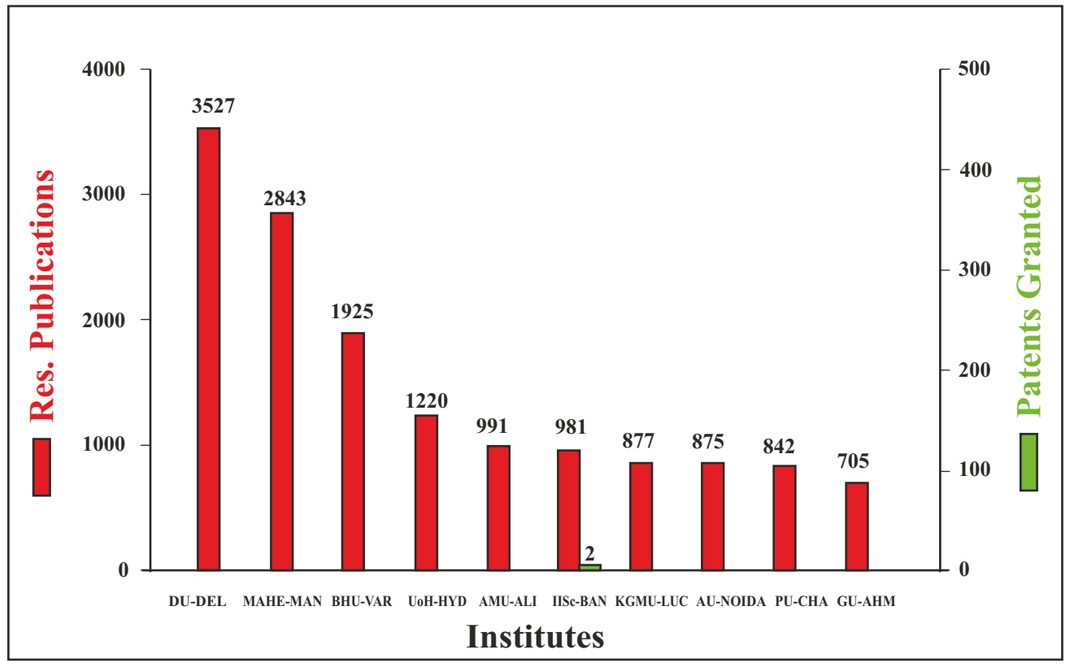


Figure 38: Top 10 Ranked NIRF Universities Based on Number of Research Publications in the Field of **Medical Sciences** (2010-2016)

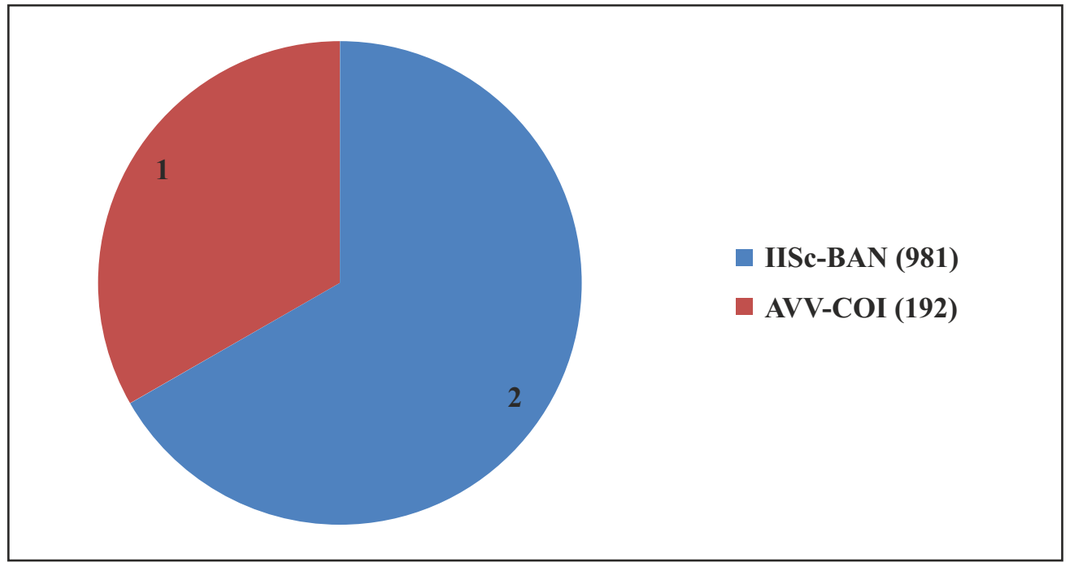


Figure 39: Universities having Patents Granted in the Field of **Medical Sciences** (2010-2016)

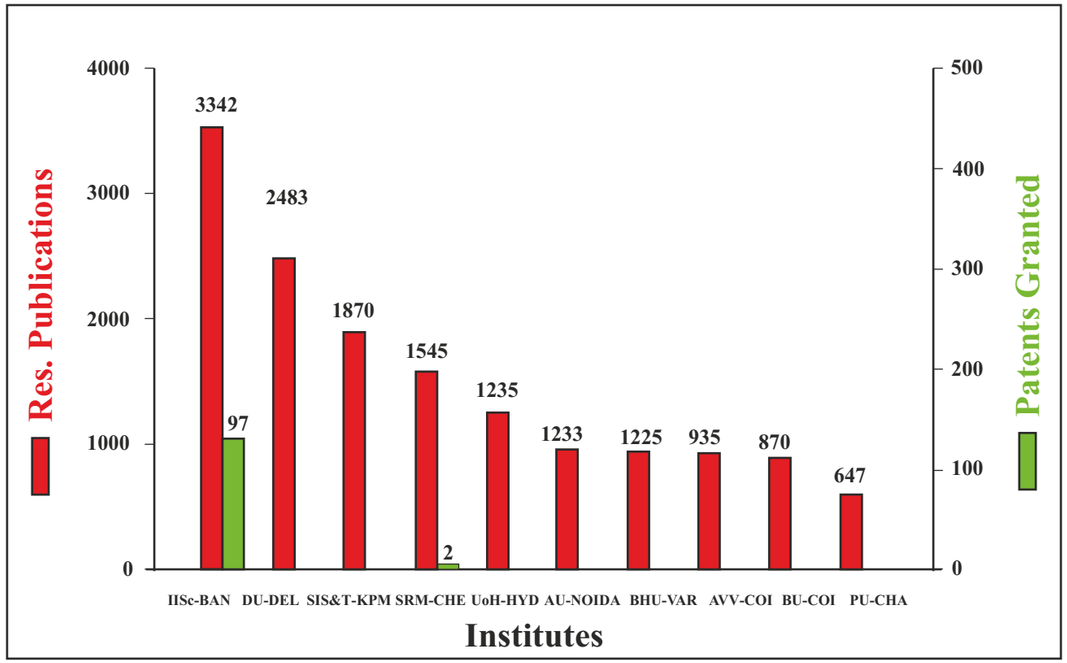


Figure 40: Top 10 Ranked Universities Based on Number of Research Publications in the Field of **Engineering** (2010-2016)

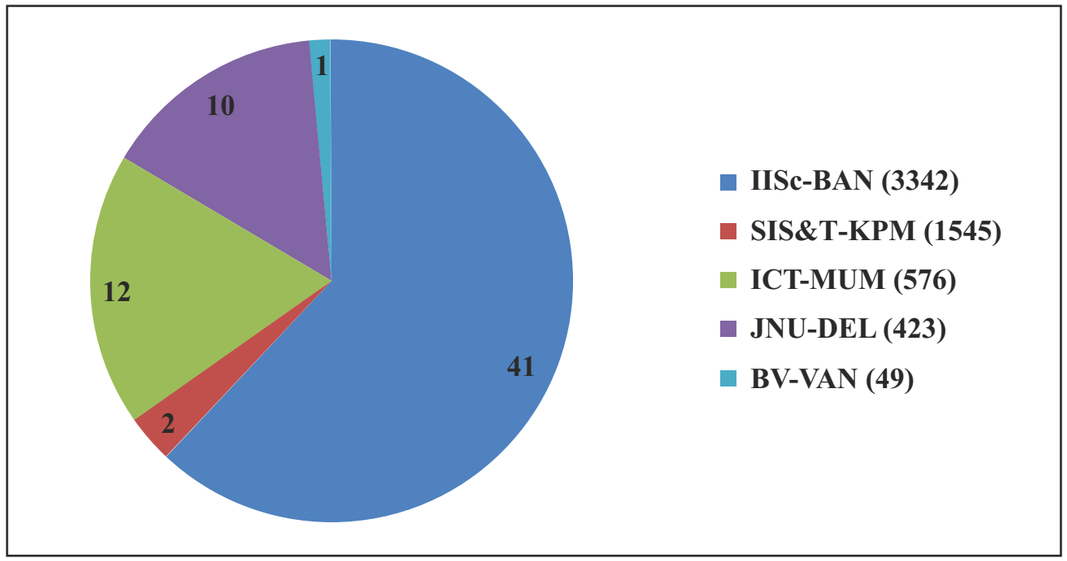


Figure 41: Top 5 Ranked Universities Based on Patents Granted in the Field of **Engineering** (2010-2016)
Note: Numbers in brackets represent number of research publications

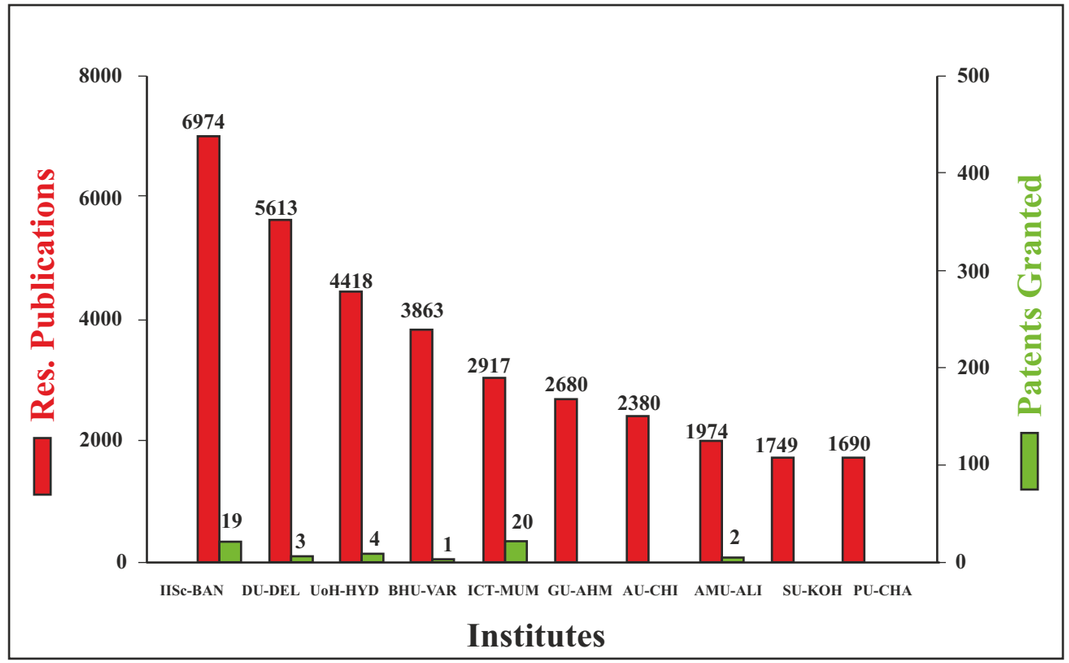


Figure 42: Top 10 Ranked Universities Based on Number of Research Publications in the Field of **Chemical Engineering** (2010-2016)

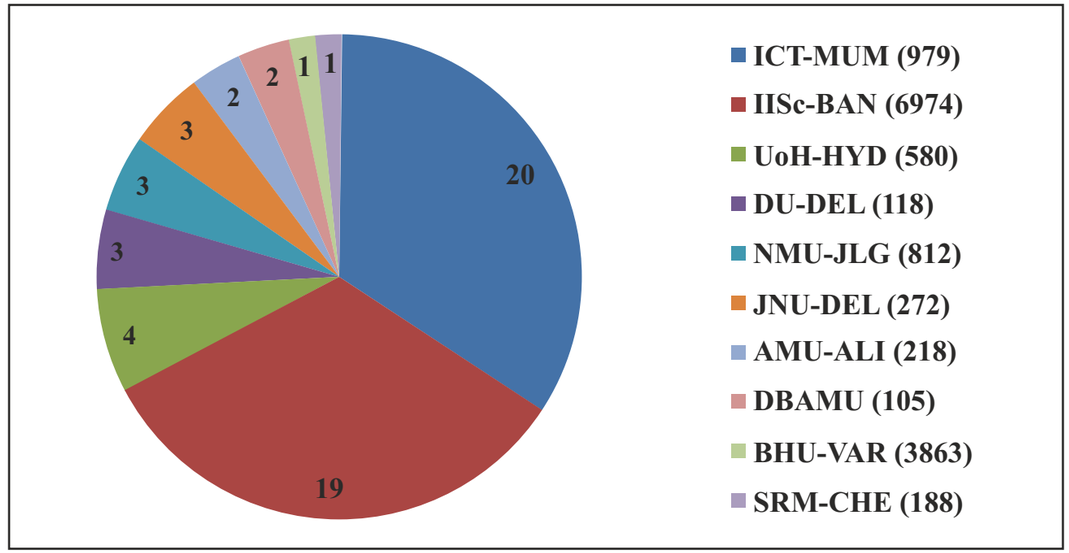


Figure 43: Top 10 Ranked Universities Based on Number of Patents Granted in the Field of **Chemical Engineering** (2010-2016)
Note: Numbers in brackets represents number of research publications

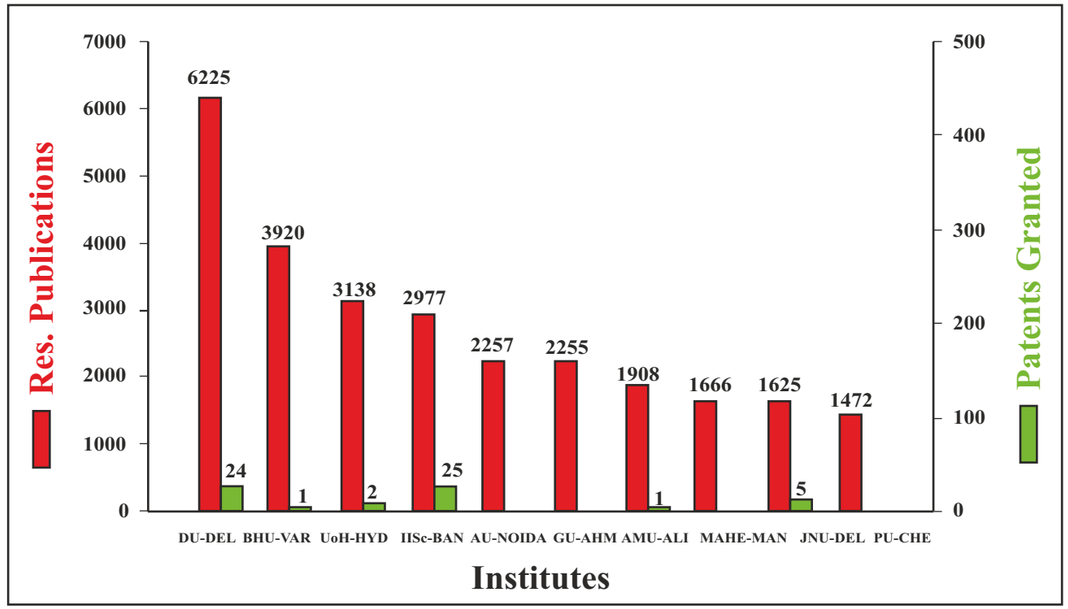


Figure 44: Top 10 Ranked NIRF Universities Based on Number of Research Publications in the Field of **Biotech/Food/Agriculture** (2010-2016)

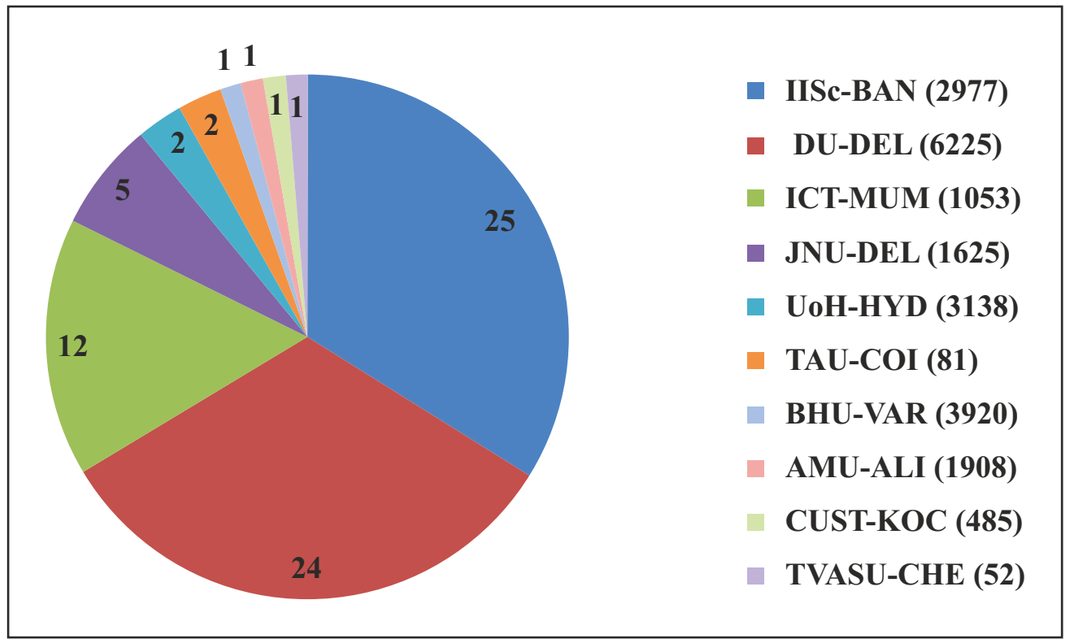


Figure 45: Top 10 Ranked NIRF Universities Based on Number of Patents Granted in the Field of **Biotech/Food/ Agriculture** (2010-2016).

Note: Numbers in brackets represent number of research publications

Conclusions

- Amongst top 100 NIRF universities, only three universities (IISc-Bangalore, DU-Delhi and ICT-Mumbai) excel in publishing research papers and generating patents (granted).
- Based on field of specialization, the leading institutes in the domains of research publications and patents (generated) are:

  Physics: IISc-Bangalore

  Engineering: IISc-Bangalore

  Chemical Engineering: IISc-Bangalore, ICT-Mumbai

  Pharma/Drugs: DU-New Delhi; IISc-Bangalore

  Medical Sciences: DU-New Delhi

  Biotech/Food/Agriculture: DU-New Delhi, IISc-Bangalore
- 68 universities have poor record of research publications i.e. <100/year.
- Only one university i.e. IISc-Bangalore has three-digit number (174) of patents (granted). ICT-Mumbai (39) and DU-Delhi (26) have two-digit number of patents (granted). 19 universities have patents (granted) in the range of 1-9. Seventy seven universities have no patent (granted) to their credit.
- The patent ecosystem of IISc-Bangalore, ICT-Mumbai and DU-New Delhi need to be understood and replicated in the universities having strong record of publishing high number of research publications.

5.4 Top 100 NIRF Engineering Institutes of India

Analyses: In this category, NIRF ranked Engineering institutes were mapped for a total number of research publications and patents granted for the period 2010-16. A list of top 100 NIRF-2016 ranked engineering institutes based on the number of research publications is mentioned in Table 17.

- **Composite Analyses of Top 100 NIRF Engineering Institutes**
- **Field Wise Analyses of Top 100 NIRF Engineering Institutes**

5.4.1 Composite Analyses of Top 100 NIRF Engineering Institutes

Top 100 NIRF engineering institutes (Table 17) comprise of

a) INIs (42) categorized as IITs (16), NITs (22), IISER (1), IIITDM (2) and IIEST (1),

b) Autonomous Institutes and Colleges (AICs) (35)

c) Universities (20)

d) University Departments (3) (Figure 46).

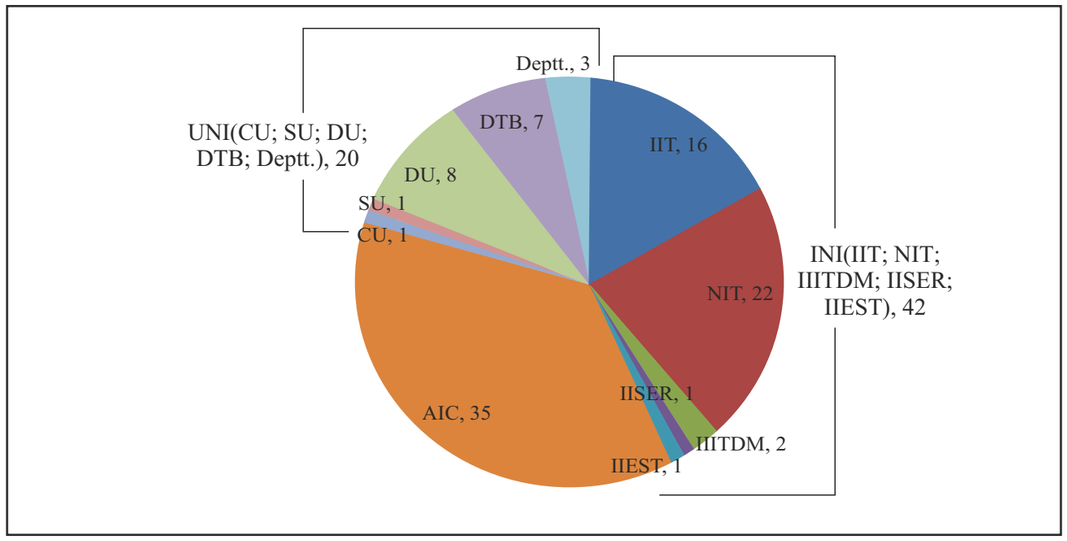


Figure 46: Categorization of Top 100 NIRF Engineering Institutes in India Based on NIRF 2016 Ranking

INI: Institution of National Importance; IIT: Indian Institute of Technology; NIT: National Institute of Technology; IISER: Indian Institute of Science Education and Research; IIITDM: Indian Institute of Information Technology, Design and Management; IIEST: Indian Institutes of Engineering Science and Technology; AIC: Autonomous Institute and College; DU: Deemed University, DTB: Deemed to be University; SU: State University; CU: Central University; UNI: University

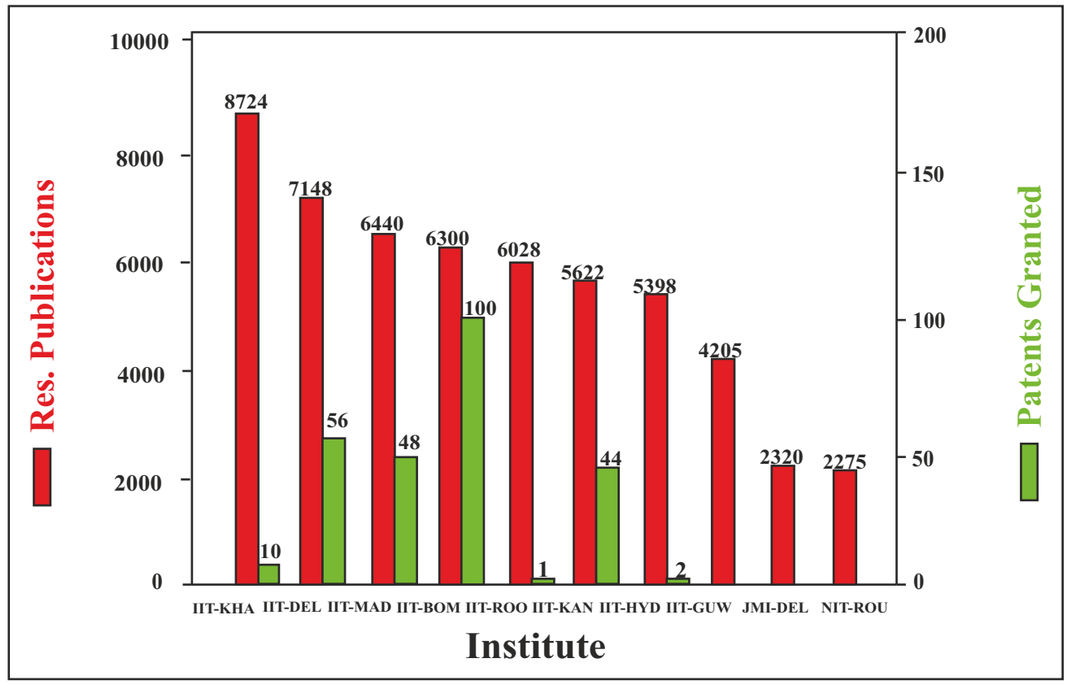


Figure 47: Top 10 Ranked NIRF Universities Based on Number of Research Publications (2010-2016)

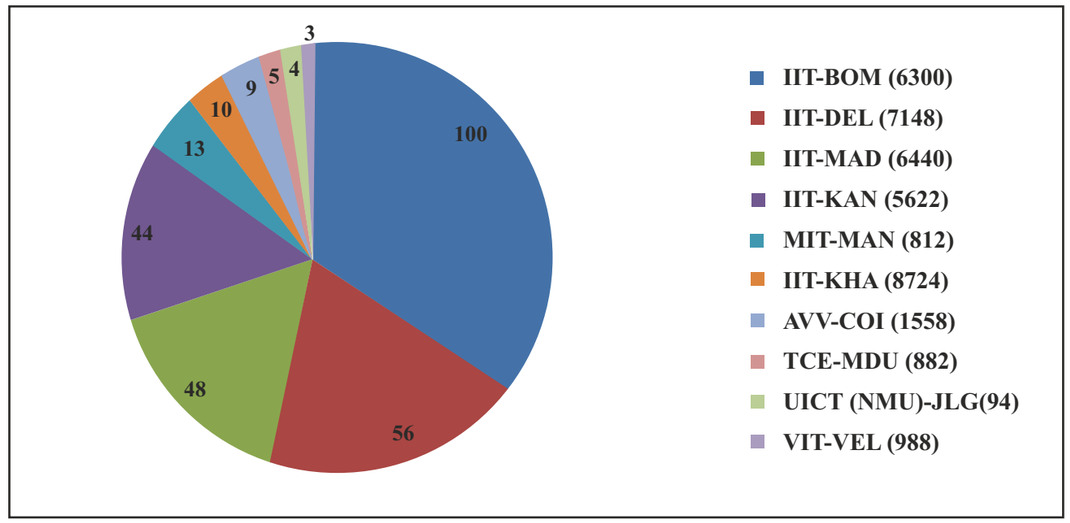


Figure 48: Top 10 Ranked NIRF Engineering Institutes Based on Number of Patents Granted (2010-16)

Table 17: Research Articles and Patent Profile of Top 100 NIRF Ranked Engineering Institutes in India

S. No.	Institute	Year of Establishment	Institute Status	Public/ Private Status	Ranking/No. of Res. Publications	Ranking/No. of Patents Granted	Ranking/No. of Patents Published
1.	Indian Institute of Technology (IIT), Kharagpur (IIT-KHA) (www.iitkgp.ac.in)	1950	INI (IIT)	Public	1 / 8724	6 / 10	5 / 171
2.	IIT, Delhi (IIT-DEL) (www.iitd.ac.in)	1961	INI (IIT)	Public	2 / 7148	2 / 56	4 / 208
3.	IIT, Madras (IIT-CHE) (www.iitm.ac.in)	1959	INI (IIT)	Public	3 / 6440	3 / 48	2 / 376
4.	IIT, Bombay (IIT-BOM) (www.iitb.ac.in)	1958	INI (IIT)	Public	4 / 6300	1 / 100	1 / 441
5.	IIT, Roorkee (IIT-ROO) (www.iitr.ernet.in)	1846 (2001)	INI (IIT)	Public	5 / 6028	12 / 1	11 / 25
6.	IIT, Kanpur (IIT-KAN) (www.iitk.ac.in)	1959	INI (IIT)	Public	6 / 5622	4 / 44	3 / 252
7.	IIT, Hyderabad (IIT-HYD) (www.iith.ac.in)	2009	INI (IIT)	Public	7 / 5398	11 / 2	10 / 26
8.	IIT, Guwahati (IIT-GUW) (www.iitg.ernet.in)	1994	INI (IIT)	Public	8 / 4205	0	13 / 23
9.	Jamia Millia Islamia (JMI-DEL), New Delhi (jmi.ac.in/)	1920	UNI (CU)	Public	9 / 2320	0	20 / 10
10.	National Institute of Technology (NIT), Rourkela (NIT-ROU) (www.nitrkl.ac.in)	2002 (1960)*	INI (NIT)	Public	10 / 2275	0	24 / 6
11.	Thapar University, Patiala (TU-PTI) (http://www.thapar.edu/)	1956	UNI (DTB)	Private	11 / 2269	0	20 / 10
12.	Birla Institute of Technology, Ranchi (BIT-RAN), (https://www.bitmesra.ac.in/)	1955	UNI (DU)	Private	12 / 1958	0	18 / 12
13.	Coimbatore Institute of Technology, Coimbatore (CIT-COI) (www.cit.edu.in/)	1956	AIC	Public	13 / 1854	0	28 / 2
14.	Cochin University of Science & Technology, Cochin (CUST-COC) (www.cusat.ac.in/)	1971	UNI (SU)	Public	14 / 1656	12 / 1	23 / 7
15.	Amrita Viswa Vidyapeetham, Coimbatore (AVV-COI) (http://www.amrita.edu/)	2003	UNI (SU)	Private	15 / 1588	7 / 9	6 / 91
16.	IIT (BHU), Varanasi [IIT(BHU)] (www.iitbhu.ac.in)	1916 (2012)	INI (IIT)	Public	16 / 1432	0	29 / 1
17.	PSG College of Technology, Coimbatore (PSG-COI) (http://www.psgtech.edu/)	1951	AIC	Public	17 / 1381	11 / 2	10 / 26
18.	NIT Karnataka, Mangalore (NIT-MNG) (www.nitk.ac.in)	2002 (1960)*	INI (NIT)	Public	18 / 1377	0	0
19.	NIT, Durgapur (NIT-DUR) (www.nitdgp.ac.in)	2003 (1960)*	INI (NIT)	Public	19 / 1281	0	29 / 1
20.	Vellore Institute of Technology, Vellore (VIT-VEL) (http://www.vit.ac.in/)	1984	UNI (DU)	Private	20 / 988	10 / 3	7 / 51
21.	NIT, Warangal (NIT-WAR) (www.nitw.ac.in)	2002 (1959)*	INI (NIT)	Public	21 / 980	0	28 / 2
22.	Motilal Nehru National Institute of Technology, Allahabad (MNNIT-ALH) (www.mnnit.ac.in)	2007 (1961)*	INI (NIT)	Public	22 / 937	0	23 / 7
23.	NIT, Calicut (NIT-CAL) (www.nitc.ac.in)	2002 (1961)*	INI (NIT)	Public	23 / 908	11/ 2	18 / 12
24.	IIT, Indore (IIT-IND) (www.iiti.ac.in)	2009	INI (IIT)	Public	24 / 902	0	20 / 10
25.	Thiagarajar College of Engineering, Madurai (TCE-MDU) (https://www.TCE-MDU.edu/)	1987	AIC	Public	25 / 882	8/ 5	19 / 11
26.	NIT, Kurukshetra (NIT-KUR) (www.nitkkr.ac.in)	2008 (1963)*	INI (NIT)	Public	26 / 834	0	28 / 2
27.	Manipal Institute of Technology, Manipal (MIT-MAN) (https://manipal.edu/mit.html)	1957	AIC	Private	27 / 812	5 / 13	9 / 43
28.	NIT, Hamirpur (NIT-HAM) (www.nith.ac.in)	2002 (1986)*	INI (NIT)	Public	28 / 697	0	29 / 1
29.	IIT, Bhubaneswar (IIT-BHU) (www.iitbbs.ac.in)	2009	INI (IIT)	Public	29 / 694	0	22 / 8
30.	Jaypee Institute of Information Technology, Noida (JIIT-NOIDA) (http://www.jiit.ac.in/)	2001	UNI (DU)	Private	30 / 689	0	29 / 1
31.	Visvesvaraya National Institute of Technology, Nagpur (VNIT-NAG) (www.vnit.ac.in)	2002 (1960)*	INI (NIT)	Public	31 / 685	12 / 1	27 / 3
32.	College of Engineering, Pune (COEP-PUN) (http://www.coep.org.in)	1854	AIC	Public	32 / 671	0	18 / 12

33.	IIT, Ropar (IIT-ROP) (www.iitrpr.ac.in)	2009	INI (IIT)	Public	33 / 627	0	28 / 2
34.	NIT, Tiruchirapalli (NIT-TIR) (www.nitt.edu)	2003 (1964)*	INI (NIT)	Public	34 / 620	0	24 / 6
35.	IIT, Patna (IIT-PAT) (www.iitp.ac.in)	2009	INI (IIT)	Public	35 / 597	0	24 / 6
36.	Indian Institute of Engineering Science and Technology, Shibpur (IIEST-SHI) (http://www.iiests.ac.in/)	1856	INI (IIEST)	Public	36 / 565	0	25 / 5
37.	Bannari Amman Institute of Technology, Sathyamangalam (BAIT-SAT) (http://www.bitsathy.ac.in/)	1996	AIC	Private	37 / 546	0	0
38.	National Institute of Engineering, Mysuru (NIE-MYS) (www.nie.ac.in/)	1946	AIC	Private	38 / 537	0	20 / 10
39.	Dr. B.R. Ambedkar NIT, Jallandhar (NIT-JAL) (www.nitj.ac.in)	2002 (1987)*	INI (NIT)	Public	39 / 532	0	27 / 3
40.	Kongu Engineering College, Coimbatore (KEN-COI) (http://www.kct.ac.in/)	1984	AIC	n.a.	40 / 501	0	26 / 4
41.	Sona College of Technology, Salem (SCT-SAL) (http://www.sonatech.ac.in/)	1997	AIC	Private	41 / 470	11 / 2	16 / 17
42.	IIT, Mandi (IIT-MND) (www.iitmandi.ac.in)	2009	INI (IIT)	Public	42 / 468	0	0
43.	NIT, Agartala (NIT-AGA) (www.nita.ac.in)	2006 (1965)*	INI (NIT)	Public	43 / 465	0	28 / 2
44.	IIT, Gandhi Nagar (IIT-GAN) (www.iitgn.ac.in)	2009	INI (IIT)	Public	44 / 460	0	26 / 4
45.	NIT, Silchar (NIT-SIL) (www.nits.ac.in)	2002 (1967)*	INI (NIT)	Public	45 / 458	0	0
46.	Kumaraguru College of Technology, Coimbatore (KGCT-COI) (http://www.kct.ac.in/)	1984	AIC	Private	46 / 446	0	0
47.	B.S. Abdur Rahman Institute of Science and Technology, Vandalu (BSARHST-VAN) (http://www.bsauniv.ac.in/)	1984	UNI (DTB)	Private	47 / 430	0	29 / 1
48.	NIT, Raipur (NIT-RAI) (www.nitrr.ac.in)	2005 (1956)*	INI (NIT)	Public	48 / 400	0	0

49.	Sri Ramakrishna Engineering College, Coimbatore (SREC-COI) (http://www.srec.ac.in/)	1994	AIC	Private	49 / 368	0	0
50.	Pondicherry Engineering College, Pondicherry (PoEC-PON) (www.pec.edu/)	1984	AIC	Public	50 / 362	12 / 1	21 / 9
51.	Noida Institute of Engineering & Technology, Noida (NIET-NOIDA) (http://www.niet.co.in/)	2001	AIC	Private	51 / 360	0	0
52.	Sardar Vallabhbhai National Institute of Technology, Surat (SVNIT-SUR) (www.svnit.ac.in)	2003 (1961)*	INI (NIT)	Public	52 / 304	0	19 / 11
53.	Indian Institutes of Science Education and Research, Mohali (IISER-MOH) (www.iisermohali.ac.in)	2007	INI (IISER)	Public	53 / 268	0	18 / 12
54.	Sant Longowal Institute of Engineering & Technology, Sangrur (SLIET-SAN) (sliet.ac.in/)	1989	UNI (DU)	Public	54 / 261	12 / 1	0
55.	M. S. Ramaiah Institute of Technology, Bangalore (MSRIT-BAN) (www.msrit.edu/)	1962	AIC	Private	55 / 256	12 / 1	25 / 5
56.	Punjab Engineering College, Chandigarh (PEC-CHA) (www.pec.ac.in/)	1921	UNI (DU)	Public	56 / 256	0	28 / 2
57.	Adhiyamaan College of Engineering, Hosur (ACE-HOS) (http://www.adhiyamaan.ac.in/)	1987	AIC	Private	57 / 242	0	0
58.	IIT, Jodhpur (IIT-JOD) (www.iitj.ac.in)	2009	INI (IIT)	Public	58 / 232	0	27 / 3
59.	NIT, Srinagar (NIT-SRI) (www.nitsri.net)	2003 (1960)*	INI (NIT)	Public	59 / 226	0	0
60.	NIT, Jamshedpur (NIT-JSR) (www.nitjsr.ac.in)	2002 (1960)*	INI (NIT)	Public	60 / 200	0	0
61.	Institute of Engineering & Management, Kolkata (IEM-KOL) (http://www.iem.edu.in/)	1989	AIC	Private	61 / 189	0	20 / 10
62.	Siddaganga Institute of Technology, Tumkur (SIT-TUM) (www.sit.ac.in/)	1963	AIC	Private	62 / 188	0	8 / 46
63.	College of Technology & Engineering, Udaipur (CTE-UDA) (http://www.ctae.ac.in/)	1964	AIC	Public	63 / 163	0	0

64.	NIT, Delhi (NIT-DEL) (www.nitdelhi.ac.in)	2010	INI (NIT)	Public	64 / 162	0	0
65.	Bengal Institute of Technology, Kolkata (BnIT-KOL) (http://www.bitcollege.in/)	2000	AIC	Private	65 / 155	0	0
66.	National Institute of Science & Technology, Berhampur (NIST-BER) (http://www.nist.edu/)	1996	AIC	Private	66 / 153	0	0
67.	University Institute of Chemical Engineering & Technology, Panjab University, Chandigarh (UICET-CHA) (http://uicet.puchd.ac.in/)	1958	Uni Deptt.	Public	67 / 152	0	0
68.	Hindustan Institute of Technology & Science, Agra (HITS-AGR) (https://www.hindustanuniv.ac.in/)	1985	UNI (DTB)	Private	68 / 142	0	14 / 22
69.	Vishwakarma Institute of Technology, Pune (VKIT-PUN) (www.vit.edu/)	1983	AIC	Private	69 / 134	0	27 / 3
70.	Institute of Technology, Nirma University, Ahmedabad (IoT-AHM) (www.nirmauni.ac.in/ITNU)	1995	AIC	Private	70 / 132	0	23 / 7
71.	NIT, Patna (NIT-PAT) (www.nitp.ac.in)	2004 (1886)*	INI (NIT)	Public	71 / 126	0	0
72.	C.V. Raman College of Engineering, Bhubaneswar (CVRCOE-BHU) (cvrce.edu.in/)	1997	AIC	Private	72 / 120	0	0
73	School of Engineering & Technology, ITM University, Gwalior (SET-ITM-GWA) (http://www.itmuniversity.ac.in/)	1997	Uni Deptt.	Private	73 / 102	0	27 / 3
74.	NIT, Meghalaya, (NIT-MEG) (www.nitm.ac.in)	2010	INI (NIT)	Public	74 / 97	0	0
75.	University Institute of Chemical Technology, North Maharashtra University, Jalgaon [UICT(NMU)-JLG] (nmu.ac.in/udct/)	1994	UNI (SU)	Public	75 / 94	9 / 4	15 / 21
76.	Indian Institute of Information Technology, Design and Manufacturing, Kancheepuram (IIITDM-KPM) (www.iiitdm.ac.in/)	2005	INI (IITDM)	Public	76 / 87	0	0

77.	Chaitanya Bharathi Institute of Technology, Hyderabad (CBIT-HYD) (http://www.cbit.ac.in/)	1979	AIC	Private	77 / 75	0	28 / 2
78.	Government College of Engineering, Aurangabad (GOE-AUR) (http://geca.ac.in/)	1960	AIC	Public	78 / 72	0	29 / 1
79.	Anand Institute of Higher Technology, Chennai (AIHT-CHE) (www.aiht.ac.in/)	2000	AIC	Private	79 / 63	0	0
80.	Centurion Institute of Technology, Jatni (CIT-JAT) (https://www.cutm.ac.in/)	2005	UNI (SU)	Private	80 / 62	0	0
81	Veermata Jijabai Technological Institute, Mumbai (VJTI-MUM) (http://www.vjti.ac.in/)	1887	AIC	Public	81 / 62	0	0
82.	Bharati Vidyapeeth, Pune (BVP-PUN) (bharatividyapeeth.edu/)	1964	UNI (DU)	Public	82 / 60	0	10 / 26
83.	Koneru Lakshmaiah Education Foundation, Vaddeswara (KLEF-VAD) (http://www.klef.ac.in/)	1980	UNI (DTB)	n.a.	83 / 53	0	0
84.	Shanmugha Arts Science Technology & Research Academy, Thirumalaisamudram (SASTRA-THI) (http://www.sastra.edu/)	1984	UNI (DU)	Private	84 / 52	12 / 1	12 / 24
85.	Kalinga Institute of Industrial Technology, Bhubaneswar (KIIT-BHU) (http://kiit.ac.in/)	1992	UNI (DTB)	Private	85 / 45	0	0
86.	Malaviya National Institute of Technology, Jaipur (MNIT-JAI) (www.mnit.ac.in)	2002 (1963)*	INI (NIT)	Public	86 / 45	0	18 / 12
87.	Noorul Islam Centre for Higher Education, Kanyakumari (NICHE-KYK) (http://www.niuniv.com/)	1989	UNI (DTB)	Private	87 / 45	0	0
88.	Yeshwantrao Chavan College of Engineering, Nagpur (YCCOE-NAG) (http://www.ycce.edu/)	1984	AIC	Private	88 / 41	0	29 / 1
89.	Shri Guru Gobind Singhji Institute of Engineering & Technology, Nanded (SGGSIET-NAN) (https://www.sggs.ac.in/)	1981	AIC	Public	89 / 38	0	25 / 5

90.	Shri Ramdeobaba College of Engineering & Management, Nagpur (SRCEM-NAG) (http://www.rknec.edu/)	1984	AIC	Private	90 / 33	11 / 2	24 / 6				
91.	Indian Institute of Information Technology, Design and Manufacturing, Jabalpur (IIITDM-JAB) (http://www.iiitdmj.ac.in/)	2007	INI (IITDM)	Public	91 / 30	0	0				
92.	NIT, Goa (NIT-GOA) (www.nitgoa.ac.in)	2010	INI (NIT)	Public	92 / 29	0	0				
93.	Vignan's Foundation for Science, Technology & Research, Guntur (VFSTR-GUN) (http://www.vignanuniversity.org/)	2008	UNI (DU)	Private	93 / 26	0	0				
94.	Maharashtra Academy of Engineering & Educational Research, Pune (MAEER-PUN) (http://www.mitaoe.ac.in/)	1999	AIC	Public	94 / 24	0	0				
95.	K. K. Wagh Institute of Engineering Education & Research, Nashik (KKWIEER-NAS) (http://www.kkwagheducsoc.org/kkwagh/)	1984	AIC	Private	95 / 23	0	17 / 15				
96.	Kasegaon Education Societys Rajarambapu Institute of Technology, Islampur (KES-ISL) (www.kongu.edu/)	1983	AIC	Private	96 / 23	0	0				
97.	R.V. College of Engineering, Bengaluru (RVCE-BAN) (www.rvce.edu.in/)	1963	AIC	Private	97 / 18	0	0				
98.	Karunya Institute of Technology & Sciences, Coimbatore (KITS-COI) (http://karunya.edu/)	1986	UNI (DTB)	Private	98 / 18	0	22 / 8				
99.	**Amrita School of Engineering, Coimbatore (ASE-COI) (https://www.amrita.edu/school/engineering)	1994	Uni Deptt.	Private	99 / 13	0	0				
100.	Sagi Ramakrishnam Raju Engineering College, Bhimavaram (SRREC-BHI) (www.srkrec.ac.in/)	1980	AIC	Private	100 / 1	0	0				

n.a.- not available;
** These NITs were established during the period (1886-1987) as Regional Engineering Colleges; later on they were upgraded to NITs in the year mentioned in braces;*
*** ASE-COI is the part of AVV-COI and number of patents granted to both are the same.IIT: Indian Institute of Technology; DU: Deemed University, DTB: Deemed to be University; SU: State University; CU: Central University, AIC: Autonomous Institute or College; NIT: National Institute of Technology; IISER: Indian Institute of Science Education and Research; IIITDM: Indian Institutes of Engineering Science and Technology.*

Blue - Good in number of patents-granted (>25)
Black – Average in number of patents-granted (10-25)
Red – Low or Nil in number of patents-granted (<10)

5.4.2 Field Wise Analyses of Top 100 NIRF Engineering Institutes

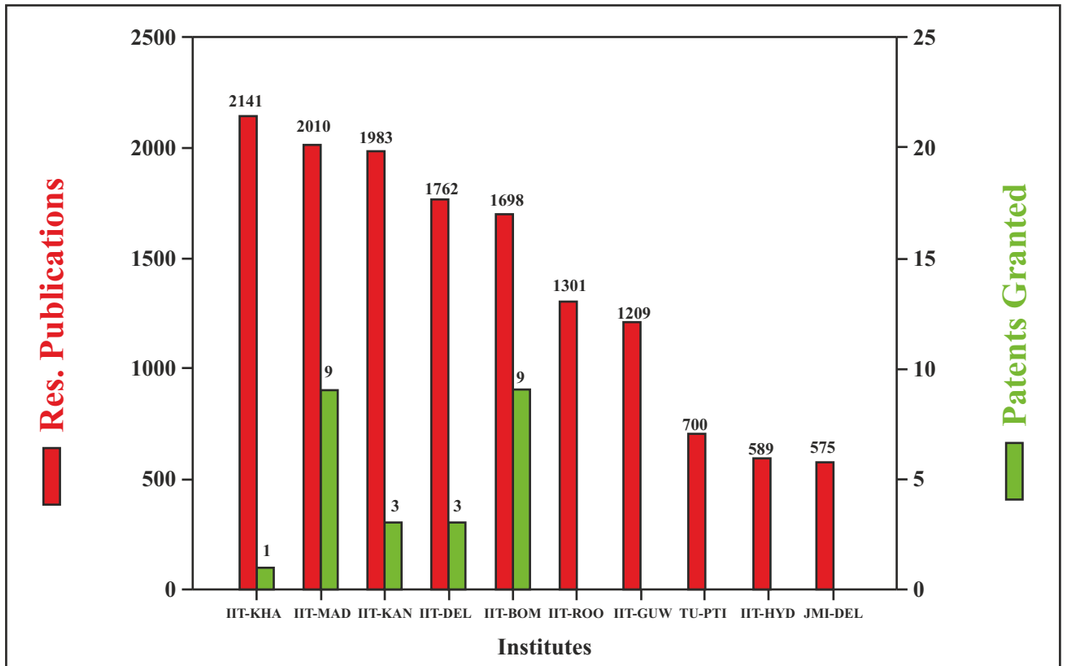


Figure 49: Top 10 Ranked Engineering Institutes Based on Number of Research Publications in the Field of **Physics** (2010-16)

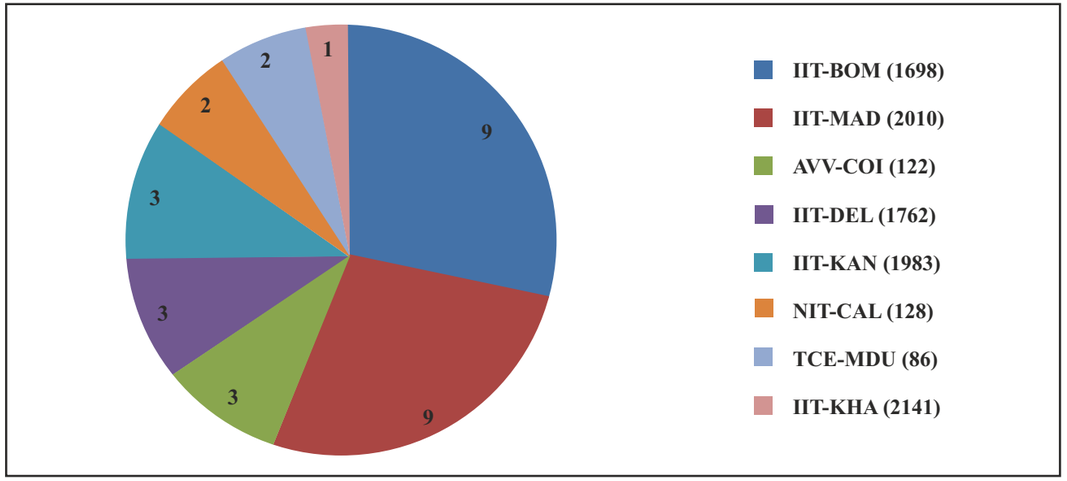


Figure 50: Top 8 Ranked Engineering Institutes based on Number of Patents Granted in the Field of **Physics** (2010-16)

Note: Numbers in brackets represent number of research publications

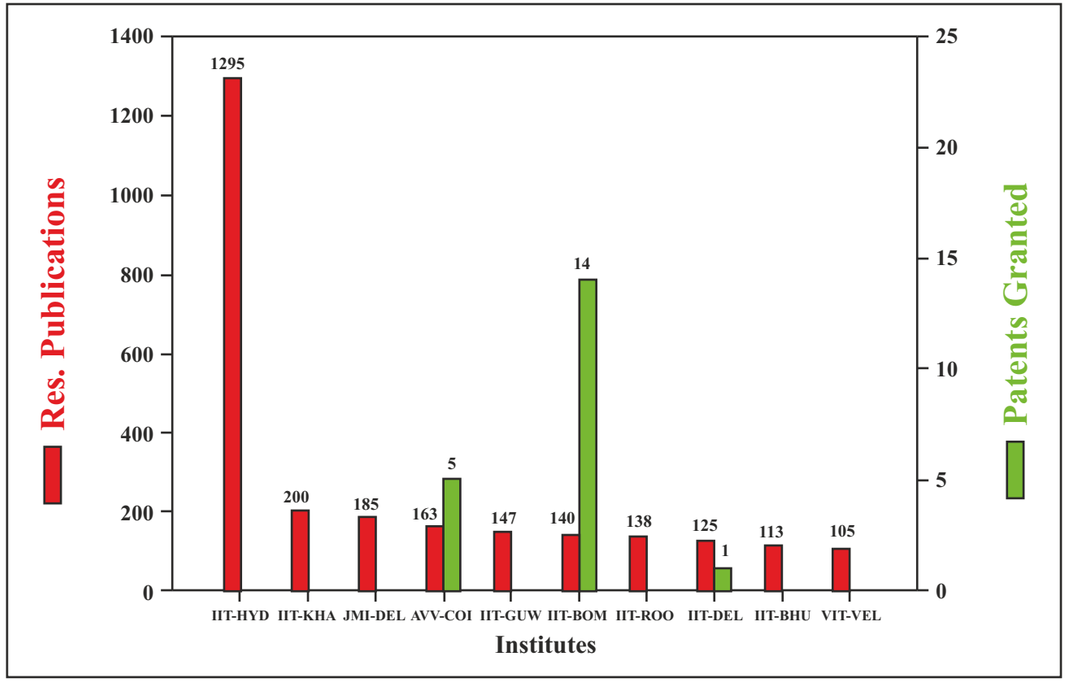


Figure 51: Top 10 Ranked Engineering Institutes Based on Number of Research Publications in the Field of **Pharma/Drugs** (2010-16)

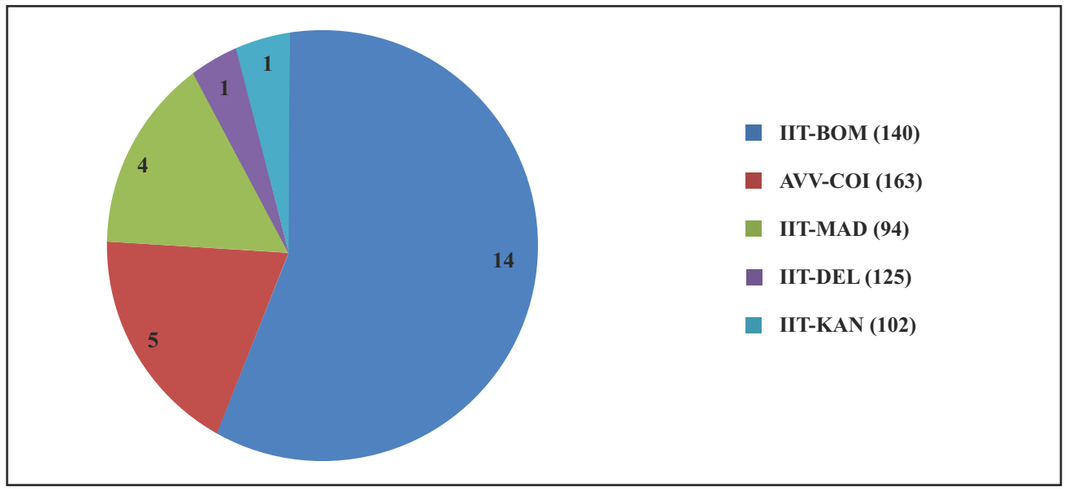


Figure 52: Top 5 Ranked Engineering Institutes based on Number of Patents Granted in the Field of **Pharma/Drugs** (2010-16)

Note: Numbers in the brackets represent number of research publications

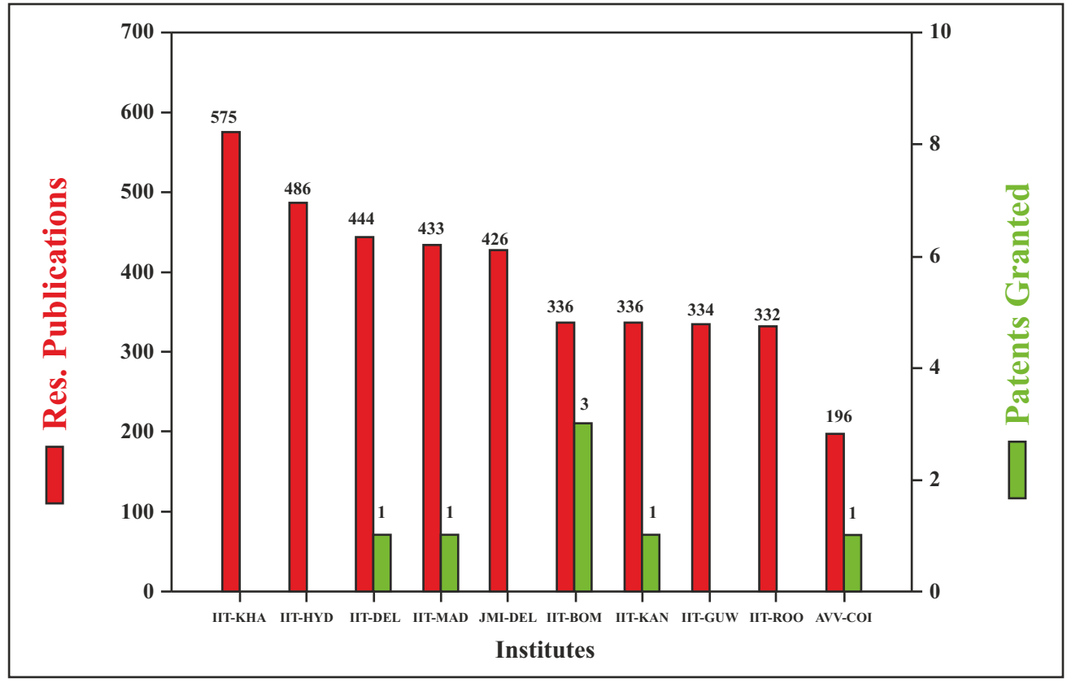


Figure 53: Top 10 Ranked Engineering Based on Number of Research Publications in the Field of **Medical Sciences** (2010-16)

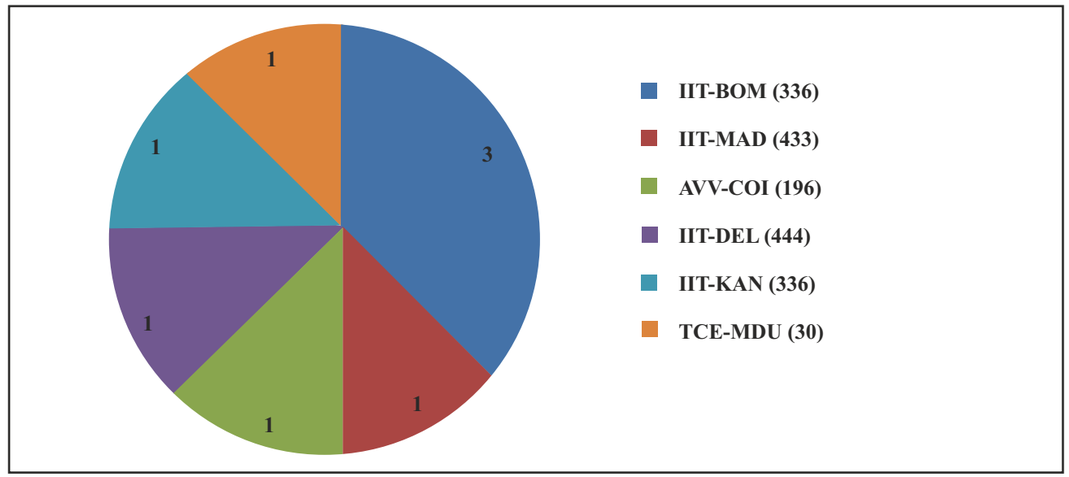


Figure 54: Top 6 Ranked Engineering Institutes based on Number of Patents Granted in the Field of **Medical Sciences** (2010-16)

Note: Numbers in brackets represents number of research publications

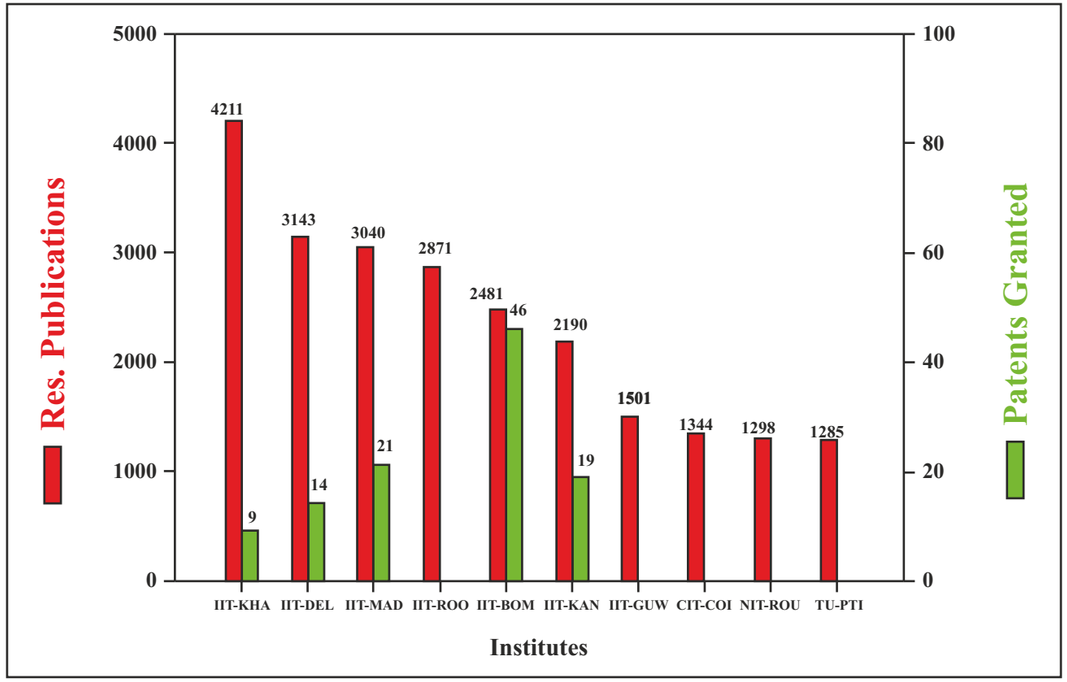


Figure 55: Top 10 Ranked Engineering Institites Based on Number of Research Publications in the Field of **Engineering** (2010-16)

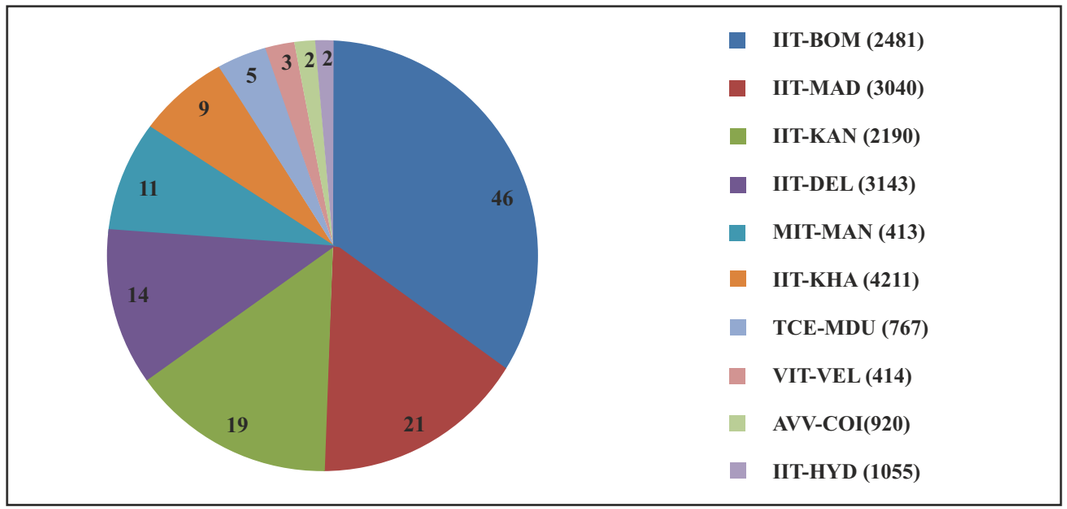


Figure 56: Top 10 Ranked Engineering Institutes based on Number of Patents Granted in the Field of **Engineering** (2010-16)

Note: Numbers in brackets represents number of research publications

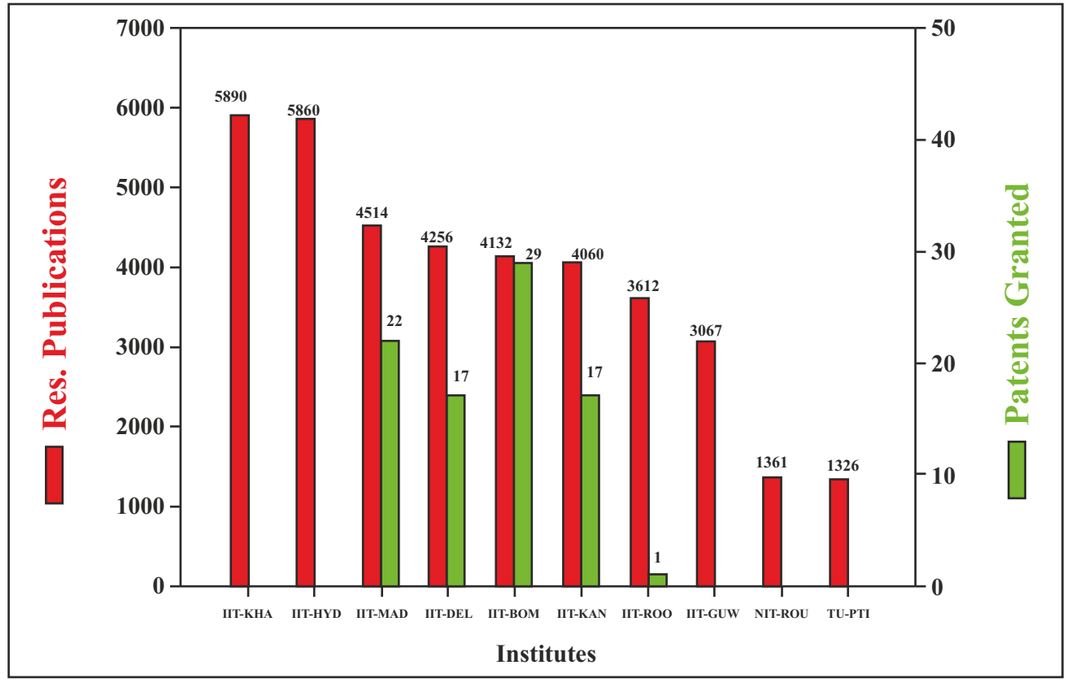


Figure 57: Top 10 Ranked Engineering Institutes Based on Number of Research Publications in the Field of **Chemical Engineering** (2010-16)

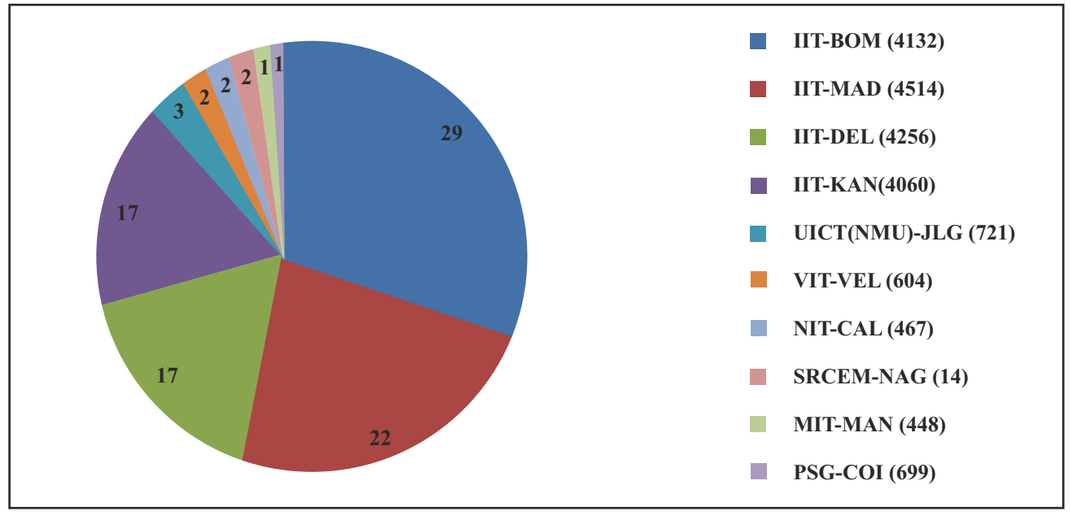


Figure 58: Top 10 Ranked Engineering Institutes based on Number of Patents Granted in the Field of **Chemical Engineering** (2010-16)

Note: Numbers in brackets represents number of research publications

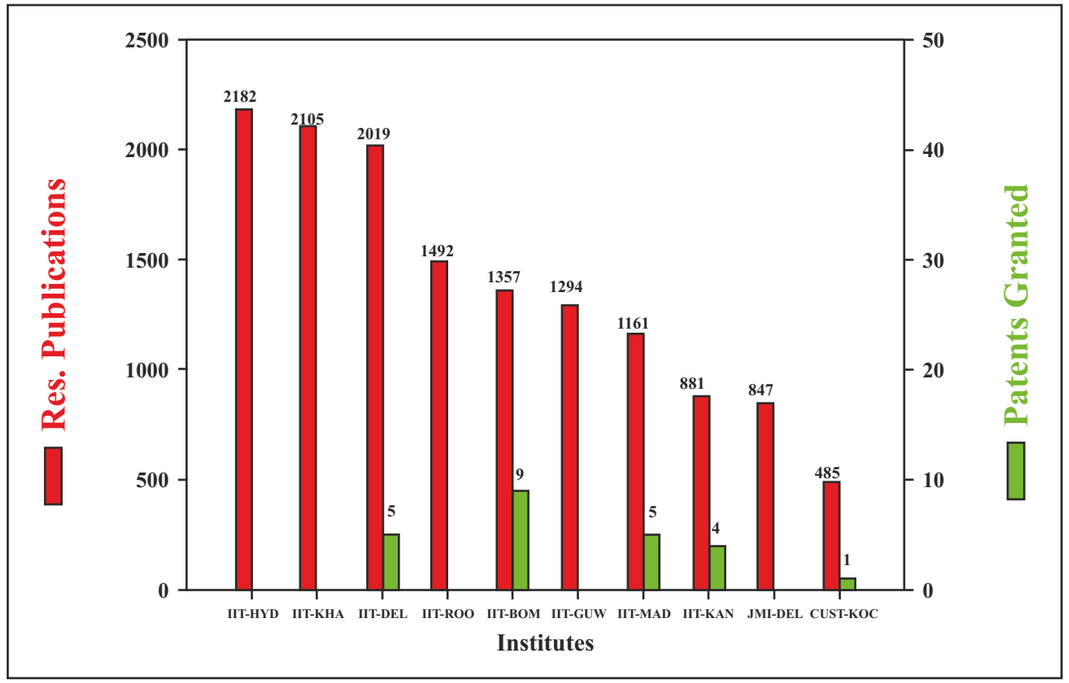


Figure 59: Top 10 Ranked Engineering Institutes Based on Number of Research Publications in the Field of **Biotech/Food/Agriculture** (2010-16)

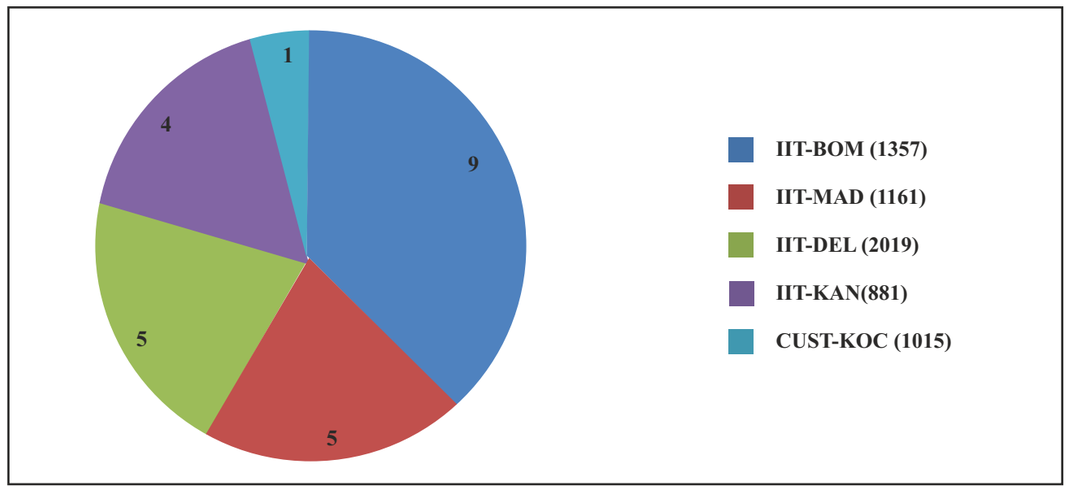


Figure 60: Top 5 Ranked Engineering Institutes based on Number of Patents Granted in the Field of **Biotech/Food/Agriculture** (2010-16)

Note: Numbers in brackets represents number of research publications

Conclusions:

- Top 100 Engineering institutes, based on NIRF-2016 rankings, comprise of 42 INIs (IITs-16, NITs-22, IIITDM-2, IISER-1 and IIEST-1), 35 AICs and 23 universities (including departments).
- Out of top 10 engineering institutes, based on research publications, barring one institute (i.e. JMI-New Delhi) all are INIs. IIT-Kharagpur leads engineering institutes in number of research publications for the period 2010-16. Three (IIT-Guwahati, JMI-New Delhi & NIT-Rourkela) institutes have no patent (granted) to their credit.
- IIT-Bombay tops the list in the category of patents (granted) (100). In the top 10 rankings, based on patents (granted), five are IITs and other five institutes are MIT-Manipur, AVV-Coimbatore, TCE-Madurai, UICT (NMU)-Jalgaon and VIT-Vellore.
- Field wise analysis revealed following institutes leading in the research publications and patent (granted):

  Physics: IIT-Kharagpur, IIT-Bombay

  Engineering: IIT-Kharagpur, IIT-Bombay

  Chemical Engineering: IIT-Kharagpur, IIT-Bombay

  Pharma/Drugs: IIT-Hyderabad, IIT-Bombay

  Medical Sciences: IIT-Kharagpur, IIT-Bombay

  Biotech/Food/Agriculture: IIT-Hyderabad, IIT-Bombay

5.5 Top 50 Private Universities

A private university is a university established through a State/Central Act by a sponsoring body viz. A Society registered under the Societies Registration Act 1860, or any other corresponding law for the time being in force in a State or a Public Trust or a Company registered under Section 25 of the Companies Act, 1956. In the present study, we are comparing the performance of private universities of the country based on their research articles published in last 7 years (2010-16). For this study the top 50 private universities (2016) are taken from CAREER 360 (https://university.careers360.com/colleges/ranking?page=3).

Analyses: In this category, top 50 private universities were mapped for the total number of research publications and patents granted for the period 2010-16. A list of top 50 private universities based on the number of research publications is mentioned in Table 18.

- **Composite Analyses of Top 50 Private Universities**
- **Field Wise Analyses of Top 50 Private Universities**

Table 18: Research Articles and Patent Profile of Top 50 Private Universities in India

S. No.	Institute	Year of Establishment	Ranking/No. of Res. Publications	Ranking/No. of Patents Granted	Ranking/No. of Patents Published
1.	**VIT University (Vellore Engineering College), Vellore** (www.vit.ac.in)	1984	1 / 6267	4 / 3	4 / 51
2.	**Manipal University, Manipal** (manipal.edu/mu.html)	1953	2 / 4444	1 / 13	5 / 43
3.	**Sathyabama University, Chennai** (www.sathyabama.ac.in)	1987	3 / 3211	0	17 / 8
4.	**Bharath University, Chennai** (www.bharathuniv.ac.in)	1984	4 / 2082	0	2 / 111
5.	**Birla Institute of Technology & Science Pilani** (www.bits-pilani.ac.in)	1964	5 / 1755	0	13 / 12
6.	**SRM University, Chennai** (www.srmuniv.ac.in)	1985	6 / 1730	3 / 4	6 / 41
7.	**Amrita Vishwa Vidyapeetham, Coimbatore** (www.amrita.edu/campus/coimbatore)	2003	8 / 1556	2 /9	3/ 91
8.	**Amity University, Noida** (www.amity.edu)	2003	9 / 1311	5 / 1	1 / 495
9.	**Karunya University, Coimbatore** (www.karunya.ac.in)	1986	10 / 1014	0	18 / 8
10.	**Karpagam University, Coimbatore** (kahedu.edu.in)	2008	11 / 953	0	10/ 23
11.	**Bharati Vidyapeeth, Pune** (bvp.bharatividyapeeth.edu)	1964	12 / 944	0	8/ 26
12.	**Lovely Professional University, Phagwara** (www.lpu.in)	2005	13 / 691	0	19/ 7

13.	**Vel Tech Dr Rangrajan Dr Sakunthala Technical University, Chennai** (veltech.edu.in)	1997 (2008)	14 / 670	0	7 / 39
14.	**Jaypee Institute of Information Technology, Noida** (www.jiit.ac.in)	2001	15 / 667	0	29/ 1
15.	**JSS University, Mysore** (www.jssuni.edu.in)	2008	16 / 581	0	22 / 5
16.	**Jaypee University of Information Technology, Solan** (www.juit.ac.in)	2002	17 / 487	5 / 1	14 / 11
17.	**Nirma University, Ahmedabad** (www.nirmauni.ac.in)	2003	18 / 455	0	16 / 10
18.	**Jain University, Bangalore** (jainuniversity.ac.in)	2009	19 / 452	0	12 / 12
19.	**Noorul Islam Centre For Higher Education, Kanyakumari (Noorul Islam University)** (www.niuniv.com)	1989 (2008)	20 / 388	0	0
20.	**Sharda University, Greater Noida** (www.sharda.ac.in)	2009	21 / 377	0	0
21.	**University of Petroleum and Energy Studies, Dehradun (**www.upes.ac.in**)**	2003	22 / 353	0	21/ 6
22.	**International Institute of Information Technology, Hyderabad *(public private partnership)*** (www.iiit.ac.in)	1998	23 / 353	0	31 / 10
23.	**Maharishi Markandeshwar University, Mullana** (www.mmumullana.org)	1993	24 / 318	0	0
24.	**Teri School of Advanced Studies, New Delhi** (www.teriuniversity.ac.in)	1998 (1999)	25 / 308	0	26 / 2
25.	**Pandit Deendayal Petroleum University, Gandhinagar** (www.pdpu.ac.in)	2007	27 / 180	0	0
26.	**Vignan University, Guntur** (www.vignanuniversity.org)	2008	28 / 175	0	0

27.	**LNM Institute of Information Technology, Jaipur** (www.lnmiit.ac.in)	2003 (2006)	29 / 142	0	20 / 7
28.	**Manipal University, Jaipur** (www.jaipur.manipal.edu)	2011	30 / 127	0	0
29.	**Manav Rachna International University, Faridabad** (www.manavrachna.edu.in)	1997	31 / 125	0	27 / 1
30.	**GLA University, Mathura** (www.gla.ac.in)	2010	32 / 121	0	30 / 1
31.	**PES University, Bengaluru (**www.pes.edu**)**	1972	33 / 91	0	23 / 3
32.	**Shiv Nadar University, Dadri** (www.snu.edu.in)	2011	34 / 83	0	0
33.	**Dhirubhai Ambani Institute of Information and Communication Technology, Gandhinagar** (www.daiict.ac.in)	2001	35 / 73	0	0
34.	**Sri Chandrasekharendra Saraswathi Viswa Mahavidyalaya, Kanchipuram** (www.kanchiuniv.ac.in)	1993	36 / 65	0	0
35.	**Kalasalingam University, Virudhunagar** (www.kalasalingam.ac.in)	1984	37 / 64	0	0
36.	**The Northcap University, Gurgaon** (www.ncuindia.edu)	1996	38 / 63	0	0
37.	**Azim Premji University, Bangalore** (www.azimpremjiuniversity.edu.in)	2010	39 / 62	0	0
38.	**ICFAI Foundation for Higher Education, Hyderabad** (www.ifheindia.org)	1995 (2008)	40 / 61	0	0
39.	**Chitkara University, Patiala** (www.chitkara.edu.in)	2010	41 / 56	0	9 / 23

40.	**International Institute of Information Technology, Bangalore *(public private partnership)*** (www.iiitb.ac.in)	1999	42 / 56	0	0
41.	**NIIT University, Neemrana** (www.niituniversity.in)	2009	44 / 53	0	0
42.	**Kalinga Institute Of Industrial Technology, Bhubaneswar** (www.kiit.ac.in)	1992	45 / 48	0	0
43.	**MS Ramaiah University of Applied Sciences, Bangalore** (www.msruas.ac.in)	2013	46 / 47	0	0
44.	**Narsee Monjee Institute Of Management Studies, Mumbai** (www.nmims.edu)	1981	47 / 45	0	0
45.	**BS Abdur Rahman University, Chennai** (www.bsauniv.ac.in)	1984	48 / 24	0	28 / 1
46.	**Xavier University, Bhubaneswar** (www.xub.edu.in)	2013	49 / 16	0	0
47.	**Hindustan University, Kelambakkam** (www.hindustanuniv.ac.in)	1985 (2008)	50 / 4	0	11 / 19
48.	**Sikkim Manipal University, Gangtok** (smu.edu.in)	1995	54	0	0
49.	**Invertis University, Bareilly** (www.invertisuniversity.ac.in)	1998	3	0	0
50.	**Sumandeep Vidyapeeth University, Waghodia** (sumandeepvidyapeethdu.edu.in)	2007	0	0	0

Red – Low or Nil in number of patents-granted (<10)

5.5.1 Composite Analyses of Top 50 Private Universities

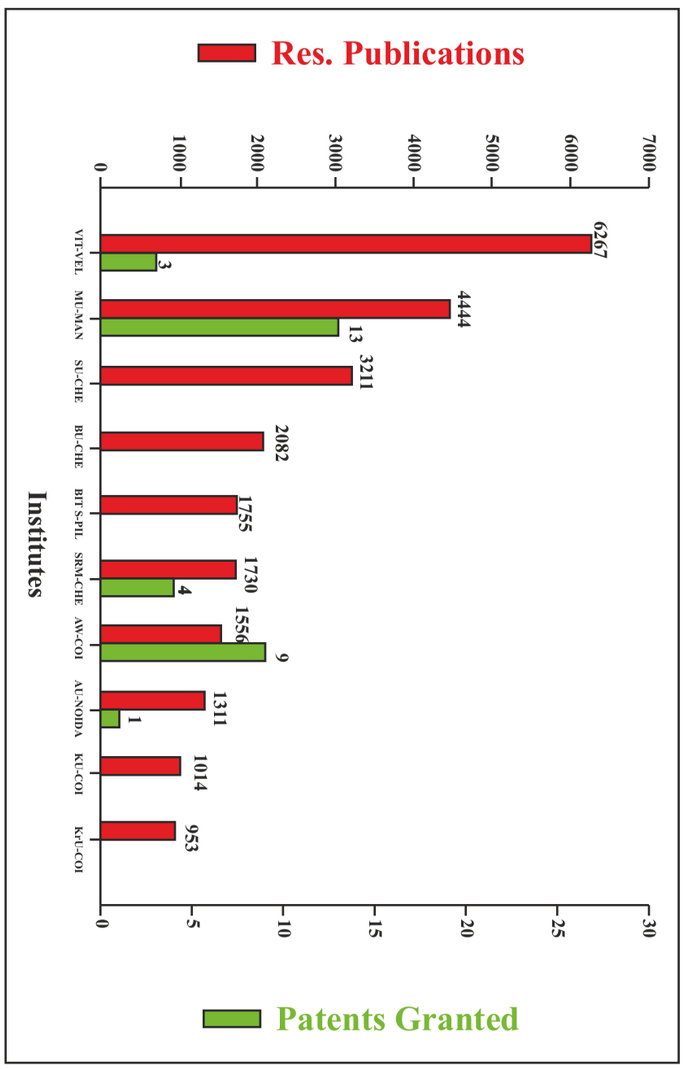


Figure 61: Top 10 Ranked Private Universities Based on Number of Research Publications (2010-16)

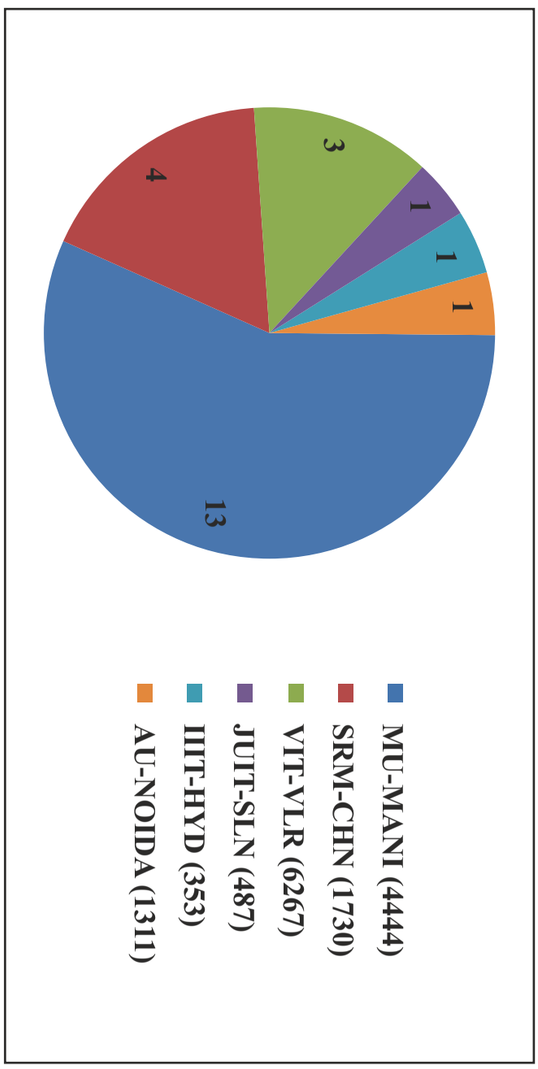


Figure 62: Top 6 Ranked Private Universities Based on Number of Patents Granted (2010-16)
Note: Numbers in brackets represent number of research publications

5.5.2 Composite Analyses of Top 50 Private Universities

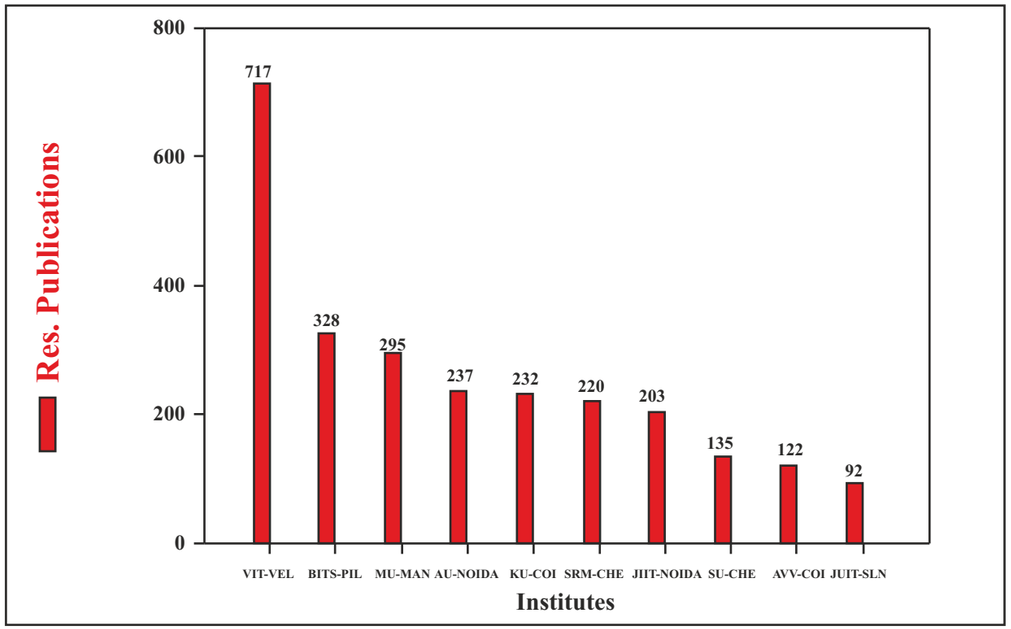


Figure 63: Top 10 Ranked Private Universities Based on Number of Research Publications in the Field of **Physics (**2010-16)
Note: No private university has patent granted in the field of Physics.

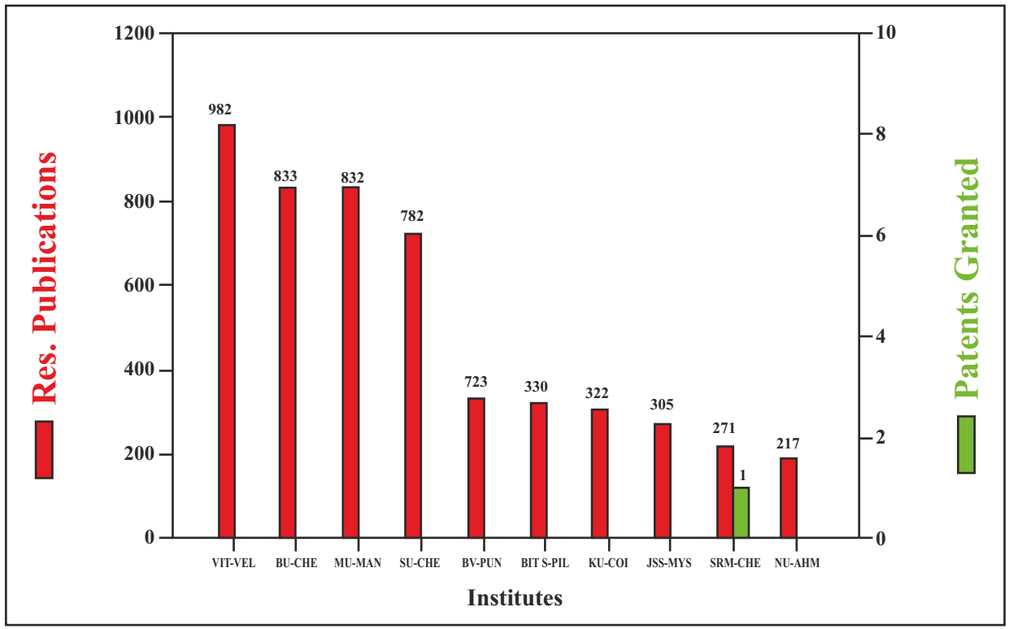


Figure 64: Top 10 Ranked Private Universities Based on Number of Research Publications in the Field of **Pharma/Drugs** (2010-16)

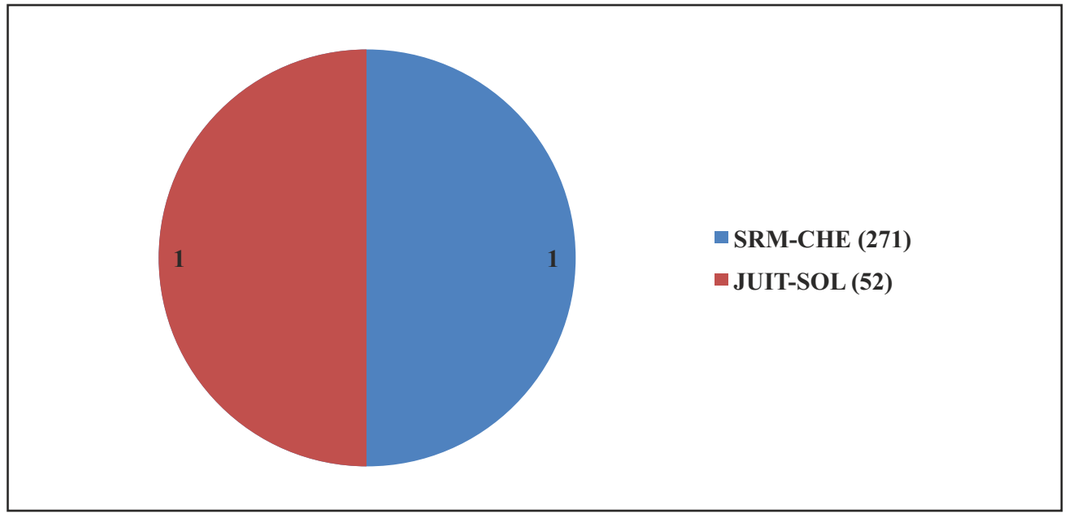


Figure 65: Private Universities having Patents Granted in the Field of **Pharma/Drugs** (2010-16)
Note: Numbers in brackets represent number of research publications

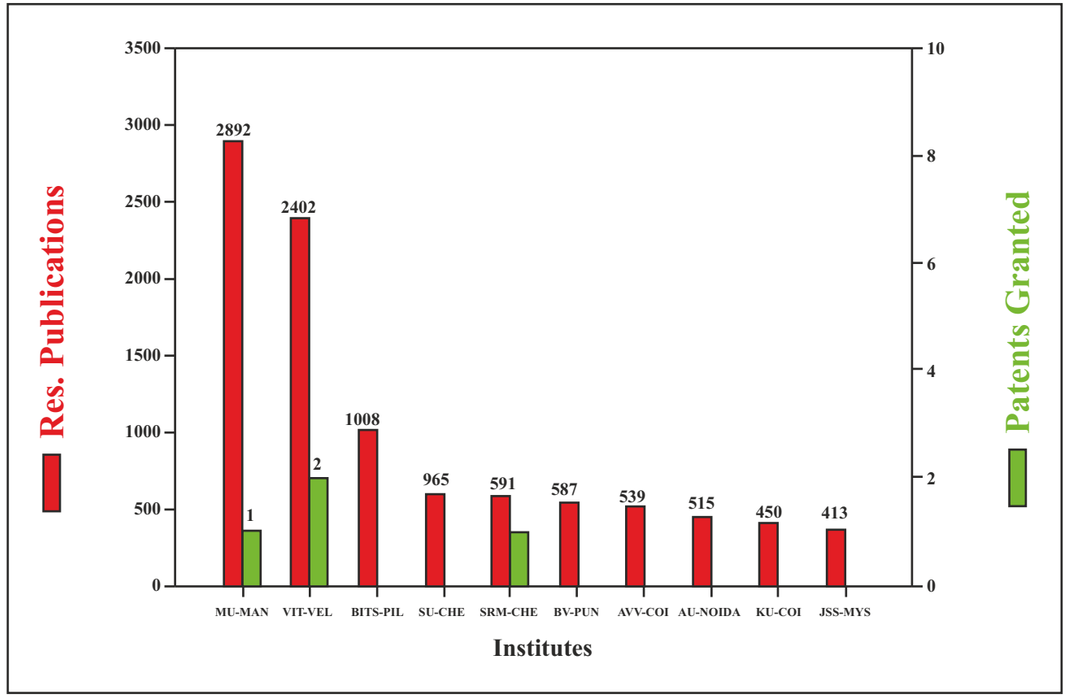


Figure 66: Top 10 Ranked Private Universities Based on Number of Research Publications in the Field of **Chemical Engineering** (2010-16)

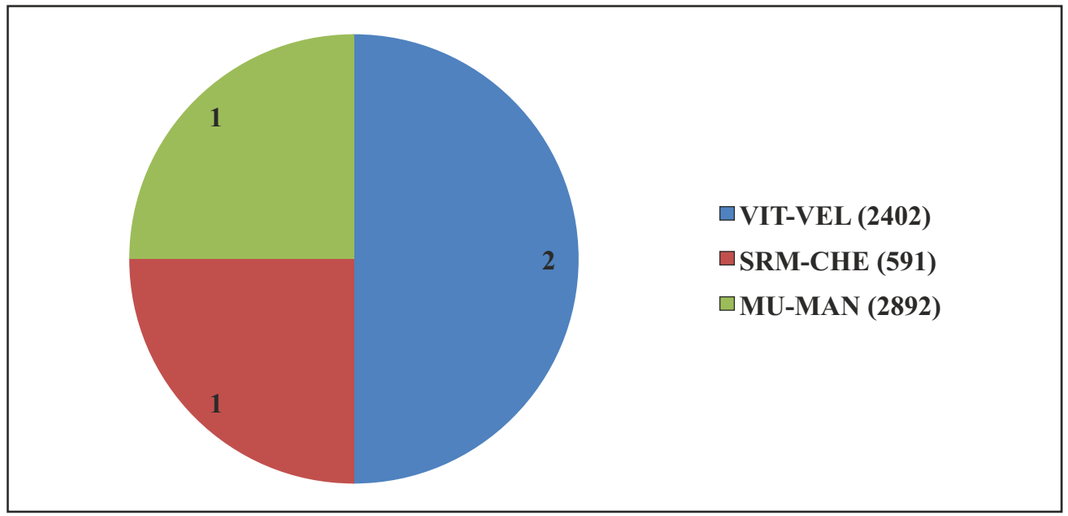


Figure 67: Private Universities having Patents Granted in the Field of **Chemical Engineering** (2010-16)
Note: Numbers in brackets represent number of research publications

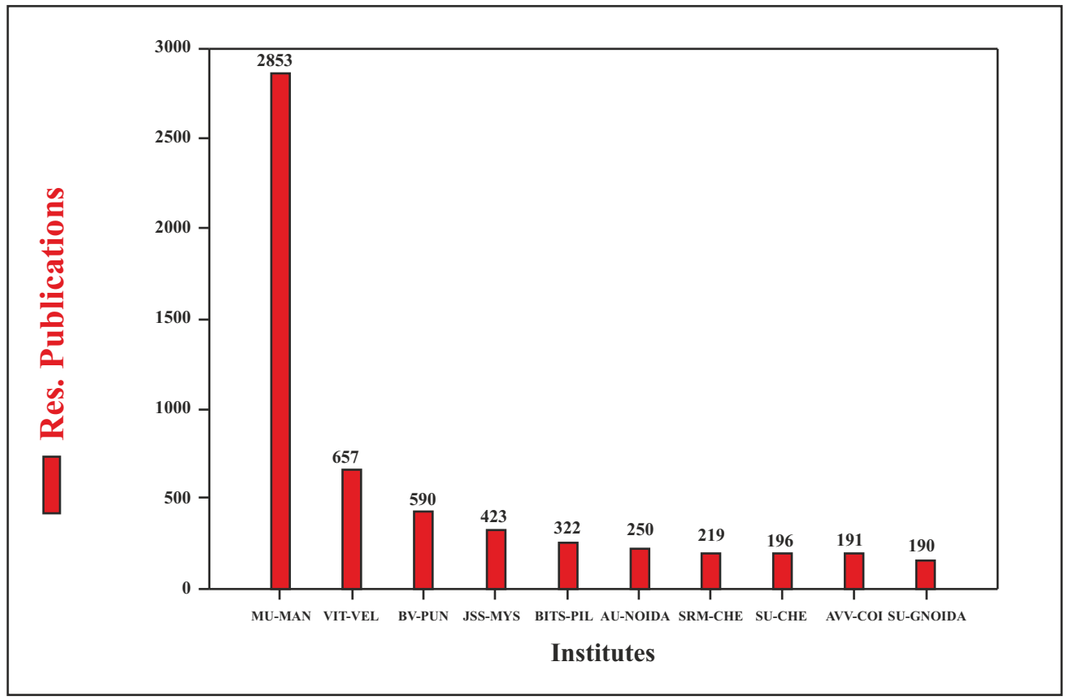


Figure 68: Top 10 Ranked Private Universities Based on Number of Research Publications in the Field of **Medical Sciences** (2010-16)
Note: No patent is granted to any of the Private University in Medical Sciences

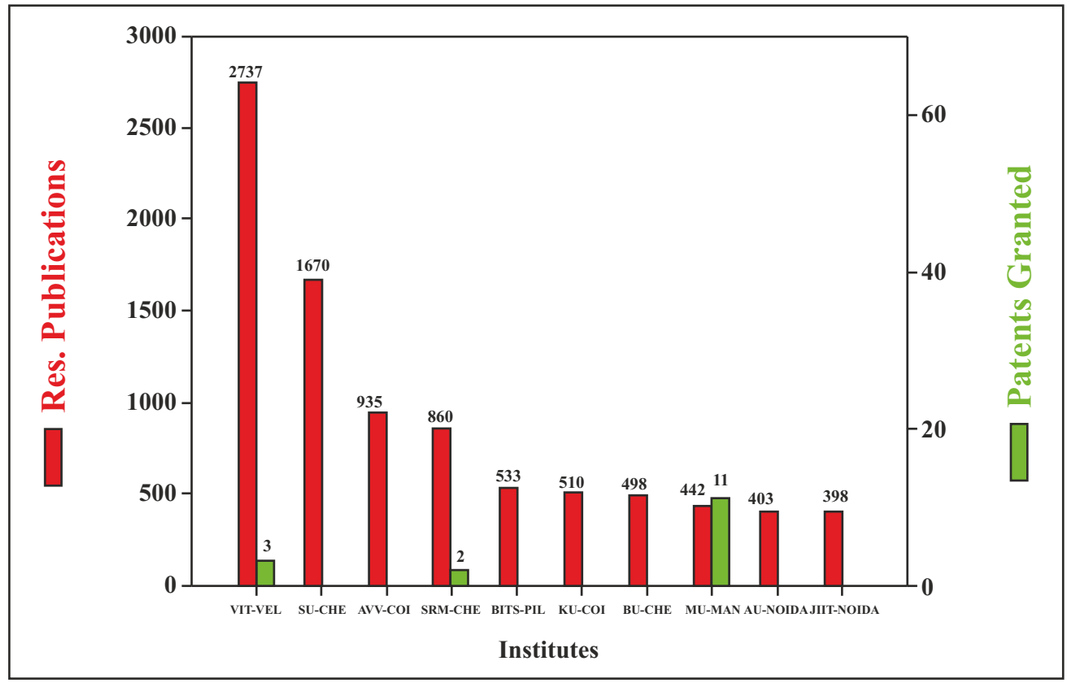


Figure 69: Top 10 Ranked Private Universities Based on Number of Research Publications in the Field of **Engineering** (2010-16)

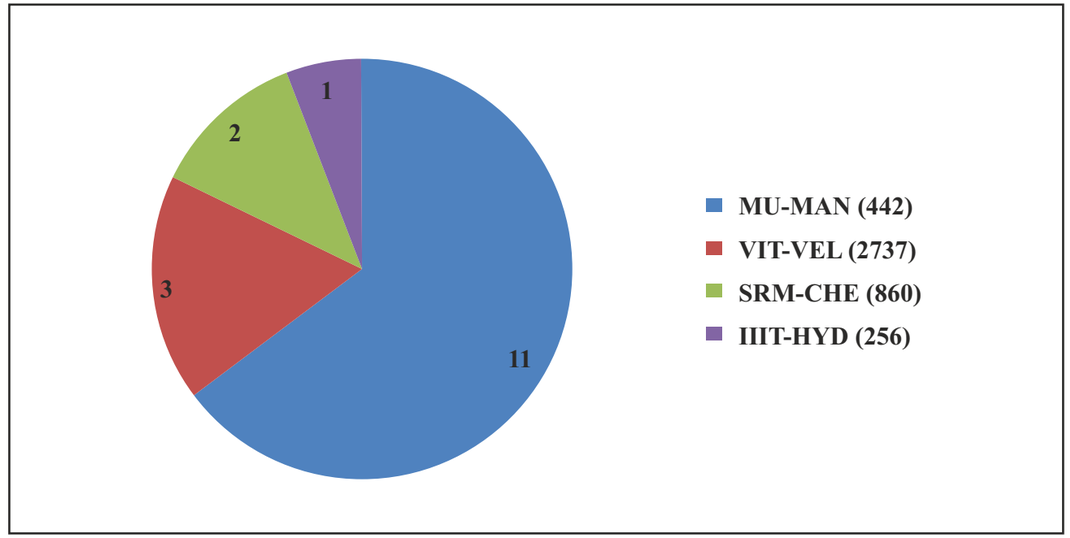


Figure 70: Top Ranked Private Universities based on Number of Patents Granted in the Field of **Engineering** (2010-16)

Note: Numbers in brackets represent number of research publications

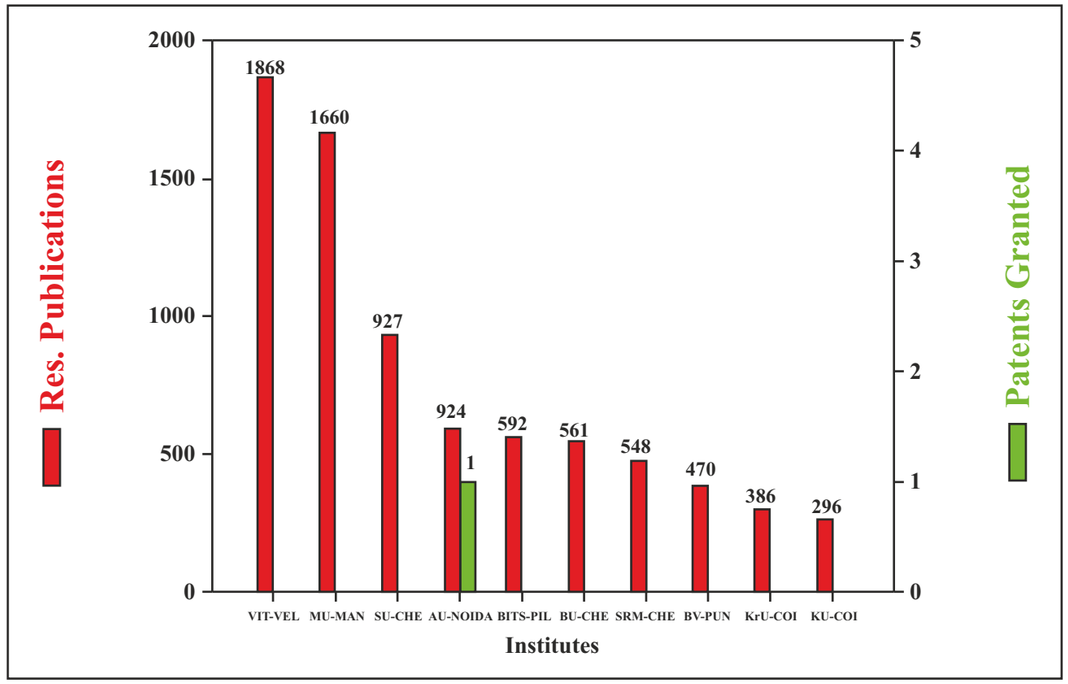


Figure 71: Top 10 Ranked Private Universities Based on Number of Research Publications in the Field of **Biotech/Food/Agriculture** (2010-16)

Note: *Amity University, NOIDA is the only university, which has a patent granted to its credit*

Conclusions:

1. VIT-Vellore leads the list of Private Universities in the domain of research publications (2010-16). It published 6167 research papers followed by MU-Manipal (4444), SU-Chennai (3211), BU-Chennai (2082) and BITS-Pilani (1755).
2. None of the private university is excelling in number of patents (granted). MU-Manipal leads with 13 patents (granted) followed SRM-Chennai (4), VIT-Vellore (3).
3. Only a few universities are excelling in field wise research publications. These universities are-

- MU-Manipal in the fields of Chemical Engineering (2892), Medical Sciences (2853), Engineering (2737) and Biotech/Food/Agriculture (1660)
- VIT-Vellore in the fields of Chemical Engineering (2402) and Biotech/Food/Agriculture (1868)
- BITS-Pilani in the field of Chemical Engineering (1008)
- The study indicates that Physics and Pharma/Drugs are not high on the priority list of private universities as no institute published research papers in four digits during the period 2010-16. The private institute leading in these domains is VIT-Vellore having 982 and 717 research publications in the fields of Pharma/Drugs and Physics respectively.

5.6 Top 50 NIRF Pharma Institutes of India

Analyses: In this category, NIRF ranked pharma institutes were mapped for the total number of research publications and patents granted for the period 2010-16. A list of top 50 NIRF-2016 ranked pharma institutes based on the number of research publications is mentioned in Table 19.

- **Composite Analyses of Top 50 NIRF Pharma Institutes**
- **Field Wise Analyses of Top 50 NIRF Pharma Institutes**

5.6.1 Composite Analyses of Top 50 NIRF Pharma Institutes

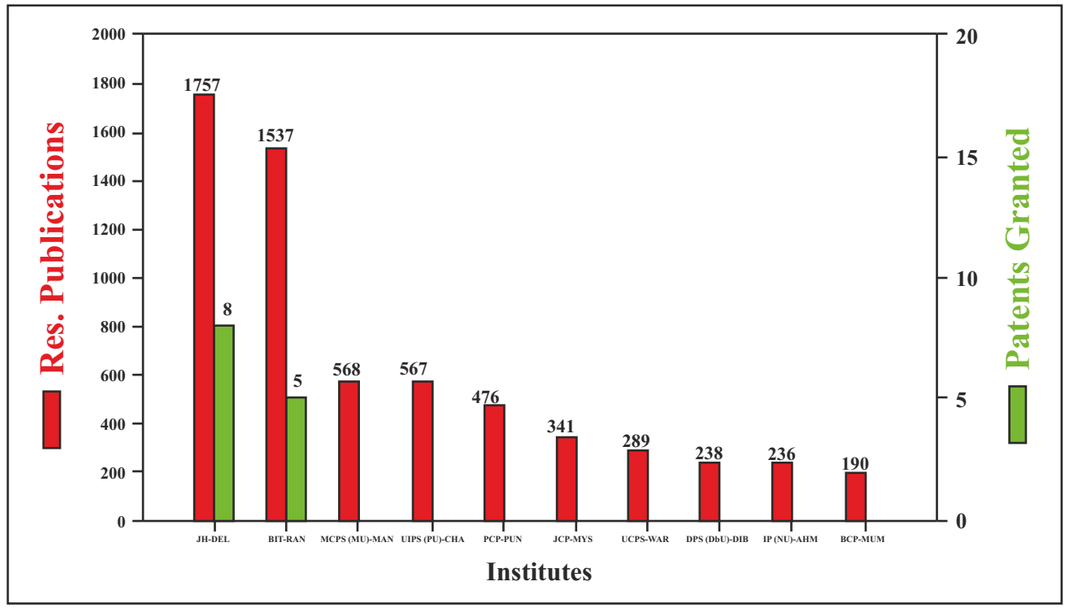


Figure 72: Top 10 Ranked NIRF Pharma Institute Based on Number of Research Publications (2010-16)

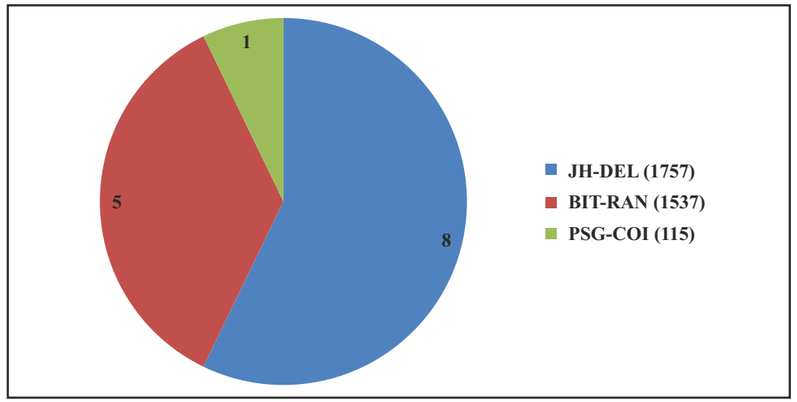


Figure 73: Top 3 Ranked NIRF Pharma Institutes Based on Number of Patents Granted (2010-16)

Note: Numbers in brackets represent number of research publications

Table 19: Research Articles and Patent Profile of Top 50 NIRF Ranked Pharma Institutes in India

S. No.	Institute	Year of Establishment	Public/Private Status	Ranking/No. of Res. Publications	Ranking/No. of Patents Granted	Ranking/No. of Patents Published
1.	**Jamia Hamdard, New Delhi** (jamiahamdard.edu)	1989	PU	1 / 1757	1 / 8	1 / 26
2.	**Birla Institute of Technology, Ranchi** (https://www.bitmesra.ac.in)	1955	PU	2 / 1537	2 / 5	2 / 8
3.	**Manipal College of Pharmaceutical Sciences, Manipal** (https://manipal.edu/mcops-manipal.html)	1971	PrU	3 / 568	0	9 / 2
4.	**University Institute of Pharmaceutical Sciences, Chandigarh** (pharma.puchd.ac.in)	1944	SU	4 / 567	0	3 / 4
5.	**Poona College of Pharmacy, Pune** (pcp.bharatividyapeeth.edu)	1981	PrU	5 / 476	0	10 / 1
6.	**JSS College of Pharmacy, Mysore** (https://www.jssuni.edu.in)	1973	PrU	6 / 341	0	6 / 3
7.	**University College of Pharmaceutical Sciences, Kakatiya University, Warangal** (kakatiya.ac.in/university-college-of-pharmaceutical-sciences)	1981	SU	7 / 289	0	0
8.	**Department of Pharmaceutical Sciences, Dibrugarh University, Dibrugarh** (https://www.dibru.ac.in)	1983	SU	8 / 238	0	6 / 3
9.	**Institute of Pharmacy, Nirma University, Ahmedabad** (http://www.nirmauni.ac.in/IPNU/)	2003	PrU	9 / 236	0	6 / 3
10.	**Bombay College of Pharmacy, Mumbai** (http://www.bcp.edu.in/)	1957	SU	10 / 190	0	0
11.	**Al Ameen College of Pharmacy, Bangalore** (http://www.alameenpharmacy.edu/)	1983	SU	11 / 178	0	3 / 4
12.	**Aissms College of Pharmacy, Pune** (http://aissmscop.com/)	1966	SU	12 / 155	0	0
13.	**Amrita School of Pharmacy, Kochi** (https://www.amrita.edu/school/pharmacy)	2010	PrU	13 / 143	0	0
14.	**L. M. College of Pharmacy, Ahmedabad** (http://www.lmcp.in/)	1947	SU	14 / 141	0	3 / 4
15.	**SLT Institute of Pharmaceutical Sciences, Bilaspur** (http://www.ggu.ac.in/Academic_Department_Pharmacy.html)	1997	CU	15 / 131	0	0
16.	**PSG College of Pharmacy, Coimbatore** (http://psgpharma.ac.in/)	2001	SU	16 / 115	0	0
17.	**N.G.S.M. Institute of Pharmaceutical Sciences, Mangalore** (http://ngsmips.nitte.edu.in/)	1983	SU	17 / 113	3 / 1	0
18.	**Bharati Vidyapeeth College of Pharmacy, Kolhapur** (copkolhapur.bharatividyapeeth.edu/)	1996	SU	18 / 105	0	0
19.	**College of Pharmacy, Madras Medical College, Chennai** (www.mmc.ac.in)	1835	SU	19 / 93	0	0
20.	**University Institute of Pharmacy, Raipur** (http://iopraipur.ac.in/)	2001	SU	20 / 89	0	0
21.	**Shri Vishnu College of Pharmacy, Bhimavaram** (svcp.edu.in)	1997	SU	21 / 85		
22.	**Nandha College of Pharmacy, Erode** (http://nandhapharmacy.org/)	1992	SU	22 / 84	0	0
23.	**Seemanta Institute of Pharmaceutical Sciences, Baripada** (http://www.seemantapharma.org/)	1982	SU	23 / 83	0	0

24.	**B. R. Nahata College of Pharmacy, Mandsaur** (http://www.meu.edu.in/brncop/)	1995	PrU	24 / 77	0	0
25.	**Chitkara College of Pharmacy, Rajpura** (https://www.chitkara.edu.in)	2005	PrU	25 / 75	0	0
26.	**Sree Siddaganga College of Pharmacy, Tumkur** (http://www.scptumkur.ac.in)	1983	SU	26 / 73	0	0
27.	**Acharya & B M Reddy College of Pharmacy, Bangalore** (www.acharya.ac.in/pharmacy)	1992	SU	27 / 70	0	0
28.	**JSS College of Pharmacy, Ooty** (https://www.jssuni.edu.in)	1980	PrU	27 / 70	0	0
29.	**KLE College of Pharmacy, Bangalore** (www.klepharm.edu)	1968	SU	29 / 66	0	10 / 1
30.	**Sinhgad Institute of Pharmacy, Pune** (www.sinhgad.edu)	2005	SU	29 / 66	0	10 / 1
31.	**Raghavendra Institute of Pharmaceuatical Education & Research (Riper), Anantapur** (riper.ac.in)	2002	SU	31 / 58	0	0
32.	**Raj Kumar Goel Institute of Technology (Pharmacy), Ghaziabad** (www.rkgit.edu.in)	2004	SU	32 / 56	0	0
33.	**S.E.T's College of Pharmacy, Dharwad** (www.soniyapharmacy.org)	1992	SU	33 / 48	0	0
34.	**Shree Dhanvantary Pharmacy College, Surat** (www.sdpc.co.in)	2005	SU	34 / 41	0	0
35.	**A.R. College of Pharmacy & G.H. Patel Institute of Pharmacy, Anand** (www.arghpharmacy.ac.in)	1981	SU	35 / 31	0	0
36.	**Periyar College of Pharmaceuitcal Sciences, Tiruchirappalli** (www.periyarpharma.in)	1982	SU	36 / 30	0	0

37.	**Goa College of Pharmacy, Panaji** (http://gcp.goa.gov.in)	1963	SU	37 / 29	0	0
38.	**Maratha Mandal`s College of Pharmacy, Belgaum**	1984*	SU	38 / 26	0	0
39.	**Maliba Pharmacy College, Tarsadi** (maliba.edu.in)	2000	PrU	39 / 22	0	0
40.	**Shri Govindram Seksaria Institute of Technology and Science, Indore** (www.sgsits.ac.in)	1952	SU	39 / 22	0	0
41.	**N.E.T Pharmacy College, Raichur** (www.navodaya.edu.in/pharmacy)	1992	SU	41 / 20	0	0
42.	**Mallige College of Pharmacy, Bangalore** (www.mallige.ac.in)	2006	SU	42 / 16	0	0
43.	**J.K.K. Nattraja College of Pharmacy, Komarapalayam** (pharmacy.jkkn.ac.in)	1985	SU	43 / 12	0	0
44.	**School of Pharmacy, Solan**	2008	SU	44 / 11	0	0
45.	**Vinyaka Mission`s College of Pharmacy, Kondappanaikenpatty** (https://www.vinayakamission.com)	1981	PrU	44 / 11	0	0
46.	**R. C. Patel Institute of Pharmaceutical Education & Research, Shirpur** (www.rcpatelpharmacy.co.in)	1992	SU	46 / 9	0	0
47.	**Sinhgad Technical Education Society`s Sinhgad College of Pharmacy, Pune** (www.sinhgad.edu)	2005	SU	46 / 9	0	0
48.	**H.R. Patel Institute of Pharmaceutical Education And Research, Shirpur** (www.hrpatelpharmacy.co.in)	2004	SU	48 / 1	0	0
49.	**Mvp Samaj`s College of Pharmacy, Nashik** (www.mvpcpn.com)	1982	SU	48 / 1	0	0
50.	**H.K.E.S S Matoshree Taradevi Rampure Institute of Pharmaceutical Sciences, Gulbarga** (pharmacy.hkes.edu.in)	1973	SU	48 / 1	0	0

Red – Low or Nil in number of patents-granted (<10)

Note: It is pertinant to mention that many institutes excelling in pharmaceutical sciences did not apply for NIRF (Pharma)-2016 rankings e.g. DU-Delhi, IISc-Bangalore, IIT-Bombay, NIPER-Mohali, IIT-Hyderabad, IICT-Hyderabad, Gujarat University-Ahmedabad, Manipal-University-Manipal etc.

5.6.2 Filed wise Analyses of Top 50 Pharma Institutes

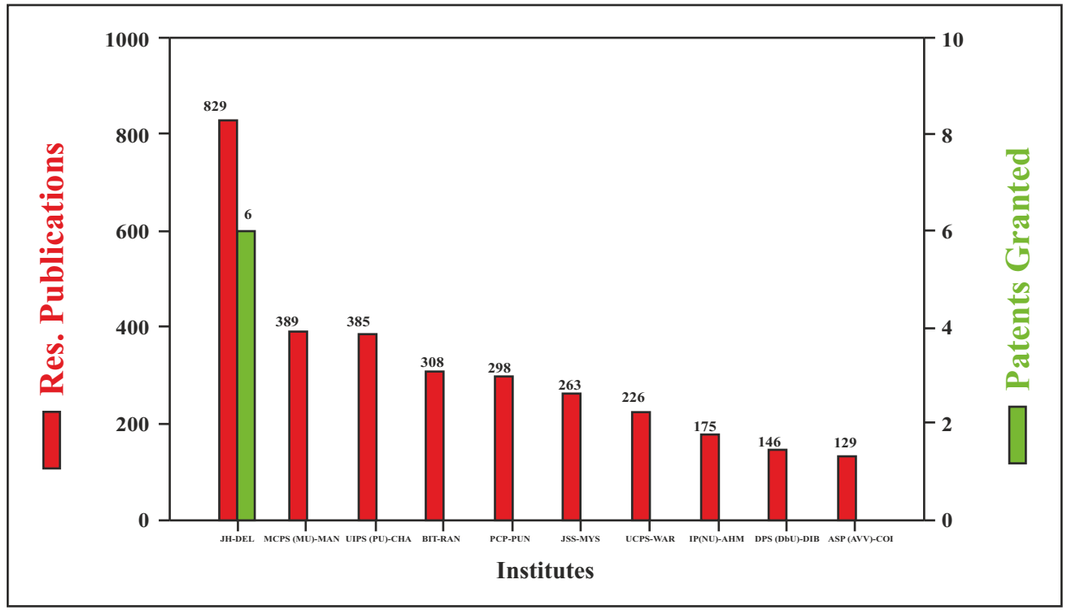


Figure 74: Top 10 Ranked NIRF Pharma Institutes Based on Number of Research Publications in the Field of **Pharma/Drugs** (2010-16)

Note: JH-DEL is the only pharma institute, which has patents granted to its credit in the field of Pharma/Drugs

Conclusions:

In the NIRF-2016 ranking of Pharma institutes, top rank in the category of number of research publications for the period (2010-16) was claimed by JH-New Delhi (1757), followed by BIT-Ranchi (1537). MCPS-Manipal was distant third (568). Amongst the top 10 ranked pharma institutes (Table 19), 4 are state universities, 2 deemed universities (public) and 4 private universities.

The patent (granted) regime of the top 50 NIRF-ranked pharma institutes is abysmal. Only 3 institutes were granted patents. These institutes are:

a) JH-New Delhi (8): *Pharma (6), Chemical Engg. (2),*
b) BIT-Ranchi (5): *Electrical Engg. (2), Mechanical Engg.(1), Chemical Engg.(1), and Physics (1)*
c) PSG-Coimbatore (1): *Chemical Engg. (1)*

5.7 National Research Laboratories

The present study is an account of the analysis of the research publications and patent profile of National R&D labs thereby assessing the position of India on the global platform. R&D profile of different research institutions under 27 ministries and 2 independent departments under Prime Minister of India has been studied, in order to identify R&D labs/institutes performing well in research publications & patents or both. The data has also been categorized based on fields of specialization.

Research and Development (R&D) Institutes: The research institutes/labs for the study have been taken from the official website of respective ministries and directory of R&D institutes by NSTMIS, DST, Govt. of India. The number of labs and ministries considered for study are mentioned in table 20.

Table 20: Ministries/Departments Covered in the Study

S. No.	Name of the Ministry	No. of Institutions Taken for Study
1.	Ministry of Health and Family Welfare (MHFW) (https://mohfw.gov.in)	154
2.	Ministry of Agriculture and Farmers Welfare (MAFW) (agriculture.gov.in)	84
3.	Ministry of Science and Technology (MST) (www.dst.gov.in)	79
4.	Ministry of Defence (MoD) (https://mod.gov.in)	52
5.	Department of Space (DoS) (www.isro.gov.in)	24
6.	Ministry of Textiles (MoT) (www.texmin.nic.in)	23
7.	Ministry of Electronics and Information Technology (MeitY) (meity.gov.in)	19
8.	Ministry of Environment, Forest & Climate Change (MOEF&CC) (envfor.nic.in)	17
9.	Department of Atomic Energy (DAE) (dae.nic.in)	15
10.	Ministry of Commerce and Industry (MCI) (commerce.gov.in)	10
11.	Ministry of Chemicals and Fertilizers (MCF) (chemicals.nic.in)	9
12.	Ministry of Earth Sciences (MES) (www.moes.gov.in)	8
13.	Ministry of Petroleum and Natural Gas (MoPNG) (petroleum.nic.in)	9
14.	Ministry of Communications (MoC) (www.dot.gov.in)	8
15.	Ministry of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homoeopathy (AYUSH) (ayush.gov.in)	5
16.	Ministry of Home Affairs (MHA) (mha.gov.in)	5

17.	Ministry of Micro, Small and Medium Enterprises (MSME) (msme.gov.in)	5
18.	Ministry of Human Resource Development (MHRD) (mhrd.gov.in)	4
19.	Ministry of New and Renewable Energy (MNRE) (mnre.gov.in)	4
20.	Ministry of Water Resources, River Development and Ganga Rejuvenation (MWRRD&GR) (mowr.gov.in)	4
21.	Ministry of Food Processing Industries (MFPI) (mofpi.nic.in)	3
22.	Ministry of Heavy Industries and Public Enterprises (MHI&PE) (dhi.nic.in)	3
23.	Ministry of Road Transport and Highways (MoRTH) (morth.nic.in)	3
24.	Ministry of Skill Development and Entrepreneurship (MSDE) (www.skilldevelopment.gov.in)	2
25.	Ministry of Steel (MoS) (steel.gov.in)	2
26.	Ministry of Rural Development (MRD) (rural.nic.in)	1
27.	Ministry of Urban Development (MUD) (mohua.gov.in)	1

For the present study, 553 R&D institutions (Annexure-2) under 27 ministries including two independent departments (DoS and DAE) were taken into account. After analysis, it was found that the major R&D organizations with the maximum contribution towards research activities being carried out in India, are CSIR, ICAR, ICMR, DRDO, DST, ISRO and DAE. The details pertaining to these organizations are given below in table 21.

Table 21: Major Government Research & Development Organizations Contributing in Patents

S. No.	Organization	Year of Establishment	Ministry	Scientific Staff	No. of Institutes/ Units/ Centres	Res. Articles Publications (2010-16)	Patents Filed/Granted (2010-16)
1.	CSIR (csir.res.in)	1942	MST	4600 active scientists/8000 scientific & technical	85	49,855	1526/957
2.	ICMR (icmr.nic.in)	1911 (as RFA) 1949 (renamed to ICMR)	MHFW	2771 technical staff	26	1,896	61/14
3.	ICAR (icar.org.in)	1929	MHFW	4619 scientists/ 6318 technical staff	89	15,469	357/49
4.	DST (dst.gov.in)	1971	MST	~2240	24	11,624	406/89
5.	DBT (dbtindia.nic.in)	1986	MST	~1550	15	3712	240/66
6.	DRDO (drdo.gov.in)	1958	MoD	7410 scientists/ 17000 technical & scientific staff	50	3,947	9/10*
7.	DAE (dae.gov.in)	1954	Dept. Under PM	~1100	15	24,059	69/47

*Data based on Applicant

5.7.1 Prominent R&D Organizations in India:

Council of Scientific and Industrial Research (CSIR): CSIR was established in 1942, as an autonomous, not for profit, publicly funded research organization. It is India's largest national R&D organization providing scientific, industrial research inputs for India's economic growth and human welfare. CSIR has been a pioneer in the domain of IP, both nationally and internationally. CSIR, since its inception in 1942 has been continuously striving to promote development of indigenous technologies and improvement of indigenous resources.

Indian Council of Agricultural Research (ICAR): ICAR is an autonomous organization under the Department of Agricultural Research and Education (DARE), MAFW, GoI, formerly known as the Imperial Council of Agricultural Research. ICAR was established on 16th July, 1929 as a registered society under the Societies Registration Act, 1860 in pursuance of the report of the Royal Commission on Agriculture (http://shodhganga.inflibnet.ac.in/bitstream/10603/38909/11/11_chapter%205.pdf). The council is coordinating guiding and managing research and education in agriculture including horticulture, fisheries and animal sciences in the entire country. It is one of the largest natural agricultural organisations in the world.

Indian Council of Medical Research (ICMR): ICMR, New Delhi, the apex body in India for the formulation, coordination and promotion of biomedical research, is one of the oldest medical research bodies in the world. As early as in 1911, the GoI set up the Indian Research Fund Association (IRFA) with the specific objective of sponsoring and coordinating, medical research in the country. After independence, several important changes were made in the organization and the activities of IRFA. ICMR is funded by GoI through MHFW (http://shodhganga.inflibnet.ac.in/bitstream/10603/38909/11/11_chapter%205.pdf).

Defence Research and Development Organization (DRDO): DRDO is an agency responsible for the development of military technology; it is headquartered at New Delhi. It was formed in 1958 and works under the Department of Defence R&D of Ministry of Defence. DRDO is dedicatedly working towards enhancing self-reliance in defence systems and undertakes design & development leading to production of world-class weapon systems and equipment in accordance with the expressed needs and the qualitative recruitments laid down by the three services (http://shodhganga.inflibnet.ac.in/bitstream/10603/38909/11/11_chapter%205.pdf).

It has a network of ~50 laboratories which are engaged in developing defence technologies covering

various disciplines.

Department of Science & Technology (DST): DST is a department within the Ministry of Science and Technology in India. It was established in May 1971 to promote new areas of science and technology and to play the role of a nodal department for organising, coordinating and promoting Scientific and Technological activities in the country. It provides funding to various approved scientific projects in India.

Department of Atomic Energy (DAE): DAE is a department directly under the Prime Minister of India with headquarters at Mumbai, Maharashtra. DAE has been engaged in the development of nuclear power technology, applications of radiation technologies in the fields of agriculture, medicine, industry and basic research. DAE comprises five research centres, three industrial organisations, five public sector undertakings and three service organisations. It has under its aegis two boards for promoting and funding extramural research in nuclear and allied fields, mathematics and a national institute (deemed university). It also supports eight institutes of international repute engaged in research in basic sciences, astronomy, astrophysics, cancer research and education.

Analyses: The analysis of a total of 553 R&D institutions, under 27 ministries and 2 independent departments under Prime Minister of India, based on research articles publications and patents granted has been executed in two parts:

- **Composite Analyses of National Research Laboratories**
- **Field Wise Analyses of National Research Laboratories**

5.7.2 Composite Analyses of National Research Laboratories:

Table 22: Top 100 National Research Labs Based on the Number of Research Publications

S. No.	Laboratory/Institute/Centre/Unit	Organization	No. of Research Publications	No. of Patents Granted
1.	Bhabha Atomic Research Centre, Mumbai (BARC-MUM) (www.barc.gov.in)	DAE	7887	16
2.	All India Institute of Medical Sciences, Delhi (AIIMS-DEL) (www.aiims.edu)	MHFW	6591	31
3.	Post Graduate Institute of Medical Education & Research, Chandigarh (PGIMER-CHA) (pgimer.edu.in)	MHFW	5380	1
4.	Indian Institute of Chemical Technology, Hyderabad (IICT-HYD) (www.iictindia.org)	CSIR	4534	76
5.	Indian Agricultural Research Institute, New Delhi (IARI-DEL) (www.iari.res.in)	ICAR	3934	4
6.	Tata Institute of Fundamental Research, Mumbai (TIFR-MUM) (www.tifr.res.in)	DAE	3494	4
7.	National Chemical Laboratory, Pune (NCL-PUN) (www.ncl-india.org)	CSIR	3232	114
8.	Indian Association for the Cultivation of Science, Kolkata (IACS-KOL) (www.iacs.res.in)	DST	2961	2
9.	Saha Institute of Nuclear Physics, Kolkata (SINP-KOL) (www.saha.ac.in)	DAE	2543	1
10.	National Physical Laboratory, New Delhi (NPL-DEL) (www.nplindia.in)	CSIR	2378	25
11.	Indira Gandhi Centre for Atomic Research, Kalpakkam (IGCAR-KAL) (www.igcar.gov.in)	DAE	2250	9
12.	Indian Veterinary Research Institute, Izatnagar (IVRI-IZA) (ivri.nic.i)	ICAR	2242	6
13.	Central Drug Research Institute, Lucknow (CDRI-LUC) (www.cdri.res.in)	CSIR	2125	42
14.	Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore (JNCASR-BAN) (www.jncasr.ac.in)	DST	1757	53
15.	National Institute of Mental Health & Neuro Sciences, Bangalore (NIMHNS-BAN) (www.nimhans.ac.in)	MHFW	1684	0
16.	Central Leather Research Institute, Chennai (CLRI-CHE) (www.clri.org)	CSIR	1475	50
17.	National Dairy Research Institute, Karnal (NDRI-KAR) (www.ndri.res.in)	ICAR	1472	7
18.	Central Food Technological Research Institute, Mysore (CFTRI-MYS) (www.cftri.com)	CSIR	1415	144
19.	Bose Institute, Kolkata (BI-KOL) (www.jcbose.ac.in)	DST	1361	4
20.	Indian Institute of Chemical Biology, Kolkata (IICB-KOL) (iicb.res.in)	CSIR	1343	5
21.	National Institute For Interdisciplinary Science and Technology ,Thiruvananthapuram (NIIST-TRI) (www.niist.res.in)	CSIR	1323	30
22.	S.N. Bose National Centre for Basic Sciences, Kolkata (SNBNCBS-KOL) (www.bose.res.in)	DST	1281	5
23.	National Centre for Disease Control, New Delhi (NCDC-DEL) (www.ncdc.gov.in)	MHFW	1241	0
24.	Indian Institute of Science Education & Research (IISER-PUN) (www.iiserpune.ac.in)	MHRD	1234	0
25.	Central Salt Marine Chemicals Research Institute, Bhavnagar (CSMCRI-BHA) (www.csmcri.org)	CSIR	1221	40

26.	Physical Research Laboratory (PRL-AHM), Ahmedabad (https://www.prl.res.in)	DoS	1203	0
27.	Indian Institute of Science Education & Research (IISER-KOL) (www.iiserkol.ac.in)	MHRD	1194	0
28.	Central Electrochemical Research Institute, Karaikudi (CERI-KRI) (www.cecri.res.in)	CSIR	1154	25
29.	Institute of Genomics and Integrative Biology, Delhi (IGIB-DEL) (www.igib.res.in)	CSIR	1090	16
30.	Central Glass Ceramic Research Institute, Kolkata (CGCRI-KOL) (www.cgcri.res.in)	CSIR	1088	37
31.	National Geophysical Research Institute, Hyderabad (NGRI-HYD) (www.ngri.org.in)	CSIR	1073	2
32.	Institute of Physics, Bhubaneswar (IP-BHU) (www.iopb.res.in)	DAE	1063	0
33.	Institute for Plasma Research, Gandhinagar (IPR-GAN) (www.ipr.res.in)	DAE	1056	0
34.	Centre for Cellular Molecular Biology, Hyderabad (CCMB-HYD) (www.ccmb.res.in)	CSIR	1033	4
35.	Sree Chitra Tirunal Institute for Medical Sciences and Technology, Thiruvananthapuram (SCTIMST-TRI) (www.sctimst.ac.in)	DST	1028	1
36.	National Botanical Research Institute, Lucknow (NBRI-LUC) (www.nbri.res.in)	CSIR	960	14
37.	Raja Ramanna Centre for Advanced Technology, Indore (RRCAT-IND) (www.rrcat.gov.in)	DAE	907	4
38.	Indian Institute of Toxicology Research, Lucknow (IITR-LUC) (iitrindia.org)	CSIR	902	1
39.	Indian Institute of Tropical Meteorology, Pune (IITM-PUN) (www.tropmet.res.in)	MoES	890	0
40.	National Institute of Oceanography, Goa (NIO-GOA) (www.nio.org)	CSIR	884	10
41.	National Metallurgical Laboratory, Jamshedpur (NML-JAM) (www.nmlindia.org)	CSIR	881	48
42.	Institute of Minerals and Materials Technology (IMMT-BHU), Bhubaneswar (www.immt.res.in)	CSIR	872	34
43.	Raman Research Institute, Bangalore (RRI-BAN) (www.rri.res.in)	DST	843	12

44.	Central Institute of Medicinal Aromatic Plants, Lucknow (CIMAP-LUC) (www.cimap.res.in)	CSIR	840	12
45.	Indian Institute of Integrative Medicine, Jammu (IIIM-JMM) (www.iiim.res.in)	CSIR	834	10
46.	Variable Energy Cyclotron Centre, Kolkata (VECC-KOL) (www.vecc.gov.in)	DAE	825	0
47.	The Institute of Mathematical Sciences, Chennai (TIMS-CHE) (www.imsc.res.in)	DAE	820	0
48.	Institute of Microbial Technology, Chandigarh (IMTECH-CHA) (www.imtech.res.in)	CSIR	757	12
49.	Defence Metallurgical Research Laboratory (DMRL-HYD), Hyderabad (www.drdo.gov.in)	DRDO	721	0
50.	Harish Chandra Research Institute, Allahabad (HCRI-ALL) (www.hri.res.in)	DAE	716	0
51.	National Environmental Engineering Research Institute, Nagpur (NEERI-NAG) (neeri.res.in)	CSIR	668	8
52.	Indian Institute of Astrophysics, Bangalore (IIA-BAN) (www.iiap.res.in)	DST	666	0
53.	National Aerospace Laboratories, Bangalore (NAL-BAN) (www.nal.res.in)	CSIR	653	16
54.	Institute of Himalayan Bioresource Technology, Palampur (IHBT-PLR) (www.ihbt.res.in)	CSIR	647	10
55.	Indian Institute of Science Education & Research (IISER-BHO) (www.iiserb.ac.in)	MHRD	635	0
56.	Liquid Propulsion Systems Centre, Thiruvananthapuram (LPSC-TRI) (www.lpsc.gov.in)	ISRO	626	0
57.	National Institute of Immunology, New Delhi (NII-DEL) (www.nii.res.in)	DBT	607	37
58.	Space Applications Centre (SAC-AHM), Ahmedabad (www.sac.gov.in)	ISRO	578	0
59.	North - East Institute of Science and Technology, Jorhat (NEIST-JOR) (www.rrljorhat.res.in)	CSIR	570	30
60.	Institute of Nuclear Medicine & Allied Sciences (INMAS-DEL), Delhi (www.drdo.gov.in)	DRDO	565	0
61.	National Institute of Plant Genome Research, New Delhi (NIPGR-DEL) (www.nipgr.res.in)	DBT	560	7
62.	National Centre for Cell Science, Pune (NCCS-PUN) (www.nccs.res.in)	DBT	516	0

63.	Homi Bhabha National Institute, Mumbai (HBNI-MUM) (www.hbni.ac.in)	DAE	498	0
64.	Armed Forces Medical College, Pune (AFMC-PUN) (www.afmc.nic.in)	MoD	496	0
65.	Institute of Post Graduate Medical Education and Research, Kolkata (IPGMER-KOL) (www.ipgmer.gov.in)	MHFW	491	0
66.	Central Mechanical Engineering Research Institute, Durgapur (CMERI-DUR) (www.cmeri.res.in)	CSIR	485	11
67.	Defence Research & Development Establishment (DRDE-GWA), Gwalior (www.drdo.gov.in)	DRDO	472	0
68.	Indian Institute of Petroleum, Dehradun (IIP-DEH) (www.iip.res.in)	CSIR	465	38
69.	Indian Institute of Space Science and Technology (IIST-TRI), Thiruvananthapuram (www.iist.ac.in)	ISRO	458	0
70.	Central Institute of Fisheries Education, Mumbai (CIFE-MUM) (www.cife.edu.in)	ICAR	453	0
71.	Institute of Life Sciences, Bhubaneshwar (ILS-BHU) (www.ils.res.in)	DBT	450	3
72.	Indian Institute of Geomagnetism, Mumbai (IIGM-MUM) (www.iigm.res.in)	DST	405	0
73.	National Institute of Pharmaceutical Education Research, SAS Nagar, Mohali (NIPER-MOH) (www.niper.nic.in)	MoC&F	405	21
74.	Central Research Institute Homeopathy, Kurichy, Kerala (CRIH-KRC) (ccrhindia.nic.in)	AYUSH	385	0
75.	Defence Institute of Advanced Technology (DIAT-PUN), Deemed University, Pune (www.diat.ac.in)	DRDO	381	0
76.	Central Electronics Engineering Research Institute, Pilani (CEERI-PIL) (www.ceeri.res.in)	CSIR	374	2
77.	Aryabhatta Research Institute of Observational-Sciences, Nainital (ARIOS-NAI) (www.aries.res.in)	DST	371	0
78.	Agharkar Research Institute, Pune (ARI-PUN) (www.aripune.org)	DST	358	1
79.	Birbal Sahni Institute of Palaeobotany, Lucknow (BSIP-LUC) (www.bsip.res.in)	DST	358	0
80.	Rajiv Gandhi Centre for Biotechnology, Thiruvananthapuram (RGCB-TRI) (rgcb.res.in)	DBT	357	2
81.	Wadia Institute of Himalayan Geology, Dehradun (WIHG-DEH) (www.wihg.res.in)	DST	356	0

82.	National Research Centre on Plant Biotechnology, New Delhi (NRCPB-DEL) (www.nrcpb.res.in)	ICAR	355	0
83.	Structural Engineering Research Centre, Chennai (SERC-CHE) (serc.res.in)	CSIR	354	0
84.	Central Institute of Mining and Fuel Research, Dhanbad (CIMFR-DHA) (www.cimfr.nic.in)	CSIR	353	38
85.	The Central Agricultural University(CAU-MNI), Manipur (www.cau.ac.in)	ICAR	351	0
86.	The Institute of Advanced Study in Science & Technology, Guwahati (TIASST-GUW) (iasst.gov.in)	DST	345	1
87.	National Bureau of Fish Genetic Resources, Lucknow (NBFGR-LUC) (www.nbfgr.res.in)	ICAR	345	0
88.	National Brain Research Centre, Gurgaon (NBRC-GUR) (www.nbrc.ac.in)	DBT	326	3
89.	Regional Institute of Medical Sciences, Imphal, Manipur (RIMS-MNI) (www.rims.edu.in)	MHFW	319	0
90.	National Institute of Virology, Pune (NIV-PUN) (www.niv.co.in)	ICMR	313	0
91.	Advanced Materials and Processes Research Institute (AMPRI-BHO), Bhopal (www.ampri.res.in)	CSIR	312	9
92.	International Advanced Research Centre for Powder Metallurgy and New Materials, Hyderabad (ARCI-HYD) (www.arci.res.in)	DST	311	10
93.	Indian Agricultural Statistics Research Institute, New Delhi (IASRI-DEL) (iasri.res.in)	ICAR	306	0
94.	Central Arid Zone Research Institute, Jodhpur (CAZRI-JOD) (www.cazri.res.in)	ICAR	299	0
95.	Central Institute of Freshwater Aquaculture, Bhubneshwar (CIFA-BHU) (cifa.nic.in)	ICAR	291	5
96.	National Institute for Research in Reproductive Health, Mumbai (NIRRH-MUM) (www.nirrh.res.in)	ICMR	290	0
97.	Defence Food Research Laboratory (DFRL-MYS), Mysore (www.drdo.gov.in)	DRDO	288	0
98.	National Institute of Pharmaceutical Education and Research, Hyderabad (NIPER-HYD) (www.niperhyd.ac.in)	MoC&F	284	0
99.	Chittaranjan National Cancer Research Institute, Kolkata (CNCRI-KOL) (cnci.org.in)	MHFW	277	1
100.	Wildlife Institute of India, Dehradun (WII-DEH) (www.wii.gov.in)	MEF&CC	274	0

Blue - Good in number of patents-granted (>25)
Black – Average in number of patents-granted (10-25)
Red – Low or Nil in number of patents-granted (<10)

Table 23: Breakup for Ministries/Departments/Organizations/Councils based on Top 100 R&D Labs in Research Publications

S. No.	Organization/Ministry/Department	No. of Labs
1.	CSIR	32
2.	DST	14
3.	DAE	11
4.	ICAR	10
5.	MHFW	7
6.	DRDO	5
7.	DBT	5
8.	MHRD	4
9.	ISRO	3
10.	ICMR	2
11.	MCF	2
12.	AYUSH	1
13.	DoS	1
14.	MEF&CC	1
15.	MoD	1
16.	MoES	1

Table 24: Top 97 National Research Labs Based on the Number of Patents Granted

S. No.	Laboratory/Institute/Centre/Unit	Organization	No. of Patents Granted	No. of Research Publications
1.	Central Food Technological Research Institute, Mysore (CFTRI-MYS) (www.cftri.com)	CSIR	144	1415
2.	National Chemical Laboratory, Pune (NCL-PUN) (www.ncl-india.org)	CSIR	114	3232
3.	Indian Institute of Chemical Technology, Hyderabad (IICT-HYD) (www.iictindia.org)	CSIR	76	4534
4.	Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore (JNCASR-BAN) (www.jncasr.ac.in)	DST	53	1757
5.	Central Leather Research Institute, Chennai (CLRI-CHE) (www.clri.org)	CSIR	50	1475
6.	National Metallurgical Laboratory, Jamshedpur (NML- JAM) (www.nmlindia.org)	CSIR	48	881
7.	Central Drug Research Institute, Lucknow (CDRI- LUC) (www.cdri.res.in)	CSIR	42	2125
8.	National Institute of Immunoheumotology, Mumbai (NIIH-MUM) (www.niih.org.in)	ICMR	41	219
9.	Central Salt Marine Chemicals Research Institute, Bhavnagar (CSMCRI-BHA) (www.csmcri.org)	CSIR	40	1221
10.	Central Institute of Mining and Fuel Research, Dhanbad (CIMFR-DHA) (www.cimfr.nic.in)	CSIR	38	353
11.	Indian Institute of Petroleum, Dehradun (IIP-DEH) (www.iip.res.in)	CSIR	38	465
12.	Central Glass Ceramic Research Institute, Kolkata (CGCR- KOL) (www.cgcri.res.in)	CSIR	37	1088
13.	National Institute of Immunology, New Delhi (NII-DEL) (www.nii.res.in)	DBT	37	607
14.	Institute of Minerals and Materials Technology, Bhubaneswar (IMMT-BHU) (www.immt.res.in)	CSIR	34	872
15.	All India Institute of Medical Sciences, Delhi (AIIMS-DEL) (www.aiims.edu)	MHFW	31	6591
16.	National Institute For Interdisciplinary Science and Technology, Thiruvananthapuram (NIIST-TRI) (www.niist.res.in)	CSIR	30	1323
17.	North - East Institute of Science and Technology, Jorhat (NEIST-JOR) (www.rrljorhat.res.in)	DST	30	570
18.	Central Electrochemical Research Institute, Karaikudi (CERI-KRI) (www.cecri.res.in)	CSIR	25	1154
19.	National Physical Laboratory, New Delhi (NPL-DEL) (www.nplindia.in)	CSIR	25	2378
20.	National Institute of Pharmaceutical, Educational and Research, Mohali (NIPER-MOH) (www.niper.nic.in)	MoC&F	21	405
21.	Central Sericultural Research & Training Institute, Mysuru (CSRTI-MYS) (www.csrtimys.res.in)	MoT	17	146
22.	Institute of Genomics and Integrative Biology, Delhi (IGIB-DEL) (https://www.igib.res.in/)	CSIR	16	1090
23.	National Aerospace Laboratories, Bangalore (NAL-BAN) (www.nal.res.in)	CSIR	16	653
24.	Bhabha Atomic Research Centre, Mumbai (BARC-MUM) (www.barc.gov.in)	DAE	16	7887

25.	National Botanical Research Institute, Lucknow (NBRI-LUC) (www.nbri.res.in)	CSIR	14	960
26.	Central Institute of Medicinal Aromatic Plants, Lucknow (CIMAP-LUC) (www.cimap.res.in)	CSIR	12	840
27.	Institute of Microbial Technology, Chandigarh (IMTECH-CHA) (www.imtech.res.in)	CSIR	12	757
28.	Raman Research Institute, Bangalore (RRI-BAN) (www.rri.res.in)	DST	12	843
29.	Centre for Development of Advanced Computing, Pune (C-DAC-PUN) (https://www.cdac.in)	MeitY	12	132
30.	Central Mechanical Engineering Research Institute, Durgapur (CMERI-DUR) (www.cmeri.res.in)	CSIR	11	485
31.	Indian Institute of Integrative Medicine (IIIM-JMM), Jammu (www.iiim.res.in)	CSIR	10	834
32.	Institute of Himalayan Bioresource Technology, Palampur (IHBT-PLR) (www.ihbt.res.in)	CSIR	10	647
33.	National Institute of Oceanography, Goa (NIO-GOA) (www.nio.org)	CSIR	10	884
34.	International Advanced Research Centre for Powder Metallurgy and New Materials, Hyderabad (ARCI-HYD) (www.arci.res.in)	DST	10	311
35.	Advanced Materials and Processes Research Institute (AMPRI-BHO), Bhopal (www.ampri.res.in)	CSIR	9	312
36.	Indira Gandhi Centre for Atomic Research, Kalpakkam (TN) (IGCAR-KAL) (www.igcar.gov.in)	DAE	9	2250
37.	National Environmental Engineering Research Institute, Nagpur (NEERI-NAG) (neeri.res.in)	CSIR	8	668
38.	National Institute of Plant Genome Research, New Delhi (NIPGR-DEL) (www.nipgr.res.in)	DBT	7	560
39.	Central Research Institute for Jute and Allied Fibres, Barrackpore (CRIJAG- BAR) (www.crijaf.org.in)	ICAR	7	103
40.	National Dairy Research Institute, Karnal (NDRI-KAR) (www.ndri.res.in)	ICAR	7	1472
41.	Centre for Development of Telematics (C-DOT), Pune (www.cdot.in)	MeitY	7	132
42.	Central Scientific Instruments Organisation, Chandigarh (CSIO-CHA) (www.csio.res.in)	CSIR	6	231
43.	Indian Veterinary Research Institute, Izatnagar (IVRI-IZA) (ivri.nic.in)	ICAR	6	2242
44.	Centre for Materials for Electronics Technology, Pune (CMET-PUN) (cmet.gov.in)	MeitY	6	2302
45.	Ahmedabad Textile Industry's Research Association (ATIRA-AHM), Ahmedabad (atira.in)	MoT	6	(data given till 2011 only)
46.	Central Silk Technological Research Institute, Banglore (CSTRI-BAN) (cstri.res.in)	MoT	6	57
47.	Indian Institute of Chemical Biology, Kolkata (IICB-KOL) (iicb.res.in)	CSIR	5	1343
48.	Center for DNA Fingerprinting and Diagnostics (CDFD-HYD), Hyderabad (www.cdfd.org.in)	DBT	5	231
49.	National Institute of Design (NID-AHM), Ahmedabad (www.nid.edu)	DIPP	5	10
50.	S.N. Bose National Centre for Basic Sciences, (SNBNCBS-KOL) Kolkata (www.bose.res.in)	DST	5	1281
51.	Central Coir Research Institute, Alleppey, Kerala (CCRI-ALP) (www.ccriindia.org)	ICAR	5	3
52.	Central Institute of Freshwater Aquaculture, Bhubneshwar (CIFA-BHU) (cifa.nic.in)	ICAR	5	291
53.	Central Building Research Institute, Roorkee (CBRI-ROO) (cbri.res.in)	CSIR	4	119
54.	Centre for Cellular Molecular Biology, Hyderabad (CCMB-HYD) (www.ccmb.res.in)	CSIR	4	1033
55.	Raja Ramanna Centre for Advanced Technology, Indore (RRCAT-IND) (www.rrcat.gov.in)	DAE	4	907
56.	Tata Institute of Fundamental Research, Mumbai (TIFR-MUM) (www.tifr.res.in)	DAE	4	3494
57.	Bose Institute, Kolkata (BI-KOL) (www.jcbose.ac.in)	DST	4	1361
58.	Central Institute Brackish water Aquaculture, Chennai (CIBA-CHE) (www.ciba.res.in)	ICAR	4	177
59.	Central Institute on Post harvest Engineering and Technology, Ludhiana (CIPHET-LUD) (www.ciphet.in)	ICAR	4	227
60.	Indian Agricultural Research Institute, New Delhi (IARI-DEL) (www.iari.res.in)	ICAR	4	3934
61.	National Institute of Research on Jute & Allied Fibre Technology, Kolkata (NIRJAFT-KOL) (www.nirjaft.res.in)	ICAR	4	67
62.	South India Textile Research Association, Coimbatore (SITRA-COI) (www.sitra.org.in)	MoT	4	30

63.	Centre for High Technology, NOIDA, Uttar Pradesh (CHT-NOIDA) (cht.gov.in)	MPNG	4	132
64.	Institute of Life Sciences, Bhubaneshwar (ILS-BHU) (www.ils.res.in)	DBT	3	450
65.	National Brain Research Centre, Gurgaon (NBRC-GUR) (www.nbrc.ac.in)	DBT	3	326
66.	Central Plantation Crops Research Institute, Kasargod (CPCRI-KAS) (www.cpcri.gov.in)	ICAR	3	103
67.	The Automotive Research Association of India, (ARAI-PUN) Pune (www.araiindia.com)	MHIPE	3	18
68.	Central Tasar Research & Training Insttute, Ranchi (CTRTI-RAN) (www.ctrtiranchi.co.in)	MoT	3	59
69.	Central Electronics Engineering Research Institute, Pilani (CEERI-PIL) (www.ceeri.res.in)	CSIR	2	374
70.	Central Road Research Institute (CRRI-DEL), New Delhi (www.crridom.gov.in)	CSIR	2	114
71.	National Geophysical Research Institute, Hyderabad (NGRI-HYD) (www.ngri.org.in)	CSIR	2	1073
72.	Institute of Bioresources and Sustainable Development(IBSD-MNI), Manipur (ibsd.gov.in)	DBT	2	144
73.	Rajiv Gandhi Centre for Biotechnology, Thiruvananthapuram (RGCB-TRI) (rgcb.res.in)	DBT	2	357
74.	Indian Association for the Cultivation of Science, Kolkata (IACS-KOL) (www.iacs.res.in)	DST	2	2661
75.	National Bureau of Plant Genetics Resources, New Delhi (NBPGR-DEL) (www.nbpgr.ernet.in)	ICAR	2	5
76.	National Centre for Integrated Pest Management, New Delhi (NCIPM-DEL) (www.ncipm.org.in)	ICAR	2	46
77.	Central Pulp and Research Institute, Saharanpur (CPRI-SAH) (www.cppri.org.in)	MoC&I	2	37
78.	Rubber Research Institute of India, Kotayam (RRII-KOT) (rubberboard.org.in)	MoC&I	2	59
79.	Indian Institute of Toxicology Research, Lucknow (IITR-LUC) (iitrindia.org)	CSIR	1	902
80.	Indian Plywood Industries Research and Training Institute, Bangalore (IPIRTI-BAN) (ipirti.gov.in)	CSIR	1	11
81.	Saha Institute of Nuclear Physics, Kolkata (SINP-KOL) (www.saha.ac.in)	DAE	1	2543

82.	Institute for Stem Cell Biology and Regenerative Medicine, Bangalore (ISCBRM-BAN) (instem.res.in)	DBT	1	112
83.	Armament Research Board-Defence Research & Development Organization, Pune (ARB-DRDO- PUN) (www.drdo.gov.in)	DRDO	1	41
84.	Agharkar Research Institute, Pune (ARI-PUN) (www.aripune.org)	DST	1	358
85.	Sree Chitra Tirumal Institute for Medical Sciences and Technology, Thiruvananthapuram (SCTIMST-TRI) (www.sctimst.ac.in)	DST	1	1028
86.	The Institute of Advanced Study in Science & Technology, Guwahati (TIASST-GUW) (iasst.gov.in)	DST	1	345
87.	Indian Institute of Horticultural Research, Bengaluru (IIHR-BAN) (www.iihr.res.in)	ICAR	1	108
88.	National Institute of Veterinary Epidemiology and Disease Informatics, Hebbal, Bengaluru (NIVEDIH-BAN) (www.nivedi.res.in)	ICAR	1	55
89.	Centre for Development of Advanced Computng Mumbai (CDAC-MUM) (www.cdac.in)	MeitY	1	132
90.	Society for Applied Microwave Electronics Engineering & Research, Mumbai (SAMEER-MUM) (www.sameer.gov.in)	MeitY	1	27
91.	Chittaranjan National Cancer Research Institute, Kolkata (CNCRI-KOL) (cnci.org.in)	MHFW	1	277
92.	Post Graduate Institute of Medical Education & Research, Chandigarh (PGIMER-CHA) (pgimer.edu.in)	MHFW	1	5380
93.	UPASI Tea Research Foundation, Coimbatore (UTRF-COI) (www.upasitearesearch.org)	MoC&I	1	65
94.	Institute of Forest Genetics and Tree Breeding, Coimbatore (IFGTB-COI) (www.bgci.org)	MoE&F	1	62
95.	Central Manufacturing Technology Institute (CMTI-BAN), Bangalore (cmti-india.net)	MoHI&PE	1	18
96.	Institute of Reservoir Studies Chandkheda Campus, Ahmedabad (IRSCC-AHM) (www.niir.org)	MPNG	1	18
97.	Central Water And Power Research Station, Pune (CWPRS-PUN) (cwprs.gov.in)	MWRRD&GR	1	44

Blue - Good in number of patents-granted (>25)
Black – Average in number of patents-granted (10-25)
Red – Low or Nil in number of patents-granted (<10)
Note: Only 97 institutions have patent granted to their credit.

Table 25: Breakup for Ministries/Departments/Organizations/Councils based on Top 97 in Patents Granted

S. No.	Ministry/Organization/Department/Council	No. of Labs
1.	CSIR	34
2.	ICAR	14
3.	DST	10
4.	DBT	8
5.	DAE	5
6.	MeitY	5
7.	MoT	5
8.	MoC&I	4
9.	MHFW	3
10.	MoPNG	2
11.	MoHI&PE	2
12.	DIPP	1
13.	DRDO	1
14.	ICMR	1
15.	MWRRD&GR	1
16.	MoE&F	1

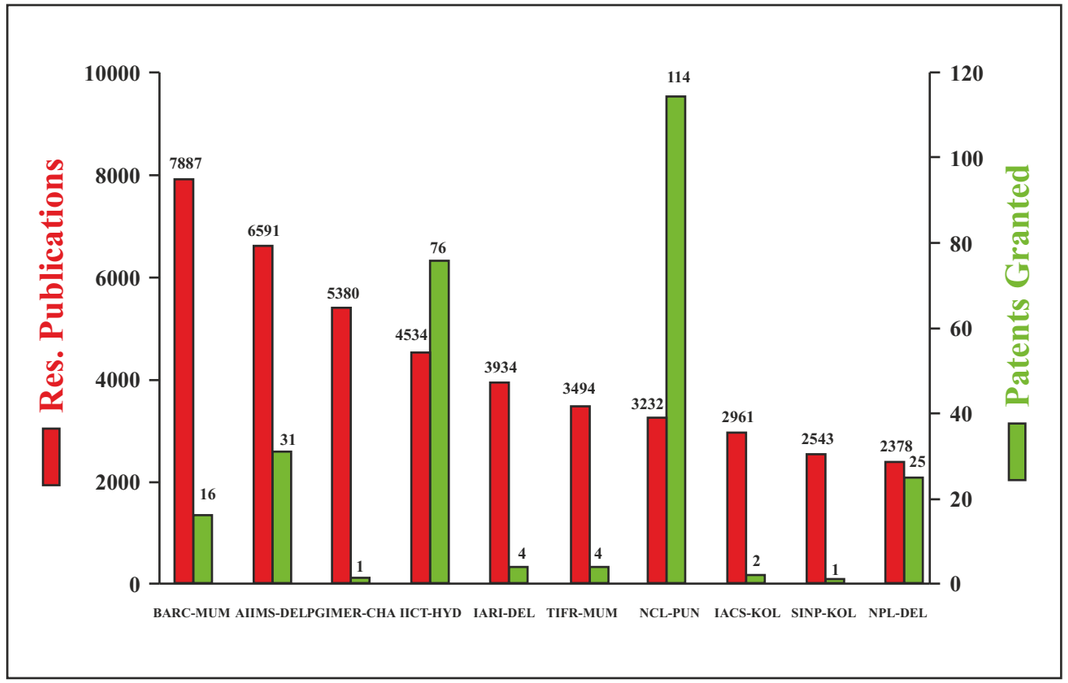


Figure 75: Top 10 Ranked National Research Labs Based on the Number of Research Publications (2010-16)

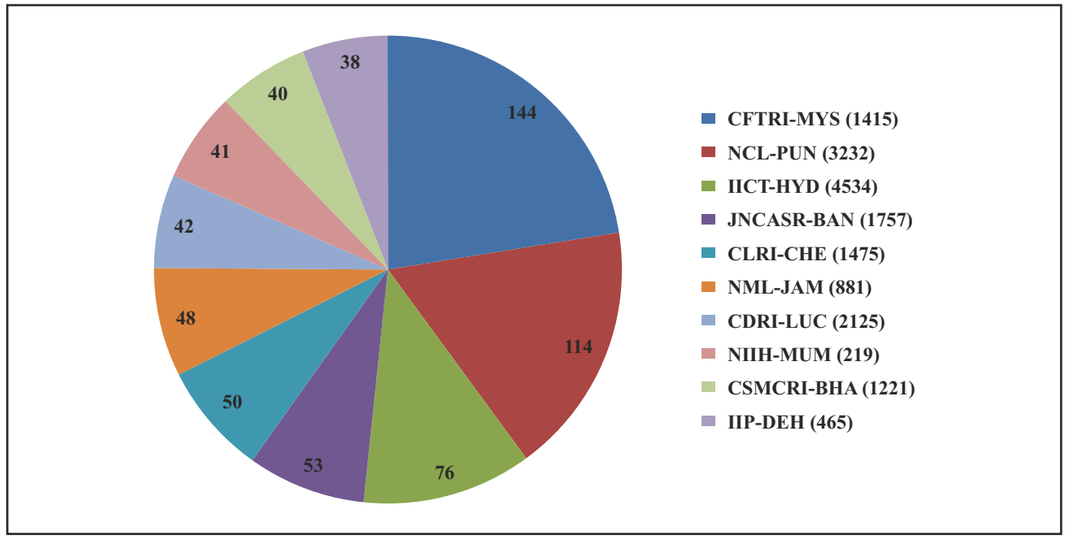


Figure 76: Top 10 Ranked National Research Labs Based on the Number Patents Granted (2010-16)
Note: Numbers in brackets represents number of research publications

5.7.3 Fields Wise Analysis of National Research Laboratories in India

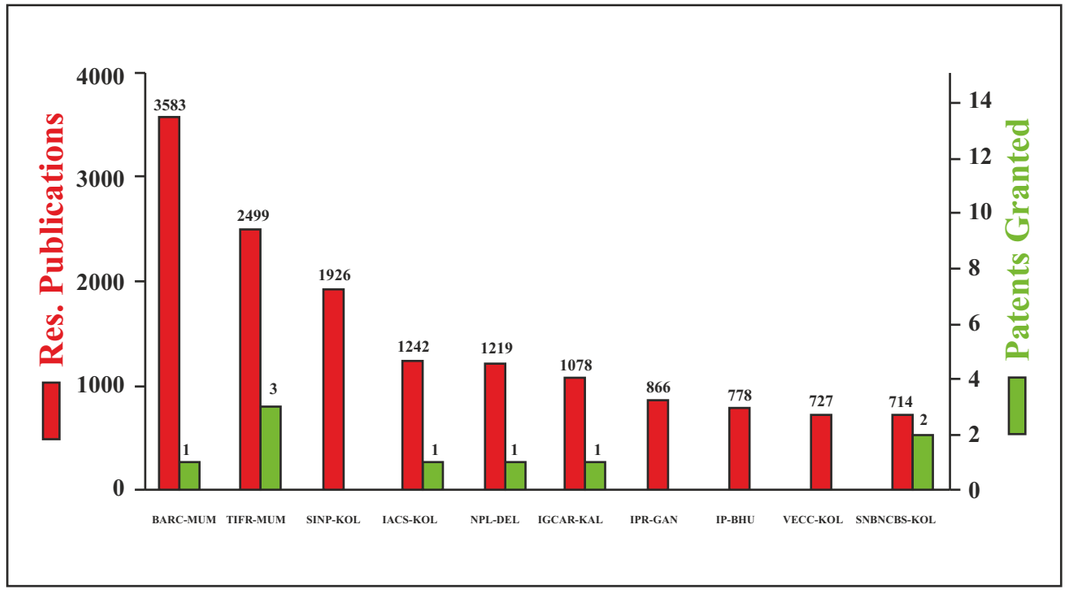


Figure 77: Top 10 Ranked National Research Labs Based on the Number of Research Publication in the Field of **Physics** (2010-16)

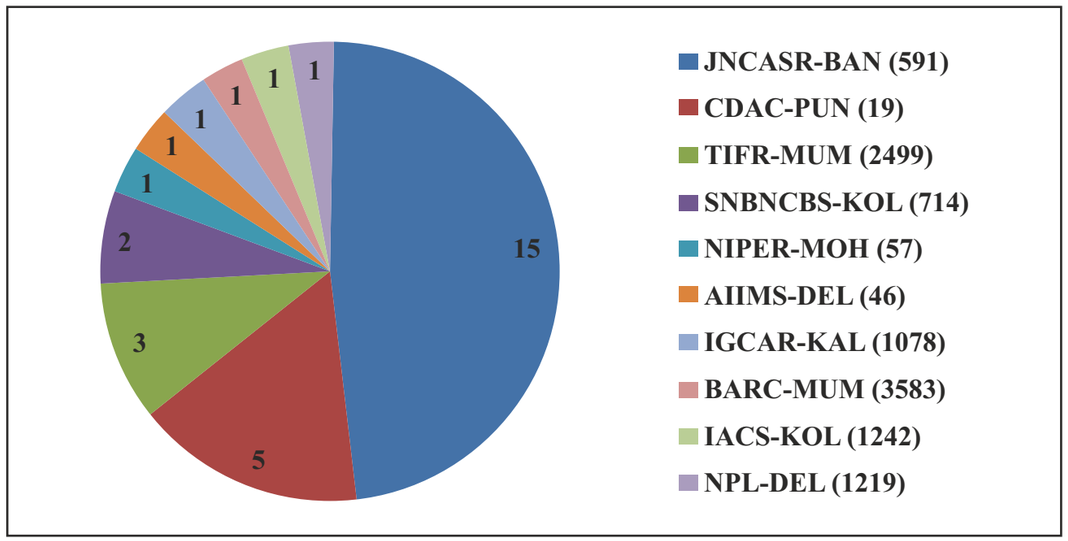


Figure 78: Top 10 Ranked National Research Labs Based on the Number of Patents Granted in the Field of **Physics** (2010-16)

Note: Numbers in brackets represents number of research publications

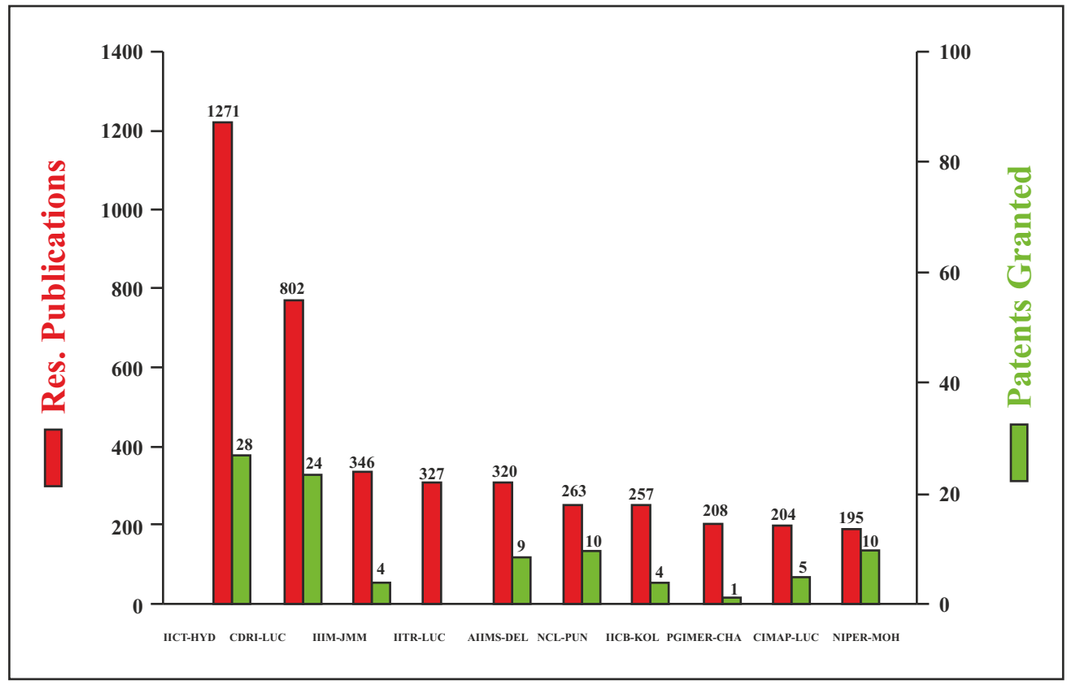


Figure 79: Top 10 Ranked National Research Labs Based on the Number of Research Publications in the Field of **Pharma/Drugs** (2010-16)

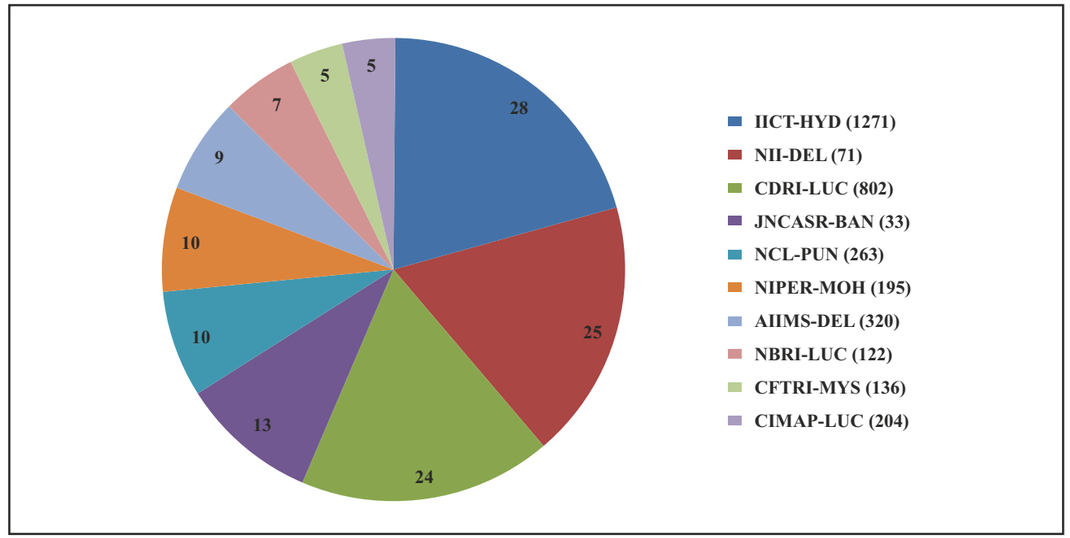


Figure 80: Top 10 Ranked National Research Labs Based on the Number of Patents Granted in the Field of **Pharma/Drugs** (2010-16)

Note: Numbers in brackets represents number of research publications

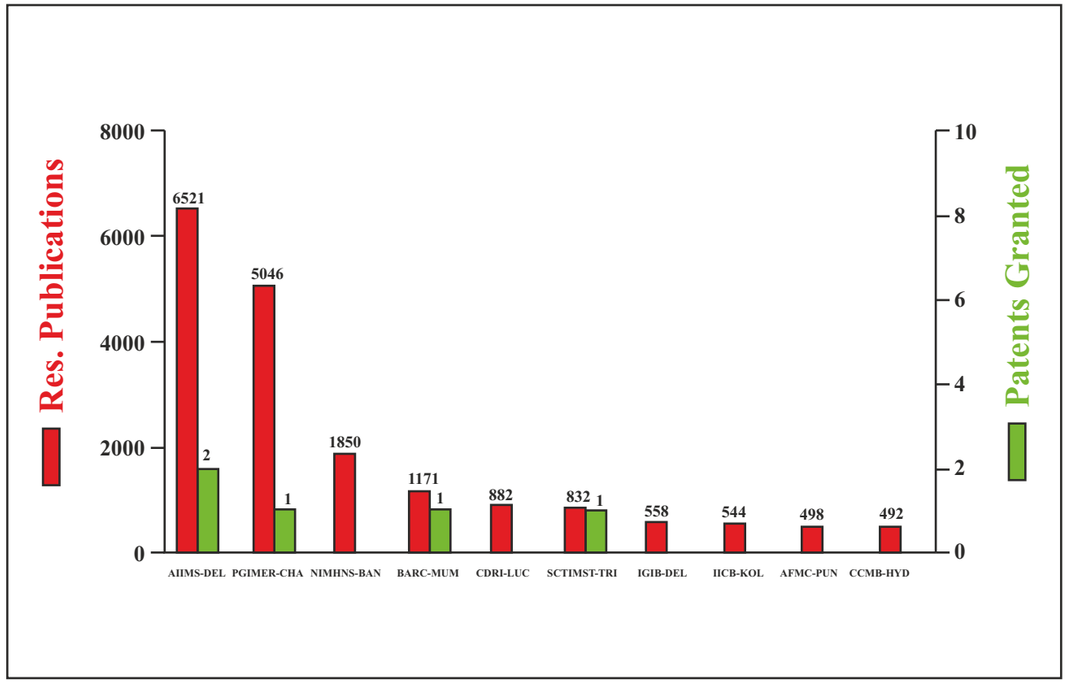


Figure 81: Top 10 Ranked National Research Labs Based on the Number of Research Publications in the Field of **Medical Sciences** (2010-16)

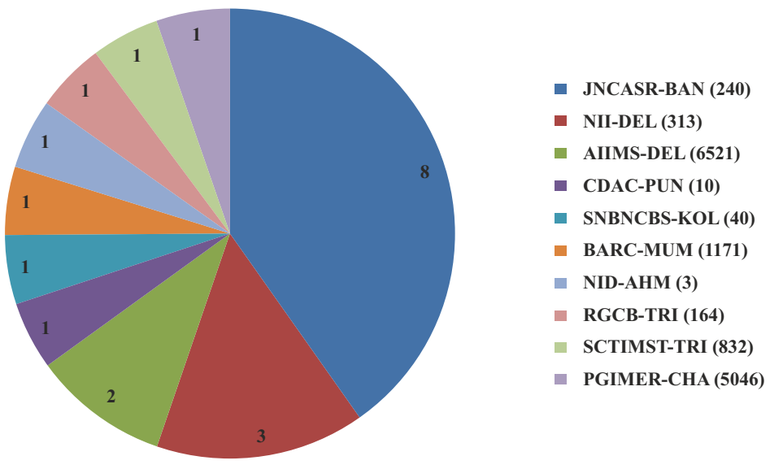


Figure 82: Top 10 Ranked National Research Labs Based on the Number of Patents Granted in the Field of **Medical Sciences** (2010-16)

Note: Numbers in brackets represents number of research publications

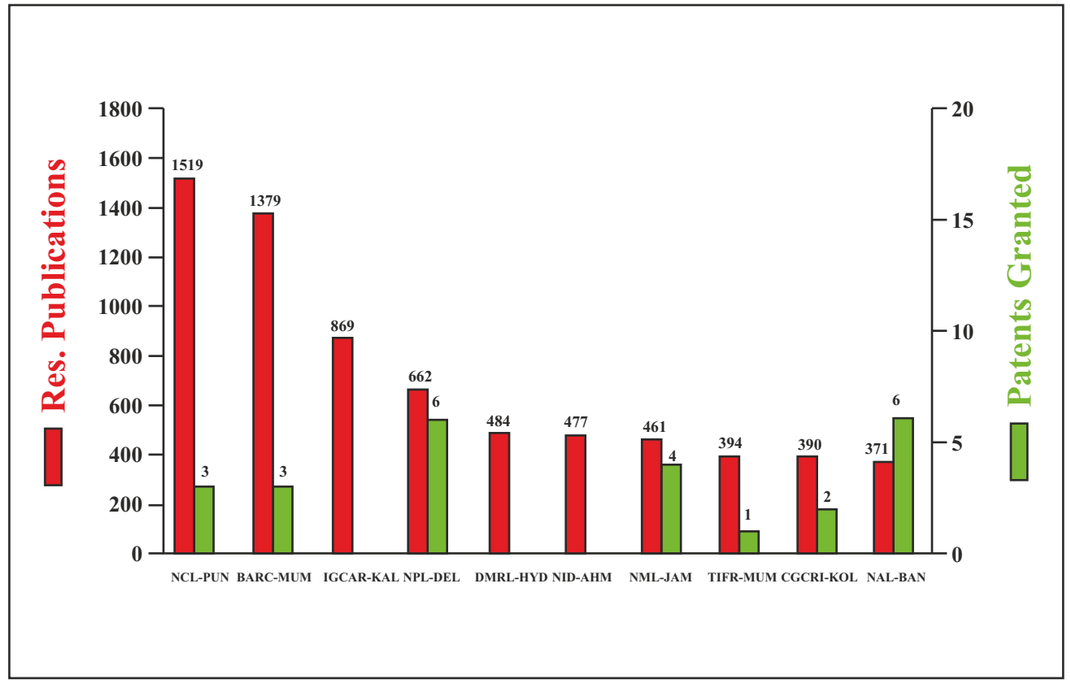


Figure 83: Top 10 Ranked National Research Labs Based on the Number of Research Publications in the Field of **Engineering** (2010-16)

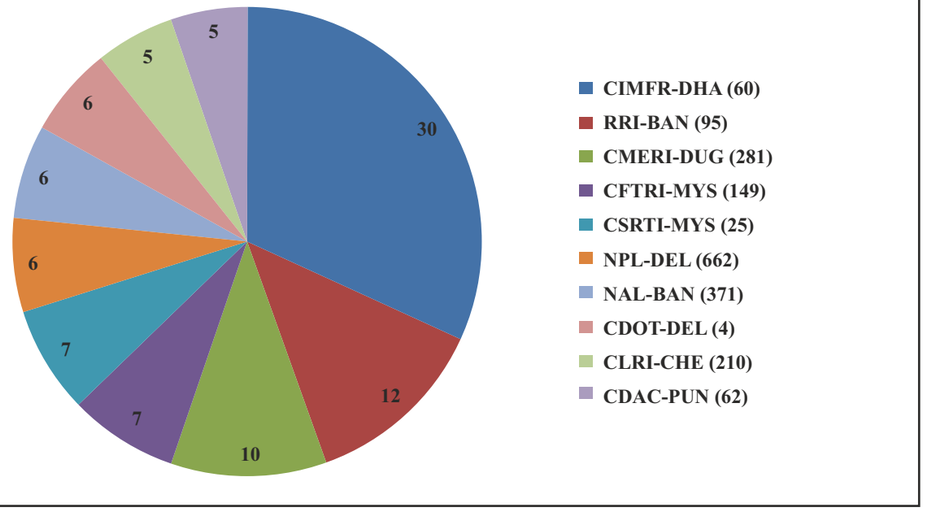


Figure 84: Top 10 Ranked National Research Labs Based on the Number of Patents Granted in the Field of **Engineering** (2010-16)

Note: Numbers in brackets represents number of research publications

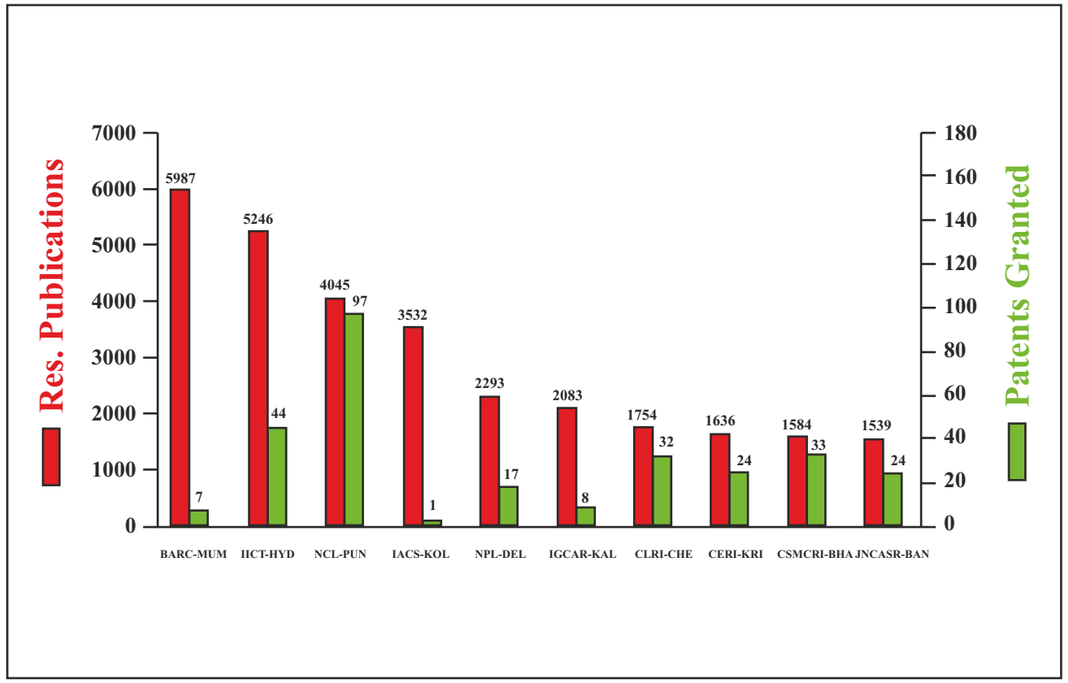


Figure 85: Top 10 Ranked National Research Labs Based on the Number of Research Publications in the Field of **Chemical Engineering** (2010-16)

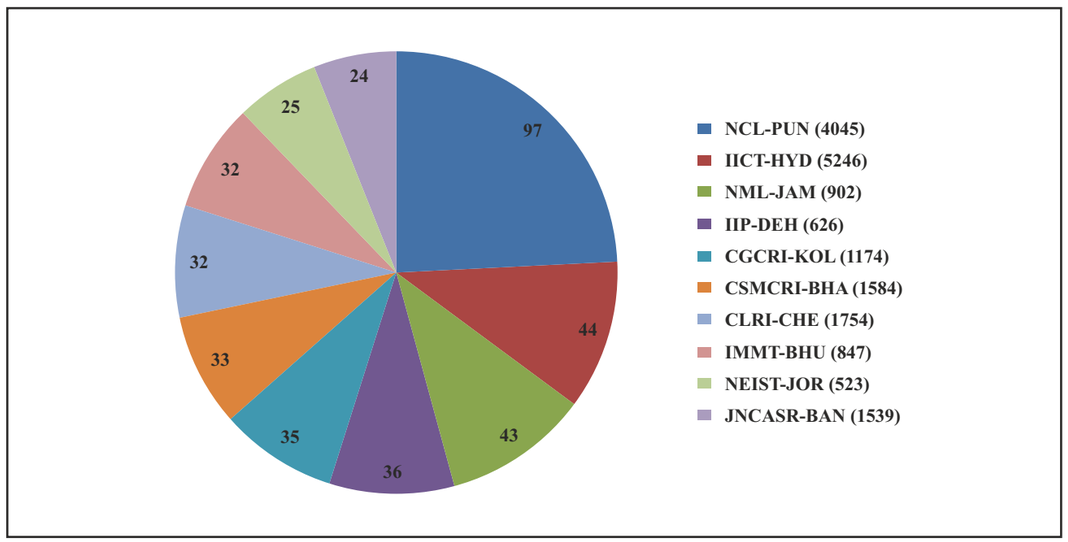


Figure 86: Top 10 National Research Labs Based on the Number of Patents Granted in the Field of **Chemical Engineering** (2010-16)

Note: Numbers in brackets represents number of research publications

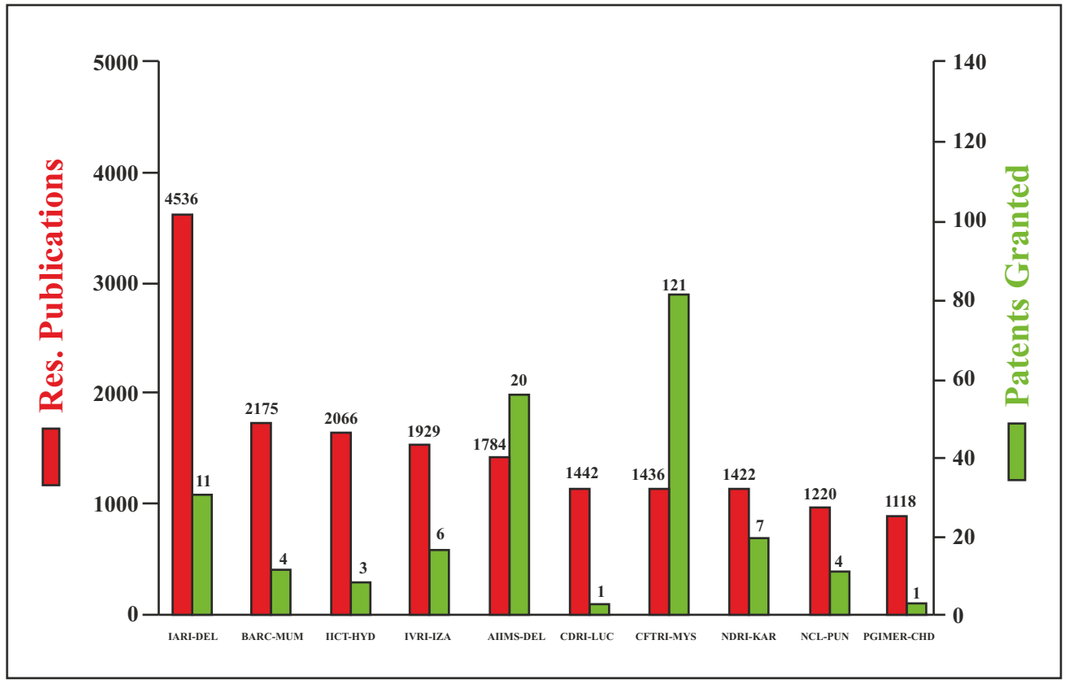


Figure 87: Top 10 Ranked National Research Labs Based on the Number of Research Publications in the Field of **Biotech/Food/Agriculture** (2010-16)

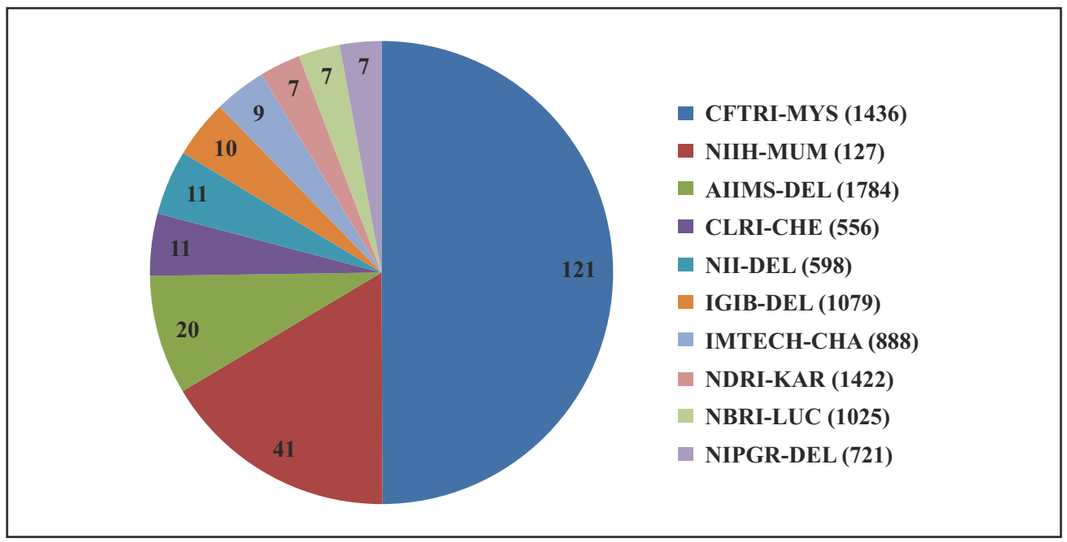


Figure 88: Top 10 Ranked National Research Labs Based on the Number of Patents Granted in the Field of **Biotech/Food/Agriculture** (2010-16)

Note: Numbers in brackets represents number of research publications

Conclusions:

1. All the 553 National Research Laboratories of India were mapped for number of research publications and patents (granted) for the period 2010-16. BARC-Mumbai (7887) leads in the category of research publications, followed by AIIMS-New Delhi (6591), PGIMER-Chandigarh (5380), IICT-Hyderabad (4534) and IARI-New Delhi (3934). However, in the category of patents (granted), CFTRI-Mysore leads the ranking with 144 patents (granted), followed by NCL-Pune (114), IICT-Hyderabad (76), JNCASR-Bangalore (53) and CLRI-Chennai (50) and NCL-Pune are the only institutes, which are amongst the top ten NRLs in the domains of research publications as well as number of patents (granted).
2. Field wise leaders in the category of patents granted:

   Physics: JNCASR-Bangalore (15)

   Pharma/Drugs: IICT-Hyderabad (28); NII-New Delhi (25); CDRI-Lucknow (24)

   Engineering: CIMFR-Dhanbad (30)

   Chemical Engineering : NCL-Pune (97); IICT-Hyderabad (44), NML-Jamshedpur (43); IIP-New Delhi (36); CGRI-Kolkata (35); CSMCRI-Bhavnagar (33); CLRI-Chennai (32); IMMT-Bhubaneswar (32); NEIST-Jorhat (25)

   Biotech/Food/Agriculture: CFTRI-Mysore (121); NIIH-Mumbai (41)

Chapter-6: Feedback for Enhancing IPR Regime in India

India ranks very highly in terms of research publications [5th as per Scimago Journal & Country Rank, *(http://www.scimagojr.com/countryrank.php?year=2016)*] but its patent profile needs a major boost. It ranks 45thin the indicator of Intellectual Property Rights (IPR) according to the International Property Rights Index (IPRI) Report 2017 (https://internationalpropertyrightsindex.org/countries). These two parameters indicate that Indian researchers have the capability to do research but are reluctant to translate their research into patents. Such translation would not only bring appreciation from their peers, but also providing financial benefits for themselves as well as for the institutions, they are affiliated with.

In a study carried out by DST-Centre for Policy Research at Panjab University, Chandigarh for nearly 1000 institutions [Higher Education Institutes (HEIs) and National R&D Labs (NRLs)], it was observed that while India has a large number of institutes that excel in publishing research articles, only a handful of them translate it further through patent publications. The institutes performing well in both the categories (research publications and patents-granted) are IISc-Bangalore, IIT-Bombay, IIT-Kanpur, IIT-Madras, IIT-Delhi, University of Delhi-Delhi and AIIMS-Delhi.

In order to strengthen the patent regime of institutes, especially those which are excelling in research publications, but low on patents, DST-CPR prepared a 'Questionnaire' which was sent to 36 HEIs (10 IITS, 15 Universities and 11 other institutes) as listed in table 1 to 4. Sixteen of them responded to the questionnaire (Table 5).

The observations, based on the report of respondents, are discussed below.

सत्यमेव जयते
Department of Science and Technology
Government of India

Questionnaire

DST-Centre for Policy Research,
Panjab University, Chandigarh

DST-Centre for Policy Research

at

PANJAB UNIVERSITY, CHANDIGARH-160 014 (INDIA)

(Estt. Under the Panjab University Act VII 1947 enacted by the Govt. of India)

CASE STUDY

(FOR PROMOTION AND GENERATION OF IPR)

The information sought pertains to your Institute only. Please put a tick mark in the box for an appropriate answer. The filled up Questionnaire can either be emailed at dstprc2014@gmail.com or mamtab@pu.ac.in *or a hard copy may be sent to* ***Prof. Rupinder Tewari,*** *Coordinator,DST – Centre for Policy Research, Room No. 316,Aruna Ranjit Chandra Hall, Top Floor, Panjab University, Sector-14, Chandigarh-160014.*

Name of the University / Institute:

Complete Postal Address:

E-Mail Address:

Contact Number:

S.No.	Query	Yes	No
1.	**Presence of Translational Research Ecosystem in the institute (*Please tick the below-mentioned facilities)*** i. Intellectual Property Right (IPR) Cell ii. Technology Transfer Cell iii. Entrepreneurship Cell iv. Industry-Institute Partnership Cell		
2.	Does the Institute have a dedicated "IPR Policy" or its equivalent? If any please provide a web link or printed version by post.		
3.	Does the Institute provide courses/workshops on IPR? If yes please mention.		
4.	Does the Institute provide training to faculty members/researchers/students related to IPR? If yes please mention.		
5.	Number of faculty members to have completed a course/diploma/degree in IPR.		
6.	Number of industry-academia research collaborations of the Institute		
7.	Does the institute provide special incentives for faculty members/ researchers/student, who have obtained patents/ transferred technology?		
8.	**Number of Technologies (Till now)** (i) Commercialized..... (ii) Available..... (iii) Under Process.....		
9.	**Any Other Suggestions**		

Table 1: Universities Excelling in Research Publications and Patents (2010-2016)

S. No.	Name of the Institution	Total No. of Publications	Total No. of Patents Granted
1.	DU- Delhi	15052	26
2.	Manipal University-Manipal	4444	13
3.	ICT-Mumbai	2671	39

Table 2: Universities Excelling in Research Publications, but Low on Patents Granted (2010-2016)

S. No.	Name of the Institution	Total No. of Publications	Total No. of Patents Granted
1.	BHU-Varanasi	8140	3
2.	UoH- Hyderabad	7649	5
3.	VIT University-Vellore	6267	3
4.	Annamalai University-Chidambaram	5400	1
5.	Gujarat University-Ahmedabad	4871	0
6.	PU-Chandigarh	4733	2
7.	AMU-Aligarh	4588	2
8.	S.R.M Institute of Science and Technology University-Chennai	3509	4
9.	Sathyabama University-Chennai	3211	0
10.	Jawaharlal Nehru University-Delhi	2739	6
11.	Bharath University-Chennai	2082	0
12.	Amity University-Noida	1311	1
13.	Jamia Hamdard-New Delhi	1757	8

Table 3: Institutes Excelling in Research Publications and Patents (2010-2016)

S. No.	Name of the Institution	Total No. of Publications	Total No. of Patents Granted
1.	IISc.-Bangalore	10852	174
2.	IIT-New Delhi	7148	56
3.	AIIMS-New Delhi	7634	31
4.	IIT-Chennai	6440	48
5.	IIT-Bombay	6300	100
6.	IIT-Kanpur	5622	44
7.	NIPER-Mohali	990	21
8.	ISI-Kolkata	1886	13

Table 4: Institutes Excelling in Research Publications Only (2010-2016)

S. No.	Name of the Institution	Total No. of Publications	Total No. of Patents Granted
1.	IIT-Kharagpur	8724	10
2.	IIT- Roorkee	6028	1
3.	IIT-Guwahati	4205	0
4.	IIT-Hyderabad	5398	2
5.	IIT-Dhanbad	2323	3
6.	NIT-Rourkela	2275	0
7.	Amrita Vishwa Vidyapeetham-Amrita Nagar	1588	0
8.	PSG College of Technology-Coimbatore	1381	2
9.	IISER-Pune	1234	1
10.	NIT-Calicut	908	2
11.	IIT-Indore	902	0
12.	Sree Chitra Tirunal Institute For Medical Sciences And Technology-Thiruvananthapuram	1028	1

Results & Discussion: The above-mentioned institutions were selected on the basis of research publications and patents granted. Out of these 36 institutes, 16 institutes responded back. The overall rate of response for the questionnaire was 41.66%.

Q.1 Presence of Translational Research Ecosystem

In most of the Indian HEIs and national research laboratories (NRLs), the researchers, scholars and scientists are carrying out good research in every field of science. Unfortunately, there is a gap in converting research into tangible products or patents. In order to bridge this gap, the researchers need to be supported with adequate and effective translational research ecosystem comprising of IPR Cell, Technology Transfer Cell, Entrepreneur Cell, Industry-Institute Partnership Cell.

All the responding institutes (16) have a dedicated IPR Cell indicating these institutes are more proactive in the domain of IP. However, only 7 institutes have dedicated Technology Transfer Cells (TTC). Out of 5 institutes performing well in the domain of research publications and patents, 3 of them, namely IIT-Mumbai, IIT-Kanpur and Manipal University-Manipal have dedicated TTCs. The other two institutes i.e. AIIMS-Delhi and NIPER-Mohali do not have TTC. However, AIIMS-Delhi makes use of the services of other bodies e.g. FITT of IIT-Delhi for Technology Transfer assistance, whereas, NIPER-Mohali has a business department, which looks after this facility. Amongst the 12 institutes performing well in research publications, but low on patents, 5 institutes have responded, out of which only 2 (IIT-Roorkee and IIT-Indore) have TTC.

Table 5: Translation Research Ecosystem in Respondent Institutions

S. No.	Institution	IPR Cell	Tech. Transfer Cell	Entrepren-eurship Cell	Industry-Academia Cell
1.	IIT-Bombay	✓	✓	✓	✓
2.	IIT-Kanpur	✓	✓	✓	✓
3.	Manipal University-Manipal	✓	✓	✓	✓
4.	NIPER-Mohali	✓	✗	✗	✗
5.	AIIMS-New Delhi	✓	✗	✗	✓
6.	IIT-Guwahati	✓	✗	✓	✓
7.	PSG College of Technology-Coimbatore	✓	✗	✓	✓
8.	IISER-Pune	✓	✗	✓	✗
9.	IIT-Indore	✓	✓	✓	✓
10.	UoH-Hyderabad	✓	✗	✗	✗
11.	PU-Chandigarh	✓	✗	✓	✓
12.	AMU-Aligarh	✓	✗	✓	✓
13.	Sathyabama University-Chennai	✓	✓	✓	✓
14.	JNU-New Delhi	✓	✗	✗	✗
15.	BHU-Varanasi	✓	✓	✓	✓
16.	IIT-Roorkee	✓	✓	✓	✓

Q. 2 **Does the Institute have a dedicated 'IPR Policy':**

Out of the total 16 institutes that responded to the questionnaire, 14 institutes have a dedicated 'IPR Policy'. Only two institutes (IIT-Guwahati and AMU-Aligarh) have still to lay down an exclusive IPR Policy. The absence of an IPR policy in these institutes creates a hesitation in the industry to invest in the institute, fearing legal hassles during the transfer of patents or technology to the concerned party.The IPR policy of AIIMS-Delhi is being drafted and is in the final stage.

Q. 3 Does the Institute provide courses on IPR:

The recent National IPR Policy-2016, projects the inclusion of IPR education as one of its important objectives. Nearly ¾ of the institutes claimed to have exposed their students to IPR. This exposure varies from a few lectures to a complete course. However, the need of the hour is to stream-line IPR courses from fundamental courses at the level of undergraduate students, to advance level courses at the post graduate level. Pre-PhD course should include hands on experience in patent search and patent filing.

Q. 4 Does the Institute provide training to faculty members/researchers/students on IPR:

Except University of Hyderabad, all institutes responded positively for the conduct of IPR related workshops and seminars for researchers and faculty members. This data indicates that institutions do understand the importance of IPR in the current era, and desire that not only young minds but also teachers/researchers should be IPR savy.

Q. 5 Number of faculty members having completed a course/diploma/degree in IPR:

Barring a couple of institutes (Manipal University-Manipal and Satyabama University-Chennai), majority of the respondent institutes have very few faculty members who have completed a course/diploma/degree in IPR. Six institutes (AIIMS-Delhi, NIPER-Mohali, IIT-Roorkee, PSG College of Technology-Coimbatore, UoH-Hyderabad, AMU-Aligarh) do not have a single faculty member who is IPR savy. Three institutes (IIT-Bombay, JNU-Delhi, BHU-Varanasi) did not provide the requisite information, but it is safe to assume that these institutes also lack faculty who have passed IPR related exam.

Table 6: Number of Faculty Members who have Completed IPR Course(s)

S. No.	Name of the Institution	No. of Faculty
1.	AIIMS-New Delhi	0
2.	IIT-Bombay	Information not provided
3.	IIT-Kanpur	1
4.	NIPER-Mohali	0
5.	IIT-Roorkee	0
6.	IIT-Guwahati	1
7.	PSG College of Technology-Coimbatore	0
8.	IISER-Pune	1
9.	IIT-Indore	1
10.	Manipal University-Manipal	~30
11.	UoH-Hyderabad	0
12.	PU-Chandigarh	3
13.	AMU-Aligarh	0
14.	Sathyabama University-Chennai	216
15.	JNU-Delhi	Information not provided
16.	BHU-Varanasi	Information not provided

Q. 6 Number of industry-academia (I-A) research collaborations of the institute:

I-A research collaborations are an important component for development of innovative products. The research carried out in the laboratories has to be brought to the market, which a scientist/institute cannot do. There has to be a handholding by industry for converting basic research into a product, which is then commercialized by the private sector. Also, no industry can solve its scientific problem using in-house R&D. It needs scientific intellect of public institutes like universities and research labs. The STI Policy of India, which was launched in 2013 also emphasized the importance of I-A collaborations for the development of new innovations/products/patents/technologies. Hence, a study was conducted to find out the level of I-A research collaborations of institutes (Table 7). Maximum number of collaborations are claimed by IITs such as IIT-Bombay (450) followed by IIT-Guwahati (374) and IIT-Kanpur (223).

Table 7: Number of Industry - Academia (I-A) Collaborations in the Respondent Institutes

S. No.	Institution	Number of I-A Collaborations
1.	AIIMS-Delhi	06
2.	IIT-Bombay	450
3.	IIT-Kanpur	223
4.	NIPER-Mohali	22
5.	IIT-Roorkee	0
6.	IIT-Guwahati	374
7.	PSG College of Technology-Coimbatore	150
8.	IISER-Pune	4
9.	IIT-Indore	2
10.	Manipal University-Manipal	176
11.	UoH-Hyderabad	74
12.	PU-Chandigarh	89
13.	AMU-Aligarh	18
14.	Sathyabama University-Chennai	85
15.	JNU-Delhi	0
16.	BHU-Varanasi	1

Apart from IITs, a few other institutes such as Manipal University-Manipal (176), PSG College of Technology-Coimbatore (150), Panjab University-Chandigarh (89) and Sathyabama University-Chennai (85) also have creditable number of I-A research collaborations. However, JNU-Delhi, BHU-Varanasi, IISER-Pune have a very poor record of I-A research collaborations. Surprisingly, IIT-Roorkee has no I-A research collaborations, as per the information supplied by the institute.

Q.7 Does the institute provide special incentives for faculty members/researchers/ students, who have obtained patents/transferred technologies?

A total of 12 institutes have introduced incentives for awarding and felicitating a researchers for their contribution towards innovations and technology transfer. These incentives are in the form of cash awards (salary hike, financial assistance for patent filing or attending international conferences), decreasing teaching load and so on. Only four institutes, namely AIIMS-Delhi, IISER-Pune, BHU-Varanasi and University of Hyderabad-Hyderabad have yet to introduce incentive measures.

Q. 8 Technologies in the Institutions:

The research momentum in India, as reflected by the quality and quantity of research publications is quite commendable. However, if these knowledge dividends are not converted into patents and transferred or licensed to industries for commercialization, the knowledge economy will not be fully functional. According to the response to our questionnaire, maximum number of technologies were commercialized by IIT-Kanpur (56) followed by IIT-Bombay (55) and PSG College of Technology-Coimbatore (>10).

IIT-Kanpur has the maximum number of technologies available for transfer (430) followed by AIIMS-Delhi (95), NIPER-Mohali (61 patents granted), PSG College of Technology-Coimbatore (>75), JNU-Delhi (51), IIT-Indore (36), Manipal University-Manipal (22) and so on (Table 8).IIT-Bombay tops the list with 580 technologies under process followed by Aligarh Muslim University-Aligarh (229), NIPER-Mohali (patents filed-184), IIT-Guwahati (110), PSG College of Technology-Coimbatore (100), Sathyabama University-Chennai (102) and so on (Table 8).

Table 8: Number of Technologies Commercialised (TC), Technologies Available (TA) and Technologies under Process (TuP)

S. No.	Institution	TC	TA	TuP
1.	AIIMS-Delhi	4	95	30
2.	IIT-Bombay	55	~10	580
3.	IIT-Kanpur	56	430	60
4.	NIPER-Mohali	08	Information not provided	Information not provided
5.	IIT-Roorkee	0	6	20
6.	IIT-Guwahati	1	10	110
7.	PSG College of Technology-Coimbatore	>10	>75	>100
8.	IISER-Pune	0	1	16
9.	IIT-Indore	0	36	15
10.	Manipal University-Manipal	2	22	5
11.	University of Hyderabad-Hyderabad	0	19	4
12.	Panjab University-Chandigarh	3	0	0 (TT/TL=5)
13.	Aligarh Muslim University-Aligarh	0	8	229
14.	Sathyabama University-Chennai	4	8	102
15.	JNU-Delhi	1	51	2
16.	BHU-Varanasi	0	1	59

Q. 9 Suggestions received from institutions for strengthening patent regime in HEIs:

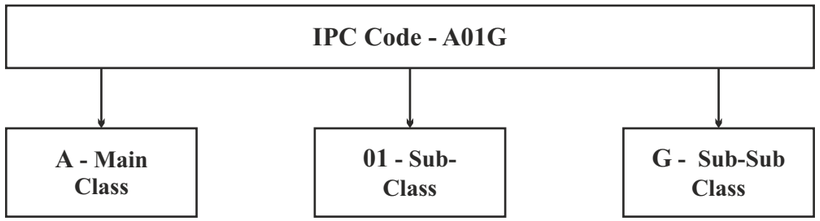
- A 'Faculty Recharge IPR Programme' for university professors should be pursued vigorously. Unless teaching community is IPR savy, it cannot emphasize the importance and necessity of IPR to the students/researchers. Similar programme should be introduced for the scientific community from research laboratories. It is suggested that DIPP should set up 4-5 IPR academies in India. The responsibilities of IPR Academy include preparing short term and long term courses (Certificate/Diploma) in the domain of IPR courses. It should also hold regular seminars/conferences and workshops for spreading awareness about the importance IPR to young minds, industry personnel, scientists and teachers of colleges and universities.
- Institutes carrying out quality research should have a dedicated I-A Cell, IPR Cell and Technology Transfer Cell. These Cells should be run by professionals. Allocating such an important task to a faculty member, as an additional responsibility, should be discouraged. Let teachers/scientists do innovative research only. The commercialization of technologies/products should be handled by experts, as is the practice in developed countries and at a few research institutes in India.
- In National Research Laboratories, the filing and maintenance of a patent is borne by the respective research organization. However, MHRD does not have this facility. Sometimes, the faculty members have to shell out money from their pockets. It is suggested that each university should create 'IPR Fund' which could be used for IPR related activities of the institute.
- Each institute should have an exclusive IPR Policy. Institutes may seek help from organizations such as IITs and CSIR institutes for drafting dedicated institutional IPR Policy. This step will attract industries to do business with academia.
- Each institute should incentivize patent publishing so as to encourage the faculty which has generated patents/technologies. Incentivization may be in the form of financial assistance (cash award, jump in salary, financial assistance for visit to national/international event etc.), decreasing teaching load, honouring scientists on special occasions and so on.
- A national level web-portal should be designed, which mentions all the patents and technologies developed by Indian scientists. In addition, a national level Industry-Academia Meet should be organized on annual basis, for a face-to-face meetings of inventors with investors.

Chapter-7: International Patent Classification

7.1 The International Patent Classification (IPC) established by the Strasbourg Agreement (http://www.wipo.int/treaties/en/classification/strasbourg/), provides a hierarchical system of language independent symbols for the classification of patents and utility models, according to the different areas of technology to which they pertain. (http://www.wipo.int/classifications/ipc/en/). The appropriate IPC codes are indicated on each patent document. The IPC codes are allotted by the national or regional intellectual property office that publishes the patent document. For PCT documents, IPC codes are allotted by the International Searching Authority(ISA).

The classification is indispensable for the retrieval of patent documents in the search for "prior art." Such retrieval is also needed by patent-issuing authorities, potential inventors, research and development units, and others concerned with the application or development of technology. DST-Centre for Policy Research at Panjab University, Chandigarh has collected data for Indian Higher Education Institutes and national R&D labs for the period 2010-16. Out of the total 12, 402 patents (published & granted) 9074 (72.16%) are in application phase and 3328 (26.83 %) are granted to the Indian institutions taken for the study.

A patent is assigned a minimum of four digit IPC code, which categorise a patent for its main class (first digit), subclass (2nd and 3rd digit) and sub-sub class (4th digit) as mentioned below



Meaning of the Code A01G

A - *Human Necessities*

A01 - *Agriculture; Forestry; Animal Husbandry; Hunting; Trapping; Fishing*

A01G - *Horticulture; Cultivation of Vegetables, Flowers, Rice, Fruit, Vines, Hops, or Seaweed; Forestry; Watering*

In the present study, 12,402 patents (published and granted) by Indian HEIs and national R&D labs for the period 2010-16, have been classified, based on IPC codes. The Centre believes that this will facilitate industries and researchers by providing a hassle free and easy access of the knowledge of the academia.

In the table 12, sub-sub classes are arranged for the patents under sub-classes of main class-A. The breakup for all the 12, 402 patents, under main classes is mentioned below in table 1.

Table 1: Main IPC Classes of the Patents

S. No.	IPC Codes	No. of Patents (2010-16)
1.	A - Human Necessities	3456
2.	B - Performing Operations; Transporting	1669
3.	C - Chemistry; Metallurgy	5519
4.	D - Textiles; Paper	191
5.	E - Fixed Constructions	164
6.	F - Mechanical Engineering; Lighting; Heating; Weapons; Blasting	425
7.	G - Physics	1739
8.	H - Electricity	1394
9.	L - Definition Not Available	1
10.	Y - General Tagging of New Technological Developments; General Tagging of Cross-Sectional Technologies Spanning Over Several Sections of the IPC; Technical Subjects Covered by Former USPC Cross- Reference Art Collections [Xracs] And Digests	14

Note: *There is a possibility that one patent can fall under 2 or more classes*

Note: *There is a possibility that one patent can fall under 2 or more classes*

Table 2: Definitions for the Patents under Main Class A

	Classes	Subclasses
A – Human Necessities (3456)	A01 - Agriculture; Forestry; Animal Husbandry;Hunting; Trapping; Fishing (541)	A01B (14), A01C (23), A01D (26), A01F (7), A01G (44), A01H (73), A01J (38), A01K (67), A01L (2), A01M (16), A01N (241), A01P(19)
	A03 – Definition not available (1)	A03B (1)
	A21 - Baking; Equipment For Making Or Processing Doughs; Doughs For Baking (18)	A21B (1), A21C (2), A21D (14), A21L (1)
	A22 - Butchering; Meat Treatment; Processing Poultry or Fish (12)	A22B (3), A22C (8), A22D (1)
	A23 - Foods or Foodstuffs; Their Treatment, Not Covered by Other Sub Classes (420)	A23B (14), A23C (26), A23D (8), A23F (16), A23G (5), A23J (28), A23K (32), A23L (276), A23N (31), A23P (2)
	A24 - Tobacco; Cigars; Cigarettes; Smokers' Requisites (6)	A24B (3), A24D (3)
	A26 - Definition Not Available (1)	A26B (1)
	A41 -Wearing Apparel (8)	A41B (2), A41C (1), A41D (4), A41F (1)
	A42 –Headwear (2)	A42B (1), A42C (1)
	A43 – Footwear (5)	A43B (5)
	A44 – Haberdashery; Jewellery (2)	A44B (1), A44C (1)
	A45-Hand or Travelling Articles (8)	A45B (4), A45C (2), A45F (2)
	A46-Brushware (3)	A46B (2), A46D (1)
	A47-Furniture; Domestic Articles Or Appliances; Coffee Mills; Spice Mills; Suction Cleaners In General (42)	A47B (4), A47C (7), A47D (2), A47F (1), A47G (2), A47H (2), A47J (15), A47L (9)
	A61-Medical or Veterinary Science; Hygiene (2430)	A61B (171), A61C (15), A61D (7), A61F (48), A61G (12), A61H (26), A61J (3), A61K (1954), A61L (115), A61M (35), A61N (31), A61P (600), A61Q (29)
	A62-Life-Saving; Fire-Fighting (19)	A62B (6), A62C (1), A62D (12)
	A63- Sports; Games; Amusements (17)	A63B (11), A63D (1), A63F (1), A63H (3), A63J (1)

Note: The numbers shown in the braces are total number of patents under class/*subclass*

Table 3: Definitions for the Patents under Main Class B

	Classes	Subclasses
B - Performing Operations; Transporting (1669)	B01 - Physical or Chemical Processes or Apparatus in General (732)	B01D (248), B01F (20), B01J (485), B01L (28)
	B02 - Crushing, Pulverising, or Disintegrating; Preparatory Treatment of Grain for Milling (16)	B02B (3), B02C (14)
	B03 - Separation of Solid Materials Using Liquids or Using Pneumatic Tables or Jigs; Magnetic or Electrostatic Separation of Solid Materials From Solid Materials or Fluids; Separation by High-Voltage Electric Fields (16)	B03B (5), B03C (5), B03D (6)
	B04 - Centrifugal Apparatus or Machines for Carrying-Out Physical or Chemical Processes (2)	B04C (2)
	B05 - Spraying or Atomising in General; Applying Liquids or Other Fluent Materials to Surfaces, in General (77)	B05B (28), B05C (4), B05D (48)
	B06 - Generating or Transmitting Mechanical Vibrations in General (2)	B06B (2)
	B07 - Separating Solids from Solids; Sorting (22)	B07B (20), B07C (2)
	B08 - Cleaning (13)	B08B (13)
	B09 - Disposal of Solid Waste; Reclamation of Contaminated Soil (16)	B09B (6), B09C (10)
	B13 - Definition not available (1)	B13B (1)
	B21 - Mechanical Metal-Working Without Essentially Removing Material; Punching Metal (18)	B21B (7), B21C (1), B21D (6), B21F (1), B21G (1), B21K (2)
	B22 - Casting; Powder Metallurgy (73)	B22B (1), B22C (9), B22D (14), B22F (49), B22Q (1)
	B23 - Machine Tools; Metal-Working not Otherwise Provided for (63)	B23B (24), B23C (1), B23D (3), B23G (1), B23H (5), B23K (20), B23P (3), B23Q (8)
	B24 - Grinding; Polishing (22)	B24B (15), B24C (5), B24D (2)
	B25 - Hand Tools; Portable Power-Driven Tools; Handles for Hand Implements; Workshop Equipment; Manipulators (16)	B25D (1), B25F (2), B25H (3), B25J (10)

B - Performing Operations; Transporting (1669)	B26 - Hand Cutting Tools; Cutting; Severing (11)	B26B (3), B26D (6), B26F (2)
	B27 - Working or Preserving Wood or Similar Material; Nailing or Stapling Machines in General (18)	B27B (2), B27J (1), B27K (4), B27L (2), B27M (3), B27N (7)
	B28 - Working Cement, Clay, or Stone (12)	B28B (12)
	B29 - Working of Plastics; Working of Substances in a Plastic State in General (55)	B29B (7), B29C (40), B29D (7), B29F (1), B29K (1)
	B30 - Presses (4)	B30B (4)
	B31 - Making Articles of Paper, Cardboard or Material Worked in a Manner Analogous to Paper; Working Paper, Cardboard or Material Worked in a Manner Analogous to Paper (6)	B31B (3), B31C (3)
	B32 - Layered Products (56)	B32B (55), B32D (1)
	B41 - Printing; Lining Machines; Typewriters; Stamps (22)	B41B (2), B41C (3), B41D (5), B41F (1), B41G (1), B41J (5), B41L (1), B41M (4)
	B42 - Bookbinding; Albums; Files; Special Printed Matter (16)	B42B (1), B42D (15)
	B43 - Writing or Drawing Implements; Bureau Accessories (9)	B43K (3), B43L (7)
	B44 - Decorative Arts (6)	B44B (1), B44C (4), B44D (1)
	B60 - Vehicles in General (81)	B60B (4), B60C (5), B60D (2), 60F (1), B60G (5), B60H (4), B60J (2), B60K (17), B60L (5), B60N (1), B60P (1), B60Q (2), B60R (14), B60S (4), B60T (14), B60W (7)
	B61 - Railways (5)	B61B (2), B61D (2), B61F (1)
	B62 - Land Vehicles for Travelling Otherwise than on Rails (39)	B62B (6), B62D (18), B62H (1), B62J (1), B62K (7), B62M (6), B62Y (1)
	B63 - Ships or Other Waterborne Vessels; Related Equipment (19)	B63B (13), B63C (1), B63G (2), B63H (2), B63J (1)
	B64 - Aircraft; Aviation; Cosmonautics (43)	B64B (1), B64C (20), B64D (18), B64F (6), B64G (3)
	B65 - Conveying; Packing; Storing; Handling Thin or Filamentary Material (76)	B65B (4), B65C (1), B65D (44), B65F (2), B65G (13), B65H (12)
	B66 - Hoisting; Lifting; Hauling (7)	B66B (1), B66C (3), B66D (1), B66F (1), B66L (1)
	B67 - Opening or Closing Bottles, Jars or Similar Containers; Liquid Handling (2)	B67D (2)
	B68 - Saddlery; Upholstery (1)	B68F (1)
	B81 - Microstructural Technology (8)	B81B (3), B81C (6)
	B82 - Nanotechnology (190)	B82B (26), B82Y (168)

Table 4: Definitions for the Patents under Main Class C

	Classes	Subclasses
C – Chemistry and Metallurgy (5519)	C01 -Inorganic Chemistry (514)	C01B (279), C01C (16), C01D (76), C01F (84), C01G (123), C01L (1), C01P (3)
	C02 - Treatment of Water, Waste Water, Sewage, orSludge (271)	C02F (271)
	C03 - Glass; Mineral or Slag Wool (44)	C03B (17), C03C (28)
	C04 - Cements; Concrete; Artificial Stone; Ceramics; Refractories (153)	C04B (152), C04C (1)
	C05 - Fertilisers; Manufacture Thereof (56)	C05C (1), C05D (14), C05F (26), C05G (16), C05P (2)
	C06 - Explosives; Matches (9)	C06B (7), C06D (2)
	C07 - Organic Chemistry (2299)	C07B (74), C07C (833), C07D (1019), C07F (121), C07G (12), C07H (101), C07J (35), C07K (316), C07S (1)
	C08 - Organic Macromolecular Compounds; Their Preparation or Chemical Working-Up; Compositions Based Thereon (564)	C08B (62), C08C (7), C08F (132), C08G (163), C08H (10), C08J (91), C08K (92), C08L (105)
	C09 - Dyes; Paints; Polishes; Natural Resins; Adhesives; Compositions not otherwise provided for; Applications of Materials not otherwise provided for (272)	C09B (36), C09C (37), C09D (94), C09F (1), C09G (1), C09J (17), C09K (101)
	C10 - Petroleum, Gas or Coke Industries; Technical Gases Containing Carbon Monoxide; Fuels; Lubricants; Peat (210)	C10B (8), C10C (3), C10F (1), C10G (54), C10J (8), C10K (1), C10L (82), C10M (60), C10N (10)
	C11 - Animal Or Vegetable Oils, Fats, Fatty Substances Or Waxes; Fatty Acids Therefrom; Detergents; Candles (134)	C11B (34), C11C (79), C11D (32)

C – Chemistry and Metallurgy (5519)	C12 - Biochemistry; Beer; Spirits; Wine; Vinegar; Microbiology; Enzymology; Mutation or Genetic Engineering (1176)	C12C (4), C12D (2), C12F (1), C12G (5), C12H (1), C12M (35), C12N (727), C12P (256), C12Q (262), C12R (51), C12S (4)
	C13 - Sugar Industry (12)	C13B (5), C13D (2), C13K (5)
	C14 - Skins; Hides; Pelts; Leather (45)	C14B (3), C14C (42)
	C20 - Definition not available (1)	C20F (1)
	C21 - Metallurgy of Iron (27)	C21B (12), C21C (4), C21D (11), C21P (1)
	C22 - Metallurgy; Ferrous or Non-Ferrous Alloys; Treatment of Alloys or Non-Ferrous Metals (109)	C22B (54), C22C (51), C22F (5)
	C23 - Coating Metallic Material; Coating Material with Metallic Material; Chemical Surface Treatment; Diffusion Treatment of Metallic Material; Coating by Vacuum Evaporation, by Sputtering, by Ion Implantation or by Chemical Vapour Deposition, in general; Inhibiting Corrosion of Metallic Material or Incrustation in general (113)	C23C (104), C23F (10)
	C25 - Electrolytic or Electrophoretic Processes; Apparatus Therefor (85)	C25B (33), C25C (20), C25D (32), C25F (1)
	C30 - Crystal Growth (15)	C30B (15)
	C40 - Combinatorial Technology (16)	C40B (16)
	C01 - Inorganic Chemistry (514)	C01B (279), C01C (16), C01D (76), C01F (84), C01G (123), C01L (1), C01P (3)

Note: The numbers shown in the braces are total number of patents under class/subclass

Table 5: Definitions for the Patents under Main Class D

	Classes	Subclasses
D - Textiles; Paper (191)	D01 - Natural or Man-Made Threads or Fibres; Spinning (76)	D01B (20), D01C (9), D01D (18), D01F (19), D01G (5), D01H (12), D01M (1)
	D02 - Yarns; Mechanical Finishing of Yarns or Ropes; Warping or Beaming (7)	D02G (6), D02J (1)
	D03 - Weaving (14)	D03C (3), D03D (10), D03J (2)
	D04 - Braiding; Lace-Making; Knitting; Trimmings; Non-Woven Fabrics (12)	D04B (1), D04H (11)
	D05 - Sewing; Embroidering; Tufting (3)	D05B (3)
	D06 - Treatment of Textiles or The Like; Laundering; Flexible Materials not otherwise provided for (57)	D06B (3), D06F (6), D06H (1), D06L (4), D06M (28), D06N (5), D06P (11)
	D07 - Ropes; Cables Other than Electric (4)	D07B (4)
	D21 - Paper-Making; Production of Cellulose (21)	D21B (2), D21C (10), D21H (9)
	D24 - Definition not available (1)	D24D (1)

Note: The numbers shown in the braces are total number of patents under class/subclass

Table 6: Definitions for the Patents under Main Class E

	Classes	Subclasses
E - Fixed Constructions (164)	E01 - Construction of Roads, Railways, or Bridges (12)	E01C (9), E01F (3)
	E02 - Hydraulic Engineering; Foundations; Soil- Shifting (22)	E02B (7), E02D (12), E02F (3)
	E03 - Water Supply; Sewerage (12)	E03B (5), E03D (4), E03F (4)
	E04 - Building (36)	E04B (15), E04C (10), E04D (1), E04F (4), E04G (3), E04H (6)
	E05 - Locks; Keys; Window or Door Fittings; Safes (23)	E05B (3), E05D (20)
	E06 - Doors, Windows, Shutters, or Roller Blinds, in general; Ladders (1)	E06B (1)
	E21 - Earth or Rock Drilling; Mining (62)	E21B (21), E21C (8), E21D (23), E21F (9), E21L (1)
	E61 - Definition not available (1)	E61L (1)

Note: The numbers shown in the braces are total number of patents under class/subclass

Table 7: Definitions for the Patents under Main Class F

	Classes	Subclasses
F- Engineering Elements or Units; General Measures for Producing and Maintaining Effective Functioning of Machines or Installations; Thermal Insulation in general (425)	F01 - Machines or Engines in general; Engine Plants in general; Steam Engines (38)	F01B (3), F01C (1), F01D (8), F01K (7), F01L (11), F01N (7), F01P (1)
	F02 - Combustion Engines; Hot-Gas or Combustion-Product Engine Plants (66)	F02B (23), F02C (9), F02D (15), F02F (1), F02K (3), F02M (15), F02N (1), F02P (1)
	F03 - Machines or Engines for Liquids; Wind, Spring, or Weight Motors; Producing Mechanical Power or A Reactive Propulsive Thrust, not otherwise provided for (30)	F03B (7), F03C (1), F03D (15), F03G (7)
	F04 - Positive-Displacement Machines for Liquids; Pumps For Liquids or Elastic Fluids (27)	F04B (9), F04C (4), F04D (13), F04F (1)
	F15 - Fluid-Pressure Actuators; Hydraulics or Pneumatics In General (7)	F15B (1), F15C (3), F15D (6)
	F16 - Engineering Elements or Units; General Measures for Producing and Maintaining Effective Functioning of Machines or Installations; Thermal Insulation in general (52)	F16B (5), F16C (12), F16D (8), F16F (4), F16H (11), F16J (1), F16K (2), F16L (7), F16M (2), F16P (1), F16S (1)
	F17 - Storing or Distributing Gases or Liquids (14)	F17B (1), F17C (12), F17D (1)
	F21 - Lighting (10)	F21Q (1), F21S (5), F21V (5), F21Y (1)
	F22 - Steam Generation (3)	F22B (2), F22G (1)
	F23 - Combustion Apparatus; Combustion Processes (19)	F23B (2), F23C (6), F23D (3), F23G (1), F23J (1), F23L (1), F23N (3), F23R (2)
	F24 - Heating; Ranges; Ventilating (85)	F24B (3), F24C (6), F24D (2), F24F (13), F24H (3), F24J (58)
	F25 - Refrigeration or Cooling; Combined Heating and Refrigeration Systems; Heat Pump Systems; Manufacture or Storage of Ice; Liquefaction or Solidification of Gases (30)	F25B (13), F25D (6), F25J (11)
	F26 - Drying (11)	F27B (3), F27D (1)
	F27 - Furnaces; Kilns; Ovens; Retorts (4)	F28B (1), F28C (1), F28D (17), F28F (20)
	F28 - Heat Exchange in general (34)	F41G (1), F41H (2)
	F41 - Weapons (3)	F42B (4), F42D (1)
	F42 - Ammunition; Blasting (5)	F26B (11)

Note: The numbers shown in the braces are total number of patents under class/subclass

Table 8: Definitions for the Patents under Main Class G

	Classes	Subclasses
G - PHYSICS (1739)	G01 - MEASURING; TESTING (829)	G01B (49), G01C (19), G01D (10), G01F (28), G01G (5), G01H (8), G01J (25), G01K (17), G01L (27), G01M (12), G01N (539), G01P (3), G01Q (1), G01R (52), G01S (46), G01T (11), G01V (21), G01W (3)
	G02 - OPTICS (95)	G02B (62), G02C (1), G02F (33)
	G03 - PHOTOGRAPHY; CINEMATOGRAPHY; ANALOGOUS TECHNIQUES USING WAVES OTHER THAN OPTICAL WAVES; ELECTROGRAPHY; HOLOGRAPHY (31)	G03B (5), G03C (3), G03F (19), G03G (3), G03H (1)
	G04 - HOROLOGY (5)	G04B (2), G04G (3), G04R (1)
	G05 - CONTROLLING; REGULATING (52)	G05B (20), G05D (16), G05F (16), G05G (1)
	G06 - COMPUTING; CALCULATING; COUNTING (552)	G06C (8), G06F (319), G06G (7), G06J (1), G06K (89), G06M (2), G06N (16), G06Q (80), G06T (84)
	G07 - CHECKING-DEVICES (23)	G07B (1), G07C (5), G07D (10), G07F (9)
	G08 - SIGNALLING (66)	G08B (38), G08C (3), G08G (26)
	G09 - EDUCATING; CRYPTOGRAPHY; DISPLAY; ADVERTISING; SEALS (82)	G09B (37), G09C (2), G09F (10), G09G (34)
	G10 - MUSICAL INSTRUMENTS; ACOUSTICS (33)	G10D (2), G10H (3), G10K (4), G10L (24)
	G11 - INFORMATION STORAGE (40)	G11B (20), G11C (19), G11D (1)
	G12 - INSTRUMENT DETAILS (1)	G12B (1)
	G21 - NUCLEAR PHYSICS; NUCLEAR ENGINEERING (22)	G21B (1), G21C (6), G21F (8), G21G (4), G21H (1), G21K (3)

Note: The numbers shown in the braces are total number of patents under class/subclass

Table 9: Definitions for the Patents under Main Class H

	Classes	Subclasses
H - Electricity (1394)	H01 - Basic Electric Elements (747)	H01B (48), H01F (32), H01G (62), H01H (15), H01J (57), H01K (7), H01L (318), H01M (179), H01N (1), H01P (10), H01Q (39), H01R (10), H01S (12), H01T (5)
	H02 - Generation, Conversion, or Distribution of Electric Power (133)	H02B (1), H02G (1), H02H (7), H02J (44), H02K (23), H02M (39), H02N (3), H02P (21), H02S (5)
	H03 - Basic Electronic Circuitry (104)	H03B (9), H03D (4), H03F (34), H03G (3), H03H (18), H03J (2), H03K (25), H03L (3), H03M (16)
	H04 - Electric Communication Technique (408)	H04B (91), H04H (1), H04J (31), H04K (3), H04L (168), H04M (17), H04N (68), H04Q (17), H04R (6), H04S (2), H04W (83)
	H05 - Electric Techniques not Otherwise Provided For (36)	H05B (17), H05G (2), H05H (2), H05K (15)
	H12 - Definition not available (1)	H12Q (1)

**(The numbers shown in the braces are total number of patents under class/subclass)*

Table 10: Definitions for the Patents under Main Class L

	Classes	Subclasses
L (1)	L07 - Definition Not Available (1)	L07C (1)

**(The numbers shown in the braces are total number of patents under class/subclass)*

Table 11: Definitions for the Patents under Main Class Y

	Classes	Subclasses
Y - General Tagging of New Technological Developments; General Tagging of Cross - Sectional Technologies Spanning over Several Sections of The Ipc;Technical Subjects Covered by Former USPC Cross - Reference Art Collections [Xracs] and Digests(14)	Y02 - TECHNOLOGIES OR APPLICATIONS FOR MITIGATION OR ADAPTATION AGAINST CLIMATE CHANGE (5)	Y02P (5)
	Y10 - TECHNICAL SUBJECTS COVERED BY FORMER USPC (11)	Y10S (1), Y10T (10)

Note: The numbers shown in the braces are total number of patents under class/subclass

Table 12: Definitions and Patents under Sub-Sub classes of Main Class A

A01- Agriculture; Forestry; Animal Husbandry; Hunting; Trapping; Fishing (541)*

IPC	CodesDefinitions	No. of Patents
A01B	Soil Working in Agriculture or Forestry; Parts, Details, or Accessories of Agricultural Machines or Implements, in General	14
A01C	Planting; Sowing; Fertilising	23
A01D	Harvesting; Mowing	26
A01F	Threshing; Baling of Straw, Hay or the Like; Stationary Apparatus or Hand Tools for Forming or Binding Straw, Hay or the Like Into Bundles; Cutting of Straw, Hayor the Like; Storing Agricultural or Horticultural Produce	07
A01G	Horticulture; Cultivation of Vegetables, Flowers, Rice, Fruit, Vines, Hops, or Seaweed; Forestry; Watering	44
A01H	New Plants or Processes For Obtaining Them; Plant Reproduction by Tissue Culture Techniques	73
A01J	Manufacture of Dairy Products	38
A01K	Animal Husbandry; Care of Birds, Fishes, Insects; Fishing; Rearing or Breeding Animals, Not Otherwise Provided for; New Breeds of Animals	67
A01L	Shoeing of Animals	02
A01M	Catching, Trapping or Scaring of Animals; Apparatus for the Destruction of Noxious Animals or Noxious Plants	16
A01N	Preservation of Bodies of Humans or Animals or Plants or Parts Thereof; Biocides, E.G. as Disinfectants, as Pesticides or as Herbicides; Pest Repellants or Attractants; Plant Growth Regulators	241
A01P	Biocidal, Pest Repellant, Pest Attractant or Plant Growth Regulatory Activity of Chemical Compounds or Preparations	19
	A03 – Definition not available (1)	
A03B	Definition not available	01
	A21-Baking; Equipment For Making Or Processing Doughs; Doughs For Baking (18)	
A21B	Bakers' Ovens; Machines or Equipment for Baking	01
A21C	Machines or Equipment for Making or Processing Doughs; Handling Baked Articles Made From Dough	02
A21D	Treatment, E.G. Preservation, of Flour or Dough for Baking, E.G. by Addition of Materials; Baking; Bakery Products; Preservation Thereof	14
A21L	Definition not available	01

A22-Butchering; Meat Treatment; Processing Poultry or Fish (12)		
A22B	Slaughtering	03
A22C	Processing Meat, Poultry, or Fish	08
A22D	Definition not available	01
A23-Foods or Foodstuffs; Their Treatment, Not Covered By Other Sub Classes (420)		
A23B	Preserving, E.G. By Canning, Meat, Fish, Eggs, Fruit, Vegetables, Edible Seeds; Chemical Ripening of Fruit or Vegetables; the Preserved, Ripened, or Canned Products	14
A23C	Dairy Products, E.G. Milk, Butter, Cheese; Milk or Cheese Substitutes; Making Thereof	26
A23D	Edible Oils or Fats, E.G. Margarines, Shortenings, Cooking Oils	08
A23F	Coffee; Tea; Their Substitutes; Manufacture, Preparation, or Infusion Thereof	16
A23G	Cocoa; Cocoa Products, E.G. Chocolate; Substitutes for Cocoa or Cocoa Products; Confectionery; Chewing Gum; Ice-Cream; Preparation Thereof	05
A23J	Protein Compositions for Foodstuffs; Working-Up Proteins for Foodstuffs; Phosphatide Compositions for Foodstuffs	28
A23K	Feeding-Stuffs Specially Adapted For Animals; Methods Specially Adapted For Production Thereof	32
A23L	Foods, Foodstuffs, or Non-Alcoholic Beverages, not Covered by Subclasses A21d Or A23b- A23j; Their Preparation or Treatment, E.G. Cooking, Modification of Nutritive Qualities, Physical Treatment; Preservation of Foods or Foodstuffs, in General	276
A23N	Machines or Apparatus for Treating Harvested Fruit, Vegetables, or Flower Bulbs in Bulk, not Otherwise Provided for; Peeling Vegetables or Fruit in Bulk; Apparatus for Preparing Animal Feeding-Stuffs	31
A23P	Shaping or Working of Foodstuffs, not Fully Covered by a Single Other Subclass	02
A24-Tobacco; Cigars; Cigarettes; Smokers' Requisites (6)		
A24B	Manufacture or Preparation of Tobacco for Smoking or Chewing; Tobacco; Snuff	03
A24D	Cigars; Cigarettes; Tobacco Smoke Filters; Mouthpieces for Cigars or Cigarettes; Manufacture of Tobacco Smoke Filters or Mouthpieces	03
A26-Definition Not Available (1)		
A26B	Definition not available	01
A41-Wearing Apparel (8)		
A41B	Shirts; Underwear; Baby Linen; Handkerchiefs	02
A41C	Corsets; Brassières	01
A41D	Outerwear; Protective Garments; Accessories	04
A41F	Garment Fastenings; Suspenders	01
A42-Headwear (2)		
A42B	Hats; Head Coverings	01
A42C	Manufacturing or Trimming Hats or Other Head Coverings	01
A43-Footwear (5)		
A43B	Characteristic Features of Footwear; Parts of Footwear	05
A44-Haberdashery; Jewellery (2)		
A44B	Buttons, Pins, Buckles, Slide Fasteners, or the Like	01
A44C	Jewellery; Bracelets; Other Personal Adornments; Coins	01
A45-Hand or Travelling Articles (8)		
A45B	Walking Sticks; Umbrellas; Ladies' or Like Fans	04
A45C	Purses; Luggage; Hand Carried Bags	02
A45F	Travelling or Camp Equipment; Sacks or Packs Carried on the Body	02
A46-Brushware (3)		
A46B	Brushes	02
A46D	Manufacture of Brushes	01
A47-Furniture; Domestic Articles Or Appliances; Coffee Mills; Spice Mills; Suction Cleaners In General (42)		
A47B	Tables; Desks; Office Furniture; Cabinets; Drawers; General Details of Furniture	04
A47C	Chairs; Sofas; Beds	07
A47D	Furniture Specially Adapted for Children	02
A47F	Special Furniture, Fittings, or Accessories For Shops, Storehouses, Bars, Restaurants, or The Like; Paying Counters	01
A47G	Household or Table Equipment	02
A47H	Furnishings for Windows or Doors	02
A47J	Kitchen Equipment; Coffee Mills; Spice Mills; Apparatus for Making Beverages	15
A47L	Domestic Washing or Cleaning; Suction Cleaners In General	09

A61-Medical or Veterinary Science; Hygiene (2430)		
A61B	Diagnosis; Surgery; Identification	171
A61C	Dentistry; Apparatus or Methods For Oral or Dental Hygiene	15
A61D	Veterinary Instruments, Implements, Tools, or Methods	07
A61F	Filters Implantable Into Blood Vessels; Prostheses; Devices Providing Patency to, or Preventing Collapsing of, Tubular Structures of the Body, E.G. Stents; Orthopaedic, Nursing or Contraceptive Devices; Fomentation; Treatment or Protection of Eyes or Ears; Bandages, Dressings or Absorbent Pads; First-Aid Kits	48
A61G	Transport, Personal Conveyances, or Accommodation Specially Adapted for Patients or Disabled Persons; Operating Tables or Chairs; Chairs for Dentistry; Funeral Devices	12
A61H	Physical Therapy Apparatus, E.G. Devices for Locating or Stimulating Reflex Points in the Body; Artificial Respiration; Massage; Bathing Devices for Special Therapeutic or Hygienic Purposes or Specific Parts of the Body	26
A61J	Containers Specially Adapted For Medical or Pharmaceutical Purposes; Devices or Methods Specially Adapted For Bringing Pharmaceutical Products Into Particular Physical or Administering Forms; Devices For Administering Food or Medicines Orally; Baby Comforters; Devices for Receiving Spittle	03
A61K	Preparations for Medical, Dental, or Toilet Purposes	1954
A61L	Methods or Apparatus for Sterilising Materials or Objects in General; Disinfection, Sterilisation, or Deodorisation of Air; Chemical Aspects of Bandages, Dressings, Absorbent Pads, or Surgical Articles; Materials For Bandages, Dressings, Absorbent Pads, or Surgical Articles	115
A61M	Devices for Introducing Media Into, or onto, the Body; Devices for Transducing Body Media or for Taking Media From the Body; Devices For Producing or Ending Sleep or Stupor	35
A61N	Electrotherapy; Magnetotherapy; Radiation Therapy; Ultrasound Therapy	31
A61P	Specific Therapeutic Activity of Chemical Compounds or Medicinal Preparations	600
A61Q	Specific Use of Cosmetics or Similar Toilet Preparations	29
A62-Life-Saving; Fire-Fighting (19)		
A62B	Devices, Apparatus or Methods for Life-Saving	06
A62C	Fire-Fighting	01
A62D	Chemical Means for Extinguishing Fires; Processes for Making Harmful Chemical Substances Harmless, or Less Harmful, by Effecting a Chemical Change; Composition of Materials for Coverings or Clothing for Protecting Against Harmful Chemical Agents; Composition of Materials for Transparent Parts of Gas-Masks, Respirators, Breathing Bags or Helmets; Composition of Chemical Materials for Use in Breathing Apparatus	12

A63- Sports; Games; Amusements (17)		
A63B	Apparatus for Physical Training, Gymnastics, Swimming, Climbing, or Fencing; Ball Games; Training Equipment	11
A63D	Bowling Games, E.G. Skittles, Bocce or Bowls; Installations Therefor; Bagatelle or Similar	01
A63F	Card, Board or Roulette Games; Indoor Games Using Small Moving Playing Bodies; Video Games; Games not Otherwise Provided For	01
A63H	Toys, E.G. Tops, Dolls, Hoops, Building Blocks	03
A63J	Devices for Theatres, Circuses, or the Like; Conjuring Appliances or the Like	01

Chapter- 8: Recommendations for Strengthening Patent Ecosystem in India

➢ **Creation of an Indian Patent Trust System:** Patents are of no value unless the commercial worth of the product or technology is demonstrated and exploited. Many patentable inventions have failed not because they didn't work, but because the inventor was unable to exploit them commercially, because of lack of knowledge. There is a need for policy in India to fill this gap. If an institution or an individual is unable to utilize/commercialize the patent, they should entrust their patent to a specialized agency for its management, utilization or disposal as is practised in *S. Korea. (*http://nopr.niscair.res.in/bitstream/123456789/34014/1/JIPR%2021%281%29%2027-37.pdf*)*.

In 2008, S. Korea established a specialised agency (Patent Trust System, PTS) to facilitate technology transfer and commercialization in the country. This agency works only for dormant patents which have not been utilised for a long time. Patent Trust is defined as 'an arrangement whereby the inventor transfers the patent to a trustee, who is responsible or commissioned to manage or dispose off the patent for the truster's interest'. By virtue of this facility, any institution (universities, public research laboratories and SMEs) that lacks financial resource or capability to protect the patent and is unable to utilise or commercialise the patent may handover the technology or a patent to this specialised agency for its management. It is suggested that Indian PTS may be created to probe the potential of commercialization of patents.

➢ **Establishing 'IPR Academies' in Universities:** It is an accepted fact that overwhelming percentage of teaching faculty in the universities has little knowledge of IPR. Unless teaching community is IPR savvy, it cannot emphasize the importance/necessity of IPR to the young students/researchers. It is suggested that DIPP, GoI may set up 4-5 'IPR Academies' in India, whose major responsibility should be to train at least two faculty members of each university in the domain of IPR. Each faculty member should be well acquainted with IP fundamentals, so that he/she not only dispenses knowledge but also provide justifiable answers to the queries raised by students/ researchers. The other responsibilities of 'IPR Academy' may include a) preparing short-term and long term courses in the domain of IPR, and b) holding regular seminars/conferences and workshops for spreading awareness about the importance IPR to young minds, industry personnel, scientists and teachers of colleges and universities. The 'IPR Academies' can be run on self-sustainable basis. The finances can be generated by conducting workshops/seminars and offering courses (certificate/diploma) for public and private sectors including students/researchers/teachers (schools/colleges/universities) and employees of industries. These courses can be offered on-line as well.

➢ **Introduce Patent-Insurance Scheme:** The infringement claim and defence of IPs, especially patents is a very complex and expensive process and researchers/scientists are ill-equipped to deal with such contingencies. Larger companies with huge resources can infringe upon patents of SMEs as a market strategy to prevent them from blooming inside their niche market and posing as a potential threat to them, knowing that SMEs are not in a financial position to fight legal battles. In such a situation, patent insurance can play a major role in protecting patents from infringement and assist the inventor to fight against infringement. Additionally, during the process of licensing or commercialization, patent insurance adds credibility to the patents, since it's issued by the insuring company after detailed investigation of its claims and values. The instrument of patent insurance is especially important for developing countries like India, where there are many small and emerging SMEs. The same is being

practiced in the developed countries and is prevalent in USA and some European countries. China has recently (2012) started issuing patents insurance product.

➢ **Lucrative Weightage for IP in API framework:** The Academic Performance Indicator (API) laid down by MHRD for the promotion of assistant professor to associate professor and then to full professor does not provide enough weightage to patents. A teacher can secure promotion by publishing research papers in ordinary journals, without bothering about patent generation. Unless lucrative weightage is given to IP in the API, teaching community will not take IP matter seriously.

➢ **Creation of IP Fund in MHRD**: In national research laboratories, the cost of filing and maintenance of a patent is borne by the respective organizations. However, MHRD does not offer such facility to researchers from the universities. It depends on the policy of an individual university, whether to set aside funds for patent filing and maintenance or not. At times, the university teachers shell out money from their pockets. In order to promote IP activity in institutes of higher education, it is suggested that MHRD may create 'IP Fund' which could be used for IP related activities of the universities.

In addition, MHRD is desirous of universities to become less dependent on central government for financial assistance. One of the possible ways is to convert scientific knowledge, existing in HEIs, into patents, which can be licensed out to industries for commercial gains.

➢ **Assessment of Research for Patent Generation:** Every educational institute ought to have a mechanism of vetting each research manuscript by an independent body for its potential patentability, before it is sent for publication in a journal. The vetting of a manuscript for patentability before publication will surely boost the number of patent filing applications.

➢ **Dedicated IPR Cell in Universities:** Institutes carrying out quality research should have a dedicated I-A Cell, IPR Cell and Technology Transfer Cell. These Cells should be run by professionals, as practiced in the universities of developed countries. Allocating such an important task to a faculty member as an additional responsibility should be discouraged. In most cases, the added responsibility is bestowed upon a faculty member, who has no prior exposure to IPR, and thus not able to do justice with the responsibility entrusted upon him/her. Let teachers/scientists concentrate on quality research and leave patent related matters to the IP experts.

➢ **Knowledge Sharing between Academia and Private Sector:** By and large, the patents generated by academia are commercialized by the industries. Therefore, research being undertaken in the research laboratories of HEIs should be communicated to the industry. Also, a mechanism needs to be devised through which knowledge sharing, especially IP sharing, happens between the academia and the industry on regular basis so that they can collectively harness each other's innovation and knowledge for generation of quality patents and technologies. Keeping these factors in mind, industry-academia linkage becomes important for a) aiding in licensing-out patents from universities to industries and b) generation of futuristic innovations/patents. This partnership will get a big boost if angel investors, venture capitalists and/or financial institutions can also be roped in, especially when financially limited industries like SMEs are involved in industry-academia collaborations.

➢ **Institutional IPR Policy:** Each institute should have an IPR Policy in place. This step is crucial for attracting industries to do business with academia. Institutes may seek help from organizations such as IITs and CSIR institutes which have a well drafted institutional IPR Policy.

➢ **Incentivisation of Individuals:** Each institute must incentivize its teaching faculty/research scholars who have generated patents/technologies. Incentivisation may be in the form of financial assistance (cash award, salary-hike, financial assistance for visits to national/international events), decreasing teaching load, and honouring scientists on special occasions and so on.

➢ **Creation of a National IP Web Portal:** In India, organizations such as CSIR, ICMR, and ICAR etc. have independent IP/Technology web portals which have to be scanned individually by a scientist/industry personal, when searching for a particular patent/ technology information, thus making the process very laborious. Unfortunately, there is no web portal which lists all the patents (filed/granted) in India. A national level web-portal may be designed, which mentions all the patents (current and expired) and technologies developed by Indian scientists.

➢ **Linking Universities with Local PICs:** Effective networking between institutions and regional/national IPR agencies is the need of the hour. For example, universities need to collaborate with at least one local 'Patent Information Cell' (PIC), which has been established by Technology Information and Forecasting Council (TIFAC) (GoI) in 20 states (http://pfc.org.in/index.htm). Efforts should be made by the universities to establish a 'Patent Nodal Centre' in the campus under the aegis of PIC, to avail financial assistance and other facilities of PIC.

➢ **Dedicated Chamber to Resolve IPR Issues:** Patent litigation is another area of concern. It is a sensitive and expensive issue. The academician/researcher/scientist may not be aware of how to deal with legal issues related to IPR. Hence there must be a committed team of IP experts and a dedicated chamber in courts to take care of IPR issues. So, if infringement is proved, damages may be awarded to the owner on time. It will prove a deterrent to those who infringe other's inventions.

➢ **Incentivize Institutions Excelling in IP**: Institutions engaged in the promotion of patent ecosystem (generation of IP, introducing IPR as a subject at undergraduate, postgraduate and pre-PhD coursework, holding symposia/seminars/workshops in IP) should be incentivized by the government by way of providing special grants to the concerned institutions. One way of incentivizing could be granting **'IP Chairs'** in such Universities.

➢ **Promoting Linkages between Universities, Research Laboratories and Industries:** There is direct relationship between R&D levels and patent-index of a nation. In other words, to stimulate patent profile of a nation, it has to support its R&D ecosystem prevailing in the universities, R&D institutes and industries. It is recommended that, these sectors work in a system, and not in silos. The professional collaborations in the domain of scientific research among these sectors can overcome the limitations of working individually. Such partnerships will help the scientists of the public sector (universities and R&D institutes) to work on real-life scientific challenges being faced by the private sector i.e. industries. In return, the industry would be benefitted by the intelligentsia of the public sector for the development of futuristic innovations for commercial and societal gains. Universities have enormous scientific talent and enthusiastic manpower but limited in the scientific infrastructure. This limitation can be overcome by developing linkages with national research laboratories, which are equipped with sophisticated instruments, but low on manpower. Such tripartite partnership will definitely boost the levels of applied research/patents/technologies in India, without pumping in additional funds by the funding agencies. To start with, industries having DSIR accredited R&D Units may be roped in to forge this tripartite linkage.

Annexure - 1 (Description of Abbreviations)

Symbols & Abbreviations	Description
ABVIITM-GWA	Atal Bihari Vajpayee Indian Institute of Information Technology and Management, Gwalior
ACE-HOS	Adhiyamaan College of Engineering, Hosur
ACIP	Advisory Council on Intellectual Property
AFMC-PUN	Armed Forces Medical College, Pune
AIHT-CHE	Anand Institute of Higher Technology, Chennai
AIIMS-BHO	All India Institute of Medical Sciences, Bhopal
AIIMS-BHU	All India Institute of Medical Sciences, Bhubaneswar
AIIMS-DEL	All India Institute of Medical Sciences, New Delhi
AIIMS-JOD	All India Institute of Medical Sciences, Jodhpur
AIIMS-PAT	All India Institute of Medical Sciences, Patna
AIIMS-RAI	All India Institute of Medical Sciences, Raipur
AIIMS-RIS	All India Institute of Medical Sciences, Rishikesh
AMPRI-BHO	Advanced Materials and Processes Research Institute, Bhopal
AMU-ALI	Aligarh Muslim University, Aligarh
APCTT	Asian and Pacific Centre for Transfer of Technology
API	Active Pharmaceutical Ingredient
ARB(DRDO)-PUN	Armament Research Board-Defence Research & Development Organization, Pune
ARCI-HYD	International Advanced Research Centre for Powder Metallurgy and New Materials, Hyderabad
ARDI	Access to Research for Development and Innovation
ARIOS-NAI	Aryabhatta Research Institute of Observational Sciences, Nainital
ARI-PUN	Agharkar Research Institute, Pune
ASE-COI	Amrita School of Engineering, Coimbatore
ASIR-CHE	Academy of Scientific & Innovative Research, Chennai
ASP(AVV)	Amrita School of Pharmacy (Amrita Vishva Vidyapeetham), Kochi/Cochin
ASPI	Access to Specialized Patent Information
AU-CHI	Annamalai University, Chidambaram
AU-NOIDA	Amity University, Noida
AU-KRI	Alagappa University, Karaikudi
AVV-COI	Amrita Viswa Vidyapeetham, Coimbatore
AYUSH	Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homoeopathy
BAIT-SAT	Bannari Amman Institute of Technology, Sathyamangalam
BARC-MUM	Bhabha Atomic Research Centre, Mumbai
BCP-MUM	Bombay College of Pharmacy, Mumbai
BHEL	Bharat Heavy Electricals Limited
BHU-VAR	Banaras Hindu University, Varanasi

BI-KOL	Bose Institute, Kolkata
BIRAC	Biotechnology Industry Research Assistance Council
BIT-RAN	Birla Institute of Technology, Ranchi
BITS-PIL	Birla Institute of Technology & Science, Pilani
BnIT-KOL	Bengal Institute of Technology, Kolkata
BSARIST-VAN	B.S. Abdur Rahman Institute of Science and Technology, Vandalu
BSIP-LUC	Birbal Sahni Institute of Palaeobotany, Lucknow
BU-CHE	Bharath University, Chennai
BU-COI	Bharathiar University, Coimbatore
BVP-PUN	Bharati Vidyapeeth, Pune
BV-VAN	Banasthali Vidyapith, Vanasthali
CAU-MNI	Central Agricultural University, Manipur
CAZRI-JOD	Central Arid Zone Research Institute, Jodhpur
CBIT-HYD	Chaitanya Bharathi Institute of Technology, Hyderabad
CCMB-HYD	Centre for Cellular Molecular Biology, Hyderabad
CDAC-MUM	Centre for Development of Advanced Computng, Mumbai
CDAC-PUN	Centre for Development of Advanced Computing, Pune
CDRI-LUC	Central Drug Research Institute, Lucknow
CEERI-PIL	Central Electronics Engineering Research Institute, Pilani
CERI-KRI	Central Electrochemical Research Institute, Karaikudi
CFTRI-MYS	Central Food Technological Research Institute, Mysore/Mysuru
CGCRI-KOL	Central Glass and Ceramic Research Institute, Kolkata
CGPDTM	Controller General for Patents, Designs and Trade Marks
CIBA-CHE	Central Institute Brackish Water Aquaculture, Chennai
CICS-CHE	Centre for International Cooperation in Science, Chennai
CIFA-BHU	Central Institute of Freshwater Aquaculture, Bhubaneswar
CIFE-MUM	Central Institute of Fisheries Education, Mumbai
CIIPP	Centre for Institute Industry Partnership Program
CIMAP-LUC	Central Institute of Medicinal Aromatic Plants, Lucknow
CIMFR-DHA	Central Institute of Mining and Fuel Research, Dhanbad
CIPAM	Cell for IPR Promotion and Management
CIT-COI	Coimbatore Institute of Technology, Coimbatore
CLRI-CHE	Central Leather Research Institute, Chennai
CMERI-DUR	Central Mechanical Engineering Research Institute, Durgapur
CMTI-BAN	Central Manufacturing Technology Institute, Bangalore/Bengaluru
CNCRI-KOL	Chittaranjan National Cancer Research Institute, Kolkata
CRIH-KRC	Central Research Institute Homeopathy, Kurichy

CRIJAG-BAR	Central Research Institute for Jute and Allied Fibres, Barrackpore
CRIKC	Chandigarh Region Innovation and Knowledge Cluster
CRRI-DEL	Central Road Research Institute, New Delhi
CSIR	Council of Scientific and Industrial Research
CSMCRI-BHA	Central Electro Chemical Research Institute, Bhavnagar
CSR	Corporate Social Responsibility
CSRTI-MYS	Central Sericultural Research & Training Institute, Mysore/Mysuru
CSTRI-BAN	Central Silk Technological Research Institute, Bangalore/Bengaluru
CTE-UDA	College of Technology & Engineering, Udaipur
CTRTI-RAN	Central Tasar Research &Training Institute, Ranchi
CU	Central University
CUB-PAT	Central University of South Bihar, Patna
CUG-GAN	Central University of Gujarat, Gandhinagar
CUP-BAT	Central University of Punjab, Bathinda
CUR-AJM	Central University of Rajasthan, Ajmer
CUST-KOC	Cochin University of Science & Technology, Kochi/Cochin
CUTN-NEE	Central University of Tamil Nadu, Neelakudi
CVRCOE-BHU	C.V. Raman College of Engineering , Bhubaneswar
CWPRS-PUN	Central Water And Power Research Station, Pune
DAE	Department of Atomic Energy
DARE	Department of Agricultural Research and Education
DBAMU-AUR	Dr. Babasaheb Ambedkar Marathwada University, Aurangabad
DBHPS-CHE	Dakshina Bharat Hindi Prachar Sabha, Chennai
DBT	Department of Biotechnology
DFRL-MYS	Defence Food Research Laboratory, Mysore/Mysuru
DIAT	Defence Institute of Advanced Technology, Pune
DIC	District Industry Centre
DIPP	Department of Industrial Policy and Promotion
DMRL-HYD	Defence Metallurgical Research Laboratory, Hyderabad
DoS	Department of Space
DPS(DbU)-DIB	Department of Pharmaceutical Sciences, Dibrugarh University, Dibrugarh
DRDO	Defence Research and Development Organisation
DSIR	Department of Scientific and Industrial Research
DST	Department of Science & Technology
DST-CPR	Department of Science & Technology-Centre for Policy Research
DU-DEL	University of Delhi, New Delhi
FICCI	Federation of Indian Chambers of Commerce & Industry

IASRI-DEL	Indian Agricultural Statistics Research Institute, New Delhi
IBSD-MNI	Institute of Bioresources and Sustainable Development, Manipur
ICAR	Indian Council of Agricultural Research
ICMR	Indian Council of Medical Research
ICT	Information and Communications Technology
ICT-MUM	Institute of Chemical Technology, Mumbai
IDA	International Depository Authority
IEM-KOL	Institute of Engineering & Management, Kolkata
IFGTB-COI	Institute of Forest Genetics and Tree Breeding, Coimbatore
IGCAR-KAL	Indira Gandhi Centre for Atomic Research, Kalpakkam
IGIB-DEL	Institute of Genomics and Integrative Biology, Delhi
IHBT-PLR	Institute of Himalayan Bioresource Technology, Palampur
IIA-BAN	Indian Institute of Astrophysics, Bangalore/Bengaluru
IICB-KOL	Indian Institute of Chemical Biology, Kolkata
IICT-HYD	Indian Institute of Chemical Technology, Hyderabad
IIEST-SHI	Indian Institute of Engineering, Science and Technology, Shibpur
IIFT-DEL	Indian Institute of Foreign Trade, Delhi
IIGM-MUM	Indian Institute of Geomagnetism, Mumbai
IIHR-BAN	Indian Institute of Horticultural Research, Bangalore/Bengaluru
IIIM-JMM	Indian Institute of Integrative Medicine, Jammu
IIIT-DHR	Indian Institute of Information Technology, Dharwad
IIITDM-JAB	Indian Institute of Information Technology, Design and Manufacturing, Jabalpur
IIITDM-KPM	Indian Institute of Information Technology, Design and Manufacturing , Kancheepuram
IIIT-GUW	Indian Institute of Information Technology, Guwahati
IIIT-HYD	International Institute of Information Technology, Hyderabad
IIIT-KOT	Indian Institute of Information Technology, Kottayam
IIIT-KOTA	Indian Institute of Information Technology, Kota
IIIT-KUR	Indian Institute of Information Technology, Design & Manufacturing, Kurnool
IIIT-LUC	Indian Institute of Information Technology, Lucknow
IIIT-KLY	Indian Institute of Information Technology, Kalyani
IIIT-NAG	Indian Institute of Information Technology, Nagpur
IIIT-PUN	Indian Institute of Information Technology, Pune
IIIT-RAN	Indian Institute of Information Technology, Ranchi
IIIT-SEN	Indian Institute of Information Technology, Senapati
IIIT-SON	Indian Institute of Information Technology, Sonepat
IIIT-TRU	Indian Institute of Information Technology, Tiruchirapa
IIIT-UNA	lliIndian Institute of Information Technology, Una

IIIT-VAD	Indian Institute of Information Technology, Vadodara
IIP-DEH	Indian Institute of Petroleum, Dehradun
IISc-BAN	Indian Institute of Science, Bangalore/Bengaluru
IISER-BHO	Indian Institute of Science Education and Research, Bhopal
IISER-KOL	Indian Institute of Science Education and Research, Kolkata
IISER-MOH	Indian Institutes of Science Education and Research, Mohali
IISER-PUN	Indian Institute of Science Education and Research, Pune
IISER-TRI	Indian Institute of Science Education and Research, Thiruvananthapuram/Trivandrum
IISER-TIR	Indian Institute of Science Education and Research, Tirupati
IIST-TRI	Indian Institute of Space Science and Technology, Thiruvananthapuram/Trivandrum
IIT (BHU)	Indian Institute of Technology (Banaras Hindu University), Varanasi
IIT-BHI	Indian Institute of Technology, Bhilai
IIT-BHU	Indian Institute of Technology, Bhubaneswar
IIT-BOM	Indian Institute of Technology, Bombay
IIT-DEL	Indian Institute of Technology, Delhi
IIT-DHA	Indian Institute of Technology(Indian School of Mines), Dhanbad
IIT-DHR	Indian Institute of Technology, Dharwad
IIT-GAN	Indian Institute of Technology, Gandhinagar
IIT-GOA	Indian Institute of Technology, Goa
IIT-GUW	Indian Institute of Technology, Guwahati
IIT-HYD	Indian Institute of Technology, Hyderabad
IIT-IND	Indian Institute of Technology, Indore
IIT-JOD	Indian Institute of Technology, Jodhpur
IIT-JMM	Indian Institute of Technology, Jammu
IIT-KAN	Indian Institute of Technology, Kanpur
IIT-KHA	Indian Institute of Technology, Kharagpur
IIT-MAD	Indian Institute of Technology, Madras
IIT-MND	Indian Institute of Technology, Mandi
IITM-PUN	Indian Institute of Tropical Meteorology, Pune
IIT-PAL	Indian Institute of Technology, Palakkad
IIT-PAT	Indian Institute of Technology, Patna
IITR-LUC	Indian Institute of Toxicology Research, Lucknow
IIT-ROO	Indian Institute of Technology, Roorkee
IIT-ROP	Indian Institute of Technology, Ropar
IIT-TIR	Indian Institute of Technology, Tirupati
ILO	International Labour Organisation
ILS-BHU	Institute of Life Sciences, Bhubaneshwar

IMMT-BHU	Institute of Minerals and Materials Technology, Bhubaneswar
IMTECH-CHA	Institute of Microbial Technology, Chandigarh
INI	Institution of National Importance
INMAS-DEL	Institute of Nuclear Medicine & Allied Sciences, Delhi
InPASS	Indian Patent Advanced Search System
INTA	International Trademarks Association
IP(NU)	Institute of Pharmacy, Nirma University
IPAB	Intellectual Property Appellate Board
IP-BHU	Institute of Physics, Bhubaneswar
IPGMER-KOL	Institute of Post Graduate Medical Education and Research, Kolkata
IPM	Intellectual Property Management
IPO	Indian Patent Office
IPR	Intellectual Property Rights
IPR-GAN	Institute for Plasma Research, Gandhinagar
IPRI	International Property Rights Index
IRSCC-AHM	Institute of Reservoir Studies Chandkheda Campus, Ahmedabad
ISA	International Searching Authority
ISCBRM-BAN	Institute for Stem Cell Biology and Regenerative Medicine, Bangalore/Bengaluru
ISI-KOL	Indian Statistical Institute, Kolkata
ISRO	Indian Space Research Organisation
IUSSTF	Indo-US Science and Technology Forum
IVRI-IZA	Indian Veterinary Research Institute, Izatnagar
JCP-MYS	JSS College of Pharmacy, Mysore/Mysuru
JH-DEL	Jamia Hamdard, New Delhi
JIIT-NOIDA	Jaypee Institute of Information Technology, Noida
JIPGMER-PUD	Jawaharlal Institute of Post Graduate Medical Education &Research, Pondicherry/Puducherry
JMI-DEL	Jamia Millia Islamia, New Delhi
JNCASR-BAN	Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore/Bengaluru
JNTU-HYD	Jawaharlal Nehru Technological University, Hyderabad
JNU-DEL	Jawaharlal Nehru University, Delhi
JSS-MYS	JSS University, Mysore/Mysuru
JUIT-SOL	Jaypee University of Information Technology, Solan
JU-TAW	Jammu Universuty, Tawi
KEC-COI	Kongu Engineering College, Coimbatore
KES-ISL	Kasegaon Education Societys, Rajarambapu Institute of Technology, Islampur
KGCT-COI	Kumaraguru College of Technology, Coimbatore
KGMU-LUC	King Georges Medical University, Lucknow

KIIT-BHU	Kalinga Institute of Industrial Technology, Bhubaneswar
KIRAN	Knowledge Involvement in Research Advancement through Nurturing
KITS-COI	Karunya Institute of Technology & Sciences, Coimbatore
KKWIEER-NAS	K. K. Wagh Institute of Engineering Education & Research, Nashik
KLEF-VDD	Koneru Lakshmaiah Education Foundation, Vaddeswara
KrU-COI	Karpagam University, Coimbatore
KU-COI	Karunya University, Coimbatore
LPSC-TRI	Liquid Propulsion Systems Centre, Thiruvananthapuram
MAEER-PUN	Maharashtra Academy of Engineering &Educational Research, Pune
MAFW	Ministry of Agriculture and Farmers Welfare
MAHE-MAN	Manipal Academy of Higher Education, Manipal
MANIT-BHO	Maulana Azad National Institute of Technology, Bhopal
MCF	Ministry of Chemicals and Fertilizers
MCI	Ministry of Commerce and Industry
MCPS-MAN	Manipal College of Pharmaceutical Sciences, Manipal
MeitY	Ministry of Electronics and Information Technology
MES	Ministry of Earth Sciences
MFPI	Ministry of Food Processing Industries
MHA	Ministry of Home Affairs
MHFW	Ministry of Health and Family Welfare
MHI&PE	Ministry of Heavy Industries and Public Enterprises
MHRD	Ministry of Human Resource Development
MIT-MAN	Manipal Institute of Technology, Manipal
MNIT-JAI	Malaviya National Institute of Technology, Jaipur
MNNIT-ALL	Motilal Nehru National Institute of Technology, Allahabad
MNRE	Ministry of New and Renewable Energy
MoC	Ministry of Communications
MoD	Ministry of Defence
MOEF&CC	Ministry of Environment, Forest & Climate Change
MoPNG	Ministry of Petroleum and Natural Gas
MoRTH	Ministry of Road Transport and Highways
MoS	Ministry of Steel
MoT	Ministry of Textiles
MoU	Memorandum of Understanding
MRD	Ministry of Rural Development
MSDE	Ministry of Skill Development and Entrepreneurship
MSME	Ministry of Micro, Small and Medium Enterprises

MSRIT-BAN	M. S. Ramaiah Institute of Technology, Bangalore/Bengaluru
MST	Ministry of Science and Technology
MTCC	Microbial Type Culture Collection and Gene Bank
MUD	Ministry of Urban Development
MU-MNI	Manipal University, Manipal
MWRRD&GR	Ministry of Water Resources, River Development and Ganga Rejuvenation
NAL-BAN	National Aerospace Laboratories, Bangalore/Bengaluru
NBA	National Biodiversity Authority
NBFGR-LUC	National Bureau of Fish Genetic Resources, Lucknow
NBRC-GUR	National Brain Research Centre, Gurgaon/Gurugram
NBRI-LUC	National Botanical Research Institute, Lucknow
NCCS-PUN	National Centre for Cell Science, Pune
NCDC-DEL	National Centre for Disease Control, New Delhi
NCL-PUN	National Chemical Laboratory, Pune
NDA	Non-Disclosure Agreement
NDRI-KAR	National Dairy Research Institute, Karnal
NEERI-NAG	National Environmental Engineering Research Institute, Nagpur
NEIST-JOR	North East Institute of Science and Technology, Jorhat
NER	North Eastern Region
NGO	Non-Governmental Organisation
NGRI-HYD	National Geophysical Research Institute, Hyderabad
NICHE-KYK	Noorul Islam Centre for Higher Education, Kanyakumari
NID-AHM	National Institute of Design, Ahmedabad
NIE-MYS	National Institute of Engineering, Mysore/Mysuru
NIET-NOIDA	Noida Institute of Engineering & Technology, Noida
NIF	National Innovation Foundation
NIFT	National Institute of Fashion Technology
NII-DEL	National Institute of Immunology, Delhi
NIIH-MUM	National Institute of Immunohaematology, Mumbai
NIMHNS-BAN	National Institute of Mental Health and Neuro-Sciences, Bangalore/Bengaluru
NIO-GOA	National Institute of Oceanography, Goa
NIPER	National Institute of Pharmaceutical, Educational and Research
NIPER-AHM	National Institute of Pharmaceutical, Educational and Research, Ahmedabad
NIPER-GUW	National Institute of Pharmaceutical, Educational and Research, Guwahati
NIPER-HAJ	National Institute of Pharmaceutical, Educational and Research, Hajipur
NIPER-HYD	National Institute of Pharmaceutical, Educational and Research, Hyderabad
NIPER-KOL	National Institute of Pharmaceutical, Educational and Research, Kolkata

NIPER-MOH	National Institute of Pharmaceutical Education Research, Mohali
NIPER-RAE	National Institute of Pharmaceutical, Educational and Research, Raebareli
NIPGR-DEL	National Institute of Plant Genome Research, New Delhi
NIRF	National Institute Ranking Framework
NIRJAFT-KOL	National Institute of Research on Jute & Allied Fibre Technology, Kolkata
NIRRH-MUM	National Institute for Research in Reproductive Health, Mumbai
NISTADS/ISTIP	National Institute of Science, Technology and Development Studies/Indian Science & Technology and Innovation Policy
NIST-BER	National Institute of Science & Technology, Berhampur
NIT-AGA	National Institute of Technology, Agartala
NIT-ARU	National Institute of Technology, Arunachal Pradesh
NIT-CAL	National Institute of Technology, Calicut
NIT-DEL	National Institute of Technology, Delhi
NIT-DUR	National Institute of Technology, Durgapur
NIT-GOA	National Institute of Technology, Goa
NIT-HAM	National Institute of Technology, Hamirpur
NIT-JAL	Dr. B.R. Ambedkar National Institute of Technology, Jallandhar
NIT-JAM	National Institute of Technology, Jamshedpur
NIT-KUR	National Institute of Technology, Kurukshetra
NIT-MEG	National Institute of Technology, Meghalaya
NIT-MIZ	National Institute of Technology, Mizoram
NIT-MNG	National Institute of Technology, Manglore
NIT-MNI	National Institute of Technology, Manipur
NIT-NGD	National Institute of Technology, Nagaland
NIT-PAP	National Institute of Technology, Papum Pare
NIT-PAT	National Institute of Technology, Patna
NIT-PUD	National Institute of Technology, Pondicherry/Puducherry
NIT-RAI	National Institute of Technology, Raipur
NIT-ROU	National Institute of Technology, Rourkela
NIT-SIK	National Institute of Technology, Sikkim
NIT-SIL	National Institute of Technology, Silchar
NIT-SRI	National Institute of Technology, Srinagar
NIT-SRI-UK	National Institute of Technology, Srinagar, Uttarakhand
NIT-TAD	National Institute of Technology, Tadepalligudam
NIT-TIR	National Institute of Technology, Tiruchirapalli
NIT-WAR	National Institute of Technology, Warangal
NIVEDIH-BAN	National Institute of Veterinary Epidemiology and Disease Informatics, Bangalore/Bengaluru
NIV-PUN	National Institute of Virology, Pune

NML-JAM	National Metallurgical Laboratory, Jamshedpur
NMU-JLG	North Maharashtra University, Jalgaon
NPL-DEL	National Physical Laboratory, Delhi
NRCPB-DEL	National Research Centre on Plant Biotechnology, New Delhi
NRDC	National Research Development Corporation
NSTMIS	National Science and Technology Management Information System
NU-AHM	Nirma University, Ahmedabad
OECD	Organisation of Economic Cooperation and Development
OSDD	Open Source Drug Discovery
PAU-LUD	Punjab Agricultural University, Ludhiana
PCP-PUN	Poona College of Pharmacy, Pune
PDPMIIIT-JAB	Pandit Dwarka Prasad Mishra Indian Institute of Information Technology & Manufacturing, Jabalpur
PEC-CHA	Punjab Engineering College, Chandigarh
PFC	Patent Facilitating Centre
PGIMER-CHA	Postgraduate Institute of Medical Education and Research, Chandigarh
PIC	Patent Information Cell
PIII	Programme for Inspiring Inventors and Innovators
PoEC-PON	Pondicherry Engineering College, Pondicherry/Puducherry
PPCB	Punjab Pollution Control Board
PPP	Public Private Partnership
PRL-AHM	Physical Research Laboratory, Ahmedabad
PrU	Private University
PSCST	Punjab State Council for Science and Technology
PSG-COI	PSG College of Technology, Coimbatore
PSGCP	PSG College of Pharmacy
PSU	Public Sector Undertaking
PU-CHA	Panjab University, Chandigarh
PU-SAL	Periyar University, Salem
R&D	Research and Development
RGCB-TRI	Rajiv Gandhi Centre for Biotechnology, Thiruvananthapuram
RGIPT-RAE	Rajiv Gandhi Institute of Petroleum Technology, Rae Bareli
RGNIIPM-NAG	Rajiv Gandhi National Institute of Intellectual Property Management, Nagpur
RGNIYD-SPR	Rajiv Gandhi National Instiute of Youth Development, Sriperumbudur
RIMS-MNI	Regional Institute of Medical Sciences, Imphal, Manipur
RRCAT-IND	Raja Ramanna Centre for Advanced Technology, Indore
RRI-BAN	Raman Research Institute, Bangalore/Bengaluru
RRII-KOT	Rubber Research Institute of India, Kotayam

RVCE-BAN	R.V. College of Engineering, Bangalore/Bengaluru
SAC-AHM	Space Applications Centre, Ahmedabad
SAMEER-MUM	Society for Applied Microwave Electronics Engineering & Research, Mumbai
SASTRA-THI	Shanmugha Arts Science Technology & Research Academy, Thirumalaisamudram
SCTIMST-TRI	Sree Chitra Tirunal Institute for Medical Sciences and Technology, Trivandrum
SCT-SAL	Sona College of Technology, Salem
SEP	Standard Essential Patent
SERC-CHE	Structural Engineering Research Centre, Chennai
SET(ITM)-GWA	School of Engineering & Technology, Itm University, Gwalior
SGGSIET-NAN	Shri Guru Gobind Singhji Institute of Engineering & Technology, Nanded
ShU-KOH	Shivaji University, Kohlapur
SICLDR	Semiconductor Integrated Circuits Layout Design Registry
SINP-KOL	Saha Institute of Nuclear Physics, Kolkata
SIPEIT	Support for International Patent Protection in Electronics and IT
SIPP	Start-Ups Intellectual Property Protection
SIS&T-CHE	Sathyabama Institute of Science and Technology, Chennai
SIT-TUM	Siddaganga Institute of Technology, Tumkur
SLIET-SAN	Sant Longowal Institute of Engineering & Technology, Sangrur
SME	Small and Medium Enterprise
SNBNCBS-KOL	S. N. Bose National Centre for Basic Sciences, Kolkata
SNIP-KOL	Saha Institute of Nuclear Physics, Kolkata
SNU-DDRI	Shiv Nadar University, Dadri
SPA-DEL	School of Planning & Architecture, New Delhi
SPA-VIJ	School of Planning & Architecture, Vijaywada
SRCEM-NAG	Shri Ramdeobaba College of Engineering & Management, Nagpur
SREC-COI	Sri Ramakrishna Engineering College, Coimbatore
SRM-CHE	SRM University, Chennai
SRM-KPM	S.R.M Institute of Science and Technology, Kanchipuram
SRREC-BHI	Sagi Ramakrishnam Raju Engineering College, Bhimavaram
SU	State University
SU-CHE	Sathyabama University, Chennai
SVNIT-SUR	Sardar Vallabhbhai National Institute of Technology, Surat
SVU-TIR	Sri Venkateswara University, Tirupati
TAU-COI	Tamil Nadu Agricultural University, Coimbatore
TCE	Traditional Cultural Expressions
TCE-MDU	Thiagarajar College of Engineering, Madurai
TDB	Technology Development Board
TIASST-GUW	The Institute of Advanced Study in Science & Technology, Guwahati

TIFAC	Technology Information Forecasting and Assessment Council
TIFR-MUM	Tata Institute of Fundamental Research, Mumbai
TIME-IS	Technology Innovation Management & Entrepreneurship-Information Service
TIMS-CHE	The Institute of Mathematical Sciences, Chennai
TISC	Technology Innovation Support Centre
TK	Traditional Knowledge
TKDL	Traditional Knowledge Digital Library
TRE	Translational Research Ecosystem
TRIPS	Trade Related Aspects of Intellectual Property Rights
TTC	Talwar & Talwar Consultants
TU-NAP	Tezpur University, Napaam
TU-PTI	Thapar University, Patiala
UA-ALL	University of Allahabad, Allahabad
UCPS-WAR	University College of Pharmaceutical Sciences, Warangal
UICET(PU)-CHA	University Institute of Chemical Engineering & Technology, Panjab University, Chandigarh
UICT(NMU)-JLG	University Institute of Chemical Technology, North Maharashtra University, Jalgaon
UIPS(PU)-CHA	University Institute of Pharmaceutical Sciences (Panjab University), Chandigarh
UNO	United Nations Organisation
UNESCO	United Nations Educational Scientific and Cultural Organisation
UNFCCC	United Nations Framework Convention on Climate Change
UoH-HYD	University of Hyderabad, Hyderabad
UPOV	International Union for Protection of New Varieties of Plants
USPTO	United States Patent Trademark Office
UTRF-COI	UPASI Tea Research Foundation, Coimbatore
VB-BOL	Visva Bharati, Bolpur
VECC-KOL	Variable Energy Cyclotron Centre, Kolkata
VFSTR-GUN	Vignan's Foundation for Science, Technology & Research, Guntur
VIT-VEL	Vellore Institute of Technology, Vellore
VJTI-MUM	Veermata Jijabai Technological Institute , Mumbai
VKIT-PUN	Vishwakarma Institute of Technology, Pune
VNIT-NAG	Visvesvaraya National Institute of Technology, Nagpur
WIHG-DEH	Wadia Institute of Himalayan Geology, Dehradun
WII-DEH	Wildlife Institute of India, Dehradun
WIPO	World Intellectual Property Organization
WIPOCOS	WIPO Copyright Management System
WIPOIPAS	WIPO's Industrial Property Automation System
WOS	Women Scientist Scholarship Scheme
WTO	World Trade Organisation
YCCOE-NAG	Yeshwantrao Chavan College of Engineering, Nagpur

Annexure-2 (List of R&D Labs Considered for the Study)

S. No.	Name of the Research Institution
1.	Advanced Centre for Ayurveda in Mental Health and Neuro Sciences Ayurvedic Research Unit, Bangalore/Bengaluru
2.	Advanced Numerical Research & Analysis Group, Hyderabad
3.	Aerial Delivery Research & Development Establishment, Agra
4.	Aeronautical Development Establishment, Bangalore/Bengaluru
5.	Agharkar Research Institute, Pune
6.	Ahmedabad Textile Industry's Research Association, Ahmedabad
7.	All India Institute of Ayurveda, New Delhi
8.	All India Institute of Hygiene and Public Health, Kolkata
9.	All India Institute of Medical Sciences, Bhopal
10.	All India Institute of Medical Sciences, Bhubaneswar
11.	All India Institute of Medical Sciences, Jodhpur
12.	All India Institute of Medical Sciences, New Delhi
13.	All India Institute of Medical Sciences, Patna
14.	All India Institute of Medical Sciences, Raipur
15.	All India Institute of Medical Sciences, Rishikesh
16.	All India Institute of Physical Medicine and Rehabilitaton, Mumbai
17.	All India Institute of Speech and Hearing, Mysore/Mysuru
18.	Ammonium Perchlorate Experimental Plant, Aluva
19.	Arid Forest Research Institute, Jodhpur
20.	Armament Research & Development Establishment, Pune
21.	Armed Forces Films And Photo Division, New Delhi
22.	Armed Forces Medical College, Pune
23.	Aryabhatta Research Institute of Observational-Sciences, Nanital
24.	Atomic Minerals Directorate for Exploration and Research, Hyderabad
25.	Ayurveda Central Research Institute, Jaipur
26.	Ayurveda Contraceptve Drug Research Institute, Ahmedabad
27.	Ayurveda Mental Health Research Institute, Nagpur
28.	Ayurveda Regional Research Institute, Gangtok
29.	Ayurveda Regional Research Institute, Itanagar
30.	Ayurveda Regional Research Institute, Jammu
31.	Ayurveda Regional Research Institute, Mandi
32.	Ayurveda Regional Research Institute, Patna
33.	Ayurveda Research Institute for Mother and Child Health Care, Thiruvananthapuram/ Trivandrum
34.	Ayurveda Research Institute, Lucknow
35.	Ayurveda Tribal Health Care Research Project, Port Blair

36.	BCG Vaccine Laboratory Guindy, Chennai
37.	Bhabha Atomic Research Centre, Mumbai
38.	Bhopal Memorial Hospital &Research Centre, Bhopal
39.	Biju Patnaik National Steel Institute, Puri
40.	Birbal Sahni Institute of Palaeobotany, Lucknow
41.	Bombay Textile Research Association, Mumbai
42.	Bose Institute, Kolkata
43.	Cancer Institute, Chennai
44.	Captain Srinivasa Murthy Research Insttute of Ayurveda and Siddha Drugs Development, Chennai
45.	Center for Artificial Intelligence & Robotics, Bangalore/Bengaluru
46.	Center for DNA Fingerprinting and Diagnostics, Hyderabad
47.	Center for Fire, Explosive and Environment Safety, Delhi
48.	Center for Military Airworthiness & Certification, Bangalore/Bengaluru
49.	Central Building Research Institute, Roorkee
50.	Central Coffee Research Institute, Koppa
51.	Central Coir Research Institute, Kalavoor
52.	Central Drug Research Institute, Lucknow
53.	Central Electrochemical Research Institute, Karaikudi
54.	Central Electronics Engineering Research Institute, Pilani
55.	Central Food Laboratory, Kolkata
56.	Central Food Technological Research Institute, Mysore/Mysuru
57.	Central Forensic Science Laboratory, Chandigarh
58.	Central Forensic Science Laboratory, Hyderabad
59.	Central Forensic Science Laboratory, Kolkata
60.	Central Glass Ceramic Research Institute, Kolkata
61.	Central Institute of Medicinal Aromatic Plants, Lucknow
62.	Central Institute of Mining and Fuel Research, Dhanbad
63.	Central Institute of Plastic Engineering & Technology, Amritsar
64.	Central Institute of Psychiatry Kanke, Ranchi
65.	Central Institute of Tool Design, Hyderabad
66.	Central Leather Research Institute, Chennai
67.	Central Leprosy Teaching &Research Institute, Chengalpattu
68.	Central Manufacturing Technology Institute, Bangalore/Bengaluru
69.	Central Mechanical Engineering Research Institute, Durgapur
70.	Central Muga Eri Research and Training Institute, Jorhat
71.	Central Pulp and Research Institute, Saharanpur
72.	Central Research Institute (H), Kerala

73.	Central Research Institute (Siddha), Chennai
74.	Central Research Institute of Unani Medicine, Hyderabad
75.	Central Research Institute, Kasauli
76.	Central Road Research Institute, New Delhi
77.	Central RRSC- Regional Remote Sensing Centre, Nagpur
78.	Central Salt Marine Chemicals Research Institute, Bhavnagar
79.	Central Scientific Instruments Organisation, Chandigarh
80.	Central Sericultural Germplasm Resources Centre, Hosur
81.	Central Sericultural Research &Training Institute, Murshidabad
82.	Central Sericultural Research &Training Institute, Pampore
83.	Central Sericultural Research and Training Institute, Mysore/Mysuru
84.	Central Silk Technological Research Institute, Bangalore/Bengaluru
85.	Central Soil and Materials Research Station, New Delhi
86.	Central Tasar Research &Training Institute, Ranchi
87.	Central Water And Power Research Station, Pune
88.	Central Wool Development Board, Jodhpur
89.	Centre for Advanced Training in Earth System Sciences and Climate, Pune
90.	Centre for Air Borne Systems, Bangalore/Bengaluru
91.	Centre for Cellular Molecular Biology, Hyderabad
92.	Centre for Development of Advanced Computing, Bangalore/Bengaluru
93.	Centre for Development of Advanced Computing, Chennai
94.	Centre for Development of Advanced Computing, Hyderabad
95.	Centre for Development of Advanced Computing, Kolkata
96.	Centre for Development of Advanced Computing, Mohali
97.	Centre for Development of Advanced Computing, Mumbai
98.	Centre for Development of Advanced Computing, New Delhi
99.	Centre for Development of Advanced Computing, Noida
100.	Centre for Development of Advanced Computing, Pune
101.	Centre for Development of Advanced Computing, Thiruvananthapuram/ Trivandrum
102.	Centre for Development of Telematics, Delhi
103.	Centre for Developmentof Advanced Computing, Navi Mumbai
104.	Centre for Ecological ScienceIndian Institute of Science, Bangalore/Bengaluru
105.	Centre for Forestry Research and Human Resource Development, Chhindwara
106.	Centre for High Technology, Noida
107.	Centre for Marine Living Resources & Ecology, Kochi/Kochin
108.	Centre for Materials for Electronics Technology, Hyderabad
109.	Centre for Materials for Electronics Technology, Pune

110.	Centre for Materials for Electronics Technology, Thrissur
111.	Centre for Nano and Soft Matter Sciences, Bangalore/Bengaluru
112.	Centre for Research in Medical Entomology, Madurai
113.	Centre for Social Forestry and Eco-Rehabilitation, Allahabad
114.	Centre for Space Science and Technology Education in Asia-Pacific, Dehradun
115.	Centre for Wind Energy Technology, Chennai
116.	Chemical Research Unit Department of Research In Unani Medicine, Aligarh
117.	Chittaranjan National Cancer Research Institute, Kolkata
118.	CIAB (formerly Bio-Processing Unit), Mohali
119.	Clinical Research Unit (H), Port Blair
120.	Clinical Research Unit (Siddha) Govt. Siddha Medical College, Chennai
121.	Clinical Research Unit (Siddha) Santhigiri Siddha Medical College, Thiruvananthapuram/ Trivandrum
122.	Clinical Research Unit (T) for Homeopathy, Agartala
123.	Clinical Research Unit (T) for Homeopathy, Aizawl
124.	Clinical Research Unit (T) for Homeopathy, Kohima
125.	Clinical Research Unit (T) for Homeopathy, Kolkata
126.	Clinical Research Unit (T) for Homeopathy, Ranchi
127.	Clinical Research Unit (T) for Homeopathy, Shillong
128.	Clinical Research Unit (T) forHomeopathy, Puducherry/Pondicherry
129.	Clinical Research Unit Department of Pharmacology Gandhi Medical College Bhopal
130.	Clinical Research Unit for Homeopathy, Chennai
131.	Clinical Research Unit for Homeopathy, Gangtok
132.	Clinical Research Unit for Homeopathy, Tirupati
133.	Clinical Research Unit National Institute of Unani Medicine Campus, Bangalore/Bengaluru
134.	Clinical Research Unit, Kochi/Kochin
135.	Clinical Research Unit, Meerut
136.	Clinical Research Unit, Saeeda Hospital Campus, Burhanpur
137.	Clinical Veritcaton Unit for Homeopathy, Ghaziabad
138.	Clinical Veritcaton Unit for Homeopathy, Patna
139.	Combat Vehicles Research & Development Estt., Chennai
140.	CSIR Fourth Paradigm Institute, Bangalore/Bengaluru
141.	CSIR- Labs Advanced Materials and Processes Research Institute, Bhopal
142.	CSIR-UNIT : Human Resource Development Centre, Ghaziabad
143.	CSIR-UNIT : Open Source Drug Discovery, New Delhi
144.	CSIR-UNIT : Traditional Knowledge Digital Library, New Delhi
145.	CSIR-UNIT : Translational Research and Innovative Science Through Ayurveda, New Delhi
146.	CSIR-UNIT : Unit for Research and Development of Information Products, Pune

147.	Defence Avionics Research Establishment, Bangalore/Bengaluru
148.	Defence Bio-Engineering & Electro Medical Laboratory, Bangalore/Bengaluru
149.	Defence Electronics Application Laboratory, Dehradun
150.	Defence Electronics Research Laboratory, Hyderabad
151.	Defence Food Research Laboratory, Mysore/Mysuru
152.	Defence Institute of Advanced Technology, Deemed University, Pune
153.	Defence Institute of Bio-Energy Research, Haldwani
154.	Defence Institute of High Altitude Research,Leh
155.	Defence Institute of Physiology & Allied Sciences, Delhi
156.	Defence Institute of Psychological Research, Delhi
157.	Defence Laboratory, Jodhpur
158.	Defence Materials & Stores Research & Development Establishment, Kanpur
159.	Defence Metallurgical Research Laboratory, Hyderabad
160.	Defence Research &Development Establishment, Gwalior
161.	Defence Research Laboratory, Tejpur
162.	Defence Research& Development Laboratory, Hyderabad
163.	Defence Scientific Information & Documentation Centre, Delhi
164.	Defence Terrain Research Laboratory, Delhi
165.	Department of Pharmacology Gujarat Ayurved University, Jamnagar
166.	Desert Medicine Research Centre, Jodhpur
167.	Development and Educational Communication Unit, Ahmedabad
168.	Dr. Achanta Lakshmipat Research Centre for Ayurveda, Chennai
169.	Dr. Anjali Chaterjee Regional Research, Institute of Homoeopathy, Kolkata
170.	Drug Proving Research Unit (H), Kolkata
171.	Drug Standardisation Research Institute, Ghaziabad
172.	Eastern RRSC-Regional Remote Sensing Centre, Kolkata
173.	Electronics & Radar Development Establishment, Bangalore/Bengaluru
174.	Enterovirus Research Centre, Mumbai
175.	ESSO - Indian National Centre for Ocean Information Services, Hyderabad
176.	Family Welfare Training &Research Centre, Mumbai
177.	Fluid Control Research Institute, Palakkad
178.	Food & Drug Toxicology Research Centre, Hyderabad
179.	Gas Turbine Research Establishment, Bangalore/Bengaluru
180.	Genetic Research Centre, Mumbai
181.	Global Centre for Nuclear Energy Partnership, New Delhi
182.	Government Siddha Medical College, Chennai
183.	Govind Ballabh Pant Institute of Himalayan Environment & Development, Almora

184.	Hafine Institute for Training and Testing, Mumbai
185.	Harish Chandra Research Institute, Allahabad
186.	Herbal Ayurveda Research Center Nagaland University, Lumami
187.	High Energy Materials Research Laboratory, Pune
188.	Himalayan Forest Research Institute, Shimla
189.	Homeopathy Drug Research Institute (H), Lucknow
190.	Homeopathy Treatment Centre, New Delhi
191.	Homi Bhabha National Institute, Mumbai
192.	ICAR- Central Agroforestry Research Institute, Jhansi
193.	ICAR- Central Institute for Women in Agriculture, Bhubaneshwar
194.	ICAR- Indian Institute of Farming Systems Research, Modipuram
195.	ICAR- Indian Institute of Millets Research, Hyderabad
196.	ICAR- Indian Institute of Oil Palm Research, Pedavegi, West Godawari
197.	ICAR- Indian Institute of Oilseeds Research, Hyderabad
198.	ICAR- Indian Institute of Soil and Water Conservation, Dehradun
199.	ICAR- Indian Institute of Water Management, Bhubaneshwar
200.	ICAR- Indian Institute of Wheat and Barley Research, Karnal
201.	ICAR Research Complex for Eastern Region, Patna
202.	ICAR Research Complex for NEH Region, Barapani
203.	ICAR-Central Arid Zone Research Institute, Jodhpur
20.4	ICAR-Central Avian Research Institute, Izatnagar
205.	ICAR-Central Citrus Research Institute, Nagpur
206.	ICAR-Central Coastal Agricultural Research Institute, Ela
207.	ICAR-Central Inland Fisheries Research Institute, Barrackpore
208	ICAR-Central Institute Brackishwater Aquaculture, Chennai
209.	ICAR-Central Institute for Arid Horticulture, Bikaner
210.	ICAR-Central Institute for Research on Buffaloes, Hissar
211.	ICAR-Central Institute for Research on Cattle, Meerut
212.	ICAR-Central Institute for Research on Goats, Makhdoom
213.	ICAR-Central Institute of Agricultural Engineering, Bhopal
214.	ICAR-Central Institute of Cotton Research, Nagpur
215.	ICAR-Central Institute of Fisheries Technology, Cochin/ Kochi
216.	ICAR-Central Institute of Freshwater Aquaculture, Bhubaneswar
217.	ICAR-Central Institute of Research on Cotton Technology, Mumbai
218.	ICAR-Central Institute of Sub Tropical Horticulture, Lucknow
219.	ICAR-Central Institute of Temperate Horticulture, Srinagar
220.	ICAR-Central Institute on Fisheries Education, Mumbai

221.	ICAR-Central Institute on Post harvest Engineering and Technology, Ludhiana
222.	ICAR-Central Island Agricultural Research Institute, Port Blair
223.	ICAR-Central Marine Fisheries Research Institute, Kochi/ Cochin
224.	ICAR-Central Plantation Crops Research Institute, Kasargod
225.	ICAR-Central Potato Research Institute, Shimla
226.	ICAR-Central Research Institute for Jute and Allied Fibres, Barrackpore
227.	ICAR-Central Research Institute of Dryland Agriculture, Hyderabad
228.	ICAR-Central Sheep and Wool Research Institute, Avikanagar
229.	ICAR-Central Soil Salinity Research Institute, Karnal
230.	ICAR-Central Tobacco Research Institute, Rajahmundry
231.	ICAR-Central Tuber Crops Research Institute, Trivandrum/ Thiruvananthapuram
232.	ICAR-Indian Agricultural Research Institute, Hazaribag
233.	ICAR-Indian Agricultural Research Institute, New Delhi
234.	ICAR-Indian Agricultural Statistics Research Institute, New Delhi
235.	ICAR-Indian Institute of Agricultural Biotechnology, Ranchi
236.	ICAR-Indian Institute of Horticultural Research, Bangalore/Bengaluru
237.	ICAR-Indian Institute of Maize Research, New Delhi
238.	ICAR-Indian Institute of Natural Resins and Gums, Ranchi
239.	ICAR-Indian Institute of Pulses Research, Kanpur
240.	ICAR-Indian Institute of Rice Research, Hyderabad
241.	ICAR-Indian Institute of Seed Research, Mau
242.	ICAR-Indian Institute of Soil Sciences, Bhopal
243.	ICAR-Indian Institute of Spices Research, Calicut
244.	ICAR-Indian Institute of Sugarcane Research, Lucknow
245.	ICAR-Indian Institute of Vegetable Research, Varanasi
246.	ICAR-Indian Veterinary Research Institute, Izatnagar
247.	ICAR-National Academy of Agricultural Research & Management, Hyderabad
248.	ICAR-National Bureau of Agricultural Insect Resources, Bangalore/Bengaluru
249.	ICAR-National Bureau of Agriculturally Important Micro-organisms, Mau
250.	ICAR-National Bureau of Animal Genetic Resources, Karnal
251.	ICAR-National Bureau of Fish Genetic Resources, Lucknow
252.	ICAR-National Bureau of Plant Genetics Resources, New Delhi
253.	ICAR-National Bureau of Soil Survey and Land Use Planning, Nagpur
254.	ICAR-National Centre for Integrated Pest Management, New Delhi
255.	ICAR-National Dairy Research Institute, Karnal
256.	ICAR-National Institute of Abiotic Stress Management, Malegaon
257.	ICAR-National Institute of Agricultural Economics and Policy Research, New Delhi

258.	ICAR-National Institute of Animal Nutrition and Physiology, Bangalore/Bengaluru
259.	ICAR-National Institute of Biotic Stresses Management, Raipur
260.	ICAR-National Institute of High Security Animal Diseases, Bhopal
261.	ICAR-National Institute of Research on Jute & Allied Fibre Technology, Kolkata
262.	ICAR-National Institute of Veterinary Epidemiology and Disease Informatics, Hebbal, Bangalore/Bengaluru
263.	ICAR-National Research Centre for Banana, Trichi
264.	ICAR-National Research Centre for Grapes, Pune
265.	ICAR-National Research Centre for Litchi, Muzaffarpur
266.	ICAR-National Research Centre for Pomegranate, Solapur
267.	ICAR-National Research Centre on Camel, Bikaner
268.	ICAR-National Research Centre on Equines, Hisar
269.	ICAR-National Research Centre on Meat, Hyderabad
270.	ICAR-National Research Centre on Mithun, Medziphema
271.	ICAR-National Research Centre on Orchids, Pakyong
272.	ICAR-National Research Centre on Pig, Guwahati
273.	ICAR-National Research Centre on Plant Biotechnology, New Delhi
274.	ICAR-National Research Centre on Seed Spices, Ajmer
275.	ICAR-National Research Centre on Yak, West Kemang
276.	ICAR-National Rice Research Institute, Cuttack
277.	ICAR-Sugarcane Breeding Institute, Coimbatore
278.	ICAR-Vivekananda Parvatiya Krishi Anusandhan Sansthan, Almora
279.	ICMR-National JALMA Institute for Leprosy & Other Mycobacterial Diseases, Agra
280.	Indian Academy Of Sciences, Bangalore/Bengaluru
281.	Indian Association for the Cultivation of Science, Kolkata
282.	Indian Institute of Astrophysics, Bangalore/Bengaluru
283.	Indian Institute of Chemical Biology, Kolkata
284.	Indian Institute of Chemical Technology, Hyderabad
285.	Indian Institute of Crop Processing Technology (IICPT), Thanjavur
286.	Indian Institute of Entrepreneurship, Guwahati
287.	Indian Institute of Entrepreneurship, Guwahati
288.	Indian Institute of Foreign Trade, New Delhi
289.	Indian Institute of Forest Management, Bangalore/ Bengaluru
290.	Indian Institute of Geomagnetism, Mumbai
291.	Indian Institute of Indian Medical Heritage, Hyderabad
292.	Indian Institute of Integrative Medicine, Jammu
293.	Indian Institute of Petroleum, Dehradun
294.	Indian Institute of remote sensing, Dehradun

295.	Indian Institute of Space Science and Technology, Thiruvananthapuram/ Trivandrum
296.	Indian Institute of Toxicology Research, Lucknow
297.	Indian Institute of Tropical Meteorology, Pune
298.	Indian Jute Industries' Research Association, Kolkata
299.	Indian National Academy of Engineering, New Delhi
300.	Indian National Group of the International Association for Bridge and Structural Engineering New Delhi
301.	Indian National Science Academy, New Delhi
302.	Indian Plywood Industries Research and Training Institute, Bangalore/Bengaluru
303.	Indian Rubber Manufacturers Research Association, Thane
304.	Indira Gandhi Centre for Atomic Research, Kalpakkam
305.	Institute for Design of Electrical Measuring Instruments, Mumbai
306.	Institute for Plasma Research, Gandhinagar
307.	Institute for Stem Cell Biology and Regenerative Medicine, Bangalore/Bengaluru
308.	Institute of Bioresources and Sustainable Development, Imphal
309.	Institute of Biotechnology Geotectonic Studies, Jorhat
310.	Institute of Cytology and Preventive Oncology, Noida
311.	Institute of Drilling Technology, Dehradun
312.	Institute of Engineering and Ocean Technology, Mumbai
313.	Institute of Forest Biodiversity, Hyderabad
314.	Institute of Forest Genetics and Tree Breeding, Coimbatore
315.	Institute of Forest Productivity, Ranchi
316.	Institute of Genomics and Integrative Biology, Delhi
317.	Institute of Himalayan Bioresource Technology, Palampur
318.	Institute of Life Sciences, Bhubaneswar
319.	Institute of Microbial Technology, Chandigarh
320.	Institute of Minerals and Materials Technology, Bhubaneswar
321.	Institute of Nano Science and Technology, Mohali
322.	Institute of Nuclear Medicine & Allied Sciences, Delhi
323.	Institute of Oil and Gas Producton Technology, Mumbai
324.	Institute of Pesticides Formulation Technology, Gurgaon/Gurugram
325.	Institute of Petroleum Safety, Health and Environment Management, Betur
326.	Institute of Physics, Bhubaneswar
327.	Institute of Post Graduate Medical Educaton and Research, Kolkata
328.	Institute of Post Graduate Teaching and Research in Ayurveda, Jamnagar
329.	Institute of Reservoir Studies Chandkheda Campus, Ahmedabad
330.	Institute of Systems Studies & Analyses, Delhi
331.	Institute of Technology Management, Mussorie

332.	Institute of Wood Science and Technology Bangalore/Bengaluru
333.	Instruments Research & Development Establishment, Dehradun
334.	Integrated Coastal and Marine Area Management, Chennai
335.	Integrated Test Range, Balasore
336.	International Advanced Research Centre for Powder Metallurgy and New Materials, Hyderabad
337.	International Institute of Population Sciences, Mumbai
338.	ISRO Interial Systems Unit, Thiruvananthapuram/ Trivandrum
339.	ISRO Propulsion Complex, Mahendragiri
340.	ISRO Satellite Centre, Bangalore/Bengaluru
341.	ISRO-Semi Conductor Laboratory, Mohali
342.	Jawahar Lal Institute of Post Graduate Medical Education & Research, Puducherry/Pondicherry
343.	Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore/Bengaluru
344.	Laboratory for Electro-Optics Systems, Bangalore/Bengaluru
345.	Lala Ram Swarup Institute of TB and Allied Sciences, New Delhi
346.	Laser Science & Technology Centre, Delhi
347.	LGB Regional Institute of Mental Health, Tezpur
348.	Liquid Propulsion Systems Centre, Bangalore/Bengaluru
349.	Liquid Propulsion Systems Centre, Thiruvananthapuram/ Trivandrum
350.	Literary Research Institute of Unani Medicine, New Delhi
351.	Loknayak Jayaprakash Narayan Natonal Institute of Criminology & Forensic Science, New Delhi
352.	Mahatma Gandhi Institute of Medical Sciences, Wardha
353.	Man-Made Textile Research Association, Surat
354.	Marine Products Export Development Authority, New Delhi
355.	Microbial Containment Complex, Pune
356.	Microwave Tube Research & Development Center, Bangalore/Bengaluru
357.	Morarji Desai National Institute of Yoga, New Delhi
358.	NAA Unit of CFSL, Hyderabad
359.	Nation Institute of Secondary Steel Technology, Mandi Gobindgarh
360.	National Academy of Medical Sciences, New Delhi
361.	National Academy of Sciences, Allahabad
362.	National Accreditation Board for Testing & Calibration Laboratories, New Delhi
363.	National Aerospace Laboratories, Bangalore/Bengaluru
364.	National Agri-Food Biotechnology Institute, New Delhi
365.	National AIDS Research Institute, Pune
366.	National Automotive Testing and Research & Development Infrastructure Project, New Delhi
367.	National Ayurveda Dietetics Research Institute, Bangalore/Bengaluru
368.	National Ayurveda Research Institute For Vector Borne Diseases, Vijayawada

369.	National Botanical Research Institute, Lucknow
370.	National Brain Research Centre, National Brain Research Centre, Gurgaon/Gurugram
371.	National Centre For Antarctic And Ocean Research, Vasco da Gama
372.	National Centre for Cell Science, Pune
373.	National Centre for Diseases Informatics and Research, Bangalore/Bengaluru
374.	National Centre for Earth Science Studies, Thiruvananthapuram/ Trivandrum
375.	National Centre for Medium Range Weather Forecasting, Noida
376.	National Centre of Geo-Informatics, New Delhi
377.	National Centre of Laboratory Sciences, Hyderabad
378.	National Chemical Laboratory, Pune
379.	National Environmental Engineering Research Institute, Nagpur
380.	National Geophysical Research Institute, Hyderabad
381.	National Innovation Foundation, Gandhinagar
382.	National Institute For Interdisciplinary Science and Technology, Thiruvananthapuram/ Trivandrum
383.	National Institute for Micro Small & Medium Enterprises, Hyderabad
384.	National Institute for Research and Development in Defence Shipbuilding, Kozhikode
385.	National Institute for Research in Environmental Health, Bhopal
386.	National Institute for Research in Reproductive Health, Mumbai
387.	National Institute for Research in Tribal Health, Jabalpur
388.	National Institute for Research in Truberculosis, Chennai
389.	National Institute for Research in Tuberculosis, Chennai
390.	National Institute for Research in Reproductive Health, Mumbai
391.	National Institute For Training of Highway Engineers, Noida
392.	National Institute of Animal Biotechnology, Hyderabad
393.	National Institute of Ayurveda, Jaipur
394.	National Institute of Ayurvedic Pharmaceutcal Research, Patiala
395.	National Institute of Biologicals, Noida
396.	National Institute Of Biomedical Genomics, Kalyani
397.	National Institute of Cancer Prevention and Research, Noida
398.	National Institute of Cholera & Enteric Diseases, Kolkata
399.	National Institute of Cholera and Enteric Diseases, Kolkata
400.	National Institute of Communicable Diseases, New Delhi
401.	National Institute of Design, Ahmedabad
402.	National Institute of Design, Kurukshetra
403.	National Institute of Electronics & Information Technology, Mohali
404.	National Institute of Epidemiology, Chennai
405.	National Institute of Fashion Technology, New Delhi

406.	National Institute of Food Technology, Entrepreneurship and Management, Sonepat
407.	National Institute of Health & Family Welfare, New Delhi
408.	National Institute of Homoeopathy, Kolkata
409.	National Institute of Hydrology, Roorkee
410.	National Institute of Immunohaematology, Mumbai
411.	National Institute of Immunology, New Delhi
412.	National Institute of Malaria Research, New Delhi
413.	National Institute of Medical Statistics, New Delhi
414.	National Institute of Mental Health & Neuro Sciences, Bangalore/Bengaluru
415.	National Institute of Naturopathy, Pune
416.	National Institute of Nutrition, Hyderabad
417.	National Institute of Occupational Health, Ahmedabad
418.	National Institute of Oceanography, Dona Paula
419.	National Institute of Pathology, New Delhi
420.	National Institute of Pharmaceutical Education and Research, Ahmedabad
421.	National Institute of Pharmaceutical Education and Research, Guwahati
422.	National Institute of Pharmaceutical Education and Research, Hajipur
423.	National Institute of Pharmaceutical Education and Research, Hyderabad
424.	National Institute of Pharmaceutical Education and Research, Kolkata
425.	National Institute of Pharmaceutical Education and Research, Raebareli
426.	National Institute of Pharmaceutical Education Research, Mohali
427.	National Institute of Plant Genome Research, New Delhi
428.	National Institute of Science Communication And Information Resources, New Delhi
429.	National Institute of Science Education and Research Institute of Physics Campus, Bhubaneswar
430.	National Institute of Science, Technology and Development Studies, New Delhi
431.	National Institute of Siddha, Chennai
432.	National Institute of Solar Energy, Gurgaon/Gurugram
433.	National Institute of Unani Medicine, Bangalore/Bengaluru
434.	National Institute of Urban Affairs, New Delhi
435.	National Institute of Virology, Pune
436.	National Metallurgical Laboratory, Jamshedpur
437.	National Physical Laboratory, New Delhi
438.	National Research Centre on Integrated Farming, Motihari
439.	National Research Institute for Panchakarma, Cheruthuruthy
440.	National Research Institute for Sowa Rigpa, Ladakh
441.	National Research Institute of Ayurvedic Drugs Development, Kolkata
442.	National Research Institute of Basic Ayurveda Sciences, Pune

443.	National Research Institute ofAyurvedic Drug Development, Bhubaneswar
444.	National Silkworm Seed Organisation, Bangalore/Bengaluru
445.	National Sugar Institute, Kanpur
446.	National Tuberculosis Institute, Bangalore/Bengaluru
447.	Naval Materials Research Laboratory, Ambernath
448.	Naval Physical & Oceanographic Laboratory, Cochin/ Kochi
449.	Naval Science & Technological Laboratory, Vishakapatnam
450	NMRF-National Atmospheric Research Laboratory, Tirupati
451.	North - East Institute of Science and Technology, Jorhat
452.	North Eastern Indira Gandhi Institute of Health & Medical Sciences, Shillong
453.	North Eastern Institute of Ayurveda & Homoeopathy, Shillong
454.	North Eastern Institute of Folk Medicine, Pasighat
455.	North Eastern Regional Institute of Water And Land Management, Tezpur
456.	North Eastern Space Application Centre, Shillong
457.	Northern India Textile Research Association, Ghaziabad
458.	Northern India Textile Research Association, Ghaziabad
459.	Northern RRSC-Regional Remote Sensing Centre, Dehradun
460.	NRSA or NRSC – national remote sensing agency /centre, Hyderbad
461.	Pasteur Institute of India,Coonoor
462.	Petroleum Conservation Research Association, New Delhi
463.	Petroleum Conservation Research Association, New Delhi
464.	Physical Research Laboratory, Ahmedabad
465.	Post Graduate Institute of Medical Education & Research, Chandigarh
466.	Proof &Experimental Establishment, Balasore
467.	Rafi Ahmed Kidwai National Postal Academy, Ghaziabad
468.	Rain Forest Research Institute, Jorhat
469.	Raja Ramanna Centre for Advanced Technology, Indore
470.	Raja Ramdeo Anandilal Podar Ayurveda Cancer Research Institute, Mumbai
471.	Rajendra Memorial Research Institute of Medical Sciences, Patna
472.	Rajiv Gandhi Centre for Biotechnology, Thiruvananthapuram/ Trivandrum
473.	Raman Research Institute, Bangalore/Bengaluru
474.	Rani Lakshmi Bai Central Agricultural University, Jhansi
475.	Rashtriya Ayurveda Vidyapeeth, New Delhi
476.	Regional Centre for Biotechnology, Faridabad
477.	Regional Institute of Medical Sciences, Imphal
478.	Regional Institute of Paramedical & Nursing Sciences, Aizwal
479.	Regional Medical Research Centre, Belgavi

480.	Regional Medical Research Centre, Bhubaneswar
481.	Regional Medical Research Centre, Dibrugarh
482.	Regional Medical Research Centre, Port Blair
483.	Regional Remote Sensing Centres
484.	Regional Remote Sensing Centres (RRSCs),
485.	Regional Research Centre, Allahabad
486.	Regional Research Centre, Dibrugarh
487.	Regional Research Institute (H), Mumbai
488.	Regional Research Institute (H), Puri
489.	Regional Research Institute (Siddha), Puducherry/Pondicherry
490.	Regional Research Institute of Himalayan Flora Tarikhet, Almora
491.	Regional Research Institute of Unani Medicine, Aligarh
492.	Regional Research Institute of Unani Medicine, Bhadrak
493.	Regional Research Institute of Unani Medicine, Chennai
494.	Regional Research Institute of Unani Medicine, Delhi
495.	Regional Research Institute of Unani Medicine, Kolkata
496.	Regional Research Institute of Unani Medicine, Mumbai
497.	Regional Research Institute of Unani Medicine, Patna
498.	Regional Research Institute of Unani Medicine, Srinagar
499.	Regional Research Institute, Guwahati
500.	Regional Research Institute, Jaipur
501.	Regional Research Institute, New Shimla
502.	Regional Research Institute, Vijayawada
503.	Regional Sericultural Research Station, Jammu
504.	Regional Sericultural ResearchStation, Dehradun
505.	Remote Sensing Centre, Balasore
506.	Research & Development Establishment, Pune
507.	Research Center Imarat, Hyderabad
508.	Research Centre for Bamboo and Rattan, Aizawl
509.	Rubber Research Institute of India, Kotayam
510.	S.N. Bose National Centre for Basic Sciences, Kolkata
511.	Saha Institute of Nuclear Physics, Kolkata
512.	Sardar Swaran Singh National Institute of Bio-Energy, Kapurthala
513.	Sardar Vallabhbhai Patel International School of Textiles and Management, Coimbatore
514.	Satish Dhawan Space Centre, Sriharikota
515.	School of Tropical Medicine, Kolkata
516.	Seribiotech Research Laboratory, Bangalore/Bengaluru

517.	Silkworm Seed Technology Laboratory, Bangalore/Bengaluru
518.	Snow & Avalanche Study Estt, Chandigarh
519.	Society for Applied Microwave Electronics Engineering and Research, Mumbai
520.	Society for Applied Microwave Electronics Engineering Research, Kolkata
521.	Society for Applied Microwave Electronics Engineering, Chennai
522.	Solar Energy Centre, Gurgaon/Gurugram
523.	Solar Observatory, Udaipur
524.	Solid State Physics Laboratory, Delhi
525.	South India Textile Research Association, Coimbatore
526.	Space Applications Centre, Ahmedabad
527.	Sree Chitra Tirumal Institute for Medical Sciences and Technology, Thiruvananthapuram/ Trivandrum
528.	Structural Engineering Research Centre, Chennai
529.	Tata Institute of Fundamental Research, Mumbai
530.	Telecommunication Engineering Center, New Delhi
531.	Terminal Ballistics Research Laboratory, Chandigarh
532.	The Automotive Research Association of India, Pune
533.	The Central Agricultural University, Imphal
534.	The Indian Institute of Packaging, Mumbai
535.	The Indian Institute of Plantation Management, Bangalore/Bengaluru
536.	The Institute of Advanced Study in Science & Technology, Guwahati
537.	The Institute of Mathematical Sciences, Chennai
538.	The King Institute of Preventive Medicine, Chennai
539.	The National Institute for Entrepreneurship and Small Business Development, Noida
540.	Translational Health Science and Technology Institute, Faridabad
541.	Tropical Forest Research Institute, Jabalpur
542.	UPASI Tea Research Foundation, Coimbatore
543.	Vallabhabhai Patel Chest Institute, Delhi University Campus, New Delhi
544.	Variable Energy Cyclotron Centre, Kolkata
545.	Vector Control Research Centre, Puducherry/Pondicherry
546.	Vehicle Research &Development Establishment, Ahmednagar
547.	Vehicles Research & Development Establishment, Ahmednagar
548.	Vikram Sarabhai Space Centre, Thiruvananthapuram/ Trivandrum
549.	Wadia Institute of Himalayan Geology, Dehradun
550.	Western RRSC, Jodhpur
551.	Wildlife Institute of India, Dehradun
552.	Wireless Planning & Coordination Wing, New Delhi
553.	Wool Research Association, Thane