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# Science and Technology Research Players in India

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ITSMA, Fraunhofer IFF and EBTC welcome views and feedback on any aspect of the report. You can write to us or email us at the address below.

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## Disclaimer

The information compiled in this report is by online study and analysis using internet search engines. This activity is not aimed at replacing other sources of information, but to provide useful information by capturing maximum number of research players in various sectors, including the factors that would have contributed to their successful research performances.

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## Preface

The European Business and Technology Centre (EBTC), supports transfer of cleantechnology from EU and India. It helps the EU businesses and researchers to enter and work in India. During interaction with EU researchers on multiple occasions, it was observed that the EU Researchers faced difficulty in identifying and narrowing down to the appropriate organizations in terms of capabilities, for carrying out joint research initiatives. The current study is an effort to pool information about the important research organizations of India in one place to support the EU Researchers identify key research organizations in 8 sectors.

Research and Innovation plays a pivotal role in Indian economic growth. Though Indian government's investment in R&D stands low when compared to other developed countries, Indian R&D players have made remarkable contributions to the world thriving on Science and Technological innovations. Numerous top-notch Indian research institutes, research centres and high quality education provided by the universities are to be acclaimed for the great performances by the Indian R&D players. Strong foundation laid by the research institutions in terms of infrastructural facilities, international collaborations, well qualified research and scientific faculties have brought an upsurge in the Indian R&D sector growth.

According to the directory of R&D institutes developed by the Department of Science and Technology, Government of India in 2010, there are 4288 R&D institutions in India spread across several S&T sectors. This directory however provides only the addresses of the entities. There are other web portals which just list the R&D players' names and provide a hyperlink to the website of the organizations. This makes it difficult especially for an EU organization to understand the overall R&D landscape in India, and to search for sector specific R&D departments and centres. There needs to be a report or a catalogue or a profile of the research institutes available online that could act as a Ready-Reckoner which straight away provides overview about the institutes, their competencies, research focus areas, key achievements and their R&D strengths.

With the above objective in mind, this activity of mapping research players in India was conceived and executed. Thorough research was undertaken to find any reliable source that ranks the R&D entities in India based on their competencies. A web source [www.career360.com](http://www.career360.com) ranked the R&D entities based on the number of papers published in the last 5 years. While considering this as one of the sources for short-listing the entities for the report, other web sources such as the list of S&T institutions available in the Department of S&T websites have also been referred to. Instead of compiling all the R&D players under one section, they have been classified under 8 key S&T sectors such as health, biotechnology, ICT, environment, nano-sciences, etc so that specific sector focused departments within the research institutions could be reported about.

A detailed profiling including information on research focus areas, infrastructural facilities, human and financial capitals, research activities, and international collaborations and networking, running up to two pages for each institution, has been developed for 125 top institutions under each of the 8 S&T sectors classified under this report. A matrix of 50 entities each in 8 sectors, with few overlaps with the 125 organizations has also been provided in a tabular format. This matrix contains information such as contact details; paper published and Head of the Department. In spite of this well investigated, vast and detailed compilation, this report may not be necessarily complete as India is a vast country with numerous small, new and private R&D players across sectors that may lack web presence and would not have appeared in this report.

The main purpose is to provide the European organizations and research institutions a good and wholesome compilation of well known, well established and highly potential Research Players of India segregated across sectors and summarizing key competency indicators of these players in order to enlarge the knowledge, capacity and possibilities of collaboration between Europe and India.

# 1. ABOUT THE REPORT

## Objective

“**Science and Technology Research Players in India**” is a rich compilation of Indian research institutes and universities belonging to various science and technology streams.

The aim is to capture as much relevant data and useful information about the major contributors to the Indian Research and Development sector. Profiling of Research players from both public and private sector has been carried out with an objective of providing a consolidated record of Indian R&D players to European entities that are interested in collaborating with India.

## Methodology

The mapping activity was carried out mainly through online research and browsing through the portals of Indian research institutes and universities. Websites of Ministry of Science and Technology, Department of Science and Technology, and ranking and information portals were scanned to check if there is any source that could provide clear ranking criteria for the Indian research institutes based on their competencies or infrastructural facilities or research publications. But there are no such websites or sources available.

Care has been taken not just to provide comprehensive data of top entities, but also contact information of head of departments of major players under different sectors, including a matrix that maps large institutes on the various departments present in them. Different methods of profiling have been adopted under different categories in order to capture and present the information in a concise and crisp manner to keep the interest of the reader till the end in this voluminous report.

The profiling of research players has been done for 8 key Science and Technology sectors that include:

**(1) Biotechnology (2) Energy, (3) Environment, (4) Health, (5) Information and Communications Technology, (6) Nano Technology (7) Social Sciences and (8) Transport**

These 8 key sectors have been derived based on the thematic area classifications under European Commission’s Framework Programme 7.

The report provides three types of profiling of the research players.

1. **Detailed profiling of 15 to 18 top players** under each sector adding to 125 key research players in the classified 8 Science and Technology (S&T) sectors.

This is the most important and main section of the report that captures the top most players under each sector, which have very high potential for collaboration and partnerships. *Most of these entities have large number of international collaborations and experience in international projects. However it will be interesting to analyse in future studies how many of these entities have collaborations with European entities, and which EU countries have been more active with them.* This section furnishes the following information: Overview; Experience; Human and financial capital; Infrastructure; Research areas and activities; Networking and collaborations; Publications; and the Source, i.e. the website of the institute.

2. A **database of 50 entities each under each sector** which provides brief profiles of the entities, which adds up to a compilation of **400 research players**.

This database comprises of information such as the head of the department, their contact information, website, and number of publications in a tabular format. *The entities covered under this section also have high potential for collaboration, and it should be noted that most of these entities' potential still remains untapped by European players. The entities in the database can be further analysed for their research strengths in future studies.* Though there are few overlaps in the institutes covered in this database with that of the main section of 125 players, the information furnished in both these sections are entirely different and hence it only provided additional contact details of some of the top key players covered in the detailed profiling section.

3. A **matrix of 145 research institutions that maps the research players based on the different S&T sectors, by highlighting the sectors that are present in each institute.**

The matrix takes entities from both the detailed profiling section and the database of 400 entities and provides ready information on the presence of sectoral departments in the selected 145 entities. For e.g. the Indian Institute of Science, Bangalore has separate departments and centers that cater to sectors like ICT, Biotechnology, Energy, Environment, Nano Technology, Transport etc. *The matrix will be useful to readily know what sectoral departments are present in large institutions across the country.* The mapping of sectors has been done on the 8 thematic sectors selected for this activity.

It has to be noted that some of the 15-18 top institutes may be repeated under different sectors as the report tries to capture not just the institute as a whole, but specific sector focused departments and centres within some of the large prestigious institutes like the Indian Institute of Science, Indian Institutes of Technologies and National Institutes of Technologies. As most of the research institutes have departments catering to several S&T sectors, care has been taken to report all these departments under respective sectors, either in the detailed profiling section or in the database based on their competencies.

The research players compiled in this publication belong to public and private research institutes, sector specific departments in major research institutions, research centres, university departments and companies that are active in research and technology development.

## Selection Criteria

The Directory of R&D Institutions in India compiled by the Department of Science and Technology, Government of India in the year 2010 records 4288 entries. The directory is basically a compilation of addresses of the research institutions belonging to various categories, research labs, private and public sector in-house R&D units and research stations. The directory however does not furnish any further information about the institutes in terms of their competencies, facilities, research experience or collaborations.

The Directory can be downloaded at

<http://www.dst.gov.in/scientific-programme/DST%20Directory%20Link%20file.pdf>

There are some websites and web links that provide a list of top 100 or top 50 R&D institutions in India, and link them to their respective websites. But the ranking criteria are not mentioned

making them an unreliable source. Some of them are list of top Colleges and Universities in India by University Web Ranking (<http://www.4icu.org/in>), a ranking conducted by QS University Ranking - a dedicated ranking of the top 100 universities in the BRICS countries where 16 Indian universities are listed in the top 100. <http://www.topuniversities.com/university-rankings-articles/brics-rankings/top-universities-india>.

Considering that no studies are done on indicators of competencies, or reliable ranking systems on the research players in India are not arrived at, it was decided to consider papers published as one of the criteria for considering the entities in this EBTC compilation.

A survey conducted by Careers360 - India's largest higher education community & career counseling organisation, to identify top 100 Indian institutions based on the papers published, has been considered as one of the reference points to shortlist the research institutions for this report. <http://www.university.careers360.com/articles/top-100-universities-in-india-2013>. One of the criterions used by Careers360 is - Publications in the referred journals of the last ten years in two international databases such as Web of Science (Thomson Reuters) and Scopus (Elsevier) and Citations and Indian Patents were also considered to arrive at the ranking.

The compilation of List of S&T Institutes and Research Institutions in India available in the website of the C V Raman International Fellowship programme for African Researchers for 2010 which was launched by the Department of Science & Technology (DST) and Ministry of External Affairs (MEA), Government of India through the Federation of Indian Chambers of Commerce & Industry (FICCI), has also been referred to. This list is available at the following link: <http://www.indoafrika-cvrf.in/list-sci-tech-research-institutions-india.aspx>

Science and Technology Research Players in India



## 2 INDIAN RESEARCH LANDSCAPE

## 2. INDIAN RESEARCH LANDSCAPE

### Introduction

India has been ranked as the world's sixth most 'innovative' country, according to multinational company, GE's Annual Global Innovation Barometer.<sup>1</sup> For several decades India has remained one of the sought-after destinations for partnerships in Research & Development (R&D) for international entities from around the globe. As home to several corporate R&D investors in sectors like automotive, industrial machinery, Information Technology (IT), pharmaceuticals and biotechnology, India is a thriving R&D hotspot. The presence of multinationals is enlarging the scope of Indian R&D collaborations. While Indian R&D spending was still at 0.87% of GDP in 2013, India had the world's eighth largest annual R&D investment, accounting for 2.7% of global R&D expenditure and this is expected to increase to 31M Euros by 2014.<sup>2</sup>

In a study by the European Commission, published on the Indian Brand Equity Foundation (IBEF) website, the largest overall increase in R&D investments was reported by companies based in India with 35.1 percent, followed by China at 28.1 per cent.<sup>3</sup> *Indian companies occupied the topmost position globally in terms of growth in R&D investments. In terms of their absolute annual R&D investments, 14 Indian companies made it to the list of top 1,500 entities worldwide, as per this study.*<sup>4</sup>

Currently there are 1031 MNC R&D centers with an overall employment base of 244,000 in India, which has grown at a Compound Annual Growth Rate (CAGR) of 14.4%. India boasts of having centres of around 30% of the top 1,000 global R&D spending organisations.<sup>5</sup>

Brilliant scientists, devoted entrepreneurs and high-caliber research and academic institutions are some of the key characteristics of India's R&D contributing to its excellence despite the infrastructural, bureaucratic and mindset challenges. India offers three significant advantages to international players interested in R&D - **a burgeoning market for virtually all products and services, a large pool of scientists and engineers, and R&D at low cost.**<sup>6</sup>

Several other factors too have contributed to the growth of Indian R&D sector. India holds huge advantage in terms of robust demand, plethora of opportunities, high ratings and policy supports. Rising income and evolving lifestyle have led to higher demands for ambitious products pushing the Indian companies to increase investment in R&D and innovation to sustain competitive edge and stay firm in the market. These factors have made India the largest exporter of IT products and the third largest Pharma sector in the world with a fast growing contract research segment.

Establishments of Centres of Excellences and initiatives like NMITLI (New Millennium Indian Technology Leadership Initiative) on Public Private Partnership (PPP) basis, increased

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1 <http://www.ibef.org/industry/research-development-india.aspx>

2 <http://www.ibef.org/download/Innovation-and-Patents-March-2014.pdf>

3 <http://www.newindianexpress.com/magazine/A-whole-new-world/2013/10/27/article1852914.ece1#.U0ao3aiSx-N>

4 <http://www.4aims.com/research.php>

5 <http://www.ibef.org/download/Innovation-and-Patents-March-2014.pdf>

6 <http://www.battelle-india.com/wp-content/uploads/2013/08/FICCI-Battelle-Knowledge-Paper-Global-RD-Summit-2013.pdf>

investments by private players and setting up of R&D centres have brought India higher ratings in the global arena. IPR applications during Fiscal years 2007-2013 increased at a CAGR of 11.8 percent from 137,900 to 269,500. One of the latest initiatives of the government is a **'Research Funding Organisation' being set up to fund research projects selected through a competitive process**, as proposed by the finance Minister during the interim budget of 2014-2015.

Several Policy initiatives have uplifted India as one of the favorite R&D destinations. PPP for exchange of scientific knowledge and R&D, strengthening R&D infrastructure, Patent Act amendment (2007) to make it TRIPS compliant, setting up of National Innovation Council (NIC) in 2010 and Adoption of Science Technology and Innovation Policy 2013 are some of the key initiatives of the government.

Some of the more recent initiatives of the government include - The memorandum of understanding (MoUs) signed with developed countries viz Germany and France for bilateral co-operation in the field of Food Processing, which relate to collaboration in teaching and research in the food processing sector; approval for the implementation of the National Mission on Agricultural Extension and Technology (NMAET) during the 12th Plan; Approval of the proposal of the Department of Health Research (DHR) in the Ministry of Health & Family Welfare for the central sector scheme of Human Resource Development for Health Research.<sup>7</sup>

Augmentation of network of centrally funded institutions and universities, innovation in automobiles such as nano - the world's least expensive car, numerous innovations in rural India, expansion of talent pool of over 200,000 engineers at an average of 9% in the last 5 years have been some of the key contributing factors to India's flourishing R&D landscape.<sup>8</sup>

## Structure and governance of Indian Research Institutions

Successful endeavors by research institutes depend on lot of factors. Good policy framework, sufficient funding, knowledgeable human capital, top quality infrastructural facilities, well connected international networks and collaborations are key factors affecting R&D activities and performances of the research institutions. While nearly 60% of funds come from the government to public research councils and departments of scientific research, the universities and academic bodies and large private R&D laboratories too have contributed significantly to the R&D sector.

Indian research institutions' structure is a jigsaw of **4 types of key actors**. While the most prominent ones are the **public research institutions and research centres** which are managed either by the central government or the state government, the second main contributors towards research are the **academic research institutes and universities**. Most of these institutions also come under the purview of the government. The third in line are the **research labs set up by private enterprises and multinational companies**. Lastly, there is a small segment of **non-governmental research bodies** that are governed by public or private sources.

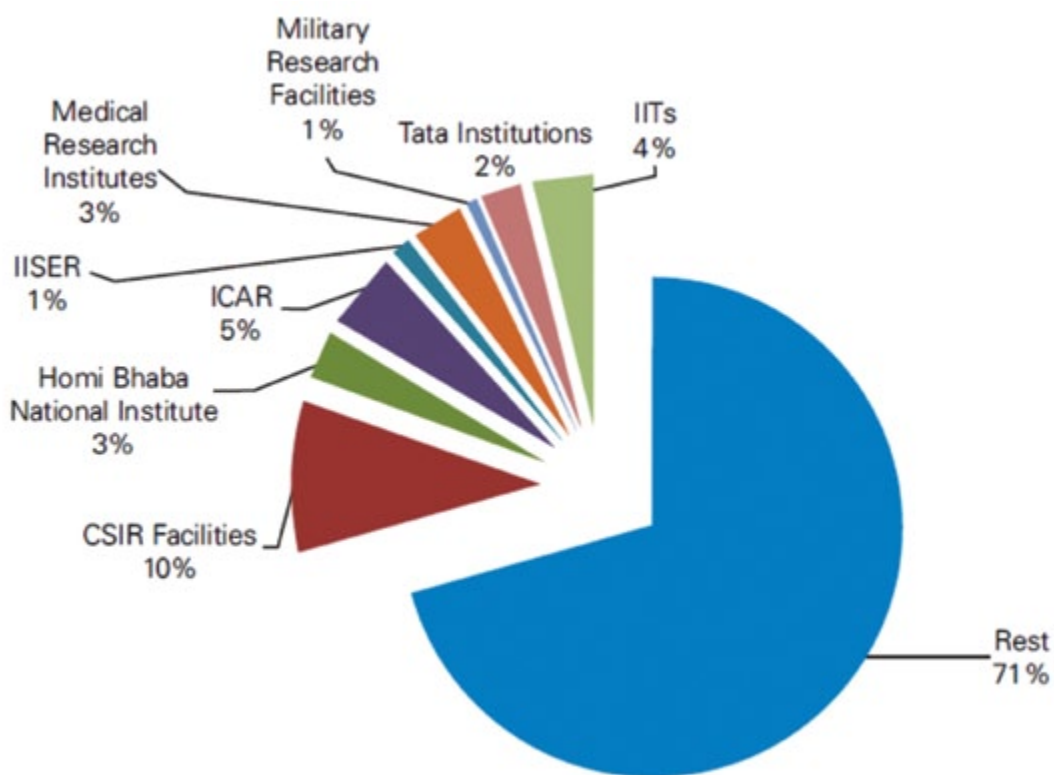
<sup>7</sup> <http://www.ibef.org/industry/research-development-india.aspx>

<sup>8</sup> <http://www.ibef.org/download/Innovation-and-Patents-March-2014.pdf>



Thousands of scientists and research staffs are employed by the research institutions run by the government and public enterprises. The largest in this category, in terms of number of scientific and technical support personnel, is the Council of Scientific and Industrial Research (CSIR) which has about 4500 scientists working in 37 research laboratories in India along with around 7000-8000 technical staff for the support of R&D programmes.<sup>9</sup>

The figure below depicts the percentage of distribution of research institutions in India, in terms of number of research centres and laboratories across the country. This picture takes into account all the major public research institutes like CSIR, ICAR, and prominent academic institutes with research focus like IITs, and other types of research facilities under universities across the country which constitutes 71%. 400 key institutions are taken into account for this categorization.



Source: FICCI-Battelle-India Knowledge Paper-Global R&D Summit 2013-Destination India.

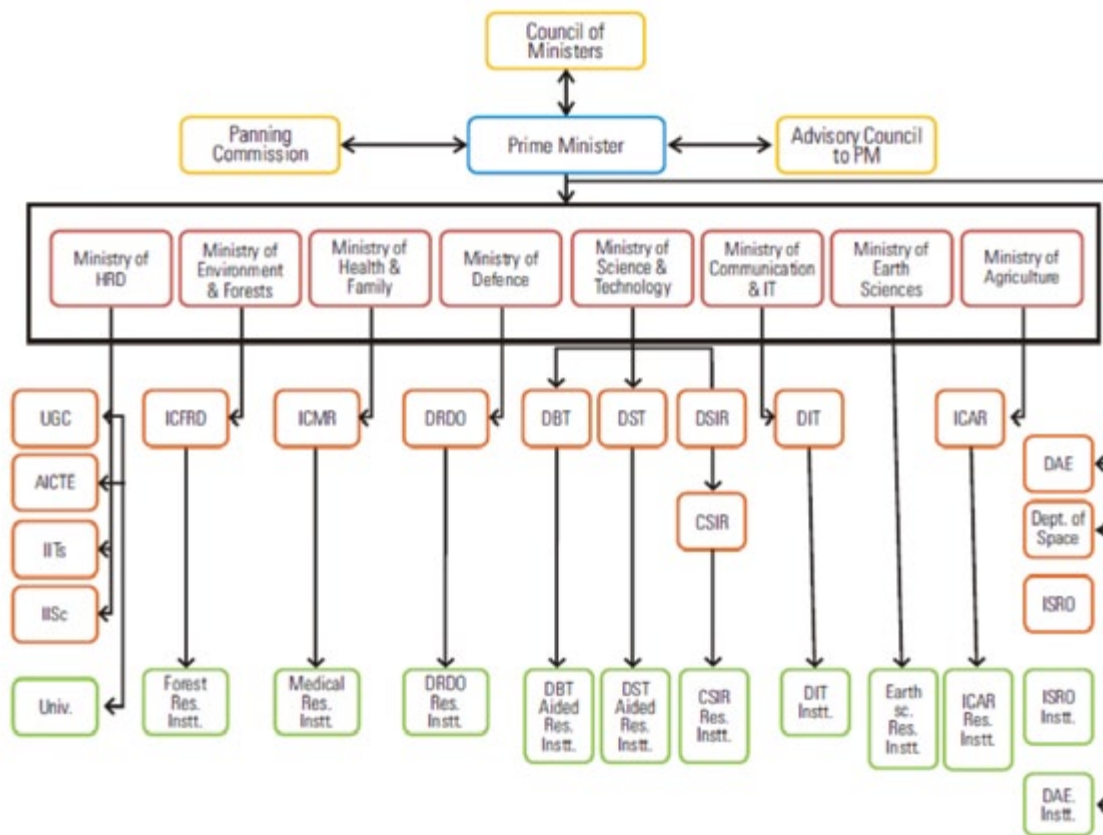
The 4 types of key actors are further described along with examples of prominent research players under each category as follows:

- a. **Public research institutions under government and public enterprises:** As the main and largest segment of the country's research system under central ministries and state level ministries, there are 8 Departments under the Central ministries which manage several science research agencies or councils.<sup>10</sup>

<sup>9</sup> [http://www.ficci.com/spdocument/20284/FICCI-Battelle-Knowledge-Paper-Global-R&D-Summit-2013\[1\].pdf](http://www.ficci.com/spdocument/20284/FICCI-Battelle-Knowledge-Paper-Global-R&D-Summit-2013[1].pdf)

<sup>10</sup> [http://erawatch.jrc.ec.europa.eu/erawatch/opencms/information/country\\_pages/in/country?section=Overview&subsection=StrResearchSystem](http://erawatch.jrc.ec.europa.eu/erawatch/opencms/information/country_pages/in/country?section=Overview&subsection=StrResearchSystem)

The structure of Indian S&T sector is pictorially represented as below.



Source: FICCI-Battelle-India Knowledge Paper-Global R&D Summit 2013-Destination India.

Abbreviations: UGC-University Grant Commission; AICTE-All Indian Council for Technical Education; IIT-Indian Institute of Technology; IISc-Indian Institute of Science; ICFRD- Indian Council of Forestry Research & Development; ICMR- Indian Council for Medical Research; DRDO- Defence Research & Development Organization; DBT- Department of Biotechnology; DST- Department of Science & technology; DSIR-Department of Scientific & Industrial Research; CSIR-Council of Scientific & Industrial Research; DeTY-Department of Electronics & Information Technology (erstwhile DIT); ICAR-Indian Council of Agricultural Research; DAE- Department of Atomic Energy; ISRO – Indian Space Research Organization.

As an example two prominent Research Councils under this category - CSIR and DRDO are described below. These institutions are explained further in the detailed sectoral profiling chapters that follow.

- i. **Council of Scientific and Industrial Research (CSIR)** is India's largest R&D organisation with 39 laboratories and 50 field stations. CSIR had over 1,872 active patents in India, 813 in the US, 328 in the EU, 147 in Japan and 829 in other countries in 2012. CSIR engaged in cross sectoral, scientific industrial R&D that brings economic, environmental and societal benefits for the country. Its research areas span across aerospace, biotechnology, chemical, energy, food, information dissemination, leather and metals, minerals and manufacturing etc.
- ii. **Defence Research and Development Organisation (DRDO)** is engaged in design and development of weapon systems and equipment in accordance with the requirements of the military services. DRDO has a network of 50 labs, over 5,000 scientists and 25,000 other scientific, technical and supporting personnel (until 2012). Research areas of

DRDO include aeronautics, armaments, combat vehicles, electronics, instrumentation engineering systems, missiles, materials, naval systems, advanced computing, simulation and life sciences.<sup>11</sup>

Other important institutions are ICAR (Indian Council for Agricultural Research), ISRO (Indian Space Research Organization), ICMR (Indian Council of Medical Research), and C-DAC (Center for Development of Advanced Computing), which are described in the following chapter.

- b. **Academic research institutes and universities:** As per the AICTE 2013 report, there were 1346 engineering colleges in India that are approved by AICTE with a total intake of around 400,000 students.<sup>12</sup> And there are over 500 universities and around 20,000 affiliated private and public colleges that include engineering colleges, specialized Indian Institutes of Technology, Indian Institutes of Management and Indian Institutes of Information Technology. There are also specialized institutes catering to fashion design, travel and hospitality sectors. While the universities are administered under the University Grants Commission, the specialized institutes, such as the engineering colleges are administered by All India Council for Technical Education.

Most prominent Institutes under this category include

- i. **Indian Institutes of Technology (IIT):** are a group of autonomous engineering, management and technology oriented institutes of higher education in India. There are 16 institutes located at different cities across the country. IITs filed the highest number of patent applications amongst all the institutes and universities in India in the year 2011. IIT Bombay filed 77 patent applications in 2011, an increase of 400 per cent from that in 2006. Worldwide, the only three institutes in India ranked in the top 300 of the QS World University Rankings of 2012 are IITs - IIT Delhi at 212, IIT Bombay at 227 and IIT Kanpur at 278.
- ii. **Indian Institute of Science (IISc):** is one of the earliest instances of Public-Private-Partnership for a research institute in India. It is engaged in research in various departments of science such as biological, chemical, electrical, mathematical, physical, mechanical, nano sciences including centres for super computers and electronics design and technology. In fiscal year 2010, the institute filed the third highest number of patent applications amongst all the institutes and universities in India.<sup>13</sup> In 2013, IISc ranked 43rd in Chemistry and 51-75 in Computer Science in the Academic Rankings of World Universities.<sup>14</sup>
- c. **Research laboratories under private enterprises:** In the last decade R&D laboratories of private business enterprises, and especially of the Multinational companies has become an important actor of the Indian research performance which now accounts for almost 30% of the national R&D expenditure. MNC R&D centres have grown from 871 in 2011 to 1031 in 2013. Ever since Texas Instruments (TI) set up a R&D facility in Bangalore in 1985, India has been an integral source of Intellectual property for big MNCs with many companies patenting R&D innovations in India and abroad.<sup>15</sup>

11 <http://www.ibef.org/download/Innovation-and-Patents-March-2014.pdf>

12 [http://www.ficci.com/spdocument/20284/FICCI-Battelle-Knowledge-Paper-Global-R&D-Summit-2013\[1\].pdf](http://www.ficci.com/spdocument/20284/FICCI-Battelle-Knowledge-Paper-Global-R&D-Summit-2013[1].pdf)

13 <http://www.ibef.org/download/Innovation-and-Patents-March-2014.pdf>

14 <http://timesofindia.indiatimes.com/home/education/news/IISc-only-Indian-institution-in-top-500-global-ranking/articleshow/21853062.cms>

15 [http://www.ficci.com/spdocument/20284/FICCI-Battelle-Knowledge-Paper-Global-R&D-Summit-2013\[1\].pdf](http://www.ficci.com/spdocument/20284/FICCI-Battelle-Knowledge-Paper-Global-R&D-Summit-2013[1].pdf)

Example of one of the prominent MNC and an Indian private entity with R&D laboratories are as follows:

- i. **Microsoft India Development Centre (MSIDC):** was set up by Microsoft India (R&D) Private Limited, a subsidiary of Microsoft Corporation at Hyderabad in 1998. Over the course of the past 14 plus years, it has become one of Microsoft Corporation's largest R&D centers outside its headquarters in Redmond. MSIDC are aligned to four engineering groups at Microsoft Corporation, namely Application & Services (A&S), Cloud & Enterprise (C&E), Microsoft Business Solutions (MBS) and Operating Systems (OS).<sup>16</sup>
- ii. **Cipla Limited:** Cipla's R&D division focuses on new product development and new drug delivery systems across a range of therapies. The company's total R&D spending stood at 42 M Euros, a growth of 13.6 per cent from a year ago. In 2011, Cipla filed 260 patent applications across the globe of which 13 were filed in India.
- d. **Non-governmental research institutions:** Though there are smaller numbers of non-governmental R&D institutes as compared to public R&D bodies, they are playing a significant role in R&D system in India, especially by representing civil society. Policy and society oriented research in science and technology has remained the forte of these research players, thus playing a major role in influencing policy decision making in the country. Focus sectors of these institutes include environment, ecology, energy, rural development, women and gender, grass root innovations and small technologies research including cottage and micro enterprises.<sup>17</sup>

Two examples of research institutes in this category are:

- i. **The Energy Research Institute (TERI):** TERI is a not-for-profit, policy research organization working in the fields of energy, environment and sustainable development. TERI is a premier research institute that has established a presence in North America and Europe and on the Asian continent in Japan, Malaysia and the Gulf.
- ii. **Gujarat Cancer & Research Institute (GCRI):** is another autonomous body jointly managed by Government of Gujarat and Gujarat Cancer Society (GCS). It is also a Regional Cancer Centre of Government of India and getting assistance under National Cancer Control Programme. GCRI is a unique example of cooperation between State Government, Central Government, and Non-Government Organization – Gujarat Cancer & Research Institute. GCRI is a multi-disciplinary research institute with close relationship between cancer care, research and education.<sup>18</sup>

## Contributors to Indian Research Policy Agenda

Indian R&D policies are framed and renewed through the release of the Five-Year Plans of the Government of India. India is currently witnessing the 12<sup>th</sup> Five Year Plan (2013-2018). A dedicated chapter on Science and Technology and Innovation Policy provides details on the current prevailing policies and also the new policies approved by the government, their objectives and their implementation plan for the next 5 years in the country.

<sup>16</sup> <https://www.microsoft.com/en-in/msidc/default.aspx>

<sup>17</sup> [http://erawatch.jrc.ec.europa.eu/erawatch/opencms/information/country\\_pages/in/country?section=Overview&subsection=StrResearchSystem](http://erawatch.jrc.ec.europa.eu/erawatch/opencms/information/country_pages/in/country?section=Overview&subsection=StrResearchSystem)

<sup>18</sup> <http://www.cancerindia.org/vision.html>

Indian S&T policies are mainly conceptualized by the Planning Commission with coordinated inputs coming from several independent committees, scientific advisors to the Government of India, Advisory Councils, and also the Departments and agencies and organizations working under respective Central Ministries such as DST, CSIR, DBT, DIT etc. Lastly the Industries Associations like CII (Confederation of Indian Industries) and FICCI (Federation of Indian Chambers of Commerce and Industries) also play a crucial role in gathering the inputs of industry stakeholders on setting R&D priorities for the country.

These four main actors responsible for R&D policy setting for the country are further explained as follows:

**Planning Commission (through the Member, In-charge of Science and Technology):**

Planning Commission plays an integrative role in the growth of a holistic approach to the policy formulation in critical areas of human and economic development. Some of the important functions of the Planning Commission included formulating a Plan for the most effective and balanced utilization of country's resources, determination of priorities and defining the stages in which the Plan should be carried out, and proposing the allocation of resources for the due completion of all the stages.<sup>19</sup> This holds well not just for S&T and R&D sectors, but all the sectors influencing economic and societal growth and development.

However, the newly formed central government of India has announced in August 2014 that the Planning Commission will be replaced by an Eight Member Think Tank, a new institution to address the current economic challenges and strengthen the federal structure. This eight-member body will comprise of top economists, social activist and scientist. Out of the eight members, four will be permanent, while the rest will be a part of the panel on a rotational basis.<sup>20</sup>

**Principal Scientific Advisor to the Government of India and to the Prime Minister:** There are several committees such as the National Knowledge Commission, the Scientific Advisory Council to the Prime Minister who works in close contact with the Prime Minister in assigning priorities and working on strategic plans in science and technology for development and nation building.<sup>21</sup> Their inputs are crucial towards the formulation of R&D policies and setting priorities.

**Departments and Organizations under Central Ministries:** The main responsibility of departments such as DSIR, DBT and CSIR is to implement the policies set forth by the Planning Commission and the Government of India. The primary endeavor of these departments is to promote R&D by industry, support a larger cross section of small and medium-sized industrial units in developing state-of-the-art globally competitive technologies with high commercial potential, catalyze the commercialization of lab-scale R&D and establish user friendly information networks to facilitate scientific and industrial research in the country. They also provide link between scientific laboratories and industrial establishments for the transfer of technologies through corporations such as the National Research Development Corporation (NRDC) and facilitate investment in R&D electronics Limited (CEL).<sup>22</sup>

**Industry and Commerce Associations:** Two key Industry associations CII and FICCI work very closely with the Government bodies and they have large networks of both large and small

<sup>19</sup> <http://planningcommission.nic.in/aboutus/history/function.php?about=funcbody.htm>

<sup>20</sup> <http://ibnlive.in.com/news/eightmember-think-tank-to-replace-planning-commission-sources/493753-37-64.html>

<sup>21</sup> [http://erawatch.jrc.ec.europa.eu/erawatch/opencms/information/country\\_pages/in/country?section=GovernanceStructures&subsection=GovernmentPolicyMakingAndCoordination](http://erawatch.jrc.ec.europa.eu/erawatch/opencms/information/country_pages/in/country?section=GovernanceStructures&subsection=GovernmentPolicyMakingAndCoordination)

<sup>22</sup> [http://erawatch.jrc.ec.europa.eu/erawatch/opencms/information/country\\_pages/in/country?section=GovernanceStructures&subsection=GovernmentPolicyMakingAndCoordination](http://erawatch.jrc.ec.europa.eu/erawatch/opencms/information/country_pages/in/country?section=GovernanceStructures&subsection=GovernmentPolicyMakingAndCoordination)

industries across the country. The seminars, workshops, think tanks, summits organized by associations such as these have dual agenda, to hear out the industry stakeholders view points of R&D priorities, and also to promote and disseminate wide scale uptake and implementation of R&D projects and initiatives by industries.

## Funds for R&D

Government is the key foundation of public research funding and provides fund to the amount of 65% while 30% comes from business enterprises and 5% by the higher education sector as per GERD (Gross Expenditure in R&D) status in 2012. The government allocated funds to the public institutions and research agencies supported by them for carrying out research at the discretion of respective institutions. There are twelve important funding agencies, which are basically the different sectoral, central ministries, such of MCIT, MOEF, MNRE and the departments and councils under such ministries such as DBT, DOS, DST, DAE and CSIR.

A major segment of these funds are used for competitive funding projects, where departments such as DBT and DST call for proposals for research projects and research institutions and universities submit proposals to win funds to carryout research under such schemes.

R&D conducted by industry players are mainly targeted at solving problems pertaining to the focus of the industry; a set percentage of funds are allocated for R&D, innovation and technology development activities undertaken within the industry.

A small percentage of funds flow through international collaboration projects as well as private non-profit sectors as well. India has signed S&T agreements with several developed and developing countries through which joint S&T projects are framed and implemented by joint consortiums. But these funds are not very significant to the national R&D and S&T effort. In the non-profit sector, industry players like The Ford Foundation, Tata Group of Companies, Birla Foundations, have set funds for research projects and educational scholarship programmes.

## Future growth trends and policy initiatives

India is seen as a favorable R&D destination by multinationals and their numbers are increasing at a CAGR of 14%. Several reasons are attributed to this growth. Rapidly increasing market for all types of products, favorable demographics, access to young science and engineering talent pool, reduced cost of doing R&D, fluency in English language, strengthening intellectual property regime, and a strong judicial framework have all been key factors influencing foreign companies to set up centres in India.<sup>23</sup>

The Planning Commission of India expects to double the government's R&D spending from the current 0.9 per cent of GDP to 2 % by 2017. The latest policy interventions described in the Science, Technology and Innovation (STI) Policy 2013 is expected to add impetus to innovation and R&D activities in both public and private sectors.

India has been able to attract a good deal of FDI in R&D in the last few years and more than 471 foreign firms have opened up R&D centres in India<sup>24</sup>. The last decade witnessed R&D growth

<sup>23</sup> [http://www.ficci.com/spdocument/20284/FICCI-Battelle-Knowledge-Paper-Global-R&D-Summit-2013\[1\].pdf](http://www.ficci.com/spdocument/20284/FICCI-Battelle-Knowledge-Paper-Global-R&D-Summit-2013[1].pdf)

<sup>24</sup> [http://erawatch.jrc.ec.europa.eu/erawatch/export/sites/default/galleries/generic\\_files/file\\_0347.pdf](http://erawatch.jrc.ec.europa.eu/erawatch/export/sites/default/galleries/generic_files/file_0347.pdf)

of over 30 billion EUR investments in India. As per a new study conducted by the European Commission Indian companies have come on the top globally when it comes to growth in their R&D investments, leaving their counterparts in the US and Europe far behind.

The government of India is making efforts through various policy initiatives to increase industry investments in R&D and also to enhance Public Private Partnerships in R&D, including participation of SMEs in R&D. The government has launched several interesting programmes with the aim to increase the R&D output of the country. *Small Business Innovation Research Initiative (SIBRI), Techno-entrepreneurs Promotion Programme (TePP), Technology Development and Demonstration Programme (TDDP), The New Millennium Indian Technology Leadership Initiative (NMITLI), Pharmaceuticals R&D and Support Fund (PRDSF), India Inclusive Innovation Fund, Innovation in Science Pursuit for Inspired Researcher (INSPIRE), Biotechnology Industry Partnership Program (BIPP) of Department of Biotechnology* are some of the important research programmes of the Indian government.

*National Innovation Foundation* is another effort of the government that promotes grass roots innovation. Government aims to further fund R&D efforts at grass roots level to make the rural innovations scalable and reproducible so that they can be successfully commercialized throughout India and abroad.

Several S&T Departments such as Department of MSME (Micro Small and Medium Enterprises), Department of Biotechnology, and Department of Science & Technology have introduced competitive funding schemes such as *calls for project proposals, entrepreneurship development programmes like supporting incubators, contract research schemes, technology transfer and acquisition programmes, MSME Cluster development programmes*, and many more that are paths taken in the right direction.

Devising policies and mechanisms to train several lakhs of students passing out as science and engineering graduates every year *on industry relevant skills* will be a step towards enhancing the talent lot of the country.

Indian mammoth middle class population demands products at very low cost, attracting both domestic as well as foreign companies to create products and innovative technologies at low cost to satisfy the masses. This is expected to create huge R&D and innovation opportunities in the country.

Increased private sector participation in scientific research, and successful conversions of research to useful technologies or products will boost India's development goals. Emphasis on applied R&D by both sides of the R&D ecosystems – the scientists that create the technologies and the industries that apply this technology to their products is the need of the hour<sup>25</sup>.

India needs to evolve applied R&D models that:

- Encourage participation of private sector
- Encourage industry-academia collaborations
- Ensure availability of resources and funds for small and medium size enterprises (SMEs)
- Help channelize government investment toward application oriented R&D, and
- Solve industry specific problems that are essential for an overall development of a R&D ecosystem<sup>26</sup>

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<sup>25</sup> [http://www.ficci.com/spdocument/20284/FICCI-Battelle-Knowledge-Paper-Global-R&D-Summit-2013\[1\].pdf](http://www.ficci.com/spdocument/20284/FICCI-Battelle-Knowledge-Paper-Global-R&D-Summit-2013[1].pdf)

<sup>26</sup> [http://www.ficci.com/spdocument/20284/FICCI-Battelle-Knowledge-Paper-Global-R&D-Summit-2013\[1\].pdf](http://www.ficci.com/spdocument/20284/FICCI-Battelle-Knowledge-Paper-Global-R&D-Summit-2013[1].pdf)

The government has taken up several initiatives to create models favoring PPP in R&D, and to create a robust infrastructure for innovation. Trade Associations play a crucial role in influencing the companies in their network to support and participate in government initiatives. Building and promoting regional technology-focused clusters has become beneficial.

*Governments, academia, research institutions and corporates are promoting S&T collaborations at international levels, encouraging innovative frameworks for partnerships. Such global approaches when integrated with National Policy frameworks enable mobility of scientific and technological faculties which can yield mutually beneficial outcomes through collaborative advantages.*

India has strong intellectual resources in terms of large and competent scientific establishments. India boasts some of the best research facilities in all the key S&T sectors be it, Health, Energy, Information Technology, Biotechnology, Space, Transport, etc. In addition to the renowned autonomous institutions like the IITs and the IISc, there are thousands of engineering colleges with a total intake of over more than 500,000 that are key knowledge resources of the country. *India is emerging as a favored Knowledge Processing Outsourcing (KPO) destiny in the world.*

Significantly, the large talent pool across diverse areas of science, technology and management prevalent in India, along with robust academic and research infrastructure and progressive policy environment is spurring scientific and industrial R&D activities in the country and increasingly making it a *sought after country among global corporations for off-shoring their R&D needs.*

Having declared the Years 2010-2020 as the 'Decade of Innovation', the Government of India is taking every step possible to make this programme successful. Policy reforms, new funding schemes and programmes promoting PPP, international collaborations, technology transfers, applied R&D, academia-industry linkages, cluster development, rural innovations and skill development are significant steps towards India becoming one of the super powers in research and innovation in the decades to come.





# 3 DETAILED PROFILING OF RESEARCH INSTITUTIONS BY SECTORS

### **3. DETAILED PROFILING OF RESEARCH INSTITUTIONS BY SECTORS**

This is a key chapter in the report that will provide detailed profiles of 15 to 18 top research institutions and organizations under each sector. The section contains profiles under the following 8 sectors in alphabetical order. A brief summary of the sector is provided as an introduction followed by the profiles.

1. Biotechnology
2. Energy
3. Environment
4. Health
5. Information and Communication Technology
6. Nano Technology
7. Social Sciences and Humanities
8. Transport



## 3.1 BIOTECHNOLOGY

### Sector Summary

The Indian biotechnology sector is one of the fastest growing sectors in the country attracting huge foreign investments. It holds comparative advantages in terms of research and development (R&D) facilities, knowledge, skills, and cost effectiveness. The sector can be divided into the segments of bio-pharmaceuticals, bio-services, bio-agriculture, bio-industrial and bio-informatics. Nearly 64 per cent of the biotech companies operate in the bio-pharma sector, followed by the bio-services (18 per cent), bio-agri (14 per cent), bio-industrial (3 per cent) and lastly the bio-informatics sector (1 per cent).<sup>27</sup> **India has been ranked among the top 12 biotech destinations worldwide and third largest in the Asia-Pacific region.**<sup>28</sup> Research and Development in Biotechnology is conducted by a network of nearly three hundred national laboratories and about an equal number of universities spread across the country.

The 18 institutions covered in this section are:

1. Institute of Chemical Technology (ICT), Mumbai
2. Rajiv Gandhi Centre for Biotechnology (RGCB)
3. National Research Centre on Plant Biotechnology (NRCPB)
4. Centre for Cellular & Molecular Biology (CCMB)
5. National Centre for Biological Sciences (NCBS)
6. Indian Institute of Chemical Biology (IICB), Kolkata
7. Department of Biosciences & Bioengineering (BSBE) - IIT Bombay
8. Department of Biosciences and Biotechnology (BSBT) – IIT Roorkee
9. Indian Agricultural Research Institute (IARI)
10. Department of Biological Sciences and Bioengineering (BSBE) - IIT Kanpur
11. Department of Biotechnology – IIT Kharagpur
12. School of Biotechnology - Jawaharlal Nehru University
13. Kusuma School of Biological Sciences - IIT - Delhi
14. Translational Health Science and Technology Institute (THSTI)
15. National Centre for Biological Sciences (NCBS)
16. Department of Biotechnology, IIT Guwahati
17. Amity Institute of Biotechnology (AIB)
18. Department of Biotechnology, University of Pune

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<sup>27</sup> <http://www.ibef.org/industry/biotechnology-india.aspx>

<sup>28</sup> <http://www.peoplesource.in/pharmaBio.php>

# 1. Institute of Chemical Technology (ICT), Mumbai

**Overview:** Institute of Chemical Technology (ICT) Mumbai formerly the University Department of Chemical Technology (UDCT) is a premier chemical engineering research institute located in Mumbai, Maharashtra, India. **It is focused on training and research in various branches of chemical engineering, chemical technology and pharmacy.** ICT was established as the Dept of Chemical Technology on 1st October, 1933 by the University of Mumbai, through active support of industries and philanthropists. It was granted deemed university status in 2008. It is the only state funded deemed university in India. Under the World Bank TEQIP programme, the Maharashtra government granted the institute full autonomy in June 2004. ICT has brought kudos to India, despite being at a disadvantaged position with reference to other technological institutes of national importance particularly the IITs, IISc, ISERS, NISERs and Central Universities.

**Experience:** ICT Mumbai has nearly 80 years of experience in training and research in various branches of chemical engineering, chemical technology, and pharmacy. ICT offers B.Tech. (Bachelor of Chemical Tech), B.Chem.Eng. (Bachelor of Chemical Eng), B.Pharm (Bachelor of Pharmacy), and masters level which specializes in Chemical Technology, Chemical Engineering, Pharmacy and PhD.

**Human and Financial Capital:** ICT produces 80 PhDs annually (10 percent of India's engineering PhDs). ICT has more than 150 students pursuing degrees and more than 40 faculties.

ICT has been receiving various grants and projects from the UGC, DAE, DBT, DST and other agencies, and Indian and foreign industries, with several centres of excellence: Centres of Advanced Studies in Chemical Engineering, Food Engineering and Technology, Pharmaceutical Science and Technology, Physico-Chemical Aspects of Textiles, Fibers, Dyes & Polymers; The DAE has sanctioned 75 crores for the Centre in Chemical Engineering Education and Research with several projects from BARC and IGCAR for development of indigenous technologies for energy.

**Infrastructure:** ICT has 7 departments involved in training and research. ICT has following centres such as: DBT-ICT Centre for Energy Biosciences, ICT-DAE Centre for Chemical Engineering Education and Research, University Grants Commission (UGC) Networking Resource Centre in Chemical Engineering and Centre for Green Technology. ICT has the following facilities such as Library, Training and Placement cell, and information processing centre.

**Research Areas and Activities:** ICT was ranked 11 in the Mint Top 50 Government Engineering Colleges of 2009. ICT is considered as No.1 Indian Schools offering Courses in **Biotechnology**. Research has been an integral part of ICT ever since its inception and it has produced over 500 first generation entrepreneurs. The University Department of Chemical Technology (UDCT) granted autonomy under UGC regulations by the University of Mumbai and further converted in to an Institute on 26th January, 2002.

- Ministry of Human Resource and Development (MHRD) had evaluated all deemed universities in the country in 2009 and granted "A" grade to 38 universities among 135 deemed universities. The ICT is rated as Number One Deemed University with "A" grade.
- ICT has also been rated as Number One Institute by National Project Implementation Unit (NPIU) among 127 Technical Education Quality Improvement Programme (TEQIP) funded institutes, all over India, in October 2010.

- Biospectrum magazine in August 2010 has also rated ICT's programme as Number One among all biotechnology programmes in India and the first prize was bestowed on 17th December 2010 at Bangalore.

ICT has a very strong research culture. The first ever Ph.D. degree in Engineering and Technology stream in India was awarded by the ICT in 1941. ICT has strong relationship with the industry and many government as well as industry sponsored projects take shape in ICT. Bio-technology and pharmacy focused R&D centres and their activities are:

**DBT-ICT Centre for Energy Biosciences:** Centre has been established as a state-of-the-art facility to carry out multidisciplinary research and development in the following disciplines: Molecular Engineering at the interface of Biology, Chemistry and Engineering, Synthetic Biology, Protein Engineering and Microbial Proteomics, Metabolomics and Metabolic Engineering, Fermentation Technology and Separation Technologies and Bioinformatics and Molecular modeling.

**Centre for Green Technology:** Research activities of the centre focuses on: Green synthesis of bulk chemicals, Refinery processes – Novel catalysts and energy efficient process development, Synthesis of nanomaterials- catalysts and composites, Pharmaceuticals and drug synthesis – chirality and Multi-step intermediate synthesis to be converted into cascade engineered synthesis.

**Networking and Collaborations:** ICT has been held in high esteem by both Indian and foreign universities and institutes. A large number of Memorandum of Understanding (MoU) has been signed to have faculty and student exchange, research programmes and joint projects and symposia. In India, it has signed MOUs with Indian Institute of Technology-Bombay, VJTI (Veermata Jijabhai Technological Institute) Mumbai.

ICT has developed useful domestic and international collaborations. Some of the collaborations are: School of Chemical Engineering, Purdue University, Indiana, USA; Department of Chemical Engineering, University of Saskatchewan, Canada; International Centre of Science and High Technology, UNIDO, Trieste, Italy; International Centre for Genetic Engineering and Biotechnology, New Delhi; Novozymes A/S, Denmark; MAHYCO Research Centre, Jalna, India; Advanced Enzyme Technologies Ltd., India; India Glycols Ltd., India.

**Publications:** There are around 3500 publications.

**Source/web link:** <http://www.ictmumbai.edu.in/default.aspx>

## 2. Rajiv Gandhi Centre for Biotechnology (RGCB)

**Overview:** Rajiv Gandhi Centre for Biotechnology (RGCB) is a growing phenomenon located in Thiruvananthapuram, Kerala which began in 1990 amongst a small charitable society called the Centre for Development of Education, Science and Technology (C-DEST). In 1991, recognizing its potential, the C-DEST was made a "Grant-in-Aid" institute of the Government of Kerala and renamed as Rajiv Gandhi Centre for Development of Education, Science and Technology (RGC-DEST), becoming the first institute in the country to be named after Sri Rajiv Gandhi, former Prime Minister of India. The institute was first managed by the Government of Kerala's Committee for Science and Technology and Environment (STEC) and subsequently by the Kerala State Council for Science, Technology and Environment. RGCB offers academic courses in PhD programmes, Young investigator awards, and post-doctoral training and student awards.

**Experience:** RGCB is a premier research institute in India and has 23 years of experience in molecular biology and biotechnology. The institute has highly focused research departments working on medical biotechnology (Molecular Medicine, Molecular reproduction, Molecular Microbiology, Cancer Biology & Neurobiology) and plant genetic engineering. RGCB has a regional facility for Genetic Fingerprinting, which provides DNA analysis services for forensic & criminal investigations, paternity disputes, identification of wildlife remains, authentication of plants and seeds besides a battery of molecular diagnostics for genetic and infectious diseases.

**Human and Financial Capital:** RGCB has strength of 25 scientists, 120 Ph.D. students and around 100 research project staff.

It received monetary support of Rs. 100 crores by the Govt. of India in 2008, for a period of 3 years, apart from the yearly allocation of Rs. 25 crores, aimed at making RGCB a world class research centre. Intramural and Extramural funding to the institute has significantly increased.

**Infrastructure:** RGCB is also a major provider of laboratory and infrastructure services to other academic and research institutions. Some of the research facilities of RGCB include: Mass Spectrometry and Proteomic Core Facility, Centralized core facility instrumentation with the following facilities: Spectroscopy, Genomics and Proteomics, Separation and Purification, Imaging and others. Other facilities include: distributed information sub-centre (Bioinformatics Centre), DNA Fingerprinting services, Laboratory Medicine & Molecular Diagnostics (LMMD), Animal Research Facility (ARF) assists investigators to plan and conduct animal experiments in accord with the highest scientific, humane and ethical principles.

**Research Areas and Activities:** BioSpectrum magazine ranked Biotechnology course and research at RGCB **as second best in India** only after Institute of Chemical Technology, Mumbai in 2010<sup>29</sup>. BioSpectrum Study in 2008 ranked Biotechnology course and research at RGCB as third best in India.

All RGCB research programmes are created with the underlying concept of "bench to bedside" and "lab to land" seeking to promote better health care and improved productivity of spices and medicinal plants. The institute has highly focused research depts. working on medical biotechnology and plant genetic engineering which includes Dept of Molecular Microbiology

<sup>29</sup> [http://en.wikipedia.org/wiki/Rajiv\\_Gandhi\\_Centre\\_for\\_Biotechnology](http://en.wikipedia.org/wiki/Rajiv_Gandhi_Centre_for_Biotechnology)

(DMM), Dept of Molecular Endocrinology and Reproduction (DMER), Dept of Molecular Medicine and Cancer Biology (DMMC), Dept of Neurobiology (DN) and Dept of Plant Molecular Biology (DPMB). Some of the research programmes are:

Chronic Disease Biology:

- Cancer Research is RGCB's leading flagship programme led by a network of 7 independent investigators to understand the fundamental mechanisms of cancer biology.
- Cardiovascular Disease Biology - Identifies factors responsible for increased risk for vascular disease in patients with type II diabetes mellitus.

Infectious Disease Biology:

- Mycobacterium Research Group
- Viral Disease Biology Program (VDBP) is designed to be a world-class research establishment in molecular and medical virology integrating theory, modeling, simulation and experiential science
- Cholera & Environmental Biology

Neurobiology and Genetics:

- Molecular Neurobiology,
- Human Molecular genetics,
- Neural Stem Cell Biology: focus of the lab is to understand the signaling cross-talks involved in maintenance/proliferation of neural stem cells and their fate specific differentiation,
- Neurobiophysics

Plant Disease Biology:

- Spice Genomics and Disease Resistance, Plant Based Bioactives and Disease Biology Chemical Biology:
- Molecular Reproduction, Germ cell division and differentiation and Female reproduction and metabolic syndromes

**Networking and Collaborations:** Two new business development ventures with industry partners, one for development of molecular diagnostics and the other for software development in clinical informatics & bioinformatics have been established.

- RGCB along with Mayo Clinic, US, will take the initiative in studying fever vaccines, in a collaboration project funded by the National Institute of Health, US, and the DBT, Government of India.
- Government of Kerala is joining hands with RGCB for a project to document diseases, predict outbreaks, and monitor healthcare delivery.
- Some of the RGCB collaborations with other institutes are: Oklahoma Medical Research Foundation (OMRF), Hindustan Latex Limited (HLL) Lifecare Ltd and Advaita.

**Publications:** There are around 2600 publications.

**Source/web link:** <http://rgcb.res.in>

### 3. National Research Centre on Plant Biotechnology (NRCPB)

**Overview:** National Research Centre on Plant Biotechnology is a prominent organization dedicated towards research and innovations in molecular biology & Biotechnology. The Centre is working towards achieving the national priorities of increased agricultural productivity and sustainability. National Research Centre on Plant Biotechnology (NRCPB) was established in 1985 with a vision to impart the biotechnology advantage to the much-needed thrust to Indian Agriculture. The Centre had adopted relatively softer option of tissue culture based research in its infancy in view of the build-up time required for a strong self-sustaining infrastructure.

**Experience:** National Research Centre on Plant Biotechnology (NRCPB) has 29 years of experience in research, teaching and training personnel in the modern areas of Molecular Biology and Biotechnology. Since its inception, the Centre has grown and has acquired high degree of scientific competence and established excellent research facilities.

**Human and Financial Capital:** NRCPB has around 150 students with nearly 60 staff (35 scientists, 15 technical, 14 administrative staff).

Funds have been received from various courses offered and through various funding agencies such as DBT, ICAR, NAIP, DST, NFBSFARA, International Maize and Wheat Improvement Center (CIMMYT), (CGIAR).

**Infrastructure:** The NRCPB has an excellent infrastructure in terms of equipment and other physical facilities and also a high degree of scientific competence. There is now considerable emphasis on structural and functional genomics of crop species such as rice, pigeonpea, chickpea, cotton, tomato and wheat in the centre. In addition to research, the centre is contributing significantly to competent human resource development by way of offering regular M.Sc and Ph.D programmes by partnering with PG School, IARI.

There is a study scope

**Research Areas and Activities:** NRCPB has been actively engaged in human resource development in the area of plant molecular biology and biotechnology since its inception. NRCPB has been identified as one of the institute among the 4288 institutes of DST directory.

The major focus area of NRCPB is basic plant molecular biology research for understanding molecular mechanisms underlying basic biological process and developing capabilities for devising tools and techniques of biotechnology and genetic engineering for crop improvement.

#### Research Areas include:

- Genetic Engineering for biotic and abiotic stress tolerance
- Molecular Mapping & DNA Finger printing
- Biotechnological approaches to improve soil nutrition
- Productivity enhancement
- Isolation and characterization of insecticidal plant genes
- Development of transformation protocols and rice genome sequencing



**Some of the challenges are:**

- Demand for sustainable agriculture
- Plant types for changed cropping pattern and mechanization
- Biosafety issues related to transgenics
- Need for enhancing bioinformatics and computational biology

**Technologies developed:**

- Regeneration protocols: Chickpea, pigeonpea, rice
- Transformation protocols: Brinjal, tomato, potato, rice, cabbage, pigeonpea
- Marker added selection and DNA fingerprinting protocols
- Chloroplast transformation protocol in brinjal

**Patent obtained:**

- Indian Patent office granted a patent for the invention titled "Synthetic gene encoding a chimeric  $\delta$ -endotoxin of *Bacillus thuringiensis*". (Patent No.: 237912)
- India Patent office granted a patent for the invention titled "Synthetic gene encoding a cry1Fa1 S-endotoxin of *Bacillus thuringiensis*". (Patent No.: 242768)

**Networking and Collaborations:** Some of the MoU's signed are:

- An MoU was signed by NRCPB and Global Transgenes Ltd. Aurangabad for transfer of Codon optimized cry2Aa gene.
- An MoU was signed by NRCPB and Advanta India Ltd. Hyderabad for transfer of *Moricandia arvensis* cytoplasmic and Fertility restorer systems for hybrid development in Mustard.

The institute has collaborated with Delhi University, Jawaharlal Nehru University, Chaudhary Sarwan Kumar Vishwavidyalaya, Central Rice Research Institute, Cuttack, Directorate of Medicinal and Aromatic Plants, University of Agricultural Sciences, Dharwad; Institute of Himalayan Bioresources and Technology, Palampur; National Bureau of Plant Genetic Resources, New Delhi; Bose Institute, Kolkata; Indian Institute of Technology, Kanpur; International Centre for Genetic Engineering and Biotechnology, New Delhi; Division of Plant Pathology, UC Davis, California.

**Publications:** NRCPB has around 350 publications from the year 2000.

**Source/web link:** <http://www.nrcpb.org>

## 4. Centre for Cellular & Molecular Biology (CCMB)

**Overview:** CCMB is a premier research organization in frontier areas of modern biology. The objectives of the Centre are to conduct high quality basic research and training in frontier areas of modern biology, and promote centralized national facilities for new and modern techniques in the inter-disciplinary areas of biology. CCMB was established in 1977 to conduct research in frontier and multi-disciplinary areas of modern biology, train people in the advanced areas of biology to serve the needs of development, provide centralized facilities in the country for new and modern techniques in the inter-disciplinary areas of biology.

**Experience:** CCMB has 37 years of experience in modern biology. In recognition for its contribution to modern biology, CCMB has been chosen as a Centre of Excellence by UNESCO Global Network for Molecular and Cell Biology MCBN and has been designated as a South Centre for Excellence for Research and Training by the Third World Academy of Sciences TWAS, Italy. Many prestigious international and national awards have come to CCMB including the CSIR Technology Award (twice) and FICCI Award for outstanding achievements in Science & Technology.

**Infrastructure:** CCMB offers a host of world-class facilities to students that include: Highly advanced research laboratories, State-of-the-art computer facility, Extensive library with a comprehensive collection of books, journals and magazines; Comfortable accommodation facilities. Some of the CCMB's research facilities are: Proteomics, Cell Culture, DNA Microarray, Transgenic Technology, Laboratory Animal, Automated DNA Sequencing, Zebrafish Laboratory, Bioinformatics, Advanced Microscopy and Imaging.

**Research Areas and Activities:** CCMB has been identified as one of the institute among the 4288 institutes of DST directory.

The ongoing research programmes at the CCMB are in three major categories - high quality basic research in the frontier areas of modern biology, research relevant to societal needs, and application-oriented research towards commercialization. These include the areas of biomedicine & diagnostics, evolution & development, gene regulation in prokaryotes and eukaryotes, host-parasite interactions, membrane biology, protein structure, bio informatics, functional genomics, theoretical biology, etc.

Technology Development: DNA fingerprinting of coffee germplasm for conservation, management and development of molecular map, Gene delivery and drug delivery systems. Application Oriented Research: Wildlife Management, Molecular characterization of scented rice germplasm of India, Tumour biology, Molecular and epidemiological characterization of clinical and environmental isolates of *Acanthamoeba keratitis* - a pathogenic protozoan causing corneal ulceration, Induction of elevated levels of interferon gamma (IFN gamma) in mice, using the T-lymphocyte triggering factor (TLTF) delivered as a DNA vaccine.

**Networking and Collaborations:** Some of the collaborations are: Tata Memorial Centre, Pushpagiri Institute of Medical Sciences & Research Centre, Indian Institute of Chemical Technology, Osmania University.

- The center is collaborated with the University of Nebraska Medical Center for translational research on Glaucoma.

- Argentina has proposed collaborative relationships with CCMB, more specifically to establish a virtual mutual collaborative centre in which scientists from the Centre for Cellular and Molecular Biology (CCMB) and Argentina would solve problems of local importance. To start with, use of Information and Computer Technology in biological data analysis will be initiated.<sup>30</sup>

International collaborations such as the Imperial Cancer Research Fund (U.K.), the Volkswagen Foundation (Germany), The India Japan Science Council and the University of Ryukyus, Okinawa (Japan), The National Institutes of Health (USA) and the Centre Nationale de la Recherche Scientifique (CNRS), the Pasteur Institute (France), Cambridge University (UK), and Harvard Medical School (USA). CCNB has collaboration with several Indian industries engaged in the areas related to the research work in its units such as Shantha Biotechnics (P) Ltd, Dr Reddy's Foundation, Bangalore Genei (P) Ltd, EID Parry Ltd, Dabur Research Foundation and the IICT.

**Publications:** CCMB has around 2000 publications, and around 40 patents have been granted.

**Source/web link:** <http://www.ccmb.res.in>

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<sup>30</sup> <http://timesofindia.indiatimes.com/home/science/Argentina-and-CCMB-to-establish-a-virtual-mutual-collaborative-centre/articleshow/30683220.cms>

## 5. National Centre for Biological Sciences (NCBS)

**Overview:** National Centre for Biological Sciences (NCBS) is located in Bangalore, and is part of the Tata Institute of Fundamental Research. The mandate of NCBS is fundamental research in the frontier areas of biology. The research interests range from the study of single molecules to ecology and evolution. In addition, the centre engages in a number of collaborative initiatives, such as inStem and the iBio; and it helps to develop cutting edge instrumentation and software via C-CAMP. NCBS is a premier research institute with all the necessary facilities. NCBS was supposed to deal with almost all aspects of biology viz cell biology, development of animals and plants, brain research, behavior, ecology and theoretical biology. An MoU was signed with the University of Agricultural Sciences (UAS) in February 1991 at Bangalore and finally a campus was set up in 1992.

**Experience:** NCBS has 31 years of experience in biological research. Research interests ranges from the study of single molecules to systems biology. Research at NCBS uses experimental and computational approaches to the study of molecules, cells and organisms. NCBS offers Post doctoral programme, PhD programme, IBIO programme, MSc and various other courses and academic programmes.

**Human and Financial Capital:** NCBS has around 100 post graduates, 32 academic staff and 100 admin staff and is a part of TIFR (Tata Institute of Fundamental Research), a major autonomous institute aided by the Dept of Atomic Energy (DAE). Research at NCBS is also supported in a major way through extra-mural grants raised by the investigators from sources including the DBT, DST, CSIR amongst others, The Wellcome DBT India Alliance, Human Frontier Science Program (HSFP), National Institutes of Health (NIH), Biotechnology and Biological Sciences Research Council (BBSRC) and corporate support for specific activities from MERCK, Astrazeneca, Pfizer and Pepsico.

**Infrastructure:** Researchers at NCBS have access to several world-class research facilities, many of which are managed by the Centre for Cellular and Molecular Platforms. **Shared facilities:** NCBS include a well-managed Central Imaging and Flow cytometry Facility (CIFF); equipped with one Transmission Electron Microscope (TEM) and an Atomic Force Microscope (AFM). **Field stations:** NCBS has collaborations at two field stations of the Madras Crocodile Bank Trust, including the Andaman and Nicobar Island's Environmental Team (ANET and the Agumbe Rainforest Research Station (ARRS), aimed at facilitating research and training in marine and island ecology. NCBS also provides various facilities for facilitating the research works conducted for - Workshop, Flow Cytometry, Computing, Animal Care center and Informatics.

**Research Areas and Activities:** The US-based National Science Foundation (NSF) has ranked the National Centre for Biological Sciences (NCBS) as the number one centre in India along with the IISc and the Indian Institute for Information Technology. These are among the top eight destinations for science research for US graduate students to take up research fellowships and short-term programmes as quoted in the article *"Three city science institutes get US pat"* From: *The Times of India, Bangalore, 10 June 2009.*

The ambit of research activities at NCBS has diversified. With this expansion, research activities in biological spectroscopy, nucleic acid biochemistry, cellular neurobiology, human and population genetics, cellular networks and cell biology have received a major infusion of

new ideas. Research interests of the faculties lies in the frontier areas of biology. Much of the research carried out at NCBS is multi-disciplinary in nature, which demands that a wide range of instrumentation be available in a user-friendly way.

Some of the Research areas NCBS include:

- **Biochemistry, Biophysics & Bioinformatics:**
  - Exploring the architecture and function of transmembrane ion channels
  - Computational Approaches to Protein Science
- **Genetics & Development**
  - Doing the Locomotion: developmental neurobiology of animal movement
  - Speciation, adaptation and morphological diversification; Evolution and genetics of butterfly wing patterns
- **Cellular Organization & Signalling**
  - Notch signaling in human cancers: molecular mechanisms and clinical translation
  - Cell Biology of the Synapse
- **Neurobiology**
  - Computational neuroscience and systems biology of olfaction and memory
  - Neurobiology of Learning and Memory
  - Neural control of movement during development and in adulthood
- **Theory And Modelling Of Biological Systems**
  - Computational cell biology
  - Computational Protein Dynamics, Folding and Function
  - Computational neuroscience and systems biology of olfaction and memory
- **Ecology And Evolution**
  - The genetic heritage of South Asia: tracking its history, conserving its future
  - Speciation, adaptation and morphological diversification; Evolution and genetics of butterfly wing patterns

**Networking and Collaborations:** National collaborations are: Kidwai Memorial Institute of Oncology, IISc, Annamalai University, Andhra University, North Orissa University, etc.

International collaborations are: Trinity College, Dublin, Stanford University, Palo Alto, CA, University of Wisconsin, University of Cambridge, University of Edinburgh, Curie Institute, CRG - Barcelona, Neils Bohr Institute, McLaughlin Research Institute -Great Falls, etc.

**Publications:** IICB has around 1500 publications under various departments and has around 60 patents granted in abroad and in India.

**Source/web link:** <http://www.ncbs.res.in>

## 6. Indian Institute of Chemical Biology (IICB), Kolkata

**Overview:** The Institute was established in 1935 as the first non official centre in India for biomedical research and was included within the aegis of CSIR in 1956. IICB today is engaged in research on diseases of national importance and biological problems of global interest, employing sophisticated state-of-the-art technology. The scientific staff has expertise in a variety of areas including chemistry, Biochemistry, Cell Biology, molecular biology, neurobiology and immunology which promotes productive interdisciplinary interaction.

**Experience:** IICB has 79 years of experience in basic biomedical research. The institute embodies a symbiosis between chemistry and biology with a commitment to achieve higher standards of health for all.

**Infrastructure:** IICB has following infrastructural facilities:

- Central Instrumentation-supports in-house operation and maintenance of various sophisticated scientific instruments
- Bioinformatics- SGI Octane Workstations, High End Server (Itanium II Hp Integrity Server 4640), Linux OS, Mail Server (Xeon server), Ftp Server (Xeon server), P4 PCs and Laser Printers
- One of the biggest libraries on biomedical sciences in the eastern zone of India.
- Depart of Engineering Services is catering services in the broad areas of Infrastructural Development for Scientific Research Activities - Maintenance Services - Renovations of Laboratories & Common facilities-Expansion of facilities - Grass Root Construction activities etc.

**Research Areas and Activities:** IICB has been ranked 22nd out of top 24 Indian Institutions involved in Pharmaceutical Research, 2000-09<sup>31</sup>.

IICB is a multidisciplinary research laboratory under the umbrella of CSIR, Govt. of India. It has 7 R&D divisions:

- Cancer Biology & Inflammatory Disorder: This division has recently been created by bringing together six dedicated scientists and more than 50 research scholars with expertise in a broad range of cancer-related fields. Conducts both basic and translational research on a range of topics that include lung, brain, oral, breast, pancreatic and cervical cancers and leukemias etc.
- Cell Biology & Physiology: This division deals with systems and Cell Biology, investigating subcellular organelles and intracellular signaling events in normal physiology and in disease.
- Chemistry: Chemistry department aims at the study of chemical and biological problems through an integrated effort entailing discovery of new molecules from plants, development of synthetic strategies for complex molecules, studies on nanoscopic materials and reactions in organized media

<sup>31</sup> <http://bipublication.com/files/ljpav211201103.pdf>

- **Drug Development / Diagnostics & Biotechnology:** To conduct well-targeted basic research for improving health and quality of life, as also for promoting future economic growth through innovation in Biotechnology, driven by multi-disciplinary approach.
- **Infectious Diseases and Immunology:** Conducts various research programmes on Leishmania donovani, the causative agent for visceral leishmaniasis, and major enteropathogens like Vibrio cholerae and Shigella spp., which are major health concerns in India.
- **Molecular & Human Genetics:** The broad aims of the division are to understand the molecular genetic basis of diseases common in Indian populations, to study gene expression and function in pathogenic microorganisms, and to develop transgenic plants with improved characteristics.
- **Structural Biology & Bioinformatics:** Structure-function analysis of various biological macromolecules using multi-pronged approaches from different angles involving modern biological, chemical and physical technologies.

**Networking and Collaborations:** Some of the collaborations of IICB are: Albert David Ltd., Kolkata; Angiogen Pharmaceuticals, Australia; Albert David Ltd., Kolkata; Biotech Consortium (I) Ltd., New Delhi; Chatterjee Management Services (P) Ltd., Kolkata; Coir Board, Kochi; Chembiotech Research Int. Pvt. Ltd., Kolkata; Dey's Medical Stores (Mfg.) Ltd., Kolkata; DNDI, France; East India Pharmaceutical Works Ltd., Kolkata; Merial SAS, Lyn, France; Mologen AG, Germany; Piramal Life Sciences Ltd., Mumbai; Qualpro Diagnostics, Goa; Santha Biotechnics; Zyphyr Biomedical, Goa; University of Kolkata; Jadavpur University, Academy of Scientific and Innovative Research.

**Publications:** IICB has around 1500 publications under various departments and has around 60 patents granted in abroad and in India.

**Source/web link:** <http://www.iicb.res.in>

## 7. Department of Biosciences & Bioengineering (BSBE) - IIT Bombay

**Overview:** Dept of Biosciences and Bioengineering comprises of two broad areas representing Biotechnology and Biomedical Engineering. The Department aims to create an ambience for the smooth pursuit of scholarly activity in research and education, and endeavors to produce the leaders of tomorrow in this field. With the formation of the Department of Biosciences and Bioengineering, there has been a great impetus to research in Biosciences at IIT Bombay. Recently in Jan 2012, IITB inaugurated Wadhvani Research Centre in Biosciences and Bioengineering (WRCBB), with an aim to up thrust the research prospective of BSBE in cancer research. WRCBB will be focusing on Cell Motility and Cancer Invasion apart from the core thrusts of BSBE.

**Experience:** BSBE department has good experience at IIT-B comprises of basic sciences, applied sciences and engineering and research work in biological sciences and biomedical engineering.

**Human and Financial Capital:** BSBE dept consists of twenty-four faculty members with 10 other staff members and around 200 students involved in M.Sc, M.Tech, and PhD.

Funds come from DST, CSIR, DBT, BRNS, MHRD, NMRL and Aeronautical Development Agency for various research projects and activities.

**Infrastructure:** Some of the research facilities are: Microscopy, Fermentation facility, Tissue culture facilities, Radioactivity facility, Protein Sequencing Facility and Central Facility Equipments. Some of the equipments are: High Performance Liquid Chromatograph (HPLC), Fast Performance Liquid Chromatograph (FPLC), High speed and ultra-centrifuges, Centrifugal lyophilizers, Spectrophotometers and Spectrofluorimeter.

**Research Areas and Activities:** In India, IIT- Bombay, among other engineering colleges, has been ranked No. 3 by Outlook India in 2012 and No. 1 by Dataquest in 2011.

MScBiotechnology course offered by BSBE dept at IIT-B is considered as one of the best among indicative biotechnology universities in India for the year 2012.

Research in the department encompasses both basic biology and applied bioengineering topics. As part of the Wadhvani foundation, cancer and cell motility has been identified as a thematic focus area of research. **Main thrust areas of R&D activity are** Biotechnology, Biochemistry and Molecular enzymology, Bioelectricity; Bioinformatics, Biointerfaces, Biomaterials, Biomechanics, Biomedical Optics (Tissue Spectroscopy and Imaging), Bionanotechnology, Biosensors, Biostatistics, Computational Biology, Drug delivery, Glycobiology, Instrumentation, Medical Signal Processing, Natural Products, Nerve-muscle Transmission, Non-invasive diagnostic tools, Prokaryotic biology, Rehabilitation, Synthesis of Bioactive molecules, Synthetic Polymer Chemistry, Tissue engineering, Yeast molecular biology.

**Some of the research groups/labs include** Biomaterials and Bio-interface Lab, Biosensors and Bioinstrumentation Lab, Cell and Tissue Engineering Lab, Cell Biology Lab, Cellular Biophysics Lab and Neuroscience Lab



Sponsored Research Projects are categorized as follows:

- New - 17
- Ongoing - 69
- Completed - 07

Some of the important new and ongoing research projects are:

- Integration Platform for III-V Semiconductors with Polymer Waveguides and Micro-Fluidic Channels
- "Embedded Polymer Optical Biosensors" by DBT
- "Designing peptide inhibitors against synuclein aggregation : Therapeutic approach for Parkinson" by ICMR
- "Mechanobiological regulation of embryonic stem cell self-renewal and differentiation" by DBT
- "Computational studies on bladder biophysics with special reference to possible mechanisms in over activity" by DBT and
- "Comparative genomics analyses of glycosylation pathways in completely sequenced bacterial genomes" by BRNS

**Networking and Collaborations:** Some of the collaborations of BSBE are: DBT, DST, MHRD, Sree Chitra Tirunal Institute of Medical Science & Technology, Nanavati Hospital, BARC, and Department of Oral Pathology and Microbiology Government Dental College.

**Publications:** BSBE has around 250 publications published by different faculties including patents.

**Source/web link:** <http://www.bio.iitb.ac.in>

## 8. Department of Biosciences and Biotechnology (BSBT) – IIT Roorkee

**Overview:** Centre of Biosciences at IIT-Roorkee was started in 1980 and upgraded to a full-fledged academic Department of Biosciences and Biotechnology in 1986. It was renamed as Department of Biotechnology in the year 2002. The department has teaching and research programmes which encompass various basic and applied aspects of modern biotechnology. The main objective of the Department is to provide academic training and conduct research in the interdisciplinary areas of biotechnology with a particular emphasis on extending the knowledge generated from these studies towards the development of technologies of commercial significance. The M.Sc. (Biotechnology) course of the Department is being funded by the Department of Biotechnology, Government of India. B.Tech (Biotechnology) course was started in 2005.

**Experience:** BSBT dept at IIT Roorkee has nearly 33 years of experience in teaching and research programmes in various basic and applied aspects of modern biotechnology.

**Human and Financial Capital:** There are around 25 faculty members and nearly 150 students who are mix of undergraduates, post graduates and PhD students.

Funding comes from various courses offered and through projects with funding agencies such as MHRD, DST, MOEF, DBT, CSIR, CDAC Pune, & NSF - USA.

**Infrastructure:** Research labs include: Molecular Biophysics, Structural Biology, DNA/Peptide Synthesis, Plant Molecular Biology, Molecular Genetics, Reproductive Biology, Microbial Biotechnology, Molecular Biology & Proteomics and Bioprocess Technology.

Some of the major research equipments are: High Performance Liquid Chromatography (HPLC), Sonicator, DNA Synthesizer, Peptide Synthesizer, Gel Documentation & Analysis System, Fluorescence Microscope, Ultrasonicator and Water Purification System.

**Research Areas and Activities:** For the year 2012, post graduate course - MScBiotechnology, offered by BSBT dept at IIT-Roorkee is considered as one of the best among the indicative biotechnology universities in India.

Major research areas or groups of BSBT- IIT Roorkee are:

**Molecular Biophysics Group:** main focus of this group is to study the interaction of anticancer drugs with nucleic acids by uv-vis, Fluorescence, Nuclear Magnetic Resonance (NMR) Spectroscopy and Restrained Molecular Dynamics (rMD). **Molecular Genetics Group:** Nitrogen, which is an important constituent of all living organisms, is abundantly available in air as nitrogen gas. But this form of nitrogen cannot be used by most of the living organisms.

**Plant Biotechnology Group:** Four T-DNA insertional mutants in Basmati 370 viz., GA-insensitive dwarf, oligo tillering, seedling lethal and polyembryony are being characterized, genes for which will be cloned using TAIL-PCR. Two genes xa13 and Xa21 for bacterial leaf blight resistance and sd1 for semi dwarf plants are being pyramided in Deharadun Type 3 basmati using marker assisted selection.

**Molecular Biology & Proteomics Group:** The group has three major thrust research interests. The first is isolation and molecular characterization proteins and glycol-conjugates with therapeutic potentials from medicinal plants. Second research activity of the group is to identify and characterize salt stress induced proteins using proteomics tools. Third area of interest is molecular cloning and characterization of esterase and ferolyl esterase genes and their proteins from potential plastic degrading and industrially important micro-organisms.

**Molecular Microbiology Group:** Presently the research is focused on the screening of different microbial strains capable of producing maximum bio surfactant. The appearance of such surface-active compounds in the culture broth grown on water miscible/immiscible substrate is monitored by measuring surface tension of the cell free broth.

**X-Ray Crystallography Group:** Usage of X-ray crystallography, enzyme kinetics, molecular biology and bioinformatics as the major tools for investigating the structure and function of enzymes for medically important or valuable in bioremediation.

**Some of the sponsored research projects are:**

- Bioprocess Development for Gluconic Acid Production from cheap carbohydrate sources
- Development of methods for differentiation of mouse embryonic stem cells to insulin producing cells
- Molecular analysis of biosurfactant produced using cost-effective renewable feed stocks
- Identification and characterization of salinity stress induced proteins from *Arachis hypogea*
- Structural studies of aromatic ring hydroxylating dioxigenases and their complexes with toxic polyaromatic compounds
- Isolation and characterization of bacteria from industrial effluents

**Networking and Collaborations:** Some of the collaborations of the department are: DBT, DST, MHRD, Punjab University, University of Hyderabad, CDAC, University Baroda, IIT Delhi, TIET Patiala, Industrial Toxicology Research Centre, Lucknow, JNU, GKVK Bangalore etc.

**Publications:** BSBE has around 300 publications published by different faculties including patents.

**Source/web link:** <http://www.iitr.ac.in/departments/BT/pages/index.html>

## 9. Indian Agricultural Research Institute (IARI)

**Overview:** The Indian Agricultural Research Institute (IARI) is the premier institute for advanced education in agriculture in India. It was originally established in 1905 as the Imperial Agricultural Research Institute with the financial assistance of an American Philanthropist, Mr. Henry Phipps in Pusa, Samastipur, Bihar and was relocated after the Bihar earthquake of 1934 to New Delhi to a place that is now called Pusa in New Delhi. The new campus at New Delhi was inaugurated in 1936. The institute was recognized as a 'deemed university' in 1958 under the UGC act of 1956 of Parliament and since then it has awarded M.Sc. and Ph.D. degrees. It is financed and administered by the Indian Council of Agricultural Research (ICAR). The IARI was responsible for the research leading to the "Green revolution" of the 1970s. IARI has 6 schools and 19 divisions, 2 multi-disciplinary centres situated in Delhi, 8 regional stations, 2 off-season nurseries, one krishi vigyan kendra at Shikohpur, 2 all India coordinated research projects with headquarters at IARI, and 16 national centres functioning under the all India coordinated research projects.

**Experience:** IARI has huge, 108 years of experience in the fields of agricultural research, education and extension. In order to conduct basic and strategic research, the IARI concentrated its activities on following 6 schools: School of Crop Improvement, School of Plant Protection, School of Basic Sciences, School of Natural Resource Management, School of Social Sciences and School of Horticultural Science.

**Human and Financial Capital:** The main strength of the institute is its faculty of 505 members (in 23 disciplines), of whom 305 are recognized as research guides. The total numbers of students on roll are nearly 1200 with M.Sc. and Ph.D. including few international students.

Some of the national funding agencies are DBT, DST, ICAR, CICR, CPRI (Mini Mission - HP), CSIR, NCPA, CPCB, Ministry of Water Resources, MNRE, MOEF, Basmati Export Development Foundation, Ministry of Earth Sciences, Directorate of Vanaspati, Vegetable Oils and Fats, National Medicinal Plant Board, DAC, SAC, NABARD, National Horticultural Mission, NRDC, BARC, AP Cess Fund, National Fellow Scheme of ICAR etc. Some of the international funding agencies are International Plant Names Index (IPNI) India Programme, USAID, UK-India Education and Research Initiative (UKIERI), International Maize and Wheat Improvement Center (CIMMYT), University of Sydney, World Bank, Rockefeller Foundation, **European Commission**, Indo-Australian Programme.

**Infrastructure:** IARI has the following facilities: Phytotron Facility, Pesticide Referral Laboratory, Other Facilities such as Central Seed Testing Laboratory, Quality Seed Facility, Scanning Electron Microscope (SEM) Facility, Library Services and Instrument Facilities such as HPLC, Consistograph, Robotic DNA analyser, Calliper Electrophoretic system, Spectrofluorometer etc.

**Research Areas and Activities:** IARI is one of the top 4 deemed universities of Indian Council of Agricultural Research (ICAR) which has been ranked as 6<sup>th</sup> government organization as per SCImago Institutions Ranking (SIR) Group Global India 2013.

In terms of research results, IARI has an exceptional record in research publications, patents, technology developed. For the year 2012-13, some of the research papers published in international journals are around – 360; and around 462, research papers have been published in national journals. Some outstanding research results of the Institute include:

1. School of Crop Improvement has developed several varieties and hybrids with enhanced productivity, quality, adaptability to different agroecosystems, and inbuilt resistance to biotic and abiotic stresses.
2. School of Plant Protection has developed diagnostic methods, identified novel molecules and validated technologies for integrated management of pests and diseases
3. School of Crop and Resource Management and Environment developed several agrotechniques for improving resource use efficiency, profitability and environmental health.
4. School of Basic and Strategic Research made significant progress in identification of donors, genetic transformation of crops, and GIS and remote sensing methods for crop management.
5. School of Social Sciences and Technology Transfer focused their research efforts on the nature and impact of growth and development initiatives in agriculture, the dissemination and assessment of the technologies generated by IARI
6. School of Horticultural Science focused on improvement of vegetable, fruit and floricultural crops using conventional and biotechnological tools, development of production technology for open and protected environments.

Some of the in-house research projects of IARI are:

- Genetic improvement of pearl millet for higher productivity and quality
- Genetic Improvement of lentil and mungbean and Genetic improvement of Wheat
- Variety characterization, maintenance and hybrid seed production technology
- Integrated post harvest management of fruits and vegetables
- Breeding of commercial flower crops

Some of the externally funded research projects of IARI are:

Distributed Information Centre (DIC) under the biotechnology System – National Infrastructural Facility in the area of Biotechnology with special reference to the Plant Tissue Culture, Photosynthesis and Molecular biology.

- Seed Production in Agricultural Crops and Fisheries
- Monitoring of Pesticides Residues at National Level
- Development of salinity stress resistance in rice varieties

**Networking and Collaborations:** International collaborations of IARI are: Potash and Phosphate Institute of Canada (PPIC), United State Agency for International Development (USAID), International Development Research Centre (IDRC), Consultative Group on International Agricultural Research (CGIAR), International Maize and Wheat Improvement Centre (CIMMYT) and United Nations Environment Program Regional Research Centre for Asia and the Pacific (UNEP RRC.AP) etc. Some of the national collaborations of IARI include: DBT, DST, Indian Council of Agricultural Research (ICAR), CSIR, MOEF, National Academy of Agricultural Science (NAAS), Central Pollution Control Board (CPCB), National Fund for Basic and Strategic Research in Agriculture (NFBSRA), National Agricultural Innovation Project (NAIP), and National Fellow Scheme of ICAR.

**Publications:** BSBE has around 2000 research publications, books, articles etc.

**Source/web link:** <http://www.iari.res.in>

## 10. Department of Biological Sciences and Bioengineering (BSBE) - IIT Kanpur

**Overview:** Department of Biological Sciences and Bioengineering (BSBE) was established in September 2001 with the aim of providing a multidisciplinary research and teaching program in modern biology and bioengineering. The department offers both undergraduate (B.Tech) and postgraduate programs (M.Tech and Ph.D) and the faculty conduct research in diverse areas of basic and applied biology.

**Experience:** IBAB has more than 10 years of experience in education, research and helping entrepreneurship. The department offers two postgraduate academic programs-M Tech and PhD in Biological Sciences and Bioengineering. A new B Tech program has been introduced from the year 2004, which provides a unique fusion of biology with other basic science and engineering disciplines.

**Human and Financial Capital:** There are around 45 postgraduates with 100 undergraduates and 20 core faculty and several guest faculties.

Research activities of the department are supported by funding from national and international agencies such as DBT, DST, MHRD, CSIR, Wellcome Trust, IBM, and RIKEN-BSI.

**Infrastructure:** Some of the facilities are: Laser Scanning Confocal Microscope, Affymetrix Microarray Facility, Beckman Coulter automated DNA sequencer, Fluorescence Microscopy, SGI Fuel Workstation, Compaq alphaserver ES 45, Eppendorf Femtojet Microinjection System and Atomic Force Microscope (AFM) etc. The department has developed extensive research facility and infrastructure to support the teaching and research activities.

**Research Areas and Activities:** Indian Institute of Technology, Kanpur has been ranked 9 under Careers360 research for 2014<sup>32</sup>. IIT Kanpur has been placed at No. 1 in the India Today-Nielsen College ranking survey - 2014 for engineering colleges.<sup>33</sup>

Research interests of the department include cell & molecular biology, genetics & developmental biology, structural & computational biology, bioinformatics, bioremediation, tissue engineering and bioprocess engineering.

Research areas are:

- Structural Biology, bioinformatics, structure-based drug design
- Molecular oncology and cancer therapeutics
- Tissue engineering; controlled drug delivery system; biomaterials
- Neurobiology of disorders, stress biology, and human genetics
- Bio-electricity, green energy, physiology, and sensor
- Cancer genetics, growth control and pattern formation using Drosophila model
- Modeling and simulation of biomolecules; bioinformatics
- Dynamics of chromatin recognition and remodelling
- Germ cell development in C. elegans; Plant parasitic nematodes

<sup>32</sup> <http://www.university.careers360.com/articles/top-100-universities-in-india-2014>

<sup>33</sup> <http://www.iitk.ac.in>

Some of the projects are:

- Some of the research focus include on molecular pathology of (i) Lafora neurodegenerative disease and (ii) the disorders caused by the cytotoxic misfolded proteins.
- Understanding the mechanisms of cartilage and bone differentiation
- G Protein-Coupled Receptors (GPCRs) are the main conduit of information transfer across the cell membrane. These receptors and their signaling networks are intricately involved in almost every physiological and pathophysiological process in human body
- Process development for the production of therapeutics from mammalian cell culture, Development of smart polymeric biomaterials

**Networking and Collaborations:** BSBE-IITK has collaborations with Jadavpur University, IIT Roorkee, Homi Bhabha National Institute, Indian Institute of Science, Max-Planck Institute, National Institute of Immunology, GSVM Medical College-Kanpur, King George's Medical University, All India Institute of Medical Sciences, and University of Michigan.

**Publications:** BSBE- IITK has around 225 research publications, books and articles.

**Source/web link:** <http://www.iitk.ac.in/bsbe/index.html>

## 11. Department of Biotechnology – IIT Kharagpur

**Overview:** The Centre was started in 1986 with a grant from the Ministry of Human resources Development. On-going research and development activities are focused on product, process to equipment improvement in the following such as Continuous Ethanol Production by using novel Bioreactor with non-conventional raw materials, High Frequency Mass Propagation of Plants in Liquid Media and Bio-reactors, Induction of Automation in Industrial Plant Cell Culture, Application of Genetic Techniques for improvement of Tasar silk etc.

**Experience:** Dept of Biotech-IIT Kharagpur has 28 years of experience in education and research. Dept offers B.Tech, Dual Degree - Biotechnology & Biochemical Engg. /MBA, M. Tech programmes etc.

**Human and Financial Capital:** There are around 100 postgraduates & undergraduates and 25 faculties.

Dept of Biotech receives funds from various courses offered and from various research projects with the DST, DBT, ICMR, NAIP-ICAR/ Govt. of India, JMDC, MNRE, ISIRD, Central Silk Board etc.

**Infrastructure:** Some of the facilities are: Air-lift bioreactor (B. Braun / Eylea); Atomic absorption spectrophotometer (Perkin-Elmer); Biochemistry and Downstream Processing; Bioinformatics; Blotting apparatus; Cell and Molecular Biology; Centrifugal evaporator (Eylea); Incubators (Heraeus); HPLC; Incubator shaker (New Brunswick / B. Braun); Linear and Orbital shakers (Grant / Eylea) and Liquid chromatography of biomolecules.

**Research Areas and Activities:** Indian Institute of Technology, Kharagpur has been ranked as top 3<sup>rd</sup> public universities under Careers360 research for the year 2014<sup>34</sup>.

Research areas include: Microbial genetics and Antimicrobial chemotherapy, Plant Molecular Biology, Transgenic Plants, Metabolic Engineering, Plant Biotechnology, Microbiology of arsenic contaminated groundwater, Microbial diversity and bioremediation, Cell based tissue engineering and regenerative medicine, Silk biomaterials, Molecular Virology, Recombinant DNA Technology, Hybridoma Technology, Biohydrogen production processes, CO<sub>2</sub> sequestration for algae cultivation, Microbial fuel cell etc.

Technologies Developed and ready for Commercialization:

- A bio-process for sandalwood somatic seedling production
- A Kit for use in Semi quantification of CRP Present in Whole Blood and a Process for Manufacture of the Same
- A method for the preparation of lectin based immuno adjuvants
- A Novel Biofuel Additive for Diesel Engines
- A Process for the production of somatic seedlings of plants
- An apparatus for Plant tissue culture

<sup>34</sup> <http://www.university.careers360.com/articles/top-100-universities-in-india-2014>



**Networking and Collaborations:** Dept is engaged in collaborative project with leading companies such as Hindustan Lever, Bangalore, Tata Tea, Calcutta, AMS Baeshen, Saudi Arabia, Bharat Serums, Mumbai, Tarson Products, Kolkata.

**Publications:** Dept of Biotech- IITK has around 280 recent research publications, books, articles etc.

**Source/web link:** <http://www.iitkgp.ac.in/departments/home.php?deptcode=BT>

## 12. School of Biotechnology - Jawaharlal Nehru University

**Overview:** Centre for Biotechnology (CBT) at JNU undoubtedly runs one of the finest masters' degree programs in biotechnology. The CBT was established in 1985 under joint sponsorship of the UGC and the DBT. School of Biotechnology, Jawaharlal Nehru University offers Master's degree courses. To begin with, it was started to initiate Biotechnology education programme with a thrust to produce a workforce that could turn into a substantially trained pool to meet the country's demands. This school was set up in 2006 from the earlier Center for Biotechnology. The faculty of the School is internationally recognized for their involvement to basic and applied aspects of Biotechnology research.

**Experience:** School of Biotech has early 8 years of experience in education and research. SBT offers both M.Sc. and Ph.D. degrees in Biotechnology. Over the years, Biotechnology programme at JNU has established itself as a leading academic programme both from the teaching and research point of view.

**Human and Financial Capital:** There are around 10 admin staff, 12 faculties, 25 postgraduates.

Funds have been received through various courses and research projects by DST, DBT, European Commission FP7, ICMR, CSIR, MOEF.

**Infrastructure:** The School has "state-of-the-art" instrumentation facilities which are excellent for training in the modern areas of biological sciences. These include: Central Instrumentation Facility, Recombinant Product Development Facility of GLP standard Spectroscopic Facility, Microcalorimetric Facility, Microscopic Facility, Protein production and purification Facility and Biosafety Level 3 Facility etc. School library is mainly supported by the funds from the Department of Biotechnology. It has over 700 books in different areas of teaching and research in Biotechnology. The library also subscribes to a number of scientific journals.

**Research Areas and Activities:** BioSpectrum magazine rated the Bio Technology program of JNU as third ranking institute among all public schools in India. SBT has been ranked at the number one position in the country consistently over many years by Biospectrum Bangalore.

During 2012-2013, the school of biotech had 45 research projects in progress. They participated in 29 conferences in India and abroad.

Research Specializations offered:

- Molecular Biology of Infectious Diseases
- Immunology of Infectious Diseases
- Tumor Suppressors Gene Regulation in Hypoxia
- Transcription Control and Gene Regulation
- Protein Stability, Conformation and Folding
- Bioprocess Monitoring and Modeling of Recombinant Cultures; Metabolic Engineering and Scale up of Recombinant Proteins
- Molecular Biophysics, Structural and Computational Biology
- Biochemical Engineering (Bioprocess Simulation)
- Virus Mediated Signal Transduction

- Molecular Cell Biology
- Recombinant DNA Technology and Cell Biology of Genetic Disorders
- Metagenomics

Advanced Instrumentation Research Facility (AIRF) is a specialized research facility which houses 21 sophisticated State of Art instruments with around 10 supporting/ basic facilities. It has been created with an objective of providing a central facility of latest and Advanced Analytical Instruments for research in the application areas of physical, environmental, biological, allied and interdisciplinary sciences. It caters to the interdisciplinary applications in research to all the Science Schools.

**Networking and Collaborations:** Some of the collaborations are: University College, Cork; National Institute of Nutrition; University of Warwick, Centre of Biotechnology of Borj-Cedria, National Research Center, Chinese Academy of Agricultural Sciences, Euro Research Support Limited, Agriculture and Agri-Food Canada; Kanpur University, Massachusetts Inst. of Technology, Max-Planck Institute, University of Delhi.

**Publications:** There are around 150-175 publications of the SBT.

**Source/web link:** <http://www.jnu.ac.in/SBT>

## 13. Kusuma School of Biological Sciences - IIT - Delhi

**Overview:** Modern Biology has departed from emphasis on individual or species level understanding to appreciating unity and diversity at the genomic level. The Indian Institute of Technology Delhi established the School of Biological Sciences in December 2008. The method of establishment of the school began in September 2007 when an Internal Task Force chaired by Prof. B. N. Jain (Deputy Director, Faculty) was set up. Following the recommendations of academic bodies at IIT Delhi, a national advisory committee (NAC), co-chaired by Prof. Surendra Prasad, Director and Prof. M. Vijayan, was constituted. In pursuance of the recommendations of the Task Force, Senate, BOG and the NAC the School of Biological Sciences came into being at IIT Delhi.

**Experience:** Kusuma SBS has 6 years of experience in biological sciences education and research. The key strength of the research programme at the School is its multi- and interdisciplinary approach towards biological sciences.

**Human and Financial Capital:** There are around 10 core faculties and 30 students.

Kusuma SBS receives funding from DST, DBT, ICMR, CSIR, Ministry of Human Resource and Development (MHRD) etc.

**Research Areas and Activities:** Research activities are conducted in the following: Modern Biology for Engineers, High-Dimensional Biology, Practical Modern Biology, Biometry, Biologics, Biology of Proteins and Chemical Biology.

Research interests include: Insulin Resistant Diabetes, Drug Resistance In Leishmania, Equilibrium, Kinetics and Thermodynamics of protein folding reactions; Molecular Biophysics, protein conformational properties and structure-Function relationship of recombinant proteins etc.

Tools for Neurodegenerative Diseases include:

NeuroDNet: is an open source platform for constructing and analyzing neurodegenerative disease associated gene networks. This database was created to provide an interactive platform for researchers in the field to interrogate the relationship between genes implicated in neurodegenerative disorders. The current version of database includes twelve neurodegenerative diseases - Adrenomyeloneuropathy, Alzheimer disease, Amyotrophic lateral sclerosis, Ataxia-telangiectasia, Dentatorubral-pallidoluysian atrophy, Friedreich Ataxia, Frontotemporal Dementia, Huntington disease, Lewy Body Dementia, Parkinson disease.

ANGDelMut: is a web-based tool for predicting and analyzing the functional loss mechanisms of deleterious angiogenin mutations associated with amyotrophic lateral sclerosis (ALS). The ANG gene is one of the most frequently mutated genes found in ALS patients across diverse ethnic groups. Human ANG encodes a 14.1 kDa monomeric protein (ANG) that induces neovascularization, maintains physiology and health of motor neurons by inducing angiogenesis, stimulates neurite outgrowth and path-finding, protects motor neurons from hypoxia-induced death, and hence acts as a neuroprotective factor.

**Networking and Collaborations:** Several collaborations are: University of Miami, USA; Queens University, Belfast, UK; Department of Chemical Engineering, IIT Delhi, Banaras Hindu University; National Institute of Technology Rourkella, Dr. Reddys Laboratory, Hyderabad; Dept of Biochemistry and University of Kashmir.

**Publications:** Kusuma SBS has around 250 publications.

**Source/web link:** <http://bioschool.iitd.ac.in/index.html>

## 14. Translational Health Science and Technology Institute (THSTI)

**Overview:** THSTI was set up in 2009 as an autonomous institute of the Department of Biotechnology under the Ministry of Science and Technology. THSTI has been developed as a part of the interdisciplinary health biotech science cluster located at Faridabad which is a part of the National Capital Region (NCR), a determined inventiveness which creates the unique institutional environment to conduct multidisciplinary research that translates scientific and technological advancements into medical innovations that will improve public health. It also seeks to establish collaborations with research institutions and hospitals around India, making this a national undertaking. In the past decade, there has been a new emphasis in India on adopting a more innovative, globally-focused agenda in science and technology institution development. THSTI is designed to be a dynamic and interactive organization with a mission to perform innovative translational research and develop research collaborations across disciplines and professions to accelerate the development of concepts into tangible products to improve human health.

**Experience:** THSTI has 4 years of experience in training, academics and research and provides following academic courses such as Short term Training Programme, Post-doctoral Training Programme, Long term PhD Programme and Fellowship schemes such as Ramalingaswami Fellowship, Ramanujan Fellowship, DBT Post-doctoral Fellowship and DBT-Wellcome Trust Fellowship.

**Human and Financial Capital:** THSTI is composed of 32 scientists and faculties with 22 research fellows & research students, 8 administrative managers & assistants with 45 technicians etc for the year 2012. THSTI talent pool operates in an ecosystem conducive for advancement of innovations.

THSTI receives funds through various research projects and also from Ministry of Science and Technology.

**Infrastructure:** The permanent campus of THSTI is coming up in a unique NCR Biotech Science Cluster (BSC) set-up by the Department of Biotechnology (DBT) in the NCR at Faridabad. The interim lab of THSTI is installed at Udyog Vihar in Gurgaon. THSTI has good state-of-the-art equipment and related research, consumables that are a prerequisite for safe molecular level translational work. Over 100 researchers at various levels are working in these buildings advancing different THSTI scientific programs. A central instrumentation lab was created for high-end expensive equipment such as FACS (analyser and sorter), ultracentrifuge, confocal microscope etc.

**Research Areas and Activities:** Research at THSTI is ranked well and some of the research activities in THSTI are taking place in the following centres.

**Vaccine and Infectious Disease Research Center (VIDRC)** was set up by the Department of Biotechnology in early 2009 as a niche center of THSTI. The aim of VIDRC is to study infectious diseases and pathogens with a view to develop effective vaccines and therapeutics. Their research activities are broadly focused in two areas: Tuberculosis, and viral infections.

**Pediatric Biology Centre (PBC):** Current research programs are: Biology of Vaccine Immunogenicity, Characterization of the immune system in neonates and infants and appropriate technology.

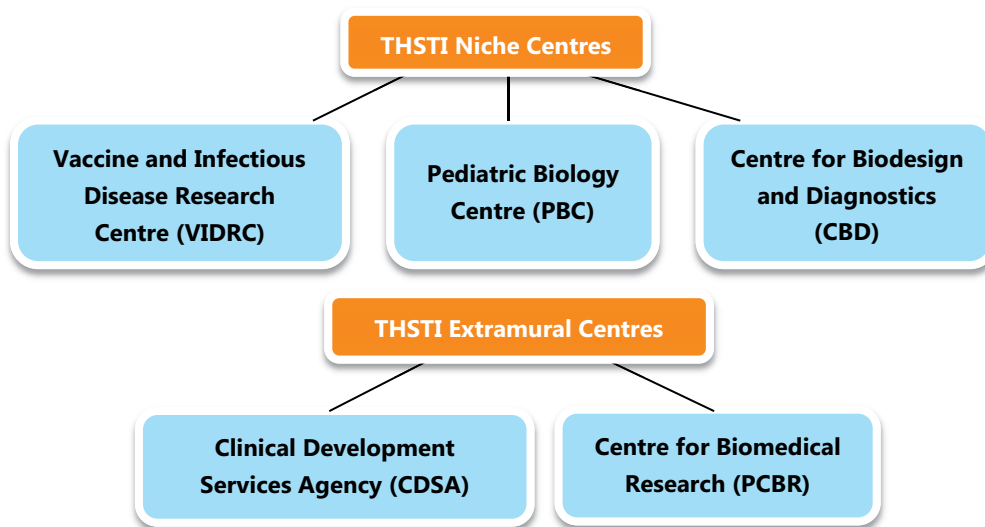


Fig 4: THSTI Niche Centre

**Centre for Biodesign and Diagnostic (CBDD):** Promote an effective translational route of basic findings ultimately into routine applications through a multidisciplinary approach, combining new bio markers, novel technological concepts and clinical expertise.

**Clinical Development Services Agency (CDSA)** is an extramural unit of THSTI. Two main streams of training have been identified, viz.; (i) drug discovery and translational medicine and (ii) training in clinical trials for regulatory submissions.

**Policy Centre for Biomedical Research (PCBR):** The function of the centre is to provide support in the areas of Vaccine, Diagnostics, Medical Devices and Drugs.

**Networking and Collaborations:** THSTI has entered into collaboration with the International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR, B): An MoU effecting the collaboration was signed at Dhaka, by Dr. John Clemens (ICDDR, B) and Dr. G.B. Nair (THSTI) on 3rd July 2013 for scientific projects.

Translational Health Science and Technology Institute (THSTI) and University of Turku, Finland have agreed to set up Indo-Finnish Diagnostic Research Centre (IFDRC) in two locations: one at THSTI, Delhi and one at the University of Turku to complement and enhance the research capabilities of Indian and Finnish scientific networks from academia and industry in the area of diagnostics.

**Publications:** There are around 250 publications of the institute since 2009.

**Source/web link:** <http://www.thsti.res.in>

## 15. School of Biotechnology - Banaras Hindu University

**Overview:** School of Biotechnology was established in 1986 with the financial support from the Department of Biotechnology, Govt. of India, New Delhi. Departments of the University participated for teaching include Departments of Microbiology and Biochemistry of IMS; Department of Chemical Engineering of IT, BHU, Departments of Botany, Zoology, Biochemistry, Chemistry and Statistics of the Faculty of Science. The core faculty of the school was appointed in 1990. At present Institute of Medical Sciences and Institute of Technology, BHU and other Universities & research institutions are actively participating in the school's multidisciplinary teaching program.

**Experience:** SBT- BHU has 27 years of experience in biological research. The school offers M.Sc and PhD in Biotech.

**Human and Financial Capital:** SBT-BHU has around 20 academic staff and 35 students admitted every year. Funds have been received from various courses offered. Research at SBT-BHU is also supported through extra-mural grants by DBT, DST, CSIR.

**Infrastructure:** The school has excellent infrastructure and equipments facilities such as Spectrofluorimeter, gel documentation systems, water purification system, ABI Prism 310 Genetic Analyzer (DNA Sequencer), Thermal cyclers, GLC, HPLC/FPLC, Scintillation Counters, High-Speed Centrifuges, Spectrophotometers, ELISA Reader, NanoDrop Spectrophotometer, Ice flaker, Circulating water bath, Incubator shaker, Plant growth chamber, Animal & Plant Cell & Tissue Culture facilities and LCD projection systems.

### Research Areas and Activities:

School is presently actively engaged in the following areas of research: a) Cellular and Molecular Immunology of Macrophages; b) Immunotherapy of cancer and inflammatory diseases; c) Microbiology of infectious diseases; d) Enzyme based diagnostics and structure-function relationship; e) Bacterial gene regulation; f) Diversity of microbes from extreme environment; g) Use of molecular markers in gene tagging; h) Germplasm conservation and propagation

Some of the research projects are:

- Increasing nitrogen fixing ability of legumes and exploring the possibility of transferring the ability of nitrogen fixation to non-leguminous crops
- Biochemical and genetic studies on genetic dwarfness in cereals
- Development of chickpea lines resistant to Ascochyta and Alternaria blights through selection for toxin-resistant cells in vitro
- Exploitation of Plant Growth Promoting Rhizobacteria for Sustainable Agriculture
- Mission Mode project on hydrogen production through biological routes

**Networking and Collaborations:** Some of the collaborations are: Centre of Food Science & Technology (CFST), Amity Institute of Virology and Immunology, Institute of Agricultural Sciences, University of Hyderabad, Delhi University and Jadhavpur University.

**Publications:** There are around 255 plus publications in the centre.

**Source/web link:** <http://www.bhu.ac.in/science/biotechnology/index.php>



## 16. Department of Biotechnology - IIT Guwahati

**Overview:** Department of Biotechnology in IIT Guwahati was established in November 2002 to contribute to the field of biological sciences. It has both undergraduate (B.Tech.) and postgraduate (M.Tech. and Ph.D.) academic programmes. The department is unique in North-Eastern India, imparting quality education and providing an excellent research environment through its continuing programmes. It imparts training for students to make them competent, motivated engineers and scientists.

**Experience:** Department of Biotechnology has 12 years of experience in biological research. The department offers B.Tech, M.Tech and PhD in Biotech.

**Human and Financial Capital:** The Department has around 35 academic staff and total student intake for the year 2012-2013 is as follows: 51 in B. Tech., 31 in M. Tech, and 35 in PhD. Funds come from various courses offered, and research at the Department is also supported through grants from DBT, DST and CSIR.

**Infrastructure:** The Department has developed extensive research facility and infrastructure to support the ongoing teaching and research initiatives. Major equipment and facilities in the department include: Atomic force microscope, Autotensiometer, Bioreactor, Trinocular phase contrast microscope, Trinocular stereo zoom microscope, Flowcytometer, Compact spectrofluorometer, FPLC System, Digital imaging system, Gradient PCR thermal cycler, HPLC System, Ion chromatography system, Gas chromatography system, Freeze dryer, Manual rotary microtome, Microplate reader, Real-Time PCR System, and Ultracentrifuge.

**Research Areas and Activities:** Research in the Department of Biotechnology covers as diverse areas as biochemical engineering, plant biotechnology, environmental biotechnology, nanobiotechnology, protein and peptide chemistry, molecular biology, structural and computational biology, bioinformatics, parasite biology, tissue engineering, stem cell biology and gene therapy, enzymology and proteomics.

**Key research activities of the Department include:** RNA Biology, Molecular Evolution and Synthetic Biology, Biomaterials, Nanotechnology, Drug Delivery and Tissue Engineering, Molecular Networks, Recombinant Proteins, Plant Cell, Tissue & Organ Culture, Protoplast Isolation and Regeneration, Isolation, Purification and Characterization of Plant Secondary Metabolites, Peptide self-assembly and amyloid aggregates, Peptide-membrane interactions Curvature inducing proteins, Metabolic engineering, Biochemical engineering, modelling of fermentation process, Biofuel Bioprocess Development, Cancer Gene Therapy, Nanobiotechnology, Molecular Pathways Involving Drug Resistance, Biocatalysis, Biosensor, Enzymatic Biofuel cell, and Biotransformation, Molecular Biology and Protein Engineering.

Some of the sponsored research projects are:

Project Title	Sponsoring Agency
Molecular Mechanism of Target Recognition and Cleavage by the CRISPR - Cas Bacterial Immune System	DBT

Project Title	Sponsoring Agency
Structural and Functional Characterization of Adaptation Stage of CRISPR-Cas System in Mycobacterium tuberculosis	DBT
X-ray crystallographic structure elucidation of key drug target enzymes of Leishmania donovani	DBT
Study of bone marrow microenvironment in patients with acute leukemia from north east India	ICMR
Role of N-glycans of Newcastle disease virus fusion protein in the host immune signaling molecules	BRNS
Stimulation of stem cell differentiation on silk fiber reinforced composite with tunable strength and degradation towards enhanced osteogenesis	SERB-DST
Strategy Development for the mitigation of heavy metals in surface waters around coal mining areas using native cyanobacterial strains	DBT
Development and establishment of efficient ultrasonic-assisted oil extraction process from microalgae for biodiesel production	CSIR

**Networking and Collaborations:** The Department has collaboration with several renowned institutes both nationally and internationally such as VTT Technical Research Centre of Finland, University of Copenhagen, National Institute of Pharmaceutical Education And Research - NIPER Guwahati, Guwahati University, Central Food & Technological Research Institute- Mysore and IIT Kharagpur.

**Publications:** There are around 455 plus publications from 2009 till 2013.

**Source/web link:** <http://www.iitg.ac.in/biotech>

## 17. Amity Institute of Biotechnology (AIB)

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**Overview:** AIB is an ISO-9001 and 14001 institute, obtained for its quality and environmental management systems applicable to biotechnology education training and research by BSI (British Standards Institution). AIB is one of the few accredited biotechnology institute to achieve this honors in India<sup>35</sup>. AIB is affiliated to Amity University. Amity today is one of the leading groups of private educational institutions in India with over 50 world class institutions conveying education to 40,000 students spread over 22 integrated campuses. AIB was established in August 2001 and is situated in the Amity University campus in Noida. *The institute has taken a lead in initiating a program in the most challenging area with high-tech encroachment in meeting the growing need of biotechnology and bioinformatics to sustain the industrial venture.*

**Experience:** AIB has around 14 years of experience in Biotechnology, Bioinformatics and Medical Biotechnology. AIB offers degrees (B.Sc, B.Tech, M.Sc, MBA, M.Tech, Integrated B.Tech-M.tech and Ph.D) in the following disciplines: Biotechnology, Medical Biotechnology and Bioinformatics. Amity Institute of Biotechnology is perhaps the largest private university providing biotech education in the country and is continuously striving to give the most advanced courses. Industry-centric curriculum of this institute enhances the professional skills of the students.

**Human and Financial Capital:** The institute has strength of 126 faculty members for its 58 specialized courses. The institute also has value addition courses wherein a student has to learn a foreign language, a compulsory course in English and behavioral sciences.

**Infrastructure:** The institute facilitates excellent state-of-the-art infrastructure in multifaceted areas within the life sciences disciplines. AIB possesses the most modern infrastructure in terms of tissue culture labs, microbiology, and central instrumentation facility, computational biology, biochemical techniques and molecular biology. Further, a 60-acre herbal garden with greenhouse facilities, a well-stocked library and state-of-art computing room, facilitate research and consultancy. AIB has Library, Laboratory, Classrooms, Internet, Computer Centre, Hostel, Medical facilities and Scholarships facilities. AIB has 57 biotechnology (including 22 research laboratories) and 8 computer laboratories. The biotechnology laboratories are specialized and equipped to conduct advanced practicals and research work. Some specialized laboratories include: Plant Biotechnology, Plant Tissue Culture, Novel Molecule Synthesis, Downstream Processing, Animal Biotechnology, Animal Cell Culture, New Drug Discovery & Innovation, Bioprocess Engineering, Biochemical Engineering, Biochemistry and Microbiology.

**Research Areas and Activities:** AIB is ranked 3rd amongst the top 20 Private Biotech Schools in India and Amity University, in the 6th Biospectrum Biotech School survey ranked 3<sup>rd</sup> in position amongst the top 20 Private Biotech Schools in India<sup>36</sup>.

Research at AIB is based on well-built scholastic footing with the objective of exploring for the benefit of humanity in different cutting edge areas/applied research especially in the fields of microbiology, transgenics plant pathology and tissue culture, host pathogen PGPR interactions for helping plant defense, enzyme technology, molecular biological aspects of plant cell functioning, immunology genomics, and antimicrobial assessment of medicinal plants.

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<sup>35</sup> <http://www.minglebox.com/college/Amity-Institute-of-Biotechnology-Noida>

<sup>36</sup> <http://www.amity.edu/aib/Academic.asp>

Some of the completed and ongoing projects are:

Title of the project	Sponsoring Agency
In vitro production of psoralen - an important bioactive compound through cotyledon culture of an endangered leguminous taxon - <i>Psoralea corylifolia</i> Linn	DST
Identification and partial purification of medicinal plant extract effective against <i>Helicobacter pylori</i>	CSIR
Impact Assessment of induced chromosomal aberrations in non-conventional use of fly ash for agriculture	DST
Role of <i>Helicobacter pylori</i> in gastro-esophageal reflux disease (GERD) in India	DST
Development Of NO- Synthase mimetic materials and its application as biosensor	DST
Identification of medicinal plants effective against <i>Vibrio cholerae</i> strains that are prevailing in north-east India and characterization of bioactive components	DBT
Comparative analysis of <i>Helicobacter pylori</i> strains isolated from North-east India with other parts of India	DBT

**Networking and Collaborations:** Some of the collaborations are: Banaras Hindu University, Indian Institute of Technology Bombay (IITB) School of Biological Sciences- Central University of Kerala, Bose Institute and Jawaharlal Nehru University.

**Publications:** There are around 35 plus publications along with 47 patents out of which 28 are filed and remaining have been applied for.

**Source/web link:** <http://www.amity.edu/aib/default.asp>

## 18. Department of Biotechnology - University of Pune

**Overview:** Department of Biotechnology, University of Pune was established in 1994. Prior to this, the teaching programme of M.Sc. Biotechnology was initiated at the Department of Zoology in 1985. In course of time, the Department of Biotechnology, University of Pune became one of the best centres of learning in Biotechnology. The Department, since its inception, emphasizes on appointing and inculcating meritorious faculty in various specialised branches in Biotechnology.

**Experience:** Department of biotech at University of Pune has 20 years of experience in teaching and research in Biotechnology. The Department offers a two years M.Sc. Biotechnology Course supported by the Department of Biotechnology (DBT), Government of India. It also offers M.Phil. and Ph.D. programmes in Biotechnology and related areas.

**Human and Financial Capital:** The department has strength of 55 faculty members and every year as many as 50 students complete their Ph.D. in Biotechnology. Around 15 MSc students had enrolled during 2011-2013.

**Infrastructure:** The Department has excellent facilities for teaching and research in Modern Biology and Biotechnology, namely, Animal and Plant Tissue culture facility, and Molecular Biology and Genetic Engineering facility. The Department has an excellent computer and network facility for the students. It has its own small Library, which caters to the immediate needs of the students as well as researchers.

List of major equipments include: Atomic Absorption Spectrophotometer, CO<sub>2</sub> Incubators, Deep Freezer (-80C), ELISA Reader, Fermenter, Gel Documentation system, HPLC-cum-Liquid chromatography system, Ice flake Machine, Laminar Air flow hoods, Luminometer, Lyophilizer, Microinjection system with Inverted Microscope, Microscopes: Dissecting, Compound & Fluorescence with Camera & Imaging system; PCR Thermal Cycler, Pulse Field Gel Electrophoresis Apparatus, Real time PCR thermal cycler, Refrigerated High Speed Centrifuges, Speed Vac Concentrator, 2-D gel electrophoresis system, Ultracentrifuges, Water filtration system, Nanodrop Spectrophotometer, Flow Cytometer (Talli, Invitrogen).

**Research Areas and Activities:** The University of Pune has been given the highest "A" rating by the National Assessment and Accreditation Council (NAAC) for its overall performance.<sup>37</sup>

There are 6 thrust areas of research pursued by the faculty members of the Department. Major areas are:

1. Cell Molecular Biology:  
*Research interest includes:*
  - Molecular regulation of protein synthesis during anemia, thalassemia and other cytoplasmic stresses
  - Regulation of protein synthesis in *Leishmania donovani*
  - Proteasomes and intracellular protein degradation.

<sup>37</sup> [http://en.wikipedia.org/wiki/University\\_of\\_Pune](http://en.wikipedia.org/wiki/University_of_Pune)

## 2. Molecular Signalling:

### *Research interest:*

- Regulation of insulin signalling in brain cells under cytoplasmic stresses
- Regulation of amyloidogenesis by insulin signalling

## 3. Proteomics and Bioremediation:

### *Research Interest:*

- Isolation and characterization of heavy-metal tolerant bacteria
- Proteomics approach of bioremediation

## 4. Epigenetics and DNA repair:

### *Research Interest:*

- Understand the role of non-coding RNAs in Diabetes
- Genomic instability in micronutrient deficient Diabetic population from India
- Identification and characterization of the regulators of the DNA damage pathway.

## 5. Plant Biotechnology:

### *Research Interest:*

- Antioxidativeisoenzymes pattern and their gene expression under the influence of brassinolide in heavy metal stress rice seedling
- Isolation and characterization of brassinosteroids from Bacopamonnieri L leaves
- Anti-inflammatory and apoptosis-promoting activities of isolated brassinosteroids

## 6. Computational Biology:

### *Research Interest:*

- Analysis and interpretation of data from high-throughput biological experiments
- Next-Generation sequencing and assembly
- Computational study on structural aspects on protein-protein or protein-ligand interactions.

**Networking and Collaborations:** Some of the collaborations of the Department are: Jawaharlal Nehru University, National Centre for Cell Science (NCCS), National Chemical Laboratory (NCL), Indian Institute of Science Education and Research (IISER), National Institute of Virology (NIV) and Fergusson College – Pune.

**Publications:** There are around 125 plus publications.

**Source/web link:** <http://www.unipune.ac.in/dept/science/biotechnology/default.htm>



## 3.2 ENERGY

### Sector Summary

India stands 11<sup>th</sup> in terms of production of energy, and 4<sup>th</sup> largest energy consumer after China, USA and Russia. It will become third largest consumer by 2020. With an installed power capacity of 248,509.63 MW as per May 2014<sup>38</sup>, India has 4% of the global capacity. In the past, the Indian power sector has been driven by fossil fuel power, predominantly coal. Renewable energy is fast emerging as a major source of power. Wind energy is the largest source of renewable energy in India accounting for an estimated 87% of total installed capacity in renewable energy. The country aims to increase the importance of wind power even further; there are plans to double wind power generation capacity to 20 GW by 2022<sup>39</sup>. Jawaharlal Nehru National Solar Mission launched in 2010, the first phase of which added 1,684 MW of grid-connected solar power. The mission aims to add 20 GW grid-connected solar power to India's energy mix by 2022<sup>40</sup>. Biomass is the second largest source of renewable energy, accounting for 12% of total installed capacity in renewable energy, and solar energy accounts for 1% of total renewable energy installed capacity. However, the share is not indicative of the country's true potential, which stands at an estimated 5,000 TWh per annum.<sup>41</sup>

The 18 energy universities and research institutes covered in this report include:

1. The Energy and Resources Institute (TERI)
2. Central Power Research Institute (CPRI)
3. Sardar Patel Renewable Energy Research Institute (SPRERI)
4. Centre for Energy & Environment, IIT Patna
5. Centre for Energy Studies (CSE) IIT Delhi
6. School of Solar Energy – Pandit Deendayal Petroleum University (PDPU)
7. Dept of Energy, University of Madras
8. School of Energy Studies (SES) – Jadavpur University
9. School of Energy Studies (SES) – University of Pune
10. University of Petroleum and Energy Studies (UPES)
11. Amity Institute of Renewable and Alternative Energy (AIRAE)
12. Gujarat Energy Research & Management Institute (GERMI)
13. Energy Research Centre (ERC) – Punjab University
14. Centre for Energy – IIT Guwahati
15. CSIR-Indian Institute of petroleum (CSIR-IIP)
16. CSIR-Central Mine Planning and Design Institute (CSIR – CMPDI)
17. Department of Chemical Engineering, NIT, Tiruchrapally
18. Sardar Swaran Singh National Institute of Renewable Energy (SSS-NIRE)

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<sup>38</sup> [http://www.cea.nic.in/reports/monthly/inst\\_capacity/may14.pdf](http://www.cea.nic.in/reports/monthly/inst_capacity/may14.pdf)

<sup>39</sup> <http://www.energytoday.co.in/subscribe.php?id=194#.U6gh9ZSSz5M>.

<sup>40</sup> [http://www.pv-magazine.com/news/details/beitrag/india-to-add-2-gw-of-solar-projects\\_100014287/#ixzz35Sz5wusR](http://www.pv-magazine.com/news/details/beitrag/india-to-add-2-gw-of-solar-projects_100014287/#ixzz35Sz5wusR)

<sup>41</sup> <http://www.ibef.org/industry/power-sector-india.aspx>

# 1. The Energy and Resources Institute (TERI)

**Overview:** The Energy and Resources Institute, commonly known as TERI (formerly Tata Energy Research Institute), established in 1974 is a research institute based in New Delhi focusing its research activities in the fields of energy, environment and sustainable development. TERI is an independent, not-for-profit, research institute devoted to efficient and sustainable use of natural resources. TERI was set up with a reserved corpus of 35 million rupees. As the scope of its activities widened over a period of time, it was renamed The Energy and Resources Institute in 2003. TERI began operations in Mumbai in Bombay House, headquarters of the house of Tatas. In 1984, it moved to Delhi. Today, TERI has a global presence with many centers both within India and abroad.

**Experience:** TERI is a leading Indian non government organization (NGO), a global think tank conducting research and analysis in the genres of energy and environment, a university with a vast focus, which ranges from micro organisms to global climate change and everything in between. TERI has 39 years of experience and has completed more than 2600 projects and has about 20 divisions.

**Human and Financial Capital:** TERI has about 1300 employees with PhD (17%), Post Graduates (67%) and Graduates (16%), with research professionals from various disciplines pertaining to issues of environment and energy.

TERI's income flows into the institute in the form of funds and research grants from multilateral and bilateral organizations, national and international banks and financial institutions, government agencies, grant-making bodies, and international academic institutions. TERI operates through the inflow of funds from income from projects (93%), Income from investments (4.31%), Sale of Publications (1.52%) and others (1.17%). MWH Global, a sustainable engineering company, funds €65,000 EUR donations to TERI on finding solutions for critical energy, environmental and sustainable development issues.

**Infrastructure:** TERI's headquarter is located within India Habitat Centre complex, one of the best and well known addresses in Delhi. TERI houses first-rate laboratory facilities particularly for advanced research in biotechnology, microbiology, tissue culture, indoor air pollution, water quality, and chemical technology. It also houses videoconferencing facility, state-of-the art library, two conference halls, and several meeting rooms. The TERI library houses a wide array of resources on energy, environment, and sustainable development—from books, journals, and papers to the world's leading academic databases.

**Research Areas and Activities:** TERI has been ranked 7th in the top 20 Energy and Resource Policy Think Tanks by the University of Pennsylvania's Think Tanks and Civil Society Program.

TERI has several research divisions where the research activities are being carried out. Some of the research divisions are:

- Biotechnology and Bioresources
- Earth Science and Climate Change
- Environmental and Industrial Biotechnology.
- Industrial Energy Efficiency
- Energy–Environment Technology Development
- Decentralized Electricity Solutions



- **TERI conducted an assessment of the renewable energy potential** in the state of Gujarat. The objective of the study was to map the available potential from various sources using the Geographic Information System (GIS). It is estimated that about 750 GW of renewable energy based potential exists in India. The study has helped identify the districts that have potential for developing various forms of renewable energy, including concentrated solar power (CSP), solar photovoltaic (SPV), wind, biomass and the hybrid solar-wind plants.
- Lighting a Billion Lives (LaBL) programme of TERI offers decentralized lighting solutions to rural households by providing solar lanterns and setting up solar charging stations.
- Teri Has developed an Eco-Friendly and effective Biopesticide product, 'Bollcure', to protect economically important crops

TERI has participated in the following European Commission FP7 projects. The details of the projects include:

Project Acronym	Project title	Challenge area
SAFEWIND	Multi-scale data assimilation, advanced wind modeling and forecasting with emphasis to extreme weather situations for a secure large-scale wind power integration	ENERGY-2007-2.3-02 External conditions, resource assessment and forecasting for wind energy
SETATWORK	Sustainable energy technology at work: thematic promotion of energy efficiency and energy saving technologies in the carbon markets	ENERGY-2007-8.7-01 Promotion and dissemination

### Networking and Collaborations:

- TERI works closely with several multilateral organizations, national governments, corporate organizations, NGOs, and academia around the world. As of now, it has over 900 organizations as sponsors and around 200 organizations as partners from 43 countries. Some of them are: University of Alabama (Huntsville), University of Basel (Switzerland), FiBL (Switzerland), IRTA, Centre de Cabrils, Carretera de Cabrils (Spain), INRA (France), VTT (Finland), European Commission, Bureau of Energy Efficiency (BEE), Housing and Urban Development Corporation (HUDCO), Department for International Development (DfID), UK MSME, Solar Energy Centre, Punjab Agricultural University, Research Council of Norway, Technische Universitat Darmstadt, GermanyTer Viva Bioenergy Pvt. Ltd and Renewable Energy and Energy Efficiency Partnership etc and many others.
- TERI collaborated with the Institute for Global Environmental Strategies (IGES) and the Asian Development Bank (ADB) to assess recent innovations in energy projects.

**Publications:** There are more than 4000 publications of the TERI institute. Industrial Energy Efficiency dept has around 75 publications.

**Source/web link:** <http://www.teriin.org>

## 2. Central Power Research Institute (CPRI)

**Overview:** Central Power Research Institute (CPRI) was established by the Government of India in 1960, with its headquarters in Bangalore. The institute was re-organized into an autonomous society in the year 1978 under the aegis of the Ministry of Power. The main objectives of setting up the institute was for it to serve as a national level laboratory for undertaking applied research in electrical power engineering, besides functioning as an independent national testing and certification authority for electrical equipment and components to ensure reliability in the power system and to innovate and develop new products. The management of the institute vests in its governing council comprising members representing different ministries, Central Electricity Authority, state electricity boards, power supply utilities, Indian Electrical & Electronics Manufacturers' Association, and various other academic and R&D organizations of national importance in the field of electric power engineering. CPRI offers expert consultancy services in the areas of Transmission and Distribution Systems, Power Quality, Energy Auditing, Conductor Vibration, Power System Instrumentation, Transformer Oil Reclamation, new materials for Power System application, High Power, Extra High Voltage and related fields.

**Experience:** CPRI has 40 years of experience as governing body including eminent professionals from industries & utilities, prestigious academic and research institutions & the government. CPRI also serves as an independent authority for testing and certification of power equipment. Various departments of CPRI include: Central Research and Testing Laboratory (CRTL), Bangalore; Research and Testing Laboratory (RTL), Guwahati; RTL, Kolkata; RTL, Noida; Switchgear Testing and Development Station (STDS), Bhopal; Thermal Research Centre (TRC), Nagpur and Ultra High Voltage Research Laboratory (UHVRL), Hyderabad which have vast experience in facilitating and promoting advanced research and to help power sector get the latest technology benefits.

**Human and Financial Capital:** CPRI employs over 300 highly qualified and experienced engineers & scientists besides other supporting staff.

Grants of money and other assistance from the Government of India and other sources, Indian or foreign or enter into any agreement has been generated to CPRI. CPRI invests the funds or money of the society not immediately required in any securities.

**Infrastructure:** CPRI with its head office located at Bangalore, has six state-of-the-art infrastructure facilities at Bhopal, Hyderabad, Nagpur, Noida, Kolkata and Guwahati. CPRI's laboratories are accredited under National Accreditation Board for Testing and Calibration Laboratories (NABL) as per ISO/IEC 17025 standards. CPRI labs have necessary infrastructure to simulate operations. Library and Information Centre of CPRI has got a collection of over 30,792 stocks, comprising of books, periodicals, back volumes, reports, standards Indian & International, technical papers, photocopies and reprints.

**Research Areas and Activities:** CPRI has been taking programs in various areas of electrical power generation, transmission and distribution in the endeavor to assist utilities to supply reliable, uninterrupted and quality services to the consumers. The broad objectives with the research projects taken up in CPRI are: offering technical advice and trouble shooting, product development and improvement to meet global standards, bridging the gap in testing and developing special testing technologies and large collaborative research projects with utilities and industries. In CPRI, R&D projects of different dimensions are taken up under 4 schemes namely:

**Plan R&D (or Research contingency):** Some of the ongoing projects are:

- Development of tracking wheel test facility & evaluation of polymeric insulators
- White LED-technology assessment
- Development of High resolution Impulse Recorder for High impulse Voltage and Current measurements

**RSoP (Research Scheme on Power):** Some of the ongoing projects are:

- Performance analysis and trading of wind power generation in emerging power system
- Development of appropriate algorithms for efficient management of energy control centers
- Wide area measurement and control for improving observability and stability of power systems
- Investigation of operation and control of multiple distributed generation sources in micro grid

**Sponsored projects:** Such as:

- Development of Indian Standard for LV Automatic Power Factor Correction (APFC) panels

**NPP (National Perspective Plan projects):** Some of the ongoing projects are:

- Study on stability and reliability of power systems with large penetration of wind power
- Design and development of high temperature superconducting fault current limiter (FCL)

**Networking and Collaborations:** CPRI works closely with several national governments and other institutes across globe. CPRI-CCAR has signed MoU with University of Saskatchewan - Canada for collaboration between the centre and the university to carry out research projects relevant to power sector. CPRI has signed an MOU with NIT Karnataka. Some other national collaborations of CPRI are: Indian Institute of Technology (IIT), Roorkee; Indian Institute of Technology Madras (IITM), Chennai; Electrical Research and Development Association (ERDA), Vadodara; The Energy and Resource Institute - Southern Region Centre (TERI - SRC); Institute of Technology - Banaras Hindu University (IT-BHU), Varanasi; and Central Board of Irrigation & Power (CBIP) New Delhi.

**Publications:** There are more than 50 papers published by CPRI and other related institutes of CPRI.

**Source/web link:** <http://www.cpri.in>

### 3. Sardar Patel Renewable Energy Research Institute (SPRERI)

**Overview:** Sardar Patel Renewable Energy Research Institute (SPRERI) was established in 1979 at Vallabh Vidyanagar (Gujarat). It is an autonomous and non-profit organization and is recognized as a Scientific and Industrial Research Organization (SIRO) by the Department of Science & Technology. It is managed by a board comprising of leading technologists, scientists, industrialists and representatives of central and state governments. Its mission is to develop viable renewable energy technologies and to promote their applications. SPRERI has developed many RE devices and systems which are now manufactured by the selected industries and supplied to the end users. SPRERI offers the following services:

- **Consultancy services:** Design, development, commissioning and monitoring the performance of renewable devices and systems, organizing seminars, workshops and business meets etc.
- **Testing:** Performance testing of renewable devices and systems for the purpose of certification and product improvement.
- **Training:** For users, technicians, students, teachers and researchers, fabricators, financiers and policy makers.

**Some of the key technologies to emerge from the R&D unit include:** Conversion of kitchen residues to biogas and manure, Open core down draft gasifier systems and Biomass combustor-cum-hot air generator.

**Experience:** SPRERI has 30 years of experience in renewable energy technologies and three major fields of specialization in SPRERI are: Solar thermal and solar photovoltaics; bio-conversion of biomass and thermo-chemical conversion of biomass.

**Financial Capital:** Major part of SPRERI's operating funds is received through projects sponsored by central and state government organizations and non-government organizations. SPRERI receives funding from various government institutions such as Indian Council of Agricultural Research (ICAR); Ministry of Science & Technology; Ministry of New and Renewable Energy (MNRE); Department of Energy and Petrochemicals Government of Gujarat, Gandhinagar; Jamshedji Tata Trust; Gujarat Energy Development Agency, Gandhinagar and other industries.

**Infrastructure:** SPRERI is divided into different departments like solar division, bio conversion division with biogas and biomass and thermo chemical division with an administration block. The institute also has a library and a small workshop where model prototypes are produced for the purpose of testing and evaluation. SPRERI has good infrastructural facilities in various research divisions to carry out design, development, field evaluation, demonstrations and trainings.

**Research Areas and Activities:** Research and Development activities are organized under the following divisions:

- **Solar Energy Division:** To carry out design, development, evaluation and refinement of solar thermal and SPV systems. Some of the projects are: Effect of dust deposition on performance of PV panels and ORP on forced circulation solar dryer by using packer bed solar air heaters (AICRP – ICAR) etc.

- **Regional Test Centre:** Approved by the Bureau of Indian Standards and MNRE, carries out testing of various solar thermal devices such as solar cookers, solar water heaters etc.
- **Bio-Conversion Division** pursues basic studies and development of technologies and systems for conversion of biomass to energy carriers through various biological routes and their utilization for thermal applications and power generation. Some of the projects are: Performance monitoring of 10 t/d biphasic system at FVU-Mother Dairy; Study on use of different packing media in SPRERI anaerobic filter system; Developing an integrated process technology for conversion of crop residues into ethanol and methane for use as transport fuel; Development of technology for detoxification of Jatropha de-oiled cake and production of fuel gas etc.
- **Thermo-Chemical Conversion Division** is engaged in basic studies and development of technologies and systems for efficient conversion of biomass to energy through thermo-chemical / mechanical pathways and their use for thermal applications and power generation. Some of the projects are: Fast pyrolysis of selected biomass to obtain liquid fuel; Comparative evaluation of improved biomass cook stoves for their suitability in tribal region of Gujarat; Value chain on biomass based decentralized power generation for agro enterprises (NAIP-ICAR) etc.
- **Technology Transfer Division** facilitates promotion of new RE technologies through field evaluation, demonstrations, trainings and entrepreneurship development, awareness programmes and integrated development of selected tribal villages.

**Networking and Collaborations:** SPRERI has collaborations with govt. organizations such as Indian Council of Agricultural Research, Ministry of New and Renewable Energy, Department of Biotechnology, and Gujarat Council of Science and Technology (GUJCOST).

**Publications:** There are more than 50 papers published by SPRERI.

**Source/web link:** <http://www.spreri.org/index.htm>

## 4. Centre for Energy & Environment, IIT Patna

**Overview:** The Centre for Energy and Environment aims to develop environmentally friendly and sustainable clean energy generation, storage, and distribution system for country's future. The current research projects undergoing at the centre includes following areas: Micro-Turbine, Direct Solar Steam Generation, Solar Thermal technology, Energy Storage/Conversion, Flexible Solar Cells, Smart Microgrid, Fog Harvesting, Robotics, and Solid Waste Management.

**Human and Financial Capital:** There are around 16 faculties with 55-60 students.

Funds have been received through courses and research projects from DST, MHRD/AICTE, CSIR, National Informatics Centre etc.

**Research Areas and Activities:** Some of the research areas are: Renewable and Alternative Energy, Green Energy Technology etc.

The Sponsored Research and Industrial Relations Unit (SRIRU) of the institute were established in 2009 with a view to initiate and nurture productive and interactive engagement with sponsoring agencies.

Some of the research projects are:

- Fluid-structure modeling of micro-turbine blades
- Direct solar steam generation for compact steam power plant
- Development of a lab scale concentrated solar collector and a thermal energy storage system for direct steam generator plant
- Smart microgrid to manage distributed generation
- Functional oxides for energy storage and conversion devices
- Clean drinking water using low-cost fog collection and moisture condensation technology

**Networking and Collaborations:** Some of the important collaborations are: University of Houston, USA; UNICEF; University of California, University of Hartford-USA, Louisiana State University, National University of Singapore and University of Saskatchewan.

**Publications:** There are around 600 publications of the centre published by different faculties.

**Source/web link:** <http://www.iitp.ac.in/index.php/schools-and-centers/cee.html>

## 5. Centre for Energy Studies (CSE) IIT Delhi

**Overview:** The Government of India established a national Centre for Energy Studies (CES) at the Indian Institute of Technology Delhi in the year 1976. Research and development activities on various relevant aspects of conventional as well as non conventional energy sources were initiated and suitable infrastructure established in its formative years. CSE of the IIT Delhi has been contributing to fulfill the need of trained manpower as well as research and development activities in the area of energy engineering. The scientists and engineers, in the field of energy are required for a variety of occupations in:

- Research and development institutions
- Organization involved in energy extraction, conversion, transmission and distribution,
- Service organizations (e.g. for energy auditing)
- Industrial and commercial organizations,
- Manufacture, sale, installation of energy equipment.

**Experience:** CES has 38 years of experience in education and research in the area of energy engineering. Centre offers the interdisciplinary post-graduate programmes - M.Tech. in Energy studies, Undergraduate Courses, Ph.D. programme etc.

**Human and Financial Capital:** There are around 20 faculties with 50-60 students getting admitted for post graduation, under graduation courses.

Funds have been received from courses offered and though projects sponsored by DST, DRDO, National Geographic Society, MNRE, MHRD, NSF-USA, European Commission, ISRO etc.

**Infrastructure:** CES-IITD has good infrastructural facilities to carry out research and development in

- Renewable energies with Photovoltaic Module and System Test Facility Including PV Pump, Solar Lanterns, Inverters for PV system, Photoluminescence set-up, Negative Ion Generating System etc.
- Internal combustion engines with Engine Data acquisition System, Smoke Meters, Gas Chromatograph etc.

**Research Areas and Activities:** Indian Institute of Technology - Delhi has been ranked No. 5 institute as per Careers360 research for the year 2014.<sup>42</sup>

- Plasma Science and Technology - Activities relating to both theoretical and experimental aspects of plasma physics are undertaken. Theoretical work is undertaken on waves, instabilities in the Ionosphere Magnetosphere and laboratory (fusion) plasmas. Significant work on nonlinear dynamics of plasmas including self organization and chaos to study plasma behaviour at high power particularly in fusion phenomenon has also been carried out.
- Energy Efficiency in Buildings - One of the main aims in buildings is to provide internal environment where one can have visual and thermal comfort. This is partly provided by an energy efficient building design and/or by providing energy efficient end use devices.

<sup>42</sup> <http://www.university.careers360.com/articles/top-100-universities-in-india-2014>

- Electrical Energy Systems - The activities in this group concentrate on real time monitoring and control of power systems, power systems reliability and production costing analysis, energy conservation in power distribution and utilization systems and reactive power compensation.

**Networking and Collaborations:** Some of the CES-IITD has collaborations are: University of Bradford (U.K.), Council of Scientific and Industrial Research, Ministry of New and Renewable Energy, University of Newcastle Australia, MNIT Jaipur and Trinity College Dublin.

**Publications:** There are around 120 research publications.

**Source/web link:** <http://ces.iitd.ac.in>



## 6. School of Solar Energy - Pandit Deendayal Petroleum University (PDPU)

**Overview:** The School of Solar Energy (SSE) at PDPU conducts teaching and research in the technologies needed to harness and supply solar energy efficiently, on an economically sound basis. Preliminary research studies have been initiated, and laboratory development is in progress. SSE operates in close collaboration with Solar Energy research wing of GERMI Research, Innovation & Incubation Centre (GRIIC).

While the research objectives of the school include developing world-class R&D competence for solar energy research and contributing to fundamental and applied research, their industrial objectives are equally strong; their goal is to commercialize the developed technologies, and also strengthen industrial-institutional linkages.

**Experience:** SSE at PDPU has 5 years of experience in renewable energy technologies and offers M.Tech (Energy Systems and Technology, Focused on Solar Energy) and PhD Programs.

**Financial Capital:** SSE-PDPU receives funding from various institutions such as: Ministry of New and Renewable Energy (MNRE); Gujarat Energy Development Agency, Gandhinagar; DST; DRDO etc.

**Infrastructure:** State of the Art Facilities for Material Characterization: XRD, FE-SEM with EDX facility, Veeco Surface Profilometer, UV-Vis SpectroPhotometer. State of the Art Facilities for Device Characterization: Class AAA Solar Simulator, IV-Measurement System, Sunshine Recorder, Infrared Thermometer Oscilloscope (15MHz) and Digital Oscilloscope (50MHz).

**Research Areas and Activities:** SSE at PDPE is established to offer state-of-the-art experimental, theoretical and computational research facility in the thrust areas of solar energy technologies. The areas of research including but not limited to:

- Fundamental and commercial solar cell technologies, such as, crystalline and amorphous Silicon, Chalcopyrites and Dye Sensitized solar cells, and Solar thermal systems and components.
- Advanced, nano-structured and hybrid solar cells and Photovoltaic systems.
- Supporting technologies, such as, electrical storage, inverter technologies, hybrid systems, grid tied and off grid technologies.

Some of the ongoing research projects are:

- Development of CZTS solar cells and modules on glass and metallic substrates by non vacuum processes.
- Investigation of key factors to efficiency improvement in low cost Kesterite (CZTS) thin-film solar cells.
- Fabrication and Characterization of TiO<sub>2</sub> Nano-rod Based Dye Sensitized Solar Cells (DSSC).
- Design & Development of Cost Effective Concentrator Photovoltaic (CPV) System.
- Studies on the Electrodeposition of Si and Ge at room temperature using less viscous ionic liquid.

**Networking and Collaborations:** SSE has collaboration with University of Tulsa-USA, University of Houston-USA, and University of Western Ontario-Canada.

**Publications:** There are around 60 publications at PDPE.

**Source/web link:** <http://sse.pdpu.ac.in>

## 7. Department of Energy, University of Madras

**Overview:** Department of Energy was established in August 1983 as part of the Post-Centenary Silver Jubilee Celebrations of the University of Madras. Considering the scenario of ever increasing energy need of our country in particular and at the global level in general, in terms of conventional and non-conventional energy resources, it was realized that in order to foster, promote and sustain scientific research in all spheres (viz., pure, applied and educational) of energy, better utilization and conservation of the existing energy sources, an inter-disciplinary approach would be the most appropriate option.

**Experience:** Dept of Energy has 33 years of experience in education and research in energy technologies. Develop scientific manpower through innovative academic training and endeavors for national growth and global needs in Energy Sciences.

**Human and Financial Capital:** There are around 40 students and 20 faculties. Funds have been received from courses and through agencies such as UGC, NCNSNT, DST, CSIR etc.

**Research Areas and Activities:** University of Madras has been ranked No. 29 institute as per Careers360 research for the year 2014.<sup>43</sup>

Research thrust areas as recognized by major funding agencies:

- Heterogeneous Photo-catalysis
- Reaction Kinetics in Solutions
- Fast Reaction Kinetics
- Hydrogen Production in Visible Light Using Semiconductors
- Solar Photoactive Materials
- Dye-sensitized Solar Cells
- SolidState Ionics
- SolidState Power Devices
- Fast Ion Transport in Solids
- Glassy Electrolytes
- Polymer Electrolytes

Some of the research projects are:

- Design and characterization of zinc ion conducting nano composite gel electrolytes based on new polymer blends
- Synthesis and Characterization of new solid polymer electrolytes containing nano scale fillers for ionic devices
- Design and development of nanocomposite polymer electrolytes for solid state energy device

**Networking and Collaborations:** Department of Energy has collaborations with STERIS Corporation MO, USA; University of Melbourne, Australia; Department of Chemistry - NIT Tuiruchirapalli; and International Biographical Centre - UK.

**Publications:** There are around 135 publications published by different faculties of the department.

**Source/web link:** <http://www.unom.ac.in/index.php?route=department/department/deptpage&deptid=30>

<sup>43</sup> <http://www.university.careers360.com/articles/top-100-universities-in-india-2014>).

## 8. School of Energy Studies (SES) – Jadavpur University

**Overview:** School of Energy Studies was the first interdisciplinary School to be set up at Jadavpur University. It is a multidisciplinary unit that co-ordinates activities in different University departments for creation of energy awareness, advocacy and promotion of non-conventional energy sources, and conducts research and development activities in that direction. It is one of the four chief institutes in India entrusted by the Ministry of Human Resource Development with the task of training manpower in the field of energy, the other three being IIT Delhi, Roorkee University, and REC Tiruchirapalli. The area of specialisation of the School is Integrated Energy Systems.

**Experience:** SES has years of experience in integrated energy systems. The School offers a 3-semester M.Tech course, as well as shorter courses. Several groups are headed by groups working on various projects in the fields of Solar Photovoltaics, Solar Thermal, Wind Energy, Biogas, Biomass, and photochemical Mini-micro Hydel.

**Human and Financial Capital:** There are around 6-7 faculties with 20-25 students pursuing M. Tech and Ph.D. A variety of teaching and learning techniques are employed to impart knowledge and skills to students at the School. Funds come in from institutions and government bodies like CSIR, DST, UGC, AICTE, and MOEF apart from the course fees.

**Infrastructure:** The department's infrastructure is well furnished with all modern facilities. Energy department have Physical Chemistry Laboratory, Organic Chemistry Laboratory, Inorganic Chemistry Laboratory and Analytical Chemistry Laboratory with latest instruments and technologies. The central Library has over 598594 volumes of books, 80,000 bound volumes of journals etc.

**Research Areas and Activities:** Jadavpur University has been ranked No. 17 institute as per Careers360 research for the year 2014<sup>44</sup>.

### Some of the research areas include:

- Solar Photovoltaic Technology and Systems, Coating Technologies, Gasification Technologies
- Energy Science & Technology.
- Bio-Energy Technology (Biomethanation Tech., Biomass Gasification Tech., Bio-diesel production),
- Energy Management, Clean Development Mechanism (CDM), Carbon Trading,
- Energy and Environment.

**Networking and Collaborations:** Some of the collaborations are: University of Calcutta, Lund University, and West Bengal University of Technology.

**Publications:** There are around 150 publications of the energy study school published by different faculties.

**Source/web link:** [http://www.jaduniv.edu.in/view\\_department.php?deptid=137](http://www.jaduniv.edu.in/view_department.php?deptid=137)

<sup>44</sup> <http://www.university.careers360.com/articles/top-100-universities-in-india-2014>

## 9. School of Energy Studies (SES) – University of Pune

**Overview:** The School of Energy Studies was established under the flag ship of University of Pune, to promote interdisciplinary research, development and teaching activities in the field of energy and renewable energy sources. The major objective of this effort was to bring and to bear, the expertise and facilities that are available in the various science departments on the university campus, for purpose of teaching and solving some of the frontline problems, both of basic and applied nature. The school was established in 1998 in response to global concerns about the rising demands for energy and the depletion of fossil fuels. The School is involved in following activities: Teaching & Training programs; Research and Development; Extension and field trials; Transfer of technology to industry and Provide consultancy to the industry or the users.

**Experience:** SES - University of Pune has 16 years of experience in teaching, research and development and extension activities in the field of energy studies. Most of the research activities undertaken by the school are related to non-conventional energy sources such as solar energy, wind energy, bio-gas and biomass.

**Human and Financial Capital:** There are around 25 faculties with 20 students for M Tech, 20 for PhD. Funds have been received from MNRE; DST, UGC, AICTE etc.

**Infrastructure:** Infrastructural facilities include Computer Laboratory, Testing set up for solar thermal devices, Anelva - Plasma Chemical Vapor Deposition (P-CVD) system, Hot Wire - Chemical Vapour Deposition (HW-CVD) System, Electron Beam Deposition System, Spray Pyrolysis techniques, DLTS for material characterization etc. In addition to the central Jaykar library of University, the School has its own internal library having good collection of book on the relevant subjects.

**Research Areas and Activities:** University of Pune has been ranked No. 31 institute as per Careers360 research for the year 2014<sup>45</sup>.

School of Energy Studies (SES) is an Inter Disciplinary Science Centre. Students from any science department can use the facilities available in SES to carry out their research work. The main research fields in SES are solar thermal and solar photovoltaic. Other research areas are biomass technologies and wind energy. Facilities available in SES to carry out research activities:

Solar Thermal: SES has a test centre for testing various solar thermal gadgets.

Solar Photovoltaic: The laboratory is equipped with all the major equipments required for research.

Major systems available in the laboratory are:

- Anelva - Plasma Chemical Vapor Deposition (P-CVD) system
- Hot Wire - Chemical Vapor Deposition (HW-CVD) system
- Electron Beam Deposition system
- Spray Pyrolysis system
- Photo Chemical Deposition system

<sup>45</sup> <http://www.university.careers360.com/articles/top-100-universities-in-india-2014>

On-Going Research Schemes / Projects:

- Regional Test and Technical Back-up Centre by MNRE.
- Energy Park
- Development and Study of Fresnel Lens based Solar Concentrator by DST.
- Synthesis of Nano-Crystalline Si: H using Hot-Wire CVD by University of Pune.

**Networking and Collaborations:** Some of the collaborations are with Thermax Ltd, Bharati Vidyapeeth University, and Symbiosis International University.

**Source/web link:** [http://www.unipune.ac.in/snc/school\\_of\\_energy\\_studies/default.htm](http://www.unipune.ac.in/snc/school_of_energy_studies/default.htm)

## 10. University of Petroleum and Energy Studies (UPES)

**Overview:** University of Petroleum and Energy Studies (UPES) is a first of its kind university in the Pan Asian region. It is the:

- First Indian Energy University recognized by UGC under Section 2(f) of the UGC Act, 1956
- First Indian Energy University accredited by the Energy Institute, UK
- First Indian Institution to offer 50 specialized programs across Oil & Gas, Power, Transportation, Infrastructure and Logistics & Supply Chain sectors
- First Indian Energy Institution to set up an in-house Bio-Diesel Laboratory

UPES was established in 2003 through an Act (UPES Act, 2003) of the State Legislature of Uttarakhand. UPES is recognized by University Grants Commission (UGC) and National Assessment and Accreditation Council (NAAC). The courses offered by the University in different constituent colleges are up-to-date, relevant and industry based. The University aspires to conduct R&D in diverse areas aiming to cover the full spectrum, from fundamental and theoretical studies, through research of relevance to business and industry with practice-based studies in Energy. Major research areas with a core focus are: Renewable energy systems, Sustainable Development, Environmental and Energy economics and Energy Law.

**Experience:** UPES has nearly 10 years of experience in energy research and development activities. Eleven exclusive dedicated research centers are deeply engaged in exploring, discovering and understanding various aspects of the core sectors. UPES has emerged as a world-class institution dedicated in developing super-specialized, ready to deploy managers and engineers for domain specific industry. UPES is committed to provide training, research, consultancy or outreach services in energy & allied areas.

**Human and Financial Capital:** The University has presently 14 numbers of Doctoral Research Fellows, 162 Management Professionals and 194 Technology professionals.

UPES funding's have been allocated for developing and demonstrating Technology solutions E.g.: Energy Efficient Stove and Gasifier. UPES receives funding from various government agencies such as DST, DBT, MNRE, Indian Oil Corporation Limited (IOCL), Oil Industry Development Board (OIDB) and Uttarakhand State Council for Science and Technology (UCOST) etc.

**Infrastructure:** The University set-up is spread over in one campus at Dehradun. University has advanced 79 research laboratories catering to pure sciences, engineering, advanced engineering as well as sector specific requirements. UPES centre consists of a network of more than 2500 computers, as well as specialized academic computing labs and services. Library facilities are well stocked with books, journals, magazines and modern e-resources making it a very important source of learning. R&D Department serves as a point of contact for all national and international research projects opportunities, activities, news and updates.

**Research Areas and Activities:** UPES has the following research centres and institutes:

- Centre for Excellence in energy economics
- Centre for Earth Sciences
- Computing Research Institute
- Institute of Alternate Energy Research (IAER)

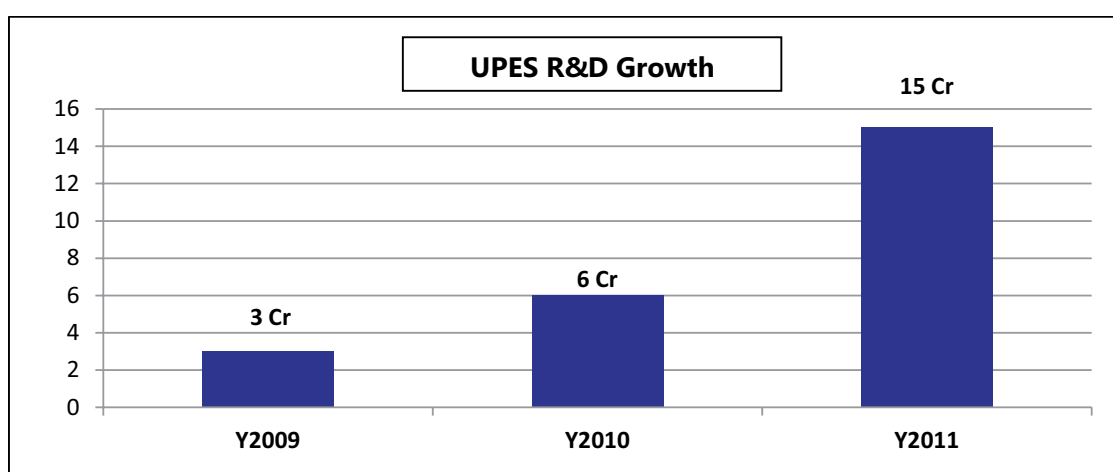
- Institute of Nanoscience and Nanotechnology (NSNT)
- Environment Research Institute (ERI)
- Centre for Energy Law

University actively promotes research, development and demonstration projects across energy and allied services. Some of the R&D projects of UPES are:

- Biomass Gasification-Route to Energy Independence in Rural Areas
- Estimation of shelf life of polymer based chemicals for drilling & production of hydrocarbons
- Establishment of Jatropha de-oiled cake based biogas plant
- CSTR Technology for Biogas from Jatropha whole plant
- Establishment of jatropha de-oiled cake based biogas plant
- Research Capacity Development in Renewable Energy

UPES innovative research efforts are geared towards the Development of Photo-catalysis route for Hydrogen Production, New Generation Bio Energy using Algae, New Initiative in Solar Energy, and Hydrogen storage through metal hydrides/zeolites. Efforts in the area of Nano-Technology include developing: (i) Nano-fluids for Drilling, (ii) Enhanced Oil recovery and (iii) Enhancing Solar PV Efficiency are being initiated.

The following diagram shows UPES R&D growth over the years through various research activities, and projects:



**Networking and Collaborations:** R&D department identifies a funding opportunity (both national and international) and further communicate with all concerned departments and build multidisciplinary project team. UPES has entered into collaboration with IBM India Pvt. Bangalore, Birbal Sahni Institute of Palaeobotany, UPES-Indian Oil Corporation Ltd. (IOCL) & Suzlon Energy Centre (SEZ), University of Nairobi, Kenya DST – Sri Lanka, UKIERI-DST, Indian Institute of Petroleum (IIP), Larsen & Toubro Mumbai, University of Edmonton, Carleton University Ottawa, Marist College, European Business School University, University of Aberdeen, Coventry University etc among many others.

**Publications:** UPES has more than 1000 publications. Department of Petroleum Engineering & Earth Sciences- UPES has around 100 publications.

**Source/web link:** <http://upes.ac.in>

## 11. Amity Institute of Renewable and Alternative Energy (AIRAE)

**Overview:** The Amity University has been established by an act of State Legislature and recognized by University Grants Commission (UGC). The institute has started M.Tech and B.Tech courses in **Solar and Alternative Energy**. The programme comprises of conceptual knowledge of solar and other renewable energy systems. Considering the importance & wide applications of Renewable energies, Amity University established an Amity Institute of Renewable and Alternative Energy (AIRAE).

**Experience:** Amity Institute has good experience in **solar and other renewable energy systems**. Amity institute offers various programmes such as Graduate: B.Tech - Solar and Alternate Energy; Post Graduate Programs: M.Tech. - Solar and Alternative Energy; Research Degree Programs: Ph. D. Solar Energy (Full Time/Part Time), Ph. D. Renewable and Alternate Energy (Full Time/Part Time).

**Human Capital:** Amity is the leading education group of India with over 100,000 students studying across 1000 acres of hi-tech campus.

**Infrastructure:** The institution has world class labs with new-age equipments to give students real life experience and conduct innovative research. Laboratories are well equipped with various B. Tech. & M. Tech. Experimental lab, Electrical characterization lab, Thin Film lab, Sensor labs, Bio-chemistry, SEM lab and sample preparation labs. Libraries at Amity are more like integrated Knowledge Resource Centres that are stocked with over 1,25,000 books in total which includes periodicals, references, national and international journals, CD-ROMs covering all aspects of academic studies and research material.

**Research Rating and Results:** Amity University received several rankings in the 2013 India Today college rankings. It was ranked India's #1 non-profit private university. Its engineering school was ranked first amongst India's emerging colleges<sup>46</sup>.

Amity University has been ranked the no. 1 private entity. University (Source: Education Times)<sup>47</sup>.

Research areas at Amity Institute of Renewable and Alternative Energy (AIRAE) and Amity Institute of Advance Research and Studies (AIARS) include:

- Photovoltaic Devices: Organic and Inorganic
- 3<sup>rd</sup> Generation Solar Cells based on Nano-materials
- Energy Generation using Renewable Energy Concepts
- Synthesis of Nano-materials
- Chemical, Gas, and Bio-Sensors based on Nanotechnology
- Organic Light Emitting Diodes
- Applications of nanotechnology in Microbiology
- Water Purification using Nano-materials

The faculty of AIRAE jointly with Amity Institute of Advance Research and Studies (Materials & Devices) – AIARS (M&D), comprises leading academicians, senior scientists and researchers

<sup>46</sup> [http://en.wikipedia.org/wiki/Amity\\_University](http://en.wikipedia.org/wiki/Amity_University)

<sup>47</sup> [http://www.amity.edu/admission/top\\_rank.asp](http://www.amity.edu/admission/top_rank.asp)



who are credited with: 20 Patents, more than 250 Published Papers and 7 Ongoing Research Projects funded by various Govt. Departments.

There are nearly 5000 research publications and 500 books in the area of science. Some of the ongoing research projects are:

- HEMT with polarization effects for high power applications
- Polarization dependent analysis of Al<sub>m</sub>Ga<sub>1-m</sub>N/GaN HEMT for high power applications
- Low Power High-Speed CMOS Circuits
- Power consumption monitor and alarm for CATV Network

### Networking and Collaborations:

- Amity University has various collaborations with national institutes such as DRDO, Delhi University and the IITs.
- Amity University and University of Seychelles signed a Memorandum of Understanding to foster and strengthen the mutual relationship and facilitate the exchange of expertise between both the Universities.
- Amity University and International School of Management (ISM), Paris established a partnership alliance in year 2012 to offer academic cooperation, joint seminars and student-faculty exchange program.
- University of Kentucky is willing to collaborate in the areas of Natural Sciences, Agro Biology, and Bio-technology and would be glad to work with Amity University in the area of student and faculty exchange in research, community engagement, international outreach and global health programs.

Some of the other international collaborations of Amity University are: Claflin University – USA, College of Business – Delaware State University, NJIT – USA, University Of Indianapolis – USA, International School Of Management (ISM) – USA, International Business School – Germany, Napier University – UK, Newcastle University – UK, and National Tsing Hua University –Taiwan.

**Publications:** There are around 10 publications<sup>48</sup>.

**Source/web link:** <http://www.amity.edu/airae>

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<sup>48</sup> <http://www.amity.edu/airae/Research.asp>

## 12. Gujarat Energy Research & Management Institute (GERMI)

**Overview:** Gujarat Energy Research & Management Institute (GERMI) was set up in 2003 as a centre of excellence in industry learning and has been set up to develop human resource assets to cater to the petroleum and allied energy sectors, improve knowledge base of policy makers and technologists and provide a competitive edge to leaders to compete in the global arena. GERMI promoted by Gujarat State Petroleum Corporation Ltd (GSPC) is a fully integrated energy company having a presence in various operations like Exploration & Production, Transportation of Gas, Power Generation, IT services etc. It is one of the fastest growing state owned companies and has excellent support from Gujarat Government as well as from Central Government. GERMI has been recognized by Scientific and Industrial Research Organization (SIRO) by DSIR, Govt. of India.

**Experience:** GERMI has a good 10 years of experience in energy research and management and has been involved in R&D, training (which has been envisioned in a backdrop of a substantial gap between the demand and supply for targeted and effective training courses in the emerging energy sector), consultancy (consulting projects are undertaken in renewable energy and environment areas) and education.

**Financial Capital:** GERMI receives funding from Gujarat government and from Central government by working on various research and development and consultancy projects and have collaborations with various international organizations in USA and Canada.

**Infrastructure:** The state-of-the-art R&D infrastructural facility at GERMI enriches the knowledge economy at local, national, regional and global levels in scientific assessment. Some of the facilities include: Basic Petroleum testing facility, Core Petroleum lab, Shale gas lab, and Geographic information system lab.

**Research Areas and Activities:** GERMI has established a **Research and Innovation Centre**, with three major research wings and various other research cells on: Petroleum, Solar and Environment.

**Petroleum Research Wing:** Petroleum Research Laboratory has the basic objective to serve as a Centre of Excellence in research on development of increasingly efficient and well adapted technologies to upgrade, manage and commercialize the oil and gas resources. The research programme includes basic studies of oil and gas displacement and production, reservoir rock and fluid properties, drilling technology, methodologies to improve oil recovery, gas production from gas hydrates, establish database and models for future reservoir management and to maximize hydrocarbon recovery.

**Renewable Research Wing:** Research wing is positioned to reach national energy goals by developing new ways to power homes and businesses and to fuel vehicles. The wing develops and advances in renewable energy and energy-efficient technologies.

**Solar Energy Research Laboratory: *The Solar Energy Research Cell of the institute is the first of the Renewable Energy Research Wing departments to become operational.***

**Environmental Research Wing:** GERMI will research on issues of national and international importance related to science, technology and management of climate change impacts.

Another area of research is energy and nutrient optimization in substrate conversions and indicators. Some more areas of research include:

- Assessment of potential renewable and alternative energy options in:
  - Unit operations and processes in industries
  - Eco-industrial development
- Bio-conversions and optimization pathways
- Environmental impacts assessment, remediation and preventive practices

**Some recent outputs include:** Structuring and bid process coordination for 5 MW Gandhinagar Photovoltaic rooftop programme; Preparation of discussion paper and traffic order for procurement of power from solar energy projects for Gujarat Electricity Regulatory Commission (GERC); Demonstration of net-zero energy building.

**Networking and Collaborations:** GERMI is in collaboration with various universities such as University of Western Ontario, Canada; University of Saskatchewan, Canada; University of Houston, USA; University of Tulsa, USA; Georgia Tech, Atlanta, USA.

GERMI also has collaborations with researchers from Pandit Deendayal Petroleum University (PDPU), Gandhinagar and CSIR-Central Electronics Engineering Research Institute (CEERI) Pilani. This collaboration has demonstrated a model-based calculation of the effect of indium composition on the open-circuit voltages of indium-gallium nitride (InGaN) Schottky junction solar cell (SJSC) under monochromatic light illumination.

**Publications:** There are around 80 publications of the institute.

**Source/web link:** <http://www.germi.org>

## 13. Energy Research Centre (ERC) – Punjab University

**Overview:** The Energy Research Centre was established in 1983 at Punjab University to promote R&D and Extension activities in the emerging field of Renewable Energy. Energy research Centre was the only R&D centre in the country which was designated as Nodal Agency for the implementation of different programmes of MNES. The Centre is responsible for undertaking training and feedback surveys in the States of Haryana, Himachal Pradesh, Chandigarh and Jammu Region of J&K state, under National Programme on Improved Cook stove, Ministry of Non Conventional Energy.

**Experience:** Energy Research Centre has 30 years of experience and has emerged as a major focal point of R&D and extension on energy and environment at national and international level. Some of the strengths of Energy Research Centre are: Solar Thermal Energy Storage, Solar Detoxification, Biomass Combustion and Gasification, Biomethanation of Agricultural/Industrial/Forest Wastes, Indoor Air Quality and Energy & Environmental Conservation and Management.

**Financial Capital:** Energy Research Centre receives funding from national institutions such as TERI, Society for Promotion of Wastelands Development, New- Delhi, M.N.E.S., M.H.R.D, Government of Haryana.

**Infrastructure:** Laboratories of the Energy Research Centre are equipped with the state-of-the-art equipment. Centre has been designated as a regional test centre for testing solar thermal equipment by MNES. Bureau of Indian Standard (BIS) has approved the centre for testing wood burning stoves. Research activities are the hallmark of Energy Research Centre, with its focal point in renewable energy.

**Research Areas and Activities:** Energy Research Centre has recently diversified its R&D activities under various thrust areas like:

- Nano fluids: characterization, hydrodynamics and thermal performance of nanofluids.
- Development of environmental friendly heterogenous catalysts for various industrially important esterification reactions.
- Studies on Photo catalytic degradation of effluents from dye and pesticide industry.
- Complex flow hydrodynamics: theoretical and experimental studies on flow through porous media.
- High temperature solar energy storage systems

Some of the R&D programmes are:

- R & D and Extension work in the Solar Thermal Energy
- R & D programme in Thermal Energy Storage Systems
- R & D and Extension in Bio Energy for Wood based Systems
- R & D Programme in Solar Detoxification
- Testing facility for solar thermal devices

**Networking and Collaborations:** Energy Research Centre (ERC) has provided consultancy to a large number of countries in Asia- Pacific region such as Maldives, Bangladesh, Sri Lanka, Myanmar, Kiribati and Tuvalu, in the area of renewable energy sources, energy management and environmental protection. Centre has also helped the states of

Haryana, Punjab and Himachal Pradesh in solving problems associated with energy planning & management and environmental protection. Centre has collaborations with some national research institutions such as TERI, Society for Promotion of Wastelands Development, MNES, MHRD and Govt. of Haryana.

**Publications:** There are around 151 publications of the centre.

**Source/web link:** <http://erc.puchd.ac.in>

## 14. Centre for Energy – IIT Guwahati

**Overview:** Centre for Energy at Indian Institute of Technology Guwahati was established in May, 2004 with an objective to impart teaching, **conduct research** and to provide consultancy in various aspects of **energy technology and systems**. The center has ambitious plans to grow into a major centre in the region catering to the training and research needs of the Indian energy sector and contributing to the international research in the energy. Looking into the potential and application of different energy resources from the north eastern region of India, it is emphasized that the centre will give priority to activities in the field of bio-energy, small hydro-power, solar photovoltaic and solar thermal power. The center plans to broaden its activities in the area of alternative fuels, clean coal technology, wind power, energy integration and conservation in process plants. The Centre has also started conducting interactive programs like short-term course, training and demonstration.

**Experience:** Centre for Energy has 9-10 years of experience in fostering development of research and education in the multi-disciplinary area of energy at the Indian Institute of Technology Guwahati. The Centre caters to the training and research needs of the Indian energy sector giving a special emphasis for rural employment generation and to create a pollution free environment.

**Human and Financial Capital:** There are around 26 faculty and staff members of the Centre for Energy whose area of interest is in Renewable Energy, Non-conventional Energy Sources, design of Heat Transfer Equipments and Chemical Reaction Engineering etc.

The Centre receives funds from various sponsoring agencies such as Defence Research Laboratory, Tezpur; CSIR; Assam Science Technology and Environment Council (ASTEC), MNRE, DBT, MNES, etc

**Infrastructure:** The Centre has Energy efficiency lab, Engine Testing Facility, Water Pump Testing Facility, solar energy lab, Bio energy lab and Fuel cells lab (which works on design and development of a biofuel cell for biomedical applications).

**Research Areas and Activities:** Research at Centre for Energy – IIT Guwahati is involved in Academic programme, in-house research, consultancy and projects.

- Academic research programme: Centre for Energy is currently offering PhD in Energy. Following are some of the broad areas of research for PhD: Biomass Gasification, Circulating Fluidized Bed Boiler, Fuel Cells, Combustion, Solar Cells and Micro propagation and Genetic Engineering of Biofuel Plants.
- The Centre has received number of consultancy projects in the area of wind energy, solar energy, biological fuel cell, engine technology, biogas, biodiesel, energy efficient machines.
- Number of In house research projects are ongoing in the Centre, prominent among which are: Development of an efficient oil expeller for biodiesel extraction and Development of a soxhlet apparatus for biodiesel extraction (for solvent extraction method)
- The Centre has received a number of sponsored research projects: A novel energy efficient hydrodynamic cavitations technique for extraction of oil from micro algae for

biodiesel production, Utilization of Biowaste for generating power in diesel engines are some key projects.

**Networking and Collaborations:** Centre for Energy has collaborations with some of the national institutes such as CSIR, Oil India Ltd, Grassroot Innovation Augmentation Network, IIT Guwahati, Defence Research Laboratory Tezpur, Assam Science Technology and Environment Council (ASTEC), MNRE and Ministry of Non-Conventional Energy Sources (MNES) in various energy projects.

**Publications:** Around 160 publications are present in the centre for energy at IIT Guwahati.

**Source/web link:** <http://www.iitg.ac.in/ceer/index.html>

## 15. CSIR-Indian Institute of Petroleum (CSIR-IIP)

**Overview:** IIP is one of the leading constituent laboratories of CSIR. It was established in 1960, dedicated to R&D in the hydrocarbon and related sector. The institute undertakes R&D work in areas of petroleum refining, natural gas, alternative fuels, petrochemicals utilization of petroleum products in IC engines and in industrial and domestic combustion. The institute also grants technical and analytical services to petroleum refining and related industry including technology transfer for developing novel, state-of-art technologies and products. It also conducts training programmes for technical personnel from refining industry, petrochemical plants, automotive sector, power plants and other related user industries.

**Experience:** IIP has 54 years of experience. The institute is engaged in multidisciplinary areas of research & development including petroleum refining, biomass to fuels & chemicals, energy efficient products & processes, fuels & lubricants, chemicals & petrochemicals, CO<sub>2</sub> capture and utilization, value addition to refinery systems, automotive engines & emissions.

**Human and Financial Capital:** There is about 510 research staff including research scientists supported by technical personnel. It is equipped with R&D facilities including pilot plants. The annual budget of the institute is around 3 Million Euros. The institute is recognized by over 14 universities to conduct research leading to Doctorate degree.

**Infrastructure:** The institute has dedicated and experienced researchers and is supported by centralized sophisticated instrumental facilities, FTIR, pilot plants, computational facilities and digital information resource centre. Apart from this, state-of-art research facilities and various equipments are available in individual research groups. The institute has developed a large number of processes & technologies.

**Research Areas and Activities:** IIP is a premier national research laboratory engaged in multidisciplinary areas of R&D including petroleum refining, biomass to fuels & chemicals, energy efficient products & processes, fuels & lubricants, chemicals & petrochemicals, CO<sub>2</sub> capture and utilization, value addition to refinery systems, automotive engines & emissions, tribology, industrial and domestic combustion.

IIP's Research Activities include:

- Petroleum Refining and catalysis, Catalytic refining and catalysis, Catalyst for refining process, Separation process, solvent extraction, adsorption, membranes
- Lubricating oil base stocks processes, evaluation and characterisation, Modified bitumen and carbon materials, Thermal conversion process
- Modeling and simulation, Chemical/petrochemicals intermediates, Additives for petrochemicals industry, Petrochemicals intermediates, Bioprocessing of petroleum streams
- Fuel lubes and chemicals from biomass

Petroleum Products Application:

- Engine emission: pollution abatements
- Alternative fuels: oxygenates, CNG, Propane, LPG, DME
- Engine development: improved efficiency, lower emission
- Tribology: evaluation and development of petroleum products, and developments of techniques for product evaluation



**Networking and Collaborations:** IIP has collaborations with several national and international institutions as follows.

**National:**

- EDCiL (India Ltd.), Ministry of Human Resource Development for training on Global level.
- Uttarakhand Technical University, Dehradun.
- Delhi Technological University for academic collaboration
- University Institute of Chemical Engineering & Technology, Panjab University, Chandigarh.
- Banasthali University, Rajasthan for enhancing within the country the availability of highly qualified manpower in the area of chemical engineering.
- BITS, Pilani; Rajiv Gandhi Institute of Petroleum Technology, Rae Bareli;
- Department of Energy, Tezpur, Assam to establish close linkage and functional coordination for pursuing higher studies, research and need-based training programmes.
- Doon University, Dehradun for academic collaboration.
- Mahatma Gandhi Institute of Combating Climate Change (MGICCC), Delhi

**International:**

- Erlangen Graduate School in Advanced Optical Technologies (SAOT), Friedrich-Alexander-University, Erlangen-Nuremberg, Germany and Lehrstuhl für Technische Thermodynamik (LTT), Germany to utilize mutual R&D facilities and expertise for scientific collaborative R & D work besides training of scientific manpower amongst researchers of CSIR/IIP, SAOT & LTT.
- MoU entitled 'Application of Bio-fuels for Aviation' under Indo-Canada Cooperation Programme signed under ISTP-GITA bringing together a consortium of institutes, universities, companies from India and Canada.
- Department of Mechanical Engineering, Combustion & Environment Research Group, University of Alberta, Edmonton, AB, Canada agreed to utilize mutual R & D facilities and expertise for scientific collaborative R&D work in the development of nano-particulate measuring facility and generation of data for CNG vehicles in India as well as in Canada.
- Illinois Sustainable Technology Centre (ISTC) of University of Illinois Centre (UIUC) for the utilization of mutual R & D facilities and expertise for scientific, collaborative, R & D work and training of scientific manpower amongst researchers of CSIR-IIP and ISTC-UIUC in the area of renewable energy and biofuels.

Some of the institutes collaborated with are: Deminco/ Kerdoon, USA; Fluor Daniel; Patcham, UAE; Sabic, UK; Shell Technologies; KRICT, Korea; Uop, USA; Unilube, KSA; Monash University, Australia; University Of Huorsfield, UK; University Of New Castle, UK; Swri, USA; Soat-Ltt, Germany; Exxon Mobil, USA; Pratt & Whitney, Canada; RTI, UAE; Shell, UK; Sintef, Norway; Ukieri, UK; Unam, Mexico; University Of Alberta, Canada; University Of Brasilia, Brazil; Technische University Munchen, Germany; Engergent Technology, USA; Imdea Energia, Spain; and Super Refinery, Bangladesh.

**Publications:** There are more than 200 publications at IIP.

**Source/web link:** <http://www.iip.res.in>

## 16. Central Mine Planning and Design Institute (CMPDI)

**Overview:** CMPDI is a fully owned subsidiary of Coal India Limited, engaged in the field of environmental engineering and provides consultancy and engineering services across the globe. It is a public sector undertaking under the Government of India and is rated as a Schedule-B and Mini Ratna-II company. CMPDI was established in 1974, under Coal Mines Authority Limited (CMAL) (former name of Coal India Limited). CPDMI has its headquarters in Ranchi, Jharkand and is involved in mineral exploration, resource evaluation, resource management, mining geology, hydro-geological and geophysical studies, and engineering geology investigations. It is an ISO 9001 accredited company and was rated as a Mini Ratna (Category II) company in 2009. The Institute is active in geological exploration, geological, geotechnical and allied support, mine planning and design, environmental management and training services.

**Experience:** CMPDI has 40 years of experience in the ground of environmental engineering and provides consultancy and engineering services across Indian and the globe. CMPDI offers complete planning and design services for architectural planning, civil, structural, electrical and mechanical engineering.

**Infrastructure:** CMPDI has well equipped laboratories for carrying out investigations for geo-chemical, coal petrography, mining technology, coal bed methane, coal washability and geo-physical studies. CMPDI has laboratories with highly skilled manpower and state-of-the-art equipment. The data generated by these laboratories form the basis for characterisation and grading of coal in exploration, mine feasibility reports.

**Research Areas and Activities:** CMPDI is the nodal agency to coordinate research activities. The major areas of coal research are:

- Production, productivity and safety
- Coal beneficiation and utilization
- Environment and ecology

CMPDI has established itself at the forefront of technological developments, through its strong commitment to research and development. It is the nodal agency, constituted by the Government of India, for funding R&D projects on coal and lignite deposits in India under Department of Science & Technology schemes. It also assists Technology Information and Forecasting Concept (TIFAC), an agency set up in the Ministry of Science & Technology, in assessing state-of-the-art technologies and forecasting technological trends. A number of research and development projects have been commercially applied to the industry.

**Networking and Collaborations:** CPMDI has entered into MOUs with many international agencies such as IMCL-UK, Metchem-Canada, Giprosakht-Russia, Montan Consulting GmbH-Germany, Rheinbraun Engineering-Germany and DMT - Germany for cooperation in the field of earth resources.

**Publications:** There are around 480 publications.

**Source/web link:** <http://www.cmpdi.co.in>

## 17. Department of Chemical Engineering – NIT – Tiruchinapally

**Overview:** Department of Chemical Engineering, NIT Trichy regarded as one of the premier centres for Chemical Engineering in India by industries as well as academia, was established in 1968. The Department offers a B.Tech programme and M.Tech programme in Energy Engineering, Plant Design and Process Controls & Instrumentation. The department is supported by highly qualified and experienced faculty; most of them have been involved in various industrial projects and consultancy services.

**Experience:** The Department has around 46 years of experience in teaching and research of engineering and technology. It offers undergraduate and graduate programs in disciplines spanning engineering, science, architecture and management. The Department's objectives include expanding areas of materials, environmental and energy-related industries and timely progress toward an advanced degree in chemical engineering or a related technical discipline.

**Human and Financial Capital:** The Department has about 20 faculty members and more than 35 enrolled students for BTech, MTech and around 40 PhD students. Funds come from various courses offered and through projects sponsored by CDAC, CSIR, DST and DBT.

**Infrastructure:** The Department of Chemical engineering has facilities such as: Fluid Mechanics, Mechanical Operations, Technical analysis, Heat Transfer, Chemical Reaction Engineering, Mass Transfer and Process Dynamics and Control. There are varieties of books in department library.

**Research Areas and Activities:** NITT is ranked as one of the top most NITs. NITT was ranked #9 on the India Today Best Engineering Colleges 2012. NITT was ranked #10 in the Outlook India Top Engineering Colleges of 2012. Among government colleges, it was ranking #12 in the Mint Top 50 Government Engineering Colleges of 2009.<sup>49</sup>

Some of the industrial projects are:

- Hydrogen from Biomass for Fuel Cell application: Process research & development, sponsored by High Energy Batteries, Trichy
- Beneficiation of iron Ore & Coal: Process Research & Development, Sponsored by Tata Steel, Jamshedpur.
- Enzymatic transformations for value added esters and chemicals from oils & Fats, Sponsored by Bunge India pvt. Ltd.
- CO<sub>2</sub> sequestration from Power plants by Absorption process- Sponsored by BHEL, Trichy.

Some of the currently running projects are:

Project Title	Sponsoring agency
Heat Transfer augmentation studies in a circular tube fitted with different inserts	CSIR

<sup>49</sup> [http://en.wikipedia.org/wiki/National\\_Institute\\_of\\_Technology,\\_Tiruchirappalli](http://en.wikipedia.org/wiki/National_Institute_of_Technology,_Tiruchirappalli)

Project Title	Sponsoring agency
Synthesis of Cellulosic Nanofibres from Aquatic Weeds	DBT
Development of polyimide membranes for Wastewater treatment & recovery	DST
Development and application of Inorganic Membrane in the treated of waste water and Processing of sugar canes.	DST
Design of cyclones and CFD Analysis of 125 MW Power Plant	BHEL
Modeling and Control of Processes with Large Process Lag and Random Processes	CDAC

Chemical Engineering Association was setup under the Department of Chemical Engineering at the National Institute of Technology, Tiruchirappalli with the aim of enhancing and enriching the knowledge in chemical engineering.

**Networking and Collaborations:** Collaborations have been established with institutes like Royal Academy of Engineering, Anna University, Coimbatore Institute of Technology, IISc and University of Madras.

**Publications:** There are around 175 publications of the department.

**Source/web link:** <http://cheme.nitt.edu/website/Home%20Page.htm>

## 18. Sardar Swaran Singh National Institute of Renewable Energy (SSS-NIRE)

**Overview:** The Ministry of New and Renewable Energy established SSS-NIRE in 2012. The Autonomous Institute, in Kapurthala District, Punjab conducts Research, Design and Development activities in all the areas relating to new and Renewable energy sources. It also engages in Post-Doctoral Research and Research leading to commercialization of the new and Renewable energy technologies. It serves as a technical focal point for development of bio-energy, including bio-fuels and synthetic fuels. This up-coming R&D centre's vision is to carry out state-of-the-art R&D covering the entire spectrum of bioenergy leading to commercialization and their integration with other renewable energy technologies. R&D activities have already been initiated in the area of Biomass and Energy, Thermochemical Conversion, Management Biochemical Conversion, Chemical Conversion, Electrochemical Processes including hybrid energy systems. The objectives of the Institute is to carry out and facilitate research, design, development, testing, standardization & technology demonstration eventually leading to commercialization of R&D output with a focus on bioenergy, biofuels & synthetic fuels in solid, liquid & gaseous forms for transportation, portable & stationary applications, development of hybrid / integrated energy systems, to undertake & facilitate human resource development and training in the area of bioenergy<sup>50</sup>.

**Experience:** SSS-NIRE is a relatively new Institute, established in 2012 with a strong mission to be knowledge based R&D Institution of high quality, to provide services and seek to find optimum solutions for major stakeholders across the entire spectrum of the bio-energy sector and to support the Rural Energy sector in developing the knowledge for promoting new technology.

**Human and Financial Capital:** The Institute has a team of 14 scientific, technical and project staff and around 6 administrative and supporting staff. Research in the institute is being funded by MNRE.

**Infrastructure:** Several state-of-the-art facilities and equipments are already available in the institute to enable high-end research work. Key R&D Laboratories include:

- R&D – I: Chemical Conversion Lab  
Biodiesel Lab; Hydrocracking Lab; Algal Biomass Lab
- R&D – II: Biochemical Conversion Lab  
Bioprocess Lab; Microbiology Lab; Molecular Biology Lab
- R&D – III: Thermochemical Conversion Lab  
Cookstove Lab; Hybrid Systems Lab; Gasification Lab; Pyrolysis Lab

Other facilities in the sprawling campus of 75 acres include Workshop to develop the research designs, Library, Hostel Block with 40 rooms, Guest House, Housing Type-II, IV & V and a Computer Centre

**Research Areas and Activities:** Some of the key research activities being undertaken in the institute include<sup>51</sup>.

<sup>50</sup> <http://mnre.gov.in/centers/sss-nire/>

<sup>51</sup> <http://mnre.gov.in/centers/sss-nire/>

- Integrated Technology Development for Biodiesel Production using Heterogeneous Catalyst (Completed)
- Biocrude Production: Hydro-cracking of non-edible vegetable
- Process development for bioethanol production from agricultural residues
- Designed and experimental efficiency of different models of Cook Stoves developed at NIRE. R&D Centre for improved biomass cookstove
- The algal biomass laboratory
- Biogas production from crop residues.
- MoU with leading Research Institutions.

**Networking and Collaborations:** This nascent institute which has already carried out high quality research activities and boasts high-end infrastructural facilities, with a strong backing from the Ministry of New and Renewable Energy, is envisaged to engage in several national and international level collaborations in the coming years. This will be an institute to look forward for networking and collaborations by international players, not just the research institutes, but also industries as innovation and technology and commercialization is a key focus area of the institute.

**Publications:** The Institute has already produced 5 journal publications, 15 conference proceedings, and two of its scientists received the most coveted Institutional and Globally reputed Presentation of 'Bharat Jyoti Award' along with 'Certificate of Excellence' for their contribution in R&D presented by India International Friendship Society.

**Source/web link:** <http://www.nire.res.in/index.php>



## 3.3 ENVIRONMENT

### Sector Summary

Environmental sector is one of the emerging sectors in India, playing a very important role in the GDP of the country. There are various under graduate, post graduate as well as doctoral courses that can be undertaken by aspirants in this field. Several public and private sector companies in the environmental sector are operational across the country. Climate change is increasingly becoming a central topic of debate for strategic decision making by governments and businesses. The Ministry of Environment & Forests (MoEF) is the nodal agency in the administrative structure of the central government for the planning, promotion, co-ordination and overseeing the implementation of India's environmental and forestry policies and programmes. With the guiding principle of sustainable development and enhancement of well-being of the man-kind, the primary concerns of the Ministry include implementation of policies and programmes relating to conservation of the country's natural resources including its lakes and rivers, its biodiversity, forests and wildlife, ensuring the welfare of animals, and the prevention and abatement of pollution. The Ministry also serves as the nodal agency in the country for the United Nations Environment Programme (UNEP), South Asia Co-operative Environment Programme (SACEP), International Centre for Integrated Mountain Development (ICIMOD) and for the follow-up of the United Nations Conference on Environment and Development (UNCED). The Ministry is also entrusted with issues relating to multilateral bodies such as the Commission on Sustainable Development (CSD), Global Environment Facility (GEF) and of regional bodies like Economic and Social Council for Asia and Pacific (ESCAP) and South Asian Association for Regional Co-operation (SAARC) on matters pertaining to the environment<sup>52</sup>.

Fifteen major environment universities and research institutes covered in this report include:

1. National Environmental Engineering Research Institute (NEERI)
2. Centre for Science and Environment (CSE)
3. Centre for Environmental Science and Engineering (CESE) - IIT Bombay
4. Centre for Ecological Sciences (CES) - Indian Institute of Science (IISc)
5. Environmental and Water Resources Engineering (EWRE) - IIT Chennai
6. Indian Institute of Environment Management (IIEM)
7. Nansen Environmental Research Centre India (NERCI)
8. Environment Protection Training and Research Institute (EPTRI)
9. Indian Council of Forestry Research and Education (ICFRE)
10. Environmental Resources Research Centre (ERRC)
11. G.B. Pant Institute of Himalayan Environment and Development (GBPIHED)
12. The Indian Institute of Forest Management (IIFM)
13. CSIR-Institute of Himalayan Bioresource Technology
14. Wildlife Institute of India (WII)
15. CSIR - National Geophysical Research Institute (NGRI)

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<sup>52</sup> <http://www.moef.nic.in/about-ministry/about-ministry>

## 1. National Environmental Engineering Research Institute (NEERI)

**Overview:** National Environmental Engineering Research Institute (NEERI), Nagpur was established in 1958 as Central Public Health Engineering Research Institute (CPHERI), when environmental concerns were limited to human health with a focus on water supply/ sewage disposal/ communicable diseases and to some extent on industrial pollution and occupational diseases. The chemical and biological solutions to address these problems were simple, though challenging. The Institute was rechristened as National Environmental Engineering Research Institute (NEERI) in the year 1974. **NEERI is a pioneer laboratory in the field of environmental science and engineering and part of Council of Scientific and Industrial Research (CSIR).** NEERI has five zonal laboratories at Chennai, Delhi, Hyderabad, Kolkata and Mumbai. NEERI comes under the Ministry of Science and Technology of central government.

**Experience:** NEERI has more than 55 years of experience in environmental concerns and is devoted to research and innovation in environmental science and engineering besides solving a range of problems posed by industry, government and public.

**Human Capital and Financial Capital:** NEERI is served by competent and experienced team of about 125 scientists in various core disciplines of relevance to environmental science and engineering, viz. environmental engineering, chemical engineering, environmental chemistry, environmental biology and fourteen other science and engineering disciplines.

NEERI is a research institute created and funded by the Government of India.

**Research Areas and Activities:** NEERI conducts research and developmental studies in environmental science and engineering and renders assistance to the industries of the region and local bodies, by solving the problems of environmental pollution. NEERI's R&D activities are being performed at various research divisions which include:

**Air Pollution Control division:** Air Pollution Control Systems Design and Development involves in Emissions generation, treatment studies and design of Air Pollution Control Systems for small/medium scale industries. **Environmental Biotechnology division:** Major R&D thrust areas of the divisions are: environmental biotechnological process development for VOC/odour control, CO<sub>2</sub> sequestration and renewable energy/resource recovery from waste; plant tissue culture for ecological capital buildup; bioprocess intensification and engineering analysis. **Environmental System Design and Modeling division includes:** Research in Development and Application of Geographical Information System (GIS) and Remote Sensing (RS) based Models and Analytical Tools for Natural Resources among many others.

NEERI is undertaking studies related to assessment, remediation and management of hazardous wastes for various industries. Recently, the institute transferred the technology on "solidification / stabilization and containment of arsenic bearing hazardous wastes" to Zuari Industries Ltd. (ZIL), Goa. **Water Technology and Management includes:** Surveillance of drinking water quality, Performance evaluation of water treatment plants, Development of analytical techniques for water quality assessment, Evaluation of water resources for health related water quality parameters. **Solid and Hazardous Waste Management includes** Rapid composting technologies, Waste to energy research projects, Recycling of waste products, Green house gas emissions from landfills. **Wastewater Technology** includes Basic engineering



designs for wastewater, Zero-discharge based wastewater treatment technologies, Physico-chemical conversions, Bioconversions, Recycle & reuse.

**Networking and Collaborations:** Some of NEERI's collaborations are:

- NEERI and International Water Association (IWA) collaborate to enhance knowledge development and integration of research, practice and policy towards the overall goal of improved water and sanitation for all, with specific emphasis on poor people in developing countries.
- National Institute for Materials Science (NIMS), Tsukuba, Japan and NEERI have collaborated for Development of advanced materials for environmental applications.
- NEERI & Damodar Valley Corporation (DVC) - Kolkata have signed an MoC agreement consultancy for comprehensive study on abatement study in Damodar River system.
- An MoU has been signed between Unit for Research & development of Information Products (URDIP) and NEERI for IP search and analysis services
- NEERI's MoU with Hindustan Lever Limited for investigations on drinking water quality in 8 cities/Towns in India.
- Agreement between DBT, New Delhi and NEERI for project "Microbial sequestration of carbon dioxide using suspended growth, attached growth and immobilized enzymes and whole cell reactor".
- Memorandum of collaboration (MoC) between Indian Oil Corporation Ltd (IOC) and NEERI, Nagpur for project: Air Quality Monitoring and Emission source apportionment studies for city of Delhi.
- An MoC between NEERI and Central Pollution Control Board, New Delhi for project "Air Quality Assessment, Emission inventory and source apportionment studies for Indian cities - city of Mumbai".
- An MoU between National Thermal Power Corporation Ltd and NEERI for Development of novel functionalized materials for CO<sub>2</sub> capture.

**Patents & Publications:** The institution owns totally 32 patents, 31 from India and 1 from USA for Preparation of Essential Oil Compositions for Potable Liquid Disinfection. NEERI has developed 92 publications in the year 2012 and more than 1000 publications in the past 10 years.

**Source/web link:** <http://www.neeri.res.in>

## 2. Centre for Science and Environment (CSE)

**Overview:** Centre for Science and Environment (CSE) is a not-for-profit public interest research and advocacy organization based in New Delhi, India. Established in 1980, CSE works as a think tank on environment-development issues in India, and advocates for policy changes and better implementation of the already existing policies. CSE uses knowledge-based activism to create awareness about problems and propose sustainable solutions. It also publishes Gobar Times, an environmental education magazine for the young adults. Anil Kumar Agarwal was the founder-director of the Centre for Science and Environment, India's leading environmental NGO.

**Experience:** CSE has 33 years of experience working in environmental issues. CSE has been an important stimulus in the growth of this concern. It has built, through its research, an understanding of the nature of the problem, it has provided solutions, and it continues to create awareness of the urgency of changing the way to growth without pollution.

**Financial Capital:** CSE has received funding from various national and international agencies such as: Swedish International Development Cooperation Agency (SIDA), Oak Foundation, Switzerland, Swedish Society for Nature Conservation (SSNC), Climate Works Foundation (CWF), Misereor, Germany, Swedish ChurchAid, United Nations Development Programme (UNDP-MoEF), New Delhi, Jamsedji Tata Trusts, Mumbai, Central Pollution Control Board (CPCB), **European Commission**, Department of Environment - New Delhi.

**Research Areas and Activities:** CSE research was among the top 20 environment think-tanks as per annual list released by the University of Pennsylvania for the year 2012.

CSE efforts are built around five broad programmes such as Communication for Awareness, Research and Advocacy, Education and Training, Knowledge Portal and Pollution Monitoring.

R&D activities in CSE are undertaken through various programmes such as:

**Sustainable Urban Mobility and Air Quality:** CSE conducted a study on In-Use Emissions Standards and analyzed emissions data from the ongoing Pollution under Control Certificate (PUC) programmes to highlight the ineffectualness of current norms. CSE team focused on the key strategies to bring stringency into fixing and meeting the air pollution reduction targets in major cities.

**Sustainable Industrialization:** This programme has three distinct components: Green rating of Indian industries, providing support to communities in their work to demand a sustainable industrialization process, and, a capacity building programme for all stakeholders. CSE team also undertakes policy advocacy cutting across these programmes for sustainable industrialization policies.

**Climate Change Programme:** CSE undertook a study on the impacts and vulnerabilities of climate change for the people and what this means for the design of development programmes.

**Sustainable Buildings Programme:** CSE carried out a detailed analysis of the clearances granted by various state level clearance committees and established the fact that the clearances are invariably given even in case of inconsistent and fictitious data provided by the project proponents.

**Sustainable Water Management Programme:** CSE's water team conducted a study that documented the sustainability of rural drinking water supply sources. Little of this has been implemented on the ground. According to the Department of Drinking Water Supply and Sanitation, only two states, Madhya Pradesh and Karnataka, have used central funds specifically for sustainable water projects.

Some of the awards of CSE:

1988: United Nations Environment Programme (UNEP) Global 500 Forum Award: The award is a tribute to successes on the front lines of global environmental action. It is granted to individuals and organizations for outstanding achievements in the protection and improvement of the environment.

2005: Stockholm Water Prize for CSE for its work: in promoting effective water management along with improved human rights

2008-09: Jawaharlal Nehru prize for 'popularization of science': The award is instituted by the Indian Science Congress Association.

**Networking and Collaborations:** CSE undertakes intensive and extensive awareness campaigns, capacity building workshops and prepares various informational materials. CSE has collaborations in South Asian countries. Some of the south Asian government or civil society agencies collaborations of CSE are:

- Sri Lanka: Ministry of Water Supply and Drainage and Lanka Rainwater Forum, Ministry of Education, Central Environment Authority, Central Environment Authority (CEA).
- Nepal: Centre for Integrated Urban Development (CIUD), Nepal, Ministry of Physical Planning and Works, Purbanchal University &
- WaterAid, Bangladesh.

**Publications:** In the year 2012-13, CSE produced seven major publications on water, industry, renewable energy and food safety.

**Source/web link:** <http://www.cseindia.org>

### 3. Centre for Environmental Science and Engineering (CESE) - IIT Bombay

**Overview:** Centre for Environmental Science and Engineering at IIT Bombay was established in 1985. CESE currently has a dedicated group of ten faculty members with multi-disciplinary background and interests. The graduate program offered by this Centre prepares individuals for careers as engineers and scientists in Environmental Quality & Pollution Control. This program offers course work and research opportunities leading to the master's and doctoral degrees and ultimately enables the graduates to contribute to the solution of current and future environmental problems. The Centre offers wide professional expertise and actively pursues sponsored research, consultancy and technical services. CESE is also very active in manpower development and regularly organizes tailor-made workshops and training programmes.

**Experience:** CESE has good 27 years of experience in the area of environmental courses and research programmes. CESE has established strong links with leading industries, institutions and national/international agencies. The Centre offers M.Tech and Ph.D. programmes in Environmental Science and Engineering with a strong focus in teaching and research.

**Human and Financial Capital:** CESE has a dynamic group of 11 faculty members and 20 research scholars and 8 staff with multi-disciplinary background and interests and around 20 post graduate students.

Financial capital has been received from organizations such as Centre for Indoor Air Research, USA (CIAR), Department of Science and Technology, Atomic Energy Regulatory Board (AERB) and Ministry of Environment and Forests (MOEF).

**Infrastructure:** CESE's laboratories and research facilities are designed specifically for environmental engineering research. The space is well equipped for physical, chemical and biological experimentation as well as engineering testing of processes on a pilot plant scale. In addition to a full range of research equipments, the laboratories house specialized instruments including: Ambient Air Analyzer, High Performance Liquid Chromatographs with UV and Fluorescence detectors.

**Research Areas and Activities:** R&D is a key component of CESE activities and spans a wide range of areas from basic to applied in tune with national and global requirements.

Some of the sponsored research projects are:

- Development of an Efficient Methodology for Marine Pollution Monitoring in an Industrialized Urban Environment: Remote Sensing Approach
- Emission Factors of Respirable Aerosols and PAHs from Biofuel Cookstoves
- Environmental Impact Assessment and Hazardous Waste Management
- Innovative Bioreactors for Wastewater Treatment
- Clean technologies and industrial pollution prevention
- Monitoring of Human Exposure to Air Pollution in Highly Industrial Area

Some consultancy projects are:

- Adaptive Technology - Environmental Systems
- Air Dispersion Modelling of Thermal Power Stations using ISC Software
- Air Pollution Dispersion Modelling for Trombay Thermal Power Station
- Capacity Building in Environmental Impact Assessment (EIA)

CESE has frequent interaction with a range of organizations from various industrial sectors such as Associated Cement Companies Limited, Batliboi & Co. Ltd., Enron Projects, Environmental Management Centre and Essar Limited and Hindustan Dorr Oliver. Major ongoing research deal with contemporary topics like: (a) clean technologies and industrial pollution prevention, (b)integrated treatment and disposal of hazardous waste (c) biomedical waste management (d) biodegradation of complex industrial wastewaters (fertilizer, food, paper, coke oven, diary, distillery, petrochemicals) and wastewaters containing halogenated aromatics, nitro-aromatics and other mixed substrates (e)biodegradation of complex non-aqueous liquid pollutants (NAPLs e.g., oil and tar) (f)development and application of toxicity/mutagenicity tests for emission and effluents.

CESE-IITB has also participated in the following European Commission FP7 projects:

Project Acronym	Project title	Challenge area
SAPH PANI	Enhancement of natural water systems and treatment methods for safe and sustainable water supply in India	ENV.2011.3.1.1-2 Natural water systems and treatment technologies to cope with water shortages in urbanised areas in India
CORFU	Collaborative research on flood resilience in urban areas	ENV.2009.1.3.3.1 Risk, prevention and management of urban floods

**Networking and Collaborations:** CESE has several collaborative projects sponsored by major industrial sectors such as Agave Industry (India) Pvt. Limited, Mumbai and governmental sectors like Ministry of Human Resource Development (MHRD), Central Pollution Control Board (CPCB), State Pollution Control Board (SPCB), Indian Women Scientists' Association (IWSA) Ministry of Non conventional Energy Sources (MNES), DBT, MoEF, CSIR, DST and international agencies like World Bank (WB), United States Environmental Protection Agency (US EPA) etc.

**Publications:** In the year 2012-2013, CESE has published several articles, paper and books. There are 4 national and 31 international articles published in Journals and 11 in national and 17 international papers published in proceedings of Conferences/Symposia.

**Source/web link:** <http://www.cese.iitb.ac.in>

## 4. Centre for Ecological Sciences (CES) - Indian Institute of Science (IISc)

**Overview:** CES at the IISc was started in 1983 with support of MOEF offers exciting opportunities for research in a variety of areas in ecology such as animal behavior, evolutionary biology and sociobiology, community and habitat ecology, molecular genetics and conservation biology, large mammal and forest ecology, and climate change. Research is being carried out on a number of taxa, ranging from ants to elephants, including wasps, crickets, spiders, herpetofauna, birds and mammals. The projects range from theoretical to laboratory to field-based research with different approaches being used in a complementary manner. Some of the information services of CES include Environmental Information System (ENVIS) which is a decentralized system with a network of distributed subject oriented centres ensuring integration of national efforts in environmental information collection, collation, storage, retrieval and dissemination to all concerned. Presently the ENVIS network consists of Focal Point at the Ministry of Environment and Forest (MoEF) and ENVIS Centres setup in different organizations/establishments in the country in selected areas of environment. ENVIS focal point ensures integration of national efforts in environmental information collection, collation, storage, retrieval and dissemination to all concerned.

**Experience:** CES has 30 years of experience in research in several areas of ecological sciences. CES centres have been set up in the areas of pollution control, toxic chemicals, central and offshore ecology, environmentally sound and appropriate technology, bio-degradation of wastes and environment management.

**Human Capital:** CES offers PhD programmes through several internet based environmental engineering programmes and environmental management programme which provides an overview of the key concepts and principles in environmental management. There are around 15 faculties in CES department of IISc with nearly 15 PhD and few post graduate students.

**Infrastructure:** CES has common laboratory facilities at Inorganic and Physical Chemistry (IPC) and Molecular Biophysics Unit (MBU) to conduct experiments. Environmental Chemistry Laboratory: is equipped with advanced instruments such as Gas chromatography-mass spectrometry (GC/MS). To facilitate researchers, permanent field stations have been set up in or close to the following four locations: Mudumalai (Tamil Nadu), Rushikulya (Orissa), Kudremukh (Karnataka), Lakshadweep.

**Research Areas and Activities:** In 2011, IISc was the only Indian university ranked in the top 500 by the Academic Ranking of World Universities, at 301-400th place overall. IISc managed to maintain its overall ranking through the 2012 and 2013 rankings.

The Indian Institute of Science (IISc) Bangalore has emerged the only Indian academic institution figuring in the world's 100 most reputed universities, according to the Times Higher Education Rankings. IISc is the only Indian institute that has made it to the top 500 in the 2013 Academic Ranking of World Universities (ARWU) which was released by the Center for World-Class Universities at Shanghai Jiao Tong University during Aug 2013.

CES research activities include animal behaviour, evolutionary and sociobiology, community and habitat ecology, molecular genetics and conservation biology, large mammal and forest ecology, and climate change. Research has been undertaken in various areas such as the following:

**Ecology** – conducts research in a wide range of frontier areas in ecology, such as dynamics of animal and plant populations and communities as well as how interactions between different scales and levels of biological organization together with environmental drivers can generate and maintain patterns of biodiversity. Research areas include: Ecosystem function and services; Plant-herbivore interactions; Coupled-human natural ecosystems; Plant-animal interactions; Mutualistic, symbiotic and parasitic interactions; Multitrophic systems; Molecular ecology and biogeography; Predator-prey interactions; Ecophysiology etc.

**Climate change & conservation** – diverse approaches to understand and address challenges of conserving biological diversity in the context of climate change and other human induced are considered.

Research areas include: Biodiversity and global change; Wildlife conservation, Energy and wetlands; Characterization, conservation, restoration and management of wetland ecosystems; Land use and land cover dynamics, Climate change in the past, present and future; Conservation of forest ecosystems and large mammals; Design of biospheres

**Behaviour** - Topics addressed include animal communication (acoustic, visual, and chemical), behavioural and physiological responses to environmental stimuli (such as stress), interaction among individual organisms to form higher levels of organization such as social-and/or super-organisms (e.g., lekking, collective movement patterns, cooperation and altruism) and how these individual and group behaviours in turn alter at higher scales such as populations and communities.

Research areas include Acoustic communication networks, Sensory biology especially chemoreception, olfaction, and vision, short-range and long-range host location strategies, multimodal signaling between plants and animals, Behavioural ecology of large mammals (e.g., Asian elephants) and Mixed foraging associations in birds and fish.

**Publications:** CES faculty has developed thousands of publications and apart from research publications in reputed journals, they have published a number of books. CES faculty also support various research and outreach journals.

**Source/web link:** <http://ces.iisc.ernet.in>

## 5. Environmental and Water Resources Engineering (EWRE) – IIT Chennai

**Overview:** EWRE under Civil Engineering Department at IIT Chennai was earlier known as Hydraulic and Water Resources Engineering division. The hydraulic laboratory was established in 1969 with significant cooperation from German Universities. In 2000, with the introduction of Environmental Engineering Graduate Program this division has been renamed as Environmental and Water Resources Engineering Division and conducts advance research in both Hydraulic and Environmental Engineering fields.

**Experience:** EWRE has tremendous experience specifically in two fields - Hydraulic engineering with 43 years of experience, and Environmental Engineering with 13 years of experience in which they have performed various progressive researches.

**Human and Financial Capital:** EWRE offers the following graduate programmes in the areas of environmental engineering, hydraulic and water resources engineering: Master of Technology (M. Tech.), Master of Science (MS) and Doctor of Philosophy (Ph.D.). There are around 20 faculties in EWRE division.

Financial capital comes from courses/programmes offered and through various sponsored research projects by MoEF, CPB and Department of Environment of Tamil Nadu.

**Infrastructure:** EWRE division has two well equipped research laboratories: *Hydraulic Engineering Laboratory* is well equipped with table-top hydraulic models, different types of flumes, facility for physical model studies, excellent computational facilities, and open air physical models. *Environmental Engineering Laboratory* has almost all state-of-the-art equipments such as atomic absorption spectrometer, total carbon analyser, US-VIS spectrophotometer, stack monitoring kit, ozonator, phase contrast microscope, flame photometer, laminar hood, Hach COD digester etc.

**Research Areas and Activities:** The major research areas in Environmental Engineering are air and water quality monitoring, modelling and management, indoor air pollution, water and wastewater treatment, solid and hazardous waste management, bioremediation of contaminated sites and subsurface contaminant transport studies. The major research areas in Hydraulic and Water Resources Engineering are: soft computing in water resources, hydrologic modelling, stochastic and spatial hydrology, computational hydraulics, conjunctive use of surface and ground water, aquifer modelling and management, fracture-rock matrix interactions, water resources planning and management, urban water supply and GIS/remote sensing applications.

**Networking and Collaborations:** Some of the major client organizations of EWRE include Madras Fertilizers Ltd, Tamil Nadu Pollution Control Board, Madras Port Trust and Central Pollution Control Board.

**Publications:** The research faculty had produced more than 500 publications in the recent years.

**Source/web link:** <http://www.civil.iitm.ac.in/new/?q=ewre>



## 6. Indian Institute of Environment Management (IEM)

**Overview:** Indian Institute of Environment Management was established in 1999 at the South Indian Education Society (SIES) campus in Nerul, Navi Mumbai. Since its foundation, IEM has been an active supporter of knowledge based research and development to address upstream concerns on conservation of natural resources and protection of environment. With immense prescience, IEM took up challenging issues in the areas of Corporate Green Accounting Procedures; Market Based Instruments for Regional Environmental Management, Minimization of Environment & Resource use Impacts, Consequence Analysis of Eco-system Health with Recourse to Hybrid Multi-layered Neural Network etc. IEM dedicates itself to preparation of trained and motivated individuals with knowledge based expertise in aspects of environmental technology, biotechnology and bioinformatics. SIES IEM offered its first academic programme, Post Graduate Diploma in Environment Management designed with the overall objective of preparing decision makers to devise win-win solution to environment problems through a state-of-the-art curriculum on problem solving mode.

**Experience:** IEM has 14 years of experience in new academic, training and research programmes. The institute today is steadily progressing on a path of functional synergism of skills in the areas of environment management, applied biotechnology, information technology and bioinformatics in education and research.

**Financial Capital:** IEM research projects were supported with funding from Indira Gandhi Institute of Development & Research (IGIDR), Ministry of Environment and Forest (MoEF), Dept of Science and Technology (DST), Global Environment Centre (GEC) and Wetlands International South Asia & Loktak Development Authority.

**Infrastructure:** IEM Environmental Science laboratory is equipped with advanced equipments and softwares such as muffle furnace flame photometer, conductometer, psychomotor, high volume air sampler, soil thermometer and sound level meter.

**Research Areas and Activities:** R&D activities at IEM are being carried out since 1999 through various sponsored projects, and programmes like Post Graduate Diploma in Environment Management (PGDEM), Post Graduate Diploma in Sustainable Environment Management (PGDSEM) students' projects etc.

Some of the sponsored research projects of IEM are:

- Evaluation of comparative performance of available technologies for removal of pathogenic organisms and turbidity from drinking water.
- Study of ANAMMOX bacteria and their application in wastewater treatment. Sponsored by Department of Science and Technology (Ongoing): The project deals with isolation and identification of ANAMMOX bacteria which are obligate anaerobic autotrophs capable of oxidation of ammonium to nitrogen gas.
- Development and Implementation of Industrial Ecology Opportunities Plan in Ankleshwar Industrial Estate, Gujarat. Sponsored by - Ministry of Environment and Forest

- Green Corporate Account Framework for Pharmaceutical and Chemical Industries. Sponsored by - Indira Gandhi Institute of Development & Research, Mumbai

### Networking and Collaborations:

- SIES-Indian Institute of Environment Management, Navi Mumbai (hereinafter referred to as SIES-IIEM) and Institute of Technology and Management, Gurgaon, Haryana (hereinafter referred to as ITM) enter into this MoU for collaboration in planning, research, development, project implementation, extension, mass communication and continuing education on Environment Management.
- Some other collaborations of IIEM are: IISc, MOEF, Indian Desalination Association and IGIDR.

**Patents & Publications:** The institution owns 5 patents mentioned below:

- Novel analogues of dihydroartemisinin with improved anti-malarial activity.
- Structural modification of Camptothecin to improve its anti-tumor activity.
- Oxopentyl derivatives of phosphoric acid as improved anti-malarial agents.
- Derivatives of carboxyamino carboxylic acid for potent and anti-obesity and hypoglycaemic activity.
- A Hydroxy derivative of Homo camptothecin as an improved anti-tumor agent.

There are 19 journals published in 2014, 5 book chapters and articles.

**Source/web link:** <http://www.siesiem.net>

## 7. Nansen Environmental Research Centre India (NERCI)

**Overview:** Nansen Environmental Research Centre India (NERCI) was established in Kochi, Kerala in 1999 as a joint venture between Indian and Norwegian partners, NERSC-Bergen, Norway. NERCI conducts basic and applied research projects in ocean and atmospheric sciences funded by national and international agencies, organizations and industry. It is a non-profit environmental and climate research centre which includes the following within the Nansen Group of research centres.

- Nansen Environmental and Remote Sensing Centre (NERSC), Bergen, Norway
- Nansen International Environmental and Remote Sensing Centre, St. Petersburg, Russia
- Nansen-Zhu International Research Centre, Beijing, China
- Nansen-Tutu Centre for Marine Environmental Research, Cape Town, South Africa
- Nansen-Bangladesh International Centre for Coastal Ocean and Climate Studies, Dhaka, Bangladesh
- Nansen Scientific Society, Bergen, Norway
- Terra Orbit AS – a research company, Bergen, Norway

**Experience:** NERCI has 14 years experience in conducting basic and applied research projects in ocean and atmospheric sciences. Two doctoral fellowship studies are currently being implemented at NERCI. The NERCI Scientific Research Advisory Board monitors the research activities of NERCI and gives guidance for R&D activities as well as promotion of education and interaction with institutes in India and abroad.

**Human and Financial Capital:** NERCI has at present a staff of 13, which includes three full time scientists, four associate scientists, one project scientist, one full time and two part time Ph.D. students and two administrative staff.

NERCI is a non-profit research Centre registered under Article 25, funded by Nansen Environmental and Remote Sensing Center, Norway. It receives funding through projects from Indian Space Research Organization (ISRO), United Nation Environmental Programme (UNEP) and other similar agencies.

**Research Areas and Activities:** NERCI has expertise in development and implementation of algorithms for satellite remote sensing data analysis, numerical ocean and coastal models for ocean circulation and eco-system studies as well as data assimilation techniques. Core R&D areas include:

- Monsoon and ocean variability, Climate Change, Sea level variations: Mainly coordinated with the Ocean modelling group of the Nansen Centres and other MoU partners through implementation and application of numerical ocean and atmospheric models with in situ data and satellite observations.
- Coastal Zone Management & Social issues
- Marine Ecosystem studies with focus on forcing mechanisms and algal blooms: Mainly through research collaboration with Ocean Colour group of the Nansen Centres through application of Satellite Remote Sensing with in situ measurements and GIS Applications. Satellite remote sensing offers the capacity of relatively inexpensive, regular and global monitoring of oceans and coasts. NERCI involves in Satellite remote sensing data analysis and interpolation for ocean and coastal zone applications, Development and validation of algorithms for satellite remote sensing data analysis in combination with field experiments.

NERCI has participated in the following European Commission FP7 project.

Project Acronym	Project title	Challenge area
INDO-MARECLIM	Indo-European research facilities for studies on Marine ecosystem and climate in India	INCO.2011-7.3 India

Some of the other projects are:

- Decadal to multi-decadal variability in the Indian Monsoon Rainfall (IMR) and tele-connection with Atlantic Multi-decadal Oscillation (AMO)
- Regional Climate Change issues and adaptation measures for low lying regions in the context of future sea level rise
- Synergistic application of Scatterometer and OCM data from Oceansat-II for the studies of coastal upwelling in the South West coast of India
- Water quality monitoring and low cost purification strategies for inland waterways of low lying areas

**Networking and Collaborations:** Some of the collaborations of NERCI are:

- An MoU was signed on 17th Feb 2008 with Indian National Center for Ocean Information Services (INCOIS).
- An MoU was signed on 26 Nov 2007 IRS (Institute of Remote Sensing), an integral part of Anna University, Chennai, which is a leading academic institution involved in academics, research and consultancy activities in the field of surveying, remote sensing, and geographical information system.
- An MoU was signed in February 2010 with CUSAT (Cochin University of Science & Technology), which is an autonomous University for higher Education founded in 1971
- MOU With TERI and United Nations Environment Programme (UNEP)-APFED
- An MoU was signed between Kerala University of Fisheries and Ocean Studies (KUFOS) and Nansen Environmental Research Centre India, Nansen Scientific Society, and Nansen Environmental and Remote Sensing Centre, Bergen, Norway to develop cooperative efforts in research and education in the areas like ocean studies, modelling, remote sensing and fisheries; socio-economics and fisheries, climate variability and marine living resources and exchange visits.

Future Collaborative research Partners include: Plymouth Marine Laboratory (PML), UK, IFREMER (France), and Alterra (The Netherlands).

**Publications:** The institute has developed 16 recent publications and 10 Papers presented in National/International seminars.

**Source/web link:** <http://www.nerci.in>

## 8. Environment Protection Training and Research Institute (EPTRI)

**Overview:** Environment Protection Training and Research Institute (EPTRI) was set up in 1992 as an independent registered society by the Government of Andhra Pradesh with assistance from the Government of India. EPTRI - a state of the art organization is abreast of wide-ranging concerns regarding environmental conservation and protection from ozone depletion, climate change, integrated environmental strategies to clean development mechanisms. It endeavors to create awareness among communities, civil societies, government organizations, NGOs and other stakeholders.

**Experience:** EPTRI has nearly 21 years of experience in various activities covering environmental issues such as industries, protected areas, biodiversity, urban agglomeration, environmental awareness, human resource development, capacity building and research. EPTRI takes up number of programs at national and international level.

**Financial Capital:** EPTRI receives funding from Government of India, the Nordic Investment Bank (NIB), Helsinki, Finland and the Swedish International Development Authority (SIDA), Stockholm, Sweden besides other international agencies as a potential base to direct aid and business related investments in the southern states of India.

**Research Areas and Activities:** EPTRI is equipped with state-of-art research and development facilities. Research at EPTRI is undertaken in various divisions such as:

- a. Environmental Engineering and Management (EEM): EEM Division undertakes projects in some of the following areas: Design, commissioning and stabilization of Effluent Treatment Plants (ETPs), Common Effluent Treatment Plants (CETPs) and Sewage Treatment Plants (STPs), Upgradation and performance evaluation studies of existing ETPs, CETPs, STPs and Design and evaluation of air pollution control equipment etc.
- b. Environment and Sustainable Development (ESD): ESD focuses on achieving a symbiotic relationship between the community and environment concerns which is precisely the National Environment policy. Key areas covered under this division for conducting studies, capacity building activities in: Environmental Education, Agriculture & allied sectors, Municipal Solid Waste and Climate Change etc.
- c. Environment Quality Mapping (EQM): The division is recognized as Center of Excellence in Spatial Environmental Planning with the focus on Industrial Planning.
- d. Environment Information System (ENVIS): It is a decentralized information network of distributed subject oriented centres ensuring integration of national efforts in environmental information collection, collation, storage, retrieval and dissemination.
- e. Nine Plus Programme: National Geophysical Research Institute (NGRI), Indian Institute of Chemical Technology (IICT), National Remote Sensing Agency (NRSA) and EPTRI have formed the Nine Plus consortium to provide expert services, unique knowledge base through sponsored programs on environmental implications of new developments to government, industry, public and national bodies to facilitate them to undertake forward planning, site selection, project development and evolving of a new road map for sustainable future growth.

**Networking and Collaborations:** Some of the national and international collaborators are: AF-Industries Process Konsult (AF-IPK, Sweden), British Council Division, UK, Sweden Royal Institute of Technology (KTH) Sweden, Indian Institute of Chemical Technology (IICT), Swedish Environment Lab (IVL), Sweden, Stockholm Environment Institute (SEI) Sweden, Central Pollution Control Board (CPCB), The World Bank, United Nations Environment Programme, (UNEP), International Institute for Industrial Environmental Economics, (IIIEE) and Ministry of Environment and Forest (MoEF).

**Source/web link:** <http://www.eptri.com>

## 9. Indian Council of Forestry Research and Education (ICFRE)

**Overview:** Indian Council of Forestry Research and Education (ICFRE) is an autonomous body under the MoEF. The mission of ICFRE is to carry out research of forests, forestry and forest products at national level, and disseminate the results of this research to all concerned parties, including State Forest Departments, forest based industries, traders, farmers and other user groups. ICFRE with headquarters at Dehradun has eight research institutes and four research centers spread across India to facilitate the forestry research, education and extension. Research institutes under the ICFRE are Forest Research Institute (FRI), Dehradun; Institute of Forest Genetics and Tree Breeding (IFGTB), Coimbatore; Institute of Wood Science and Technology (IWST), Bangalore; Tropical Forest Research Institute (TFRI), Jabalpur; Rain Forest Research Institute (RFRI), Jorhat; Arid Forest Research Institute (AFRI), Jodhpur; Himalayan Forest Research Institute (HFRI), Shimla and Institute of Forest Productivity (IFP), Ranchi. Advanced research centres under ICFRE are: Centre for Social Forestry and Eco-Rehabilitation (CSFER), Allahabad; Forest Research Centre, Hyderabad; Centre for Forestry Research and Human Resource Development (CFRHRD), Chhindwara and Advanced Research Centre for Bamboo and Rattans (ARCBR), Aizawl.

**Experience:** ICFRE has good experience and has been undertaking holistic development of forestry research through need based planning, promoting, conducting and coordinating research, education and extension covering all aspects of forestry. In the field of Ecosystem Conservation and Management, ICFRE has been awarded the status of Designated Operational Entity (DOE), the first ever in South Asia under the Clean Development Mechanism of the United Nations Framework Convention on Climate Change (UNFCCC).

**Human and Financial Capital:** ICFRE has excellent scientific man power from the eight institutes and four centres spread across the country to provide total service solution in forestry and allied disciplines.

Projects are being carried out with a number of National and International donor agencies for project funding. The international funding agencies like World Bank through Indian Council of Agricultural Research, International Foundation for Science, Sweden and Commonwealth Scientific and Industrial Research Organization (CSIRO) have funded projects executed by the ICFRE institutes.

**Research Areas and Activities:** Directorate of Research at ICFRE Headquarters plan, coordinate and monitor the forestry research in all eight research institutes and four centres of the Council and evaluate the progress of various research projects. Some of the research divisions are:

**Biodiversity and Climate Change (BCC) Division** actively engaged in capacity building programmes by conducting various national and international workshops, and training programmes on climate change, Clean Development Mechanism (CDM) and forestry for forest officers and other stakeholders. BCC division undertook two externally aided projects related to climate change: (i) **Research Needs, and the Financial, Technological and Capacity Needs and Constraints to Address Climate Change Concern vis-a-vis Forests and Forest Products in India:** The project was subcontracted to ICFRE by the Ministry of Environment and Forests, Government of India through Winrock International India. (ii) **Measurement of Forest Carbon Exchange Using Eddy Covariance and CDM Potential Studies in India:** The project

is a partnership study between the Department of Forest Science and Resources (DISAFRI), University of Tuscia (Italy), Indian Institute of Remote Sensing, ICFRE, and Uttarakhand Forest Department.

ICFRE research has been broadly categorized in to seven thrust areas and thirty two themes: Forest Productivity, Ecosystem Research, Genetic Improvement, Forest Management and Protection, Climate Change, Forest Wood Products and Non Wood Forest Product.

**Networking and Collaborations:** Some of the MoUs and agreements for the execution of collaborative projects/ programmes by ICFRE institute are:

- IFGTB, Coimbatore with Tamil Nadu Newsprint and Papers Limited undertook project on “Production and testing of control pollinated Eucalyptus hybrids with improved biomass and pulp yield to support industrial forestry in Tamil Nadu”,
- IFGTB, Coimbatore and Imperial Tobacco Company R&D Centre, Hyderabad undertook a project on “Development of an inter specific hybrid Corymbia hybrid Corymbia torelliana x Corymbia citriodora” and
- IWST, Bangalore and Indian Institute of Natural Resins and Gums, Ranchi project on “Termite and borer resistance of shellac-based varnishes”.
- An MoU between ICFRE and Chinese Academy of Forestry (CAF) was developed to foster cooperation between the two nations in identified fields of research. An MoU also paves way to develop an Umbrella action plan with emphasis on bamboo cultivation.

**Source/web link:** <http://www.icfre.org>



## 10. Environmental Resources Research Centre (ERRC)

**Overview:** Environmental Resources Research Centre (ERRC) was established in August 1991 in Kerala as an autonomous R&D centre for sustainable natural resource management and education. Since its inception, ERRC has emerged as a centre of excellence in research, higher education and public interest services, as testified by the recognition and support accorded by the national and international organizations, like the Department of Science and Technology (DST), Ministry of Environment and Forests (MoEF), Council of Industrial and Scientific Research (CSIR), Indian Council for Agricultural Research (ICAR) and the Ministry of Defense, Govt. of India; the United Nations Development Programme (UNDP); the Asian Development Bank (ADB); and the World Bank (WB). In addition, an array of public and private organizations has commissioned the centre for environmental impact assessment (EIA) and environment management (EM) studies. The credibility and excellence of the centre is further enhanced by its affiliation to the Mahatma Gandhi University, Kottayam, Kerala, for Doctoral research leading to Ph.D. degree in Environmental Science.

**Experience:** ERRC has 23 years of experience and provides specialized services and support to their own research and management programmes. ERRC extends its services in terms of carrying out scientific analyses, producing resource maps for a variety of applications, managing the region's most significant collections of flora and a wide range of resource databases, conducts environmental impact assessment (EIA) studies for industrial, power generation, infrastructure and other development projects.

**Financial Capital:** ERRC receives funding from various government agencies and organizations such as: Council of Scientific and Industrial Research (CSIR), Oil and Natural Gas Commission (ONGC), National Thermal Power Corporation (NTPC)-Asian Development Bank (ADB), Central Silk Board (CSB), Indian Council for Agricultural Research (ICAR), State Council for Science Technology and Environment (STEC), Govt. of Kerala, National Medicinal Plant Board (NMPB) and Department of Biotechnology (DBT).

**Research Areas and Activities:** R&D programmes of ERRC is interdisciplinary in nature, involving natural resource exploration and documentation; ecosystem/habitat assessment; biodiversity analysis and conservation; population distribution analysis and mapping; environmental quality assessment (air, water and soil); design of greenbelts for urban and industrial areas; human habitat studies; environmental impact assessment; and formulation of environment management plan, all coming within the purview of the mandate and thrust areas of the centre. The thrust areas that are given special attention are: Forest and Wetland Ecosystems, Coastal Habitats and Mangroves, Biodiversity, Endemism and Rarity, Pollen and Spore Biology, Environmental Pollution and Toxicology, Agro-forestry, Urban-forestry and Greenbelts, Environmental Impact Assessment, Environment Management and Environmental Education. Some of the research projects are:

- Pollen morphology in relation to the taxonomy, origin and evolution of the Rice crop
- Palynological studies of the present day environments of the Western Ghats and coastal zones of India as applied to Petroleum Palynology.
- Green and Clean Campus Awareness programmes
- Pollen as a tool in the Pharmacognosy of floral drugs and flower based natural products

Consultancy projects are involved in hydroelectric projects and Thermal power projects.

**Networking and Collaborations:** ERRC has been collaborated with some Indian organizations such as Tamil Nadu Electricity Board (TNEB), Oil and Natural Gas Commission (ONGC), Central Silk Board (CSB), Council of Scientific and Industrial Research (CSIR) Kerala State Electricity Board (KSEB) and National Thermal Power Corporation (NTPC).

**Publications:** The institution has developed 81 research papers and 31 books published since 1991.

**Source/web link:** <http://errcindia.org>

## 11. G.B. Pant Institute of Himalayan Environment and Development (GBPIHED)

**Overview:** G. B. Pant Institute of Himalayan Environment and Development was established in August 1988, at Kosi-Katarmal, Almora, as an autonomous Institute of the Ministry of Environment and Forests, Government of India. The Institute is identified as a focal agency, to advance scientific knowledge, to evolve integrated management strategies, demonstrate their efficacy for conservation of natural resources and to ensure environmentally sound development in the entire Indian Himalayan Region (IHR). Apart from undertaking research and technology development and/or demonstration on its own, the Institute has established linkages with National and International Organizations committed to environment and development linked issues in the mountain regions.

The Institute has been recognized as a nodal agency for research and development programmes in the Indian Himalaya by the Planning Commission, the Ministry of Environment and Forests, Government of India, and many International organizations. All R&D activities of the Institute are essentially multi-disciplinary in nature, and based on a conscious effort to interlink natural and social sciences to promote sustainable development.

**Experience:** G.B. Pant Institute of Himalayan Environment and Development (GBPIHED) was established in 1988-89, during the birth centenary year of Bharat Ratna Pt. Govind Ballabh Pant, as an autonomous Institute of the Ministry of Environment and Forests (MoEF), Govt. of India. It has 26 years of rich experience in research and development activities, Training, environmental education and awareness to different stakeholders to promote sustainable development.

**Infrastructure:** The Institute functions under a Society, guided by a Governing Body and a Science Advisory Committee. It has a decentralized set up, with its headquarters at Kosi-Katarmal, Almora, and at present four other units are operational at Srinagar (Garhwal Unit), Mohal – Kullu (Himachal Unit), Tadong-Gangatok (Sikkim Unit) and Itanagar (NE Unit). The R&D activities of the Institute are centered on seven core programmes, namely Land and Water Resource Management, Sustainable Development of Rural Ecosystems, Conservation of Biological Diversity, Ecological Economics and Environment Impact Assessment, Institutional Networking and Human Resource Development, Environmental Physiology and Biotechnology, and Indigenous Knowledge Systems. Apart from research and development activities, the Institute has support facilities and services such as library, arboretum, videography, nursery, instrumentation centre, consultancy, project formulation, soil, water analysis, tissue culture, data processing and information systems, training programmes, workshop and seminars.

**Human & Financial Capital:** The institute consists of 6 directors, 43 scientific and technical staff and 32 administrative and supporting staff. Towards human resource development, the Institute continues to play an important role by training project based staff and a number of Indian students have also received degree of Doctor of Philosophy while working in the Institute; in addition, the institute has conducted training/summer Programme for students/visiting scientists from various parts of India and from countries like Nepal, Bhutan, Holland, Canada, Germany, etc. The Institute receives core funding from the Ministry of Environment and Forests, Government of India. The research and development activities are, however, substantially strengthened through external funding obtained from different National (DBT, CSIR, DST, UGC, ICSSR, INSA, ICAR, UCOST, NEC, Sikkim Govt., WWF-India, etc.) and International (ICIMOD, UNESCO, NORAD, TSBF, CIDA-SICI, McArthur Foundation, BCN, TMI, UNDP, FAO, UNIDO, UNICEF, etc.) agencies. The institute receives funding from external sources like ICIMOD, IIRS / NRSA, UNESCO-Mac-Arthur NATP, CSIR etc to work on several projects and research activities.

**Research Areas and Activities:** The R &D programmes of the Institute have been reoriented into six thematic areas based on stakeholder needs, which are as follows.

- Socio Economic Development (SED)
- Environmental Assessment & Management (EAM)
- Watershed Process and Management (WPM)
- Knowledge Product & Capacity Building (KCB)
- Biodiversity Conservation and Management (BCM)
- Biotechnology Applications (BTA)

Research and developmental activities of the institute has been categorized under research actions, developmental programmes, and demonstration and dissemination actions as below.

#### **Research actions**

- Watershed services, management and land use policy
- Domestic energy needs-options and challenges
- Conservation and sustainable use of biodiversity
- Protected areas management issues & solutions
- Climate change impacts land and water resources
- Disaster mitigation and management databases and knowledge products
- Environmental Management of Urban areas
- Sustainable tourism
- Entrepreneurship and self employment in the Himalaya
- Indigenous knowledge: traditional lifestyle, architecture and health care practices
- Migration: socio-economic & cultural implications
- Biotechnological interventions in environmental rehabilitation
- Resource materials: mountain ecology and environment
- Capacity building and technology transfer/absorption

#### **Developmental Options/ Programmes/ Plans**

- Resource management for sustainable development of rural ecosystems.
- Propagation packages of high value plants.

#### **Demonstration and Dissemination**

- Eco-restoration and conservation models
- Livelihood options
- Capacity building and skill development
- Networking
- Publication/Documentation

**Networking and Collaborations:** The Institute has established linkages with National and International Organizations committed to environment and development linked issues in the mountain regions. Some of the collaborations are: India Meteorological Department (IMD), Jawaharlal Nehru University, Kumaun University, University of Delhi and Panjab University.

**Publications:** The Institute disseminates the findings of its R&D activities through publication of research papers in national & international journals, books and edited volumes (more than 525 scientific papers, 153 popular articles, 30 books/edited volumes and 2 monographs are published till date).

**Source/web link:** <http://gbpihed.gov.in/main.htm>

## 12. The Indian Institute of Forest Management (IIFM)

**Overview:** The Indian Institute of Forest Management (IIFM) (founded 1982) is an autonomous institution at Bhopal in Madhya Pradesh, India, established by the Ministry of Environment and Forests, Government of India with financial assistance from the Swedish International Development Cooperation Agency (SIDA) and course assistance from the Indian Institute of Management Ahmedabad. The institute's objective is to fulfill the growing need for managerial human resource in forest and allied sectors. IIFM has developed as an educational, research, training and consultancy organization and is gradually acquiring an international reputation.

**Experience:** IIFM was founded in the year 1982, having 32 years of experience in providing education, Research, education, training and consultancy services directed towards meeting management education needs of the entire forestry system, particularly the forest departments and forest development corporations.

**Infrastructure:** The institute is located in Nehru Nagar, in the southern west corner of the city of Bhopal. It is on a hill that overlooks the Bhadbhada barrage. The barrage controls the overflow of the upper lake or Bada Talab of Bhopal. The campus is also famous for its rich flora and fauna with sightings of various wild mammals and birds within campus. The institute has various facilities like multistoried air-conditioned library with wide range of literature. It has a collection of 312 films on forestry, environment, conservation & management. The Online Public Access Catalogue (OPAC) facility is available on all terminals connected through LAN. More than 37,500 books and subscription to more than 280 National & International periodicals are available. IIFM is equipped with excellent computing resources. The Computer Centre has hardware and software resources that are capable of providing support for diverse computing requirements. It has a number of desktops in Local Area Network (LAN) and has state-of-the-art Geographic Information System (GIS) and Image Processing facilities.

**Human & Financial Capital:** the institution has 21 board members, 15 academic council members and 32 academic professors. Research projects are commissioned to individual faculty members by institutions/organizations to carry out research on important areas of Natural Resource Management on the basis of individual capabilities in the concerned area. Faculty at IIFM develop proposals in specific research areas and seek funding from various institutes/organizations etc. the funding agencies are UNICEF; UNDP; ITTO; FAO; NERC, DFID, UK & UNEP; Ministry of Environment & Forests, Government of India; National Medicinal Plant Board, department of AYUSH, Government of India; TIFAC, New Delhi; Sir Ratan Tata Trust, Mumbai; Ministry of Rural Development; Forest Department, Government of Maharashtra; MP Council of Science & Technology; Indian Council of Social Science Research, MoEF-UNDP-GEF.

**Research Areas and Activities:** Research is one of the important activities at IIFM through which IIFM constantly strives to develop frontiers of knowledge in various areas of forest and natural resource management. Research activities at the institute are focused on finding such applications of management concepts, tools and techniques that can assist a forest manager in achieving effectiveness and efficiency in forestry operations. Most of the research projects undertaken by the faculty at IIFM are therefore, of an applied nature. Findings of research projects are also used for development of teaching material and case studies on various aspects of forest management. Many national and international organizations fund research projects at IIFM.

**Major thrust areas of research at IIFM:**

The broad thrust areas of research at IIFM are given below.

- Sustainable Forest management & Forest certification
- Marketing of Forestry Products
- Trees Outside Forests (ToF)
- Ecosystem Services and Management
- Forest policy
- Community Forestry and livelihood
- Institutional Linkages
- Gender studies
- Biodiversity, Protected Area Management and Human – Wildlife conflict
- Climate Change: vulnerability, mitigation and adaptation, REDD+
- Environment and human behavior
- Corporate Social Responsibility.

**Publications:** The institute has more than 100 publications in the form of books, teaching cases and articles.

**Source/web link:** <http://www.iifm.ac.in>

## 13. CSIR-Institute of Himalayan Bioresource Technology

**Overview:** CSIR-IHBT, a constituent laboratory of CSIR India, is located at the picturesque town of Palampur perched in the lap of majestic snow clad mountain of Dhauladhar. The institute provides R&D services on economic bioresources in western Himalayan region leading to value added plants, products and processes for industrial, societal & environmental benefit.

**Experience:** CSIR-IHBT has 30 years of rich experience. Since then the Institute is working relentlessly on developing technologies for sustainable utilization of Himalayan bioresources, and in the area of tea, floriculture, bamboos and medicinal and aromatic plants.

**Infrastructure:** The Institute has state-of -the art lab for carrying out studies in the area of proteomics, genomics and metabolomics. The facility includes automated DNA sequencer, amino acid analyzer, protein spot cutter & digester, LC-MS-MS, UPLC, and MALDI ToF etc. Cutting edge research is being carried out to unravel the genes involved in important biosynthetic pathway in plants for colour production, secondary metabolite production, catechin biosynthesis etc. Several stress related genes have been isolated, cloned and their expression analyses are being studied in target plants. Intensive work is underway for bioprospection of microbes, genes and proteins from niche locations particularly from the cold desert area of the Himalayan zone.

The Institute has fully functional facility like biolistic gun, culture rooms, containment facility, confocal microscope, fluorescence activated cell sorter etc. for undertaking transgenic research in plants. Institute has initiated studies on adaptational biology of plants in response to climate change and unique facility like FACE and FATI has been installed. Studies have also been initiated in the area of nanobiology and infrastructure is being strengthened by installing multimode scanning probe microscope, scanning electron microscope, transmission electron microscope.

The Bioresource development unit of the Institute has GIS facility, computational facility for inventorization, database development & mapping and a internationally recognized referral herbarium

The Natural Plant Product Unit focuses research on chemical characterization of active constituents from plant sources, synthetic chemistry, molecular modification for value added compounds, natural colors and dyes. The labs are equipped with NMR, preparatory and analytical HPLC, GC, GC-MS, and microwave synthesizer, Super Critical Extraction Unit with head space, spray dryer, industrial scale rotavapour, and distillation units of 10 quintals and 4 quintals and 15 Kg capacity for processing of herbals.

**Human Capital:** The institute consists of 47 scientific staff, 74 technical staff and 45 administrative staff.

**Research Areas and Activities:** The institute has state-of -the art lab for carrying out studies in the area of proteomics, genomics and metabolomics. The facility includes automated DNA sequencer, aminoacid analyzer, protein spot cutter & digester, LC-MS-MS, UPLC, MALDI ToF etc. Cutting edge research is being carried out to unravel the genes involved in important biosynthetic pathway in plants for colour production, secondary metabolite production, catechin biosynthesis etc. Several stress related genes have been isolated, cloned and their expression analyses are being studied in target plants. Intensive work is underway for bioprospection of

microbes, genes and proteins from niche locations particularly from the cold desert area of the Himalayan zone. The research areas are:

Bioresource Mapping  
Conservation and Sustainable Utilization

Bioprospection - Plants & Microbes

- Genomics, Proteomics & Metabolomics
- Plant viruses
- Nanotechnology
- Bioinformatics

**Networking and Collaborations:** The institute has developed various linkages with National and international organization.

#### International

- CRA - Centro di Ricerca per la Patologia Vegetale, Roma, Italy
- Ethio Agri-CEFT Plc, Ethiopia
- Institute of Chemistry and Dynamics of the Geosphere, ICG-3: Phytosphere,
- Forschungszentrum Jülich GmbH, Jülich, Germany
- Instituto de Bioquímica y Biología Molecular (IBBM), Facultad de Ciencias Exactas, Calles 47 y115, 1900 La Plata, Argentina
- Pannon University, H-8200 Veszprem, Egyetem u. 10, Hungary
- Procter & Gamble, England, UK

#### National

- Government/Autonomous/PSUs
- Biotech Consortium India Ltd., New Delhi
- Botanical Survey of India, Dehradun, Uttarakhand
- Commission for Scientific and Technical Terminology, Govt. of India, New Delhi
- CSK Himachal Pradesh Krishi Vishwavidyalaya, Palampur, Himachal Pradesh
- District Rural Development Agency, Mandi, Himachal Pradesh
- University of Delhi, New Delhi
- Dr. YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh
- Guru Nank Dev University, Amritsar, Punjab
- Himachal Pradesh Horticultural Produce Marketing & Processing Corporation Limited (HPMC), Shimla, Himachal Pradesh
- Indian Institute of Technology Mandi, Mandi, Himachal Pradesh
- National Dairy Research Institute, Karnal, Haryana
- The Parbati Hydroelectric Project (Stage-II), under NHPC, Nagwain, Mandi, Himachal Pradesh
- Punjab University, Chandigarh (UT)
- Punjab Agricultural University, Ludhiana, Punjab
- Punjabi University, Patiala, Punjab
- Space Applications Centre (SAC), ISRO, Ahmedabad, Gujarat
- Tea Research Association, Tocklai, Assam

#### Private

- Anel Equipment Pvt. Ltd., Mohali, Punjab
- Aroma Aromatics and Flavours, Baddi, Solan, Himachal Pradesh
- Baba Ghulam Shah Badshah University, Rajouri, Jammu & Kashmir
- Crystal Phosphate, Karnal, Haryana



- Kanan Devan Hills Plantation Pvt. Ltd., Munnar, Kerala
- Krishidhan Research Foundation Pvt. Ltd., Indore, Madhya Pradesh
- Krishna Food & Seeds Processors, Gurdaspur, Punjab
- Mahindra Shubhlabh Services Ltd., Mohali, Punjab
- Merck Specialties Pvt. Ltd., Bengaluru, Karnataka
- MESCO Equipments Pvt. Ltd., Kolkata, West Bengal
- Multiplex Bio-Tech Pvt. Ltd., Bengaluru, Karnataka
- Namiex Chemicals Pvt. Ltd., Pathankot, Punjab
- National Masala Mills (J&K) Pvt. Ltd., Anantnag, Jammu & Kashmir
- Panacea Biotech Ltd., New Delhi
- Panacea Biotec Pvt. Ltd., Lalru, Punjab
- Rescholar Equipment, Ambala Cantt., Haryana
- Thapar University, Patiala, Punjab
- Thirumalai Chemicals Pvt. Ltd., Vellore, Tamil Nadu

**NGO**

- Yog Manav Vikas Trust, Banikhet, Himachal Pradesh
- Farmer First Foundation, New Delhi

**Patents & Publications:** There are 7 patents filed and 5 patents granted and 45 publications for the year 2012-2013 and more than 500 publications developed in the previous years.

**Source/web link:** <http://www.ihbt.res.in>

## 14. Wildlife Institute of India (WII)

**Overview:** Established in 1982, Wildlife Institute of India (WII) is an internationally acclaimed Institution, which offers training program, academic courses and advisory in wildlife research and management. The Institute is actively engaged in research across the breadth of the country on biodiversity related issues. The Institute's idyllic campus that has been carefully developed to create state of the art infrastructure encourages scholarly work.

**Experience:** The Institute has 28 years of rich experience in nurturing the development of Wildlife Science and promoting its application in conservation, in consonance with our cultural and socio-economic milieu.

**Human & Financial Capital:** There are 24 researchers, 9 faculty members and 47 administrative and supporting staff. There are 87 Ph.D. theses awarded, 09 Ph.D. theses submitted and 67 Ph.D. registered students.

**Research Areas and Activities:** The research agenda is decided and guided by the Training, Research Advisory Committee (TRAC) comprising eminent conservationists, academicians and representatives of scientific organizations as well as state wildlife organizations, which ensures that research conforms to the national conservation priorities. The TRAC meets twice a year to oversee and review the ongoing research and set the tone for future programmes.

The criteria and priorities for research:

- Adoption of a multi-disciplinary landscape approach involving studies of ecological, biological and socio-economic parameters related to ecosystems/species.
- Preference to studies in potentially fragile ecosystems, especially those facing or in imminent threat of degradation.
- Preference to 'indicator' and highly endangered species.
- Studies leading to standardization of methods and techniques for research and management.
- Studies addressing people does needs and involvement, particularly in relation to those inhabit protected areas or their surrounds, with a view to ensuring compatibility.

Also, consultancies in fields such as wildlife related impact assessment of development projects, captive breeding, zoo management, capture and translocation of animals, animal health monitoring, eco development, production of AV material, setting up of visitor centres in parks including studies to establish techniques for such tasks.

### Research Activities:

- 190 Research Projects completed (1986 –March 2012)
- 48 On-going Research Projects

**Networking and Collaborations:** Some of the former collaborations:

- Food and Agriculture Organization (FAO)
- United Nations Development Programme (UNDP)
- US Fish & Wildlife Service (USFWS)
- US Forest Service (USFS)
- US National Park Service (USNPS)
- National Institute of Immunology (NII)
- Siemens Information System Ltd. (SISL)

**Some of the Current Collaborations are:**

- International Centre for Integrated Mountain Development (ICIMOD)
- United Nations Institute for Training and Research (UNITAR)
- UNESCO-United Nations Foundation
- Colorado State University (CSU), USA
- Smithsonian Institution (SI), USA
- International Association of Impact Assessment (IAIA)
- Global Biodiversity Information Facility (GBIF)
- DAIICT, Gujarat
- Central Avian Research Institute
- National Bureau of Animal Genetic Resources (NBAGR)

**Publications:** The institutes has developed 203 International Peer Reviewed Research Papers, 239 National Peer Reviewed Research Papers, 67 PhD thesis, 145 research reports, 48 consultancy reports, 133 popular articles.

**Source/web link:** <http://www.wii.gov.in>

## 15. CSIR- National Geophysical Research Institute (NGRI)

**Overview:** National Geophysical Research Institute (NGRI), a constituent Laboratory of CSIR, was established in 1961 with the mission to carry out research in multidisciplinary areas of Earth Sciences. The Institute plays a pivotal role in the exploration of Hydrocarbons, Mineral and Groundwater resources in addition to studies in Engineering Geophysics, Seismology, Geo dynamics and Geo environment. The Institute has a staff strength of 550 that includes about 150 highly qualified scientists doing extensive research in Earth Sciences assisted by an equal number of highly skilled technical staff for data acquisition, data processing and field investigations.

**Experience:** The institute has 53 years of experience in carrying out research activities in multidisciplinary areas of Earth Sciences.

### Infrastructure:

- LAM-MC-ICP-MS National facility for multi element Isotope Studies
- Micro Raman Spectrometer based on JYT64000, In-situ temperature studies in  $-196^{\circ}\text{C}$  to  $1200^{\circ}\text{C}$  range with temperature accuracy of  $\pm 1^{\circ}\text{C}$
- High pressure laboratory consisting of Keithly electrometer, strain measuring sensors, universal testing machine (100 tons) and Bridgeman-Birch high pressure apparatus
- In-situ stress measurement facility consisting of hydraulic equipment
- Rock magnetism laboratory consisting of a static magnetometer, digital spinner magnetometer, alternating magnetic field and thermal demagnetizers, high field and low field hysteresis and susceptibility meter
- High resolution paleoclimatic studies using Corals from Indian islands
- Continuous Flow Isotope Ratio Mass Spectrometry Laboratory
- Geochemical laboratory consisting of fully automated X-ray fluorescence spectrometer (XRF), atomic absorption spectrometer, Laser Ablated inductively coupled plasma mass spectrometer (LAM-ICPMS), electron probe micro analyzer (EPMA)
- Geochronology and isotope geochemistry laboratory with facilities for Rb-Sr, Sm-Nd and Pb-Pb analyses
- EM, resistivity and IP model laboratories
- Helium emanometry, heatflow and radiometry laboratory
- Tritium and carbon dating laboratory for groundwater studies.
- Seismological, Magnetic and Gravity observatories
- Gas Chromatography and Microbial Laboratory
- Mineral Physics Laboratory with high-pressure Diamond Anvil Cell (DAC), ultra high resolution ( $0.02/\text{cm}$ ) double monochromator, and micro-Raman spectrometer.
- Centralized computing facilities: PC-LAN and an array of Sun Workstations.
- Thermo luminescence (TR) Optically Stimulated Luminescence (OSL) dating facility
- Absolute Gravity Lab.
- Airborne magnetic and electromagnetic surveys

### Geochemical analytical facilities such as:

- Inductively Coupled Plasma-Mass Spectrometer (ICP-MS) with Dynamic Reaction Cell (DRC)
- Scanning Electron Microscope-Energy Dispersive Spectrometer (SEM-EDS)
- Sulphur Analyser for the estimation of sulphur content in rocks, ores etc.
- Fire Assay lab for effective separation and pre-concentration of PGEs and gold and subsequent determination by ICP-MS.
- Atomic Absorption Spectrometers (AAS)

**Human Capital:** The Institute has a staff strength of 550 that includes about 150 highly qualified scientists doing extensive research in Earth Sciences assisted by an equal number of highly skilled technical staff for data acquisition, data processing and field investigations.

**Research Areas and Activities:** The research areas are listed below:

- Hydrocarbon Exploration
- Geochemistry and Geochronology
- Mineral and Engineering Geophysics
- Ground Water
- Seismology
- Theoretical Geophysics

**Patents & Publications:** The Institutions owns 19 granted patents, 163 scientific publications, 4 review reports, 41 non-scientific publications, 27 books, 39 technical reports for the year 2011-2012.

**Source/web link:** <http://www.ngri.org.in/index.html>



## 3.4 HEALTH

### Sector Summary

India's healthcare system comprising of hospitals, medical infrastructure, medical devices, clinical trials, outsourcing, telemedicine, health insurance and medical equipment<sup>53</sup> is developing rapidly creating a large market for hospital information systems and other healthcare-related IT solutions<sup>54</sup>. The sector continues to expand its coverage, services and expenditure in the public as well as private sectors is expected to reach 115 billion Euros by 2017. It is expected to grow at a CAGR of around 22.7 per cent during the period 2013-2015. Healthcare sector in India is expected to grow at a CAGR of 15 per cent to touch Euros 116.27 billion in 2017 from Euros 57.7 billion in 2012, according to a report by Equentis Capital<sup>55</sup>.

Sixteen health research institutes covered in this report include:

1. All India Institute of Medical Sciences (AIIMS)
2. Christian Medical College Vellore (CMC, Vellore)
3. Jawaharlal Institute of Postgraduate Medical Education and Research (JIPMER)
4. Armed Forces Medical College (AFMC)
5. Banaras Hindu University (BHU) – Institute of Medical Sciences
6. Sanjay Gandhi Post Graduate Institute of Medical Sciences (SGPGIMS)
7. Postgraduate Institute of Medical Education & Research (PGIMER)
8. Mahatma Gandhi Institute of Medical Sciences (MGIMS)
9. Sree Chitra Tirunal Institute for Medical Sciences & Technology
10. Institute of Health Management Research (IHMR)
11. National Institute of Nutrition (NIN)
12. All India Institute of Hygiene & Public Health (AIIPH)
13. School of Medical Science and Technology (MST) – IIT Kharagpur
14. Maulana Azad Medical College (MAMC)
15. National Institute of Occupational Health (NIOH)
16. Central Institute of Medicinal and Aromatic Plants (CIMAP)

53 <http://finmin.nic.in/workingpaper/EmergGlobalEcoServiceSector.pdf>

54 <http://www.ibef.org/industry/healthcare-india.aspx>

55 <http://www.ibef.org/industry/healthcare-india.aspx>

# 1. All India Institute of Medical Sciences (AIIMS)

**Overview:** The All India Institute of Medical Sciences (AIIMS) was established in 1956 as an institution of national importance by an act of Parliament to develop patterns of teaching in undergraduate and postgraduate medical education. It demonstrates a high standard of medical education to all medical colleges and other allied institutions in India; to bring together in one place educational facilities of the highest order for the training of personnel in all important branches of health activity and to attain self-sufficiency in postgraduate medical education.

**Experience:** Institute has 57 years of experience in teaching and research across 52 disciplines. AIIMS runs a College of Nursing, training students for B. Sc. (Hons.) nursing and B.Sc Nursing (Post-Certificate) degrees. Thirty-eight departments and seven super-specialty centres are managed basically with all types of disease conditions with support from pre-clinical and para-clinical services. In Haryana, AIIMS also runs a 60-bedded hospital along with the Comprehensive Rural Health Centre at Ballabgarh.

**Human and Financial Capital:** AIIMS has a manpower of over 10,000 including 750 faculty members, supported by resident doctors, nurses, paramedics, scientists, non-medical officers and staff. It produces a large number of specialists (MD/MS), superspecialists, PhD scholars and allied health and basic sciences experts, including nurses and paramedical professionals.

The institute gets grants under the Heads 'Plan' and 'Non-Plan' from the Government of India, Ministry of Health and Family Welfare. In addition, Plan grants are received for National Drug Dependence Treatment, VVIP care and College of Nursing etc. Besides, extramural grants are also received from various external funding agencies such as ICMR, DST, CSIR, WHO, UNICEF, DBT, etc. for various research projects. Plan and Non-Plan grant received from the Government of India and other agencies are further allocated to Super specialties Centres/Departments/Research Projects as per their requirements. Finance Division of the institute monitor/control the expenditure against the above funds/budget by obtaining monthly expenditure from the respective centers/units/departments and also administers day to day financial matters etc.

**Infrastructure:** The institute has comprehensive facilities for teaching, research and patient-care. AIIMS conducts teaching programmes in medical and para-medical courses both at the undergraduate and postgraduate levels and awards its own degrees. The library is a treasure house having 61423 books, 53547 journals and 14008 reports in the field of Biomedical Sciences. The library receives 490 journals and 80 newsletters every year. AIIMS is a leader in the field of medical research having more than 1500 research publications for its faculty and researchers in a year.

**Research Areas and Activities:** AIIMS has been ranked third as per *Times Higher Education India Reputation Rankings in 2013*. AIIMS has been consistently ranked the top medical college in India to pursue any Medical degree by India Today in annual surveys starting in 1997 and was ranked No. 1 in 2013<sup>56</sup>.

For the sixth consecutive year, AIIMS has stuck to its number one position in the list of India's Best Colleges by the survey conducted by India Today during 2008. Several surveys by The Week and Outlook magazines have named AIIMS the best hospital in India overall.

<sup>56</sup> [http://en.wikipedia.org/wiki/AIIMS,\\_New\\_Delhi#Rankings](http://en.wikipedia.org/wiki/AIIMS,_New_Delhi#Rankings)

AIIMS is committed to high quality basic and clinical research. Over 600 research projects were conducted in the year 2012–2013 and the institute attracted extramural research grants of more than Rs. 65 crores. There is a wide variety of research performed at AIIMS. On one hand, AIIMS performs sophisticated investigations in neurosciences, genetics and computer simulation of hormone-receptor interaction. On the other hand, AIIMS undertakes clinical and epidemiological studies on the prevention and treatment of national health problems, advanced techniques such as DNA recombinant technology, immunology and electron microscopy to study common diseases such as leprosy, malaria, tuberculosis, diabetes, diarrhoea, hepatitis, fluorosis and iodine deficiency. AIIMS faculties have succeeded in bringing significant international research grants in frontier and cutting edge biomedical areas such as structural biology, viral hepatitis, immunology, biotechnology, virology, neonatology, foetal medicine, diabetes, epidemiology and cancer.

AIIMS has participated in the following European Commission FP7 project. The details of the project include:

Project Acronym	Project title	Challenge area
TBSUSGENT	Sustaining research momentum over the coming decades: mentoring the next generation of researchers for tuberculosis	HEALTH-2007-2.3.2-14 Next generation of researchers for HIV/AIDS, malaria, tuberculosis and neglected infectious diseases

### Networking and Collaborations:

- During 2011–2012, AIIMS and Meiji Pharmaceutical University, Japan, signed an MoU for collaborative development of mutually agreed areas of health sciences.
- AIIMS have continuous collaborations with the Wellcome Trust, the Department of Biotechnology, Department of Science and Technology and Indian Council of Medical Research to support research and develop projects that would provide innovative healthcare products at affordable costs.
- AIIMS continued to play an important role in the Stanford-India Biodesign Programme funded by the Department of Biotechnology, Ministry of Science and Technology, and Stanford University. National bodies like the Indian Council of Medical Research regularly request different departments of AIIMS to conduct studies on health issues of public importance and national relevance.

**Publications:** There are around 13,129 publications with articles, papers, journals etc published by different faculties under various departments of AIIMS.

**Source/web link:** <http://www.aiims.edu>



## 2. Christian Medical College Vellore (CMC, Vellore)

**Overview:** Christian Medical College and Hospital, Vellore (CMC Vellore) is recognized as one of the top medical centers in India. CMC was founded in 1900 by an American missionary, Dr. Ida S. Scudder. CMC is the single largest private medical college in India with over 31 clinical and allied specialties. There are a number of distinctive features of CMC Vellore courses. All of them, including nursing, are taught by qualified, experienced faculty who participate fully in the clinical and administrative operations of the hospital. Today with 2,500 beds, 1,210 doctors and many achievements, CMC Vellore is the beacon of medical education, research and patient care in India. The courses are extremely practical, with students learning skills on the job in clinical and working laboratory settings. One of CMC Vellore's key roles is to help train the skilled and caring medical professionals who are desperately needed for hospitals. The education fees are amongst the lowest in the world for a private institution.

**Experience:** CMC Vellore has well more than 100 years of experience in health and medical research and is well known for certain departments such as Gastroenterology, Neurosciences and Haematology. It also gives high importance to less prominent specialties such as Rheumatology, Physical Medicine and Rehabilitation, Developmental Paediatrics and Palliative Care.

**Human and Financial Capital:** CMC Vellore has over 7600 staff, including over 1200 doctors and 2400 nurses. Most of these people are involved in providing medical care, teaching and research responsibilities. Almost every clinical specialty is catered to by many departments which are subdivided into units. For example: Division of Surgery is further broken down into eight units specializing in Head and Neck Surgery, Endocrine Surgery, Vascular Surgery, Colorectal, etc.

The extent and quality of research has been widely recognized and CMC researches are now funded by all the major Indian and international funding agencies, including the Indian Council for Medical Research, Council of Scientific and Industrial Research (CSIR), Departments of Science and Technology and Biotechnology, the Wellcome Trust, the National Institutes of Health, the Bill and Melinda Gates Foundation, the European Commission's Framework Programme and many others.

**Infrastructure:** The institute is well equipped with all the modern facilities. All labs are well equipped with latest equipments. Library of the Christian Medical College serves the varied needs of its many readers efficiently. The Library makes available to the staff, and medical and Paramedical students, a wide collection of medical literature, including Books, Journals, Reference Sources and pamphlets.

**Research Areas and Activities:** Research is an integral part of the mission of CMC Vellore having a wide and long-lasting impact on the nation's health. As per Survey conducted, CMC Vellore ranked third among the top 10 multi-specialist hospitals.<sup>57</sup> CMC Vellore has been ranked second as per Outlook survey in 2008. CMC has been ranked second by the survey conducted by India Today and Nielson Company.

CMC Vellore is a leader in medical research in India from assessing the needs of the population in terms of communicable and non-communicable disease to translating interventions that arise from basic research on pathogenesis and prevention of illness. Over the past century,

<sup>57</sup> [http://articles.timesofindia.indiatimes.com/2012-12-14/chandigarh/35819341\\_1\\_speciality-sanjay-gandhi-postgraduate-institute-pgimer](http://articles.timesofindia.indiatimes.com/2012-12-14/chandigarh/35819341_1_speciality-sanjay-gandhi-postgraduate-institute-pgimer)

CMC Vellore has contributed significantly in generating and advancing knowledge which has improved curative and preventive medical services locally, throughout India and internationally. CMC Vellore is one of the leading contributors of medical research articles in India. There are numerous research programmes funded by national and international agencies as well as through internal resources. It is the home of the South Asian Cochrane Network and Centre and the internationally recognized Infectious Diseases Training and Research Centre and boasts a state of the art Stem Cell Research Centre funded as a centre of excellence by the Indian government.

CMC Vellore hosts many conferences and workshops and runs courses in research methodology, epidemiology and biostatistics, etc. Research at CMC Vellore has always aimed to be relevant to the needs of the country. Several protocols for cost effective care and solutions to problems like leprosy, polio, childhood, diarrhea, invasive bacterial infections, spinal cord injuries and cancers have been investigated here. The Department of Biotechnology has entrusted development and translation of stem cell research to CMC Vellore.

CMC Vellore has participated in the following European Commission FP7 project. The details of the projects include:

Project Acronym	Project title	Challenge area
LACTOBODY	Production and delivery of antibody fragments against gastrointestinal pathogens by lactobacilli	HEALTH-2007-1.4-1 Development and production of new generation antibodies

**Networking and Collaborations:** CMC is engaged in cutting-edge research into the causes and treatment of diseases and collaborates with hospitals and universities across the world. Some of the collaborations are:

- Potential collaborations between University of Washington School of Nursing and CMC Vellore.
- There is an MOU between CMC Vellore and Kansas University Medical Centre, Kansas for student exchange to enhance experience in research.
- CSCR (a unit of inStem, Bengaluru), a collaboration between Department of Biotechnology and CMC, Vellore aims to use stem cell science to better understand human diseases and ultimately develop cell based therapies.

**Publications:** There are around 1300 Scientific Publications under various departments of CMC institution and around 1800 e-journals published.

**Source/web link:** <http://www.cmch-vellore.edu>

### 3. Jawaharlal Institute of Postgraduate Medical Education and Research (JIPMER)

**Overview:** Jawaharlal Institute of Postgraduate Medical Education and Research (JIPMER) since 1956 is one of the leading medical institutions of India. JIPMER originated as École de Médecine de Pondichéry established by the French Government in the year 1823. This medical school was converted into Dhanvantari Medical College at the time of de facto transfer of Pondicherry to Government of India. This medical college was later upgraded JIPMER. JIPMER is an Institution of National importance under the Ministry of Health and Family Welfare. It is an autonomous body and includes a tertiary care referral hospital. Three main functions of this institute are:

- To impart quality education in Under-graduate and Post-graduate medical and paramedical courses
- To set trends in medical research and
- To offer patient care of high order

**Experience:** JIPMER has more than 50 years of experience as educational institute that imparts undergraduate and postgraduate medical training and a working hospital that provides inexpensive medical care to a large number of patients.

**Human and Financial Capital:** JIPMER offers a variety of courses such as M.B.B.S., B.Sc. M.Sc., M.D., M.S., Degree Courses offered in 32 various disciplines. JIPMER admits 127 students to the MBBS course once every year through an all-India entrance examination. Full-time Ph.D. Programmes are available in six disciplines. JIPMER has about 200 faculty and 360 resident physicians and over 3,000 nursing, administrative and support staff.

Funds for research come from mural and extramural sources like the ICMR, UGC, DBT, WHO, etc.

**Infrastructure:** JIPMER is one of the top five medical schools in India. It is located at Pondicherry. Every year JIPMER admits 100 undergraduate students and 75 postgraduate students. JIPMER is under the direct administrative control of Directorate General of Health Services (DGHS), Ministry of Health and Family Welfare on par with similar medical institutes like AIIMS, PGI Chandigarh and Sanjay Gandhi PGIMS Lucknow.

**Research Areas and Activities:** As per survey conducted by Outlook in 2008, JIPMER-Pondicherry has been ranked top third medical college. JIPMER was ranked 8th in the top medical research institutes of India in 2010. JIPMER is the second best government medical college in India. JIPMER has consistently been ranked in the top ten medical institutions in India. JIPMER was ranked fourth in the 2007 Doctor NDTV Survey and as the second best medical college for undergraduate education and the fourth best medical college for postgraduate education by The Week in its February 5, 2006 issue.

JIPMER conducts research actively in modern medicine, public health and medical education. A research council at the institute level looks after the research activities and a scientific society provides a forum for presenting research work. Numerous conferences, workshops, seminars and training courses are conducted by the institute every year. JIPMER has been promoting research activities in medical sciences since its inception. This research may be in the form of faculty research projects, postgraduate dissertation work, PhD thesis work and undergraduate research projects and that may involve human or animal subjects. There has been an increase in all types of research activities after JIPMER has become an "Institution of National Importance".

There are several departments such as Pre and Para clinical, Surgical, Medical, Advanced centres, Ancillary services wherein research has been conducted.

**Networking and Collaborations:** Some of the collaborations of JIPMER are:

- JIPMER has signed a partnership agreement in education, training and research in healthcare with Healthcare UK.
- JIPMER has been partnered with Public Health Foundation of India for a project “India Research Site Landscape Analysis” and funds were from Bill and Melinda Gates Foundation.
- JIPMER launched various initiatives in association with the Boston University and the University of Medicine and Dentistry in New Jersey to promote public health care programme.
- JIPMER is in talks with IIT Madras to set up MD-PhD as well as MD-MPH (Masters in Public Health) joint programmes, as well as programmes in health economics and health Information Technology.
- JIPMER is also looking to collaborate with the Indian Institute of Management to give out joint degrees.
- It has an intensive academic and research programme and hosts an annual symposium on vascular interventions in collaboration with the University of Diderot, Paris.

**Publication:** JIPMER has been promoting research activities in medical sciences since its inception. It has 446 research publications.

**Source/web link:** <http://jipmer.edu.in>

## 4. Armed Forces Medical College (AFMC)

**Overview:** Armed Forces Medical College (AFMC) is a medical college which was set up in 1948 in Pune during the immediate post-world war period. The college is managed by the Indian Armed Forces. The institution is responsible for providing the entire pool of specialists and super specialists to the Armed Forces. The college is also involved in conducting research in various medical subjects.

**Experience:** Armed Forces Medical College has 66 years of experience in education and research. The college provides training to under-graduate and post-graduate medical and nursing students with assured career prospects in the defence services.

**Human and Financial Capital:** Admission to MBBS course are on the basis of an objective type written examination conducted in 28 centres across India. This is followed by an interview and then after the final selection, nearly 130 students are admitted to the College. There are around 36 faculties.

Funding is through various courses offered and through research projects participation.

**Infrastructure:** The institution conducts training of medical undergraduates and post-graduates, nursing undergraduates and post-graduates, dental postgraduates and paramedical staff. The institution is responsible for providing the entire pool of specialists and super specialists to Armed Forces by giving them in-service training.

**Research Areas and Activities:** In 2013 India Today Rankings, it was ranked #3 among medical colleges in India. Outlook India also ranked Armed Forces Medical College, Pune at #2 in 2012.

Various departments of AFMC such as Anaesthesiology, College of Nursing, Community Medicine, Dental Surgery, Dermatology, Forensic Medicine, Hospital Administration, Internal Medicine, Obstetrics & Gynaecology, Ophthalmology, Orthopaedics, Paediatrics, Pharmacology, Physiology, Psychiatry, Radiodiagnosis & Imaging, Surgery and Transfusion Medicine are very active in taking up research projects either under departmental sponsorship or under the auspices of Armed Forces Medical Research Committee (AFMRC). Apart from service oriented projects, research in clinical and laboratory subjects is also carried out. AFMC has the facility for animal house, hatcheries for disease producing insects, and a virology and bacteriology bank for these purposes. AFMC is a research and referral centre for confirmation of disease, identification of pathogens (viral and bacterial) and classification of blood disorders. AFMC acts as a referral centre, designated by World Health Organization (WHO) for certain diseases.

**Networking and Collaborations:** Some of the collaborations of AFMC are with ICMR and WHO India. Affiliated hospitals include Command Hospital (Southern Command), Military Hospital (Cardio Thoracic Centre), Artificial Limb Centre and Military Hospital (Khadki).

**Publications:** There are around 800 publications including books, articles, journals, conference papers under different departments of AFMC institute. Medical Journal Armed Forces of India (MJAFI) is a professional journal sponsored by the Armed Forces Medical Services and published by the AFMC.

**Source/web link:** <http://www.afmc.nic.in>

## 5. Banaras Hindu University (BHU) – Institute of Medical Sciences

**Overview:** Medical education in Banaras Hindu University took roots in 1920 with the establishment of Department of Ayurveda under Faculty of Oriental Learning and Theology (1922-1927). Under the influence of Pandit Madan Mohan Malviyaji, Seth Mathuradas Vissanji Khimji of Bombay donated a large sum of Rs.1.5 Lakhs for the Ayurvedic College. This was further augmented by donations from Shri Daya Shankar Dev Shankar Dave of Kathiawar and Bombay. In the year 1924-25, Ayurvedic Aushadhalaya was established to prepare medicines, teach Ayurvedic students the formulations, and make the Ayurvedic formulations available to general public at affordable price. The postgraduate medical education started as in-service program in 1963. IMS is under the Banaras Hindu University, an autonomous central university under the Ministry of Human Resource Development, government of India.

**Experience:** IMS- BHU has 54 years of experience in medical education and research. Institute of Medical Sciences (IMS) – BHU is one of the finest institutes in the country. It produces one of the best physicians and results across country. There are three faculties viz. Medicine, Ayurveda and Dental Sciences. The courses offered by Faculty of Medicine include MBBS (84 students), MD/MS (134 seats in 22 subjects), DM/MCh (17 seats in 10 subjects), MSc in Health Statistics (10 seats) and PhD in all the subjects.

**Human and Financial Capital:** There are more than 300 teaching faculty and 400 technical staff, who form the backbone of the Institute. Institute of Medical Sciences (IMS) is a residential, co-educational medical institute. It admits students for its programs in medicine through the BHU-PMT entrance examination held across India. In addition to the MBBS programs, it offers specialisations and PhD programs for physicians in medicine and surgery. It also offers graduate and post-graduate programs in Nursing, Ayurvedic medicine, Dentistry and Health Statistics.

The institutes are administratively autonomous, with their own budget, management and academic bodies. Funds are being received from various government agencies such as DBT, DST, ICMR and University Grants Commission (UGC) Special Assistance Programme (SAP).

**Infrastructure:** The academic infrastructure of the Institute of Medical Sciences has been augmented with the national and international scientific congresses, conferences, workshops, seminars, public extension lectures and group discussions. The infrastructure of the SS Hospital is developing at a fast pace- the existing blood bank has been upgraded and modernized to cater for blood requirements by the hospital patients 24 hours a day, provide blood component therapy to patients of hematological conditions and cancer. An Oncology wing has been created with the generous grant of the Ministry of Health and Family Welfare for multidisciplinary treatment of cancer.

**Research Areas and Activities:** In 2013 India Today Rankings, it was ranked #18 among medical colleges in India. Outlook India also ranked Institute of Medical Sciences (BHU), Varanasi at #13 in 2012.

IMS-BHU conducts research actively in modern medicine, public health and medical education. Many Departments of IMS-BHU such as Anaesthesiology, Anatomy, Cardiology, Cardiothoracic Surgery, Community Medicine, Dermatology & Venereology, Endocrinology & Metabolism, Medicine, Nephrology, Neurology, Neuro Surgery, Obstetrics & Gynaecology, Pediatrics, Pathology,

Physiology, Plastic Surgery, Psychiatry, Radio Diagnosis, Radiotherapy & Radiation Medicine, General Surgery, Urology are actively involved in research activities, both basic and clinical, in the form of Ph.D. theses, M.S. theses, trials and projects in collaboration with other departments of the Institute and the University, and various national and international Universities. Department of Otorhinolaryngology (ear, nose and throat or ENT) is the first to introduce as separate subject in MBBS curriculum and first in state to have international research collaborations.

**Networking and Collaborations:** Some of the collaborations of IMS-BHU are:

- Dept of Vikriti Vigyan is in collaboration with Dept. of Biophysics, Faculty of Medicine, IMS, BHU for standardization of Taila Bindu Pariksha
- Has collaborations with WHO, DST, DBT, ICMR, Ministry of Health
- MoU between Banaras Hindu University and Trincomalee Campus of Easter University, Sri Lanka
- MoU between Banaras Hindu University and Rosenberg Society for Holistic Health and Education, European, Academy of Ayurveda, Birstein, Germany in October 2007.

**Publication:** IMS-BHU under several departments has nearly 7700 research publications with journals, articles, papers, books etc are publications of different faculties of the several departments.

**Source/web link:** <http://www.imsbhu.nic.in>

## 2. Sanjay Gandhi Post Graduate Institute of Medical Sciences (SGPGIMS)

**Overview:** SGPGIMS is a medical institute of India located in Lucknow, Uttar Pradesh. It was established in 1983 and is named after Sanjay Gandhi. The institute offers its own degrees, which are duly recognized by the Medical Council of India. The Institute is rated amongst the top medical institutions in the country, delivering state-of-art tertiary medical care, super-specialty teaching, training and research. Dedicated faculty members endeavor to provide quality education, patient care and research and strive to meet the challenges and needs of the society.

**Experience:** SGPGIMS was established in 1983. SGPGIMS is an educational institute that imparts postgraduate medical training and a working hospital that provides inexpensive medical care. It is a tertiary care referral hospital that caters to patients referred from not only the whole of Uttar Pradesh, neighboring states such as Bihar, Madhya Pradesh, Chhattisgarh, Uttarakhand, Orissa, West Bengal, but almost whole of India and neighboring countries including Nepal, Bangladesh, Pakistan, Sri Lanka, Bhutan, and middle Eastern countries. SGPGI is also emerging as a destination for medical tourism.

**Human and Financial Capital:** Institute has more than 150 faculty members in 29 academic departments with nearly 500 students. The academic departments are engaged in teaching, training, patient care and research. The Institute has a hospital-wide computer network with more than 500 computers spread all over the hospital and departments. Internet connections are available in all the departments. All faculty members, residents and students are provided with e-mail facilities.

Funds are being received from various courses offered and various government agencies such as DBT, DST and ICMR etc.

**Infrastructure:** SGPGIMS caters for emergencies relating to the specialties existing at the institute but not for general medical emergencies. SGPGIMS has a library with more than 16,000 books and subscriptions to nearly 450 scientific journals, a computer network with more than 230 computers, Internet connections, and e-mail facilities. Patient care activities are computerized. Campus has several facilities for patients and their attendants. SGPGIMS campus is spread over an area of 700 acres and is virtually a completely self-sufficient township in itself. The campus has virtually all facilities needed by the students, residents and faculty.

**Research Areas and Activities:** The Sanjay Gandhi Post Graduate Institute of Medical Sciences has figured on a global list of institutions undertaking quality medical research. SGPGIMS is the only institute from UP and one of the 12 from India to figure in the Scimago Institutions Ranking (Times of India, Aug 7, 2013). SGPGIMS has been ranked 26th in Careers360<sup>58</sup> for the academic year 2014.

Department of Gastroenterology has several extramural and several intramural grants which have funded most of the research. Major thrust areas of the Department's research consist of viral hepatitis (in particular, hepatitis E), chronic liver disease, gallstone disease and amebiasis resulting in an impressive list of publications in international journals.

<sup>58</sup> <http://www.university.careers360.com/articles/top-100-universities-in-india-2014>



Ongoing research projects of the institute are:

- Sentinel Surveillance of cardiovascular risk factors in Industrial population under aegis of WHO
- Web Based Taxus Intercontinental Observational Data Transitional Registry Program (MILESTONE TWO Registry). SGPGIMS is one of the five participating centers in India.
- INNOVA Observational Data Transitional Registry Program of Pronova stent
- EXCEL Observational Data Transitional Registry Program of Excel stent
- TRANSIT Observational Data Transitional Registry Program of Translumina stent
- Studies on HLA association with Rheumatoid Arthritis
- Immunogenetics of Bhargavas, Chaturvedies and Brahmins of UP
- Study of mutation, pre-mutation and mosaicism in fragile X mental retardation families
- Standardization of PCR for antenatal diagnosis of DMD
- Globulin chain separation in Thalassemia by HPLC

**Networking and Collaborations:** Some of the collaborations of SGPGIMS are:

- DST, DBT, ICMR Government of India
- IIT Kharagpur
- Central Drug Research Institute
- King George's Medical University
- Oregon Health & Science University (OHSU), Portland, Oregon USA
- International Epidemiological Association
- Shri Sathya Sai Medical College and Research Institute

**Publication:** SGPGIMS has around 3321 publications with articles, papers, books published by different faculties in different departments.

**Source/web link:** <http://www.sgpgi.ac.in>

## 7. Postgraduate Institute of Medical Education & Research (PGIMER)

**Overview:** Postgraduate Institute of Medical Education and Research (PGIMER) is a medical and research institution located in Chandigarh, India. It offers educational, medical research and training facilities for the students. PGIMER was established in 1962 to create an "ISLAND OF EXCELLENCE" to provide physical and intellectual milieu for young scientists working in multiple disciplines of medicine, to advance the frontiers of knowledge, to render humane service to the sick and suffering, and to train medical and paramedical manpower.

**Experience:** PGIMER has more than 50 years of experience in the field of medical research under the erstwhile state of Punjab. PGIMER runs a full-time residency program with specialties of medical science such as e.g. Medicine, Surgery, Pathology, Microbiology etc.

**Infrastructure:** PGIMER infrastructure is well furnished with all modern facilities. PGIMER has the following facilities such as Nehru Hospital, Advanced Pediatric Centre (APC), OPD Block, Advanced Eye Centre and Drug de-addiction centre and two research blocks which house various basic science departments such as Biochemistry, Haematology, Cytology, Pathology, Microbiology, Pharmacology and Experimental Medicine & Biotechnology.

**Research Areas and Activities:** Research forms an integral part of the education programme of the institute. It includes basic research and clinic research. PGIMER is involved in research for the rural and community related environment and health problems. The focus of research has been on tackling diseases like diarrhoea, tuberculosis, malaria, amoebiasis systemic vasculitis, relapsing polychondritis, HIV, leprosy, hepatitis, anaemia, leukemia and hypertension. PGIMER has made an endeavour to direct its various research activities to the relative needs of the society. The research work is carried out in accordance with nationally and internationally approved guidelines.

PGIMER has been graded as the **second best hospital** amongst the top 10 multi-speciality hospitals in India and also amongst the best government multi-speciality hospitals in India by a survey. The specialities of Paediatrics, Neurology, Diabetology, Gastroenterology, Cardiology and Oncology in PGIMER have been rated as **third, fourth, fourth, fifth, seventh and tenth** respectively.

All the departments of PGIMER undertake **research** in the area of national importance e.g. tuberculosis, malaria, leprosy, diarrhoea diseases, fertility control, family planning, blindness, cancer, community health, parasitic diseases, tetanus, preventable oral diseases, child health and nutrition to name a few. An **unique feature of research** of this institute is the establishment of the Department of Experimental Medicine which helps various clinical departments to have an in-depth research at the level of molecular biology and basic sciences to correlate with the various clinical problems e.g. hypertension, coronary artery heart disease etc. The **research output** of PGIMER has been incredible and has found recognition at various national and international forums.

PGIMER has completed several research projects in connection with Indian Council of Medical Research (ICMR), Department of Science and Technology (DST), Department of Biotechnology (DBT) etc in the following areas such as Anaesthesia and Intensive Care, Anatomy, Biochemistry, Biophysics, Biostatistics, Cytology and Gynaecological Pathology, Dermatology, Venereology and Leprology, Endocrinology, Experimental Medicine & Biotechnology, Forensic Medicine, Immunopathology, Internal Medicine, Medical Microbiology, Nephrology, Neurology, Oral Health Sciences Centre, Paediatrics, Pharmacology, Gastroenterology and Hematology.

**Biomedical Informatics Centre (BIC) at the Post Graduate Institute of Medical Education and Research, Chandigarh** was established in November, 2006. This is the one of the centers created by Indian Council of Medical Research (ICMR) with the objective to promote modern biology research in the regional medical colleges, to increase awareness of recent developments in modern biology through workshops and training programs, to develop and support databases of specific clinical findings and to develop new methodologies and solutions for prevention and amelioration of diseases of national importance.

PGIMER has participated in the following 2 European Commission FP7 project. The details of the project include:

Project Acronym	Project title	Challenge area
CAREPNEUMO	Combating antibiotics resistant pneumococci by novel strategies based on in vivo and in vitro host pathogen interactions	HEALTH-2007-2.3.1-2 Host-pathogen interactions in infections by <i>Streptococcus pneumoniae</i>
DEM-CHILD	A Treatment-Oriented Research Project of NCL Disorders as a Major Cause of Dementia in Childhood	HEALTH-2011.2.2.1-4 Creating clinical and molecular tools for experimental therapy of paediatric neurodegenerative disorders causing childhood dementia in Europe and India

**Networking and Collaborations:** PGIMER has several research links with government institutions such as Indian Council of Medical Research (ICMR), Department of Science and Technology (DST), Department of Biotechnology (DBT), Punjab University and National Institutes of Health (NIH) and international organizations such as World Health Organization (WHO).

**Publication:** PGIMER has around 6675 publications with articles, papers, books etc published by different faculties in different departments.

**Source/web link:** <http://pgimer.nic.in>

## 8. Mahatma Gandhi Institute of Medical Sciences (MGIMS)

**Overview:** MGIMS is India's first rural medical college, nestled in the karmabhoomi of Mahatma Gandhi, in Sevagram. It is managed by the Kasturba Health Society. MGIMS was set up in 1969, the Gandhi centenary year. The institute strives to produce doctors of high clinical competence, professional attitudes and ethical behavior. 96 non-governmental organizations have joined hands with the institute. Institute primarily caters to the rural populace. Approximately three-fourths of the patients visiting MGIMS are from rural locale. Community-based programmes have been constantly implemented to enhance health care services. Main objectives are:

- To evolve an integrated pattern of medical education
- To provide value-based and cost-effective medical education with a community oriented approach
- To teach and train doctors with a focus on rural orientation.

**Experience:** MGIMS has 45 years of experience in education and research. Institute has 2300 doctors have graduated from the hallowed premises of MGIMS. The courses offered by the institute are M.B.B.S., M.D./M.S., Diploma courses in Medicine and Surgery.

**Human and Financial Capital:** Institute enrolls nearly 200 students every year for under graduation and post graduation degrees. It has 150 staff working. It offers Medical Council of India recognized degrees and diplomas in 18 postgraduate disciplines and PhDs in seven departments. It boasts of a well equipped library which is a recognized resource library for HELLIS network in Western India. Three of its faculty members, Dr B.C.Harinath (1992), Dr (Mrs) P. Narang (2002) and Dr P.B, Behere (2005) are recipients of the National BC Roy Award.

MGIMS has consistently received funding from the ICMR, DST, DBT, WHO, UNICEF, USAID, Fogarty AIDS Research and Training Program, USA, Canadian Institute of Health Research, Population Health Research Institute, Canada, National Institutes of Health (NIH), National Heart Lung Blood Institute (NHLBI) and other such organizations.

**Infrastructure:** MGIMS has 24 teaching and research departments with 20 departments offering MD/MS and 7 offering PhDs with more than 26000 books in the library. MGIMS and Kasturba Hospital have established a unique Clinical Forensic Medicine Unit (CFMU) in the casualty, which is being headed by the Department of Forensic Medicine and Toxicology.

**Research Areas and Activities:** The seventh Outlook magazine and Marketing and Development Research Associates (MDRA) survey ranked MGIMS as the 21st best medical school in India.

The focus of the Institute has been on community based medical research. Quality research has been the feature of this rural institute and the large number of funded projects awarded to the various departments is ample testimony to the potential of the researchers. Each year, the large numbers of national and international peer reviewed publications from this Institute provide evidence of excellence in research. Over the last four decades, the MGIMS faculty has been striving hard to imbibe the philosophy which makes it pursue excellence in academics, healthcare and research, more than mundane needs and money; and to maintain excellence in quality. Today, MGIMS has impressive academic standards and excellent research facilities,

Main research objectives are to: Conduct appropriate and community-based research on priority health issues; Promote research in Indian systems of medicine along with allopathic medicine. There are around 45 funded and 40 non funded research projects.

**Networking and Collaborations:** Some of the collaborations of MGIMS are:

- World Health Organisation (WHO)
- Anna University
- Christian Medical College (CMC), Vellore
- Advanced Centre for Treatment, Research and Education in Cancer (ACTREC) – Mumbai
- Government Medical College, Patiala, Punjab
- Vadodara Govt. Medical College, Gujarat
- Centre for Innovations in Public Services (CIPS) Hyderabad
- Dept of AYUSH, Government of India
- Indian Council of Medical Research (ICMR)
- National Institute of Health (NIH), USA
- International Agency for Research on Cancer (IARC), Lyon, France
- National Institute of Health and Family Welfare
- Shastri Indo-Canadian Institute
- British Medical Journal (BMJ)

**Publication:** MGIMS has been promoting research activities in medical science. It has more than 415 research publications published under various departments of MGIMS.

**Source/web link:** <http://www.mgims.ac.in>

## 9. Sree Chitra Tirunal Institute for Medical Sciences & Technology

**Overview:** SCTIMST in Kerala, India is an Institute of National Importance established in 1974 by the government of Kerala. Now it is an autonomous Institute with National Importance under the administrative control of the Department of Science and Technology. The concept of amalgamating medical sciences and technology within a single institutional framework was regarded as sufficiently important by the Government of India to declare the center as an Institute of National Importance under the Department of Science and Technology by an Act of Parliament in 1980, and named it as Sree Chitra Tirunal Institute for Medical Sciences and Technology.

The institute has 3 divisions namely: A tertiary care hospital (about 250 beds); A biomedical technology wing (with state of technology development facilities); A center for health sciences & public health — Achuta Menon Center for Health Sciences.

**Experience:** The institute has 40 years of experience in education and research. The institute has team of clinicians, scientists and engineers dedicated to biomedical research and budding technologies in health care with importance on cardiovascular and neurological diseases.

**Human and Financial Capital:** Nearly 200-250 students get enrolled every year, there are about 100 faculties. Funds have been received from extramural and intramural projects. Some of the funding institutions are DST, DSIR, Technology Development, DAE, Institutional Internal fund, Cardiological Society of India, ICMR, Indian Heart Rhythm Society, DBT, VSSC-Trivandrum and Indian Institute of Space Science and Technology.

**Infrastructure:** The institute focuses on patient care, technology development of industrial significance and health research studies of social relevance. The stress is on development of facilities such as interventional radiology, cardiac electro-physiology, pre-surgical evaluation and surgery for epilepsy, microsurgery and deep brain stimulation for movement disorders, new biomedical devices and products, evaluation of medical devices to global specifications, new academic programmes and global public health networks.

**Research Areas and Activities:** SCTIMST has been ranked 16th in Careers360<sup>59</sup> for the academic year 2014.

**Research areas include:**

### Achutha Menon Centre for Health Science Studies

- **Community Research:** Community mobilization and participatory research & Research and community based-rehabilitation of differently-abled persons
- **Epidemiology and Biostatistics:** Epidemiology of chronic diseases and their risk factors such as tobacco use, unhealthy diet and physical inactivity, Epidemiology of diabetes, Measurement issues in health, Validation of measurement tools in health research
- **Health Policy and Management:** Health Policy with special reference to underdevelopment
- **Health Policy and Advocacy:** Policy research on intervention among children, Health Planning and Management- Healthcare administration
- **Technology:** Geo-spatial analysis in public health

<sup>59</sup> <http://www.university.careers360.com/articles/top-100-universities-in-india-2014>

## Biomedical Technology Wing

The Biomedical Technology Wing (BMT Wing) consists of an interdisciplinary team of scientists and engineers with wide ranging research interests around the broad area of biomaterials, biomedical engineering and medical devices technology. Research faculties actively pursue research projects by seeking external funding from national funding agencies and also undertake collaborative projects with other institutions and industry. The broad areas of interest in product development include:

- Cardio-vascular Devices and Implants such as mechanical heart valves, tissue based valves, coronary stents, blood pumps, LVADs, blood oxygenators, vascular grafts, ECG electrodes, tissue based cardiac patch
- Neurological devices such as EMG electrodes, DBS implants
- Neurosurgical implants such as Hydrocephalus shunt, aneurysm clips/ coils
- Blood transfusion products such as blood bags, leukocyte filters etc

**Areas of research in Hospital Wing** includes under different apartments such as Intra-operative hemodynamic performance and echocardiographic characteristics, Cardiac electrophysiology in inherited and acquired forms of cardiac dysarrhythmias, Stem cell treatment for patients with ischemic heart disease, Nutritional Cardiovascular Diseases, Multicentric, multinational, randomized, controlled clinical/surgical trials etc.

**Networking and Collaborations:** Some of the collaborations of SCTIMST are:

- University of Kerala, Rajiv Gandhi Centre for Biotechnology, Hospital Sal Petriere, Paris; TTK Healthcare Ltd, Vinvish Technologies, Lifecare Innovations Pvt. Ltd, Indian Institute for Information Technology and Management-Kerala, Trivandrum; Agharkar Research Institute, Pune; HLL Lifecare Ltd, Trivandrum
- An MoU with SIDD Life Sciences, Chennai was signed for a establishing a hub for developing cardiopulmonary devices with a view to accelerate targeted development of devices based on market pull.
- Several industrial interactions for different projects at different levels were coordinated by the division, some of which includes interactions with the following industries:
  - Reliance Lifesciences, Mumbai
  - Kerala Livestock Development Board(KLDB)
  - ISCSL, Bangalore
  - Trivitron, Chennai
  - CDAC, Trivandrum
  - Vins Biotech, Hyderabad
  - Manali Petrochemical Ltd, Chennai

**Publications:** SCTIMST has been promoting research activities in medical science. It has nearly 1672 research publications published under various departments of MGIMS.

**Source/web link:** <http://www.sctimst.ac.in>

## 10. Institute of Health Management Research (IHMR)

**Overview:** The Indian Institute of Health Management Research (IIHMR) is one of the premier institutes to have established health management as a full-fledged discipline. Established in 1984, IIHMR has 3 branches located in Jaipur, Delhi and Bangalore. The institute undertakes high quality training, research and consultancy, and offers postgraduate programs in hospital and health management, pharmaceutical management, health information technology management and rural management. The thrust areas of the institute include Primary Health Care, Health and Hospital Management, Health Economics and Finance, Population and Reproductive Health and NGO Management and Networking.

**Experience:** IIHMR has 30 years of experience primarily in **research, education and training organizations** with a focus on **health sector and related areas**. The institute is dedicated to research to generate new knowledge to provide evidence and inputs for developing effective policies and interventions.

**Infrastructure:** IIHMR has well-equipped laboratories and research labs with the state-of-the-art computing resources. IIHMR's research labs at different branches and have good training facility with required teaching aids and techniques, and is designed to facilitate participative learning environment.

**Human and Financial Capital:** There are around 2000 students in IIHMR being graduated. The institute currently awards postgraduate diplomas with specialization in pharmaceutical management, hospital management and health management for administering public health systems.

The institute receives funds from various international organizations such as United Nations Population Fund (UNFPA), United Nations Children's Fund (UNICEF), World Health Organization (WHO), World Bank, Official Development Association (ODA), Danish International Development Agency (DANIDA), Kreditanstalt für Wiederaufbau (KfW) & Gesellschaft für Technische Zusammenarbeit (GTZ), North American Aerospace Defense Command (NORAD), Credit Analysis and Research (CARE) and United States Agency for International Development (USAID). IIHMR has worked and has been working for the Ministry of Health and Family Welfare, Planning Commission, Indian Council of Medical Research, state governments and others.

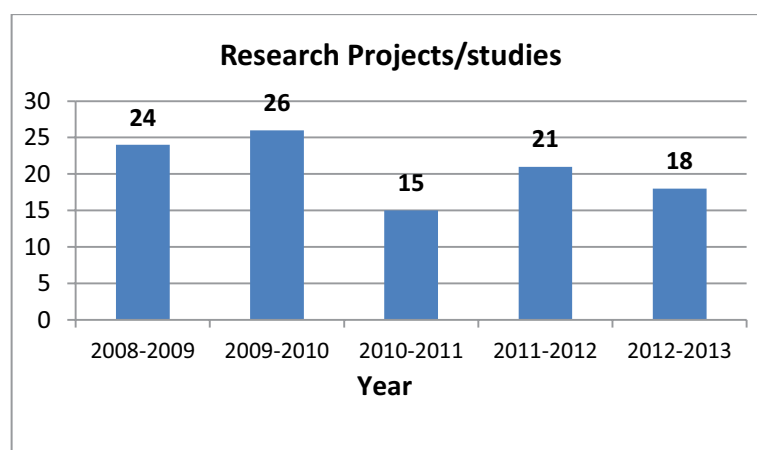
**Research Areas and Activities:** IIHMR is ranked No. 3 among the top 10 best Niche Schools and rated No. 4 by the All India Management Association (AIMA) Survey. IIHMR – Jaipur is featured in the list of top five Sectoral Business Schools of the country at Rank Number 1 in the B-Schools Ranking in healthcare since 2004 (Source – Outlook best Business School Survey 2004-2011) and No. 1 Institute in Healthcare management (Hindustan Times – 2008).

For more than 2 decades, the research work at IIHMR has successfully conducted series of projects, studies and development. IIHMR has undertaken over 440 research studies and projects in India and abroad. The research programs at IIHMR have mainly focused on policy, health programs, health systems and population management. The institute professed strengthening management in district health systems to improve the efficiency and effectiveness of health care, and has set up an operation in research projects to test and operationalize these management interventions for improving health systems. Some of the areas of research includes: Health



Program Evaluation, Health Survey, Health System and Strategies, Operations Research, Family Welfare, Nutrition, Health Economics/Financing/Insurance, NGO etc. IIHMR has an international presence in health systems research and technical support.

The following chart shows research projects / studies undertaken in IIHMR from 2008 till 2012:



Source: IIHMR-30 years of excellence

**Networking and Collaborations:** The Institute has worldwide collaboration and networking with various national and international organizations and universities to promote public health education. At present the institute has technical tie-ups with the following institutions and organizations: The Johns Hopkins University, USA; Chester University, UK; London School of Hygiene and Tropical Medicine; WHO South-East Asia Public Health Education Institution Network (SEAPHEIN); International Union against Tuberculosis and Lung Diseases, (IUATLD) Paris; UN Partners in Population and Development (PPD); Gulf Medical University, Ajman; Mahidol University, Thailand; Padjadjaran University, Indonesia; Gadjala Mada University, Indonesia and Hasanuddin University, Indonesia.

**Publications:** IHMR has nearly 500 research publications with scientific papers, articles and books. Journal of Health management is published quarterly in January, April, July and October.

**Source/web link:** <http://www.iihmr.org>

## 11. National Institute of Nutrition (NIN)

**Overview:** The National Institute of Nutrition (NIN) is an Indian Public Health, Biotechnology and Translational research center located in Hyderabad, India. The institute is one of the oldest research centers in India, and the largest center, under the Indian Council of Medical Research, located in the vicinity of Osmania University. The institute has associated clinical and pediatric nutrition research wards at various hospitals such as the Niloufer Hospital for Women and Children, the Government Maternity Hospital, the Gandhi Medical College and the Osmania General Hospital in Hyderabad. NIN offers advanced education courses and PhD program for nutrition and laboratory animal sciences. The Centre is recognized by Dr. N.T.R. University of Health Sciences for pursuing post graduation in Applied Nutrition sciences. The institute is also recognized by Osmania University, University of Hyderabad, Jawaharlal Nehru Technological University, for pursuing doctor of philosophy in Life Sciences.

**Experience:** The institute carries out research and patent development in clinical nutrition, pharmacology, pathology, toxicology, food chemistry, endocrinology, molecular biology, regenerative medicine, community nutrition, ophthalmology and sports nutrition. Agencies such as World Health Organization (WHO) and Food and Agriculture Organization (FAO) have recognized the institute as a Centre for excellence in food quality, safety and nutrition research.

**Human and Financial Capital:** The comprehensive nature of the institute's courses has attracted participants from various parts of India, and more than 30 countries of South East Asia, Middle East, Africa and the Pacific regions. The participants trained at NIN are holding key-positions in nutrition and health related areas in various countries. Manpower consists of 88 R&D personnel and 135 Support staff. The institute has trained over 1600 health professionals from 35 countries. 150 candidates obtained PhD and Master of Doctor degrees.

The institute derives funding from the Indian govt. such as Department of Biotechnology (DBT) and Indian Council of Medical Research (ICMR). The institute majorly conducts pre clinical research in obesity and diabetes in collaboration with centers such as the Rockefeller University, University of Colorado School of Medicine, Washington University in U.S and the University of Wollongong-Australia in food chemistry.

**Infrastructure:** The institute's strength lies in the dedicated and devoted scientists belonging to diverse disciplines such as medicine, pediatrics, obstetrics and gynecology, biochemistry, pathology, community health, social sciences, dietetics, statistics, communication and other related areas. The institute has been recognized by many national and international agencies as centre for conducting advanced as well as ad-hoc training courses in nutrition and laboratory animal sciences. The institute has various research laboratories, data centres and accommodation facilities.

**Research Areas and Activities:** National Institute of Nutrition has been identified as one of the institute among the 4288 institutes of DST directory.

National Institute of Nutrition maintains excellent rapport with various institutions in Hyderabad and other institutes in India to carry out its research activities. Research at NIN takes place at 3 levels namely Lab based, Community and Clinical level.

- **Lab based research** includes research in areas like Biophysics, Biochemistry, Molecular biology, Analytical chemistry, Endocrinology and Metabolism
- **Clinical research** includes Maternal and Child Health and Pathology
- **Community research** includes Field studies and Training.

The Nutrition units established in three local hospitals have been providing patient care to individuals with various nutritional disorders. Pathology division of the institute tests the fruitful collaborative research.

NIN has been providing inter-laboratory services on mutual basis to other institutes. The institute has been organizing short and long term training programmes to personnel in clinical and applied nutrition and also in allied fields where NIN has developed expertise.

Some of the research achievements include:

- Vitamin A absorption and its retention in children providing strong rationale for the National Programme for Control of Blindness.
- Developed a novel method for in vivo conversion of carotene to vitamin A using pharmacokinetic principles
- Developed Dry Blood Spot methodology for estimation of hemoglobin and vitamin A
- Genomic organization of human resistance was determined

**Networking and Collaborations:** Some of the NIN collaborations are:

- Field Studies: Assessment of nutritional status of less than 5 year children – Govt. of India / UNICEF Integrated behavioral and biological assessment (IBBA) – Avahan project with financial assistance from Bill and Melinda Gates Foundation + Technical collaboration from Family Health International (FHI)
- Behavioral Science: Indo-US Missouri Commission on Human Rights (MCHR) collaboration
- Endocrinology: Collaborative research with United Nations Children’s Fund, Centre for Cellular and Molecular Biology -India & IGIB, India
- Lipid Chemistry collaboration: with ICMR, Heinz Nutrition Foundation India, Indian Institute of Chemical Technology (IICT) -Hyderabad & Coconut Development Board.

**Publications:** Books-75, CD-5, Periodicals-4, there are more than 800 scientific publications.

**Source/web link:** <http://www.ninindia.org>

## 12. All India Institute of Hygiene & Public Health (AIH&PH)

**Overview:** The All India Institute of Hygiene & Public Health was established in Calcutta on 30th December, 1932 with generous assistance from the Rockefeller Foundation. It is the pioneer institute of India, devoted to teaching and research in various disciplines of public health and allied science and is the oldest school of public health in South-East Asia region. Through several decades of its existence, AIH&PH has contributed significantly in the public health scenario of India and South East Asia Region. Since 2004, the AIH&PH has been affiliated to the West Bengal University of Health Sciences (WBUHS).

The AIH&PH continues to strive towards public health development through contribution of its technical expertise along with capacity building in public health. Objectives of AIH&PH include:

- To develop health manpower by providing post-graduate (training) facilities
- To conduct research directed towards the solution of various problems of health and diseases in the community and to undertake operational research
- To develop methods for optimum utilization of health resources and application for protection and promotion of health care services.

**Experience:** AIH&PH has more than 80 years of experience in academics and research with two field practice units, each controlled by a Professor and Head of the Department / Officer-In-Charge. The departments provide good facilities for research in various health and allied sciences such as: Bio-Chemistry and Nutrition, Epidemiology, Health Education, Maternal and Child Health, Microbiology, Occupational Health, Public Health Administration, Public Health Nursing, Environmental Sanitation and Sanitary Engineering and Preventive and Social Medicine.

**Infrastructure:** The institute's infrastructure is well furnished with all modern facilities. The main campus of the Institute is located in the central part of the city of Kolkata. Second campus of the Institute is located at Salt Lake, Kolkata. This second campus was planned to provide for further expansion in the activities of the Institute. Recently, there are four departments namely Epidemiology, Microbiology, Sanitary Engineering, Bio-Chemistry & Nutrition. The campus is fully operational.

**Research Areas and Activities:** All India Institute of Hygiene and Public Health has been identified as one of the institute among the 4288 institutes of DST directory.

Some important on-going and recently carried out research studies in the field of occupational safety and health field are:

- Study of the socio-economic condition and physical stress of workers in selected small scale and cottage industries.
- Studies of anti-oxidant status, the index of carcinogenic risk among the industrial workers occupationally exposed to trace-elements
- Biological monitoring of environmental Nitrogen-di-oxide and Carbon-di-Oxide exposures of Calcutta population.
- Impact of cigarette smoking on psychological stress in relation to blood Vitamin-C level
- Assessment of occupational work stress and health survey of the rice cultivators
- The effect of loads, duration of the carriage and rest periods on cardio-respiratory response

Biochemistry and Nutrition department has conducted various research activities such as a study on the role of nutrition, socio-economic status and intelligence level on the academic achievement of primary school children and an epidemiological study on metabolic syndrome among college students of Kolkata.

**Networking and Collaborations:** The All India Institute of Hygiene & Public Health has been working in close collaboration with the faculty of the School of Tropical Medicine, West Bengal and various international agencies like World Bank, United Nations Children's Fund (UNICEF), United Nations Development Programme (UNDP), World Health Organization (WHO) etc.

**Publication:** AIH&PH has nearly 250 research publications with scientific papers, articles, books etc.

**Source/web link:** <http://www.aiihph.gov.in>

## 13. School of Medical Science and Technology (MST) – IIT Kharagpur

**Overview:** The main aim of the school is to provide a platform for interdisciplinary teaching and research in the field of medical science & technology to lead to a better integrated healthcare delivery system.

The School of Medical Science & Technology was started in 2001 at IIT Kharagpur with the objective to provide a platform of interdisciplinary teaching and research in diverse areas of medical science and technology. The School has collaboration with some of the best medical research institutes and medical industries from all over the world.

The School introduced an interdisciplinary 3 years Masters Program in Medical Science and Technology (MMST), first of its kind in the country. The MMST program offered by the School is the only comprehensive physician-scientist training program in India which aims to bridge the gap that has historically separated biological sciences from engineering and physical sciences.

**Experience:** MST-IIT Kharagpur has 13 years of experience in teaching and research in the field of medical science & technology.

**Infrastructure:** School has a number of well-equipped state-of-the-art laboratories and is supported by an excellent faculty, in addition to many other faculty members from different departments of the Institute. Some of the finest infrastructures available for interdisciplinary research and development activities are: Herbal Medicine Lab, Bio-MEMS Lab, Biomaterials & Tissue Engineering Lab, Multimodal Imaging & Computing for Theranostics, Biostatistics & Medical Informatics Lab, Cancer Biology Lab, Medical Instrumentation & Embedded Systems Lab and Reproductive Health Lab.

### Research Areas and Activities:

Research areas include: Wound Healing Research, Tissue Engineering, Telemedicine, Reproductive Health, Preventive & Promotive Health Care System, Pattern recognition and machine learning in medicine and Medical Imaging & Image Analysis.

### Sponsored Projects:

- Development of a Statistical Analyzer based Computer Aided Diagnostic (CAD) System for Asthma
- Development of Ceramics Based Bioactive Scaffold Through Bone Tissue Engineering (BSH)
- Identification of potential biomarkers for the diagnosis of endometriosis: a proteomics approach
- Assessment of endometrial receptivity and its correlation with sub endometrial blood flow (SEBF) in women with latent genital tuberculosis
- Design & Feasibility Study of Versatile Low-cost Functional Electrical Stimulator (FES) for Hemiplegics
- To Evaluate the Clinical Efficacy of the Functional electrical Stimulation (FES) therapy in Stroke Survivors
- Web Enabled Medical Information Access Using Handheld Devices in a Wireless Environment for Telemedicine Applications

**Technology Developed:**

- A Pumping System for Increasing Pressure of Blood or a Fluid in a Controlled and Stepwise Mode
- Palposcope
- Percutaneous Intraluminal Vas Deferens Injection System
- Preloaded Syringe for storage and enhanced pressure delivery of viscous chemically reactive drug
- Functional electrical stimulator for stroke rehabilitation
- VENUCAINE: An Electronic Travel Aid for Visually Impaired Blind People

**Networking and Collaborations:** Some of the collaboration are: RDCIS, SAIL, DRDO – Kanpur, ICMR, DBT, DST, CSIR, DRDO, DBT etc.

**Publication:** MST-IIT Kharagpur has around 450 research publications with scientific papers, articles and books.

**Source/web link:** <http://www.smstweb.iitkgp.ernet.in>

## 14. Maulana Azad Medical College (MAMC)

**Overview:** MAMC (Maulana Azad Medical College) is one of the premier medical colleges of India. The foundation stone of MAMC was laid on October 24, 1959 and the college was declared open on February 26, 1961. The Maulana Azad Medical College (MAMC) is a government medical college affiliated to University of Delhi. It is named after Indian freedom fighter and first education minister of independent India Maulana Abdul Kalam Azad. College has the following hospitals attached to it: Lok Nayak Hospital, Govind Ballabh Pant Hospital, Guru Nanak Eye Centre, Sushruta Trauma Centre and Chacha Nehru Bal Chikitsalaya.

**Experience:** MAMC has 55 years of experience in education and research. MAMC offers MBBS (Bachelor of Medicine, Bachelor of Surgery), BDS (Bachelor of Dental Surgery) undergraduate courses. Postgraduate courses include degree courses (MD/MS), diploma and postdoctoral courses (M.Ch./DM). It has attached schools offering degrees in nursing and pharmacy. The attached hospitals are renowned for the training programs across specialties and subspecialties.

**Infrastructure:** MAMC is a wholly self-contained campus catering to both day-scholars and hostellers. Students are provided with equipment personally and do not have to share microscopes, etc. The labs cater to both students' needs and to investigations requested from hospitals throughout North India.

**Research Areas and Activities:** The overall ranking of MAMC has always been in the top five. Its location in the capital city makes it a particularly attractive choice among students across Northern India. In 2013, India Today Rankings, it was ranked number 5 among medical colleges in India. Outlook India also ranked Maulana Azad Medical College at Number 5 in 2012. In terms of competitiveness for admission, it is certainly the second toughest medical institution in India.

The college has an established research society with primary objectives being to promote research activities. This society primarily addresses research grants from non-governmental organizations/institutions. There are more than 25 research projects going on. Some of them are:

- Significance of Genotypic Characterization of Hepatitis C Virus isolates
- Detection of precore mutants of Hepatitis B virus Ligase Chain Reaction in patients of chronic liver diseases & National Neonatal Perinatal Database
- Effect of IEC activities on Revised National Tuberculosis Control Programme (RNTCP) in Delhi - a preliminary assessment & Serological Status of Varicella in children below 5 years
- Role of Polymerase Chain Reaction in early diagnosis of TBM in children
- Improvement in Management of Malaria in slum areas of Delhi
- Multicentric study to establish epidemiological data on Health problem in elderly

**Networking and Collaborations:** Some of the collaborations of MAMC are: ICMR, DST, DBT, AIIMS, Lady Hardinge Medical College (LHMC), Kasturba Medical College (KMC) and Christian Medical College.

**Publication:** MAMC has around 2125 research publications with scientific papers, articles and books.

**Source/web link:** <http://mamc.ac.in>



## 15. National Institute of Occupational Health (NIOH)

**Overview:** NIOH is the premier institute, under the aegis of the Indian Council of Medical Research (ICMR) under the Department of Health Research, Ministry of Health and Family Welfare, Govt. of India. The need for research in Occupational Health in the country was first appreciated by Indian Research Fund Association (IRFA), the forerunner of the Indian Council of Medical Research (ICMR). The National Institute of Occupational Health (NIOH) has been established with the following objectives:

- To promote intensive research to evaluate environmental stresses/factors at the workplace.
- To promote the highest quality of occupational health through fundamental and applied research.
- To develop control technologies and health programmes through basic and fundamental research

The Institute started functioning as "Occupational Health Research Institute" (OHRI) in the year 1966. The Institute established two Regional Occupational Health Centres (ROHC) at Bangalore (1977) and Calcutta (1980).

**Experience:** NIOH has 48 years of experience in research in health sciences. Institute functions as a WHO Collaborative and Reference Centre for Occupational Health. The Institute has represented in many important functions of the Government of India, including the Ministry of Health and Family Welfare, Ministry of Labour, Ministry of Environment and Forests, Ministry of Agriculture, etc., to generate data and provide guidance and recommendations on issues related to occupational and environmental health.

**Research Areas and Activities:** NIOH has been identified as one of the institute among the 4288 institutes of DST directory.

The research activities of the Institute are primarily based on national priorities and needs and envisage a multi-disciplinary approach, encompassing epidemiological studies, experimental studies, ergonomics and intervention technologies. The major contribution of the institute can be seen in the form of peer-reviewed publications, reports and large number of know-how influencing policy decisions through expert advice, research, development of modules for control of occupational diseases and help development of manpower through education and training.

Some of the ongoing research projects are:

- Biological and environmental monitoring as well as health surveillance of chromium (cr) in chemical industry.
- Health status study on mercury exposure at Modi Alkalies and Chemicals Ltd., Alwar
- Studies on synthetic pyrethroids
- Health Risk assessment of Rural and Urban population due to Ambient/Indoor Air Pollution, sponsored by the Ministry of Health and family Welfare
- Experimental studies on endosulphan with special references to endocrine & reproductive dysfunction in rats.
- Neurobehavioral Toxicology of Metals: Lead, Cadmium, Zinc, Manganese, Selenium.
- Role of areca nut and pan masala chewing in the causation of oral diseases in human.

**Networking and Collaborations:** Some of the collaborations of NIOH are: World Health Organization, Ministry of Labour, Ministry of Health and Family Welfare, Pollution Control Boards, DST, Director General, Factory Advice Service & Labour Institutes (DGFASLI), Directorate General of Mines Safety (DGMS), National Institute of Miners' Health (NIMH), CSIR-Indian Institute of Toxicology Research (CSIR-IITR), US Environmental Protection Agency, USA; Centers for Disease Control and Prevention, USA and International Labour Organization.

**Publication:** NIOH has around 775 research publications with scientific papers published since 2008 and published by various faculties. NIOH has 32 newsletter published since 2004.

**Source/web link:** <http://www.nioh.org>

## 16. Central Institute of Medicinal and Aromatic Plants (CIMAP)

**Overview:** CIMAP is a cutting edge plant research laboratory of CSIR. CIMAP was established in 1959 for steering multidisciplinary high quality research in biological and chemical sciences and extending technologies and services to the farmers and entrepreneurs of medicinal and aromatic plants (MAPs) with its research headquarter at Lucknow and Research Centres at Bangalore, Hyderabad, Pantnagar and Purara. CIMAP Research Centres are appropriately situated in different agro-climatic zones of the country to facilitate multi-location field trials and research. Mint varieties released and agro-packages developed and popularised by CIMAP has made India the global leader in mints and related industrial products. CIMAP has released several varieties of the MAPs, their complete agro-technology and post harvest packages which have revolutionised MAPs farming and business circumstances.

**Experience:** CIMAP has 55 years of experience in the field of science and business of medicinal and aromatic plants.

**Infrastructure:** CIMAP is equipped with state-of-the-art multidisciplinary labs, ultra-modern instrumentation facilities and scientific knowledge in agriculture, genetics and plant breeding, molecular taxonomy, bio energy and chemical sciences, apart from development of herbal products. CIMAP, Lucknow houses the National Gene Bank of medicinal and aromatic plants, in addition to seed gene bank, tissue and DNA bank. CIMAP has been documenting and crafting scientific knowledgebase related to MAPs for its resourceful utilisation, aiding the lab to market journey of medicinal and aromatic crops (MACs) through quite a few key publications.

**Research Areas and Activities:** Some of the department's research activities are as follows.

- Agronomy's main focus is the development of agro-technologies for economically important medicinal and aromatic plants (MAPs) by introduction, domestication, crop geometry and nutrient management.
- Chemical Sciences division deals with all aspects of natural products chemistry on medicinal and aromatic plants. Their main focus is on the isolation and structure elucidation of aromatic and bioactive phytomolecules, their chemical fingerprinting, development of qualitative and quantitative analytical techniques.
- Microbial Technology and Nematology department deals with microorganisms like bacteria, fungi, AMF and nematodes. Microorganisms benefit agriculture by cycling organic and inorganic matter into useful molecules needed by the plants.
- Genetic Resource Management Department focus is management of "Genetic Resources" of Medicinal and Aromatic Plants (MAPs). Research focus is also on fine characterization of germplasm of medicinal and aromatic plants.

Research & Development areas are:

- Conservation & utilization of genetic resources of medicinal & aromatic plants
- Bioprospection & development of technologies for therapeutic, nutraceutical, agrichemical & health care product.

- Transforming R& D leads into technologies and products.
- Bio-village approach for mission programme on technology dissemination in geranium, patchouli, Artemisia annua, rose, mints, rosemary and Cymbopogon grasses.
- Development of improved varieties and agro technologies for priority plants.
- Plants genomics and biotechnological improvement in Catharanthus, Withania and Mentha species.
- Plant tissue culture technology for developing high throughput regeneration and secondary metabolite production.
- Integrated nutrient and pest management strategies leading to near organic farming.
- Basic research in selected medicinal and aromatic plants for future exploitation.

Some of the R&D output includes products formulations in fields such as Skin Care, Anti Fungals, Hair Care, Disinfectants, Mosquito Repellants and Pain Reliever.

### Networking and Collaborations:

- CIMAP has been recognized as Focal Point for South East Asia by International Centre for Science and High Technology- United Nations Industrial Development Organization (ICS-UNIDO).
- CIMAP has scientific collaboration with Bulgarian Academy of Science for Rose oil technology.
- At National level CIMAP has established alliances with Indian Institute of Agriculture Research (IIAR), Gandhinagar (Gujarat) and North East Institute of Science & Technology (NEIST), Jorhat (Assam) for multiplier effect for its endeavour in western and North East Region.
- CSIR-CIMAP and UNIK will also explore and develop the use of herbs, plants, flowers and fruits for medicinal and aromatic purposes in Malaysia by way of improving extraction techniques, modern processes and herbal products.
- CIMAP has signed MoUs with several universities including JNU, GB Pant University of Agriculture & Technology (GBPUAT), Pantnagar, Chandra Shekhar Azad University of Agriculture & Technology (CSAUAT), Kanpur, Banaras Hindu University (BHU), Universities of Allahabad and Lucknow.

**Publication:** There are around 120 publications with 28 patents.

**Source/web link:** <http://www.cimap.res.in>

## 3.5 INFORMATION AND COMMUNICATION TECHNOLOGIES (ICT)

### Sector Summary

India is the world's second-largest telecommunications market, with 898 million subscribers as on March 2013. The sector's revenue grew by 13.4 percent to reach 46 billion Euros in FY12.<sup>60</sup> IT & ITeS (Information Technology Enabling Services) industry in India has become a growth engine for the economy, contributing substantially to increases in the GDP, urban employment and exports leading to achieve the vision of a powerful and resilient India.<sup>61</sup> While Indian IT companies such as Tata Consultancy Services (TCS), Wipro, Infosys and HCL are some of the renowned ICT players in the global market, global giants like IBM, Motorola, Microsoft, General Electric and many others are gaining immense revenue benefits through their successful outsourcing strategy by investing in India<sup>62</sup>. India continues to maintain a leading position in the global sourcing market. Its market share increased to 52.0 per cent in 2012 from 50.0 per cent in 2011. India's IT market is experiencing a significant shift from a few large-size deals to multiple small-size ones. Increased focus on R&D by IT firms in India resulted in rising number of patents filed<sup>63</sup>. India's IT sector is also gradually moving from linear models to non-linear ones. Non-linear growth does not measure improvement on the basis of headcount growth. Instead, organisations measure growth by the number of value-added services they offer to customers, by introducing non-linear or non-headcount related services like platform-based solutions or invest in creating intellectual property (IP) rather than focus on just pure application development and maintenance (ADM) work<sup>64</sup>.

Segments of India's IT sector:

- IT Services: Market Size: EUR 41.29 billion during FY13
- Business Process Management (BPM): Market size: EUR15.33 billion during FY13
- Software products and engineering services: Market size: EUR13.13 billion during FY13
- Hardware: Market size: USD9.75 billion during FY12

The 16 ICT research players from both public and private sectors covered in this report include:

1. Department of Computer Science and Automation (CSA) – IISc
2. Amar Nath and Shashi Khosla School of Information Technology – IIT Delhi
3. Department of Computer Science and Engineering (CSE) at IIT-B
4. Computer Science & Engineering (CSE) – IIT Kharagpur
5. Computer Science & Engineering (CSE) – IIT Madras
6. Department of Computer Science and Engineering (CSE) – IIT Kanpur

<sup>60</sup> <http://www.ibef.org/industry/indian-telecommunications-industry-analysis-presentation>

<sup>61</sup> [http://www.indianotes.com/uploads/article\\_pdf/fce\\_Wipro\\_28Oct13.pdf](http://www.indianotes.com/uploads/article_pdf/fce_Wipro_28Oct13.pdf)

<sup>62</sup> <http://www.cii.in/Sectors.aspx?enc=prvePUj2bdMtgTmvPwwisYH+5EnGjyGXO9hLECvTuNtm4hrH7qvQL245kuWHeE2S>

<sup>63</sup> <http://www.ibef.org/download/IT-and-ITeS-March-2014.pdf>

<sup>64</sup> [http://www.business-standard.com/article/technology/it-companies-may-take-time-for-non-linear-growth-109081200089\\_1.html](http://www.business-standard.com/article/technology/it-companies-may-take-time-for-non-linear-growth-109081200089_1.html)

7. Centre for Development of Advanced Computing (C-DAC)
8. Dept of Computer Science and Engineering (CSE) – IIT Roorkee
9. Dept of Computer Science and Engineering (CSE) – IIT Guwahati
10. International Institute of Information Technology, Hyderabad (IIIT-H)
11. International Institute of Information Technology, Bangalore (IIIT-B)
12. Tata Consultancy Services (TCS)
13. Infosys Limited
14. Wipro Limited
15. HCL Technologies
16. National Institute of Science Communication and Information Resources (NISCAIR)

## 1. Department of Computer Science and Automation (CSA) – IISc

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**Overview:** Department of Computer Science and Automation (CSA) was created in 1969 and was originally called the School of Automation till the mid-eighties. Ever since its inception, the department has been a pioneering academic centre for higher education, research, and innovation in key areas of computer science. The vision of the department is to enable India's excellence in the world of computer science and automation. The driving mission for the department is to advance the frontiers of research in computer science and automation and offer world-class pedagogical and research experience to its students.

**Experience:** The department has 45 years of experience in research and teaching activities. CSA researchers contribute to cutting-edge research in topical areas of computer science and are actively engaged in many high impact collaborative projects. CSA offers two research programs, Ph.D. and M.Sc. (Engineering), and two course-based M.E. programs.

**Human and Financial Capital:** CSA department currently comprises of 31 faculty members who are active researchers in many of the principal areas of computer science with 96 Ph.D , 44 M.Sc. (Engg), 112 M.E. (CSE) students.

CSA is recognized as a Centre for Advanced Study by the University Grants Commission (UGC) and has recently been awarded a FIST (Fund for Infrastructure in Science and Technology) grant by the DST.

**Infrastructure:** Department quarters excellent research facilities counting research laboratories for conducting focused research, well equipped classrooms, and high performance computing clusters. In addition, students and faculty have access to the computing facilities at the Supercomputer Education and Research Centre (SERC) within IISc. Also, department houses a number of research labs with faculty, students (both ME and research students) and dedicated project staff. The labs are usually equipped with specialized software and computing facilities, and carry out work on various projects.

**Research Areas and Activities:** According to the 2013 Academic Ranking of World Universities, IISc Computer Sciences is ranked in the range 51-75. The department is ranked among the top 100 computer science departments in the world in terms of its publication profile and citations accumulated by the publications (Source: Academic Ranking of World Universities, ARWU, August 2012). Indian Institute of Science has been ranked No.1 institute in India as per Careers360 research for the year 2014 <sup>65</sup>.

Research in the department can be broadly grouped into three areas:

**Theoretical Computer Science:** Algorithms, complexity theory, graph theory, algorithmic algebra, automata theory, combinatorial geometry, computational geometry, computational topology, coding theory, cryptology, logic, formal verification, computational biology.

**Computer Systems and Software:** Computer architecture, multi-core systems and programming, parallelization, embedded systems, energy aware computing, operating systems, storage systems, database systems, distributed computing, cloud computing, systems security, mobile

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<sup>65</sup> <http://www.university.careers360.com/articles/top-100-universities-in-india-2014>

and wireless systems, cyber-physical systems, performance modeling, graphics, visualization, Programming languages, compilers, program analysis, software engineering.

**Intelligent Systems:** Pattern recognition, machine learning, Information theory and statistical learning, convex optimization, data mining, information retrieval, bioinformatics, social network analysis, network science, reinforcement learning, stochastic control and optimization, stochastic simulation, electronic commerce, game theory, auctions and mechanism design, cognitive systems

Some of the completed research projects are:

- A parallel cylindrical algebraic decomposition algorithm for quantifier elimination on real closed fields
- Cognitive modelling and text understanding
- Geometric representation of graphs
- Rainbow coloring of graphs
- Integrated geometric and topological measures of features
- Automata construction for metric temporal logic
- Design and analysis of provable secure protocols

### Networking and Collaborations:

- Many students are supported by research fellowships from Bell labs, IBM IRL, Infosys, Microsoft Research India, and TCS.
- Adobe Labs, AMD, Google, IBM, Infosys, Intel, Microsoft Research India, NetApp, Nokia, Philips, SAP, SUN, TCS, Xerox, and Yahoo!,
- CSA is involved in joint research projects or faculty collaboration or student internships with several universities including Alberta, Chalmers, CMI, CMU, Grenoble, Harvard, IITB, IITM, INRIA, ISI, Leipzig, MIT, MPI, UCB, UCD, UCSC, SUNY, Technion, TIFR, Waterloo, York, and Zurich.

**Publications:** Dept of CSE has around 525 research publications since 2008.

**Source/web link:** <http://www.csa.iisc.ernet.in>



## 2. Amar Nath and Shashi Khosla School of Information Technology – IIT Delhi

**Overview:** The Amar Nath and Shashi Khosla School of Information Technology was established in 2004, under the aegis of IIT Delhi, with an bequest from the notable IIT alumnus, Vinod Khosla (B.Tech., EE 1976). The aim of the School is to foster inter-disciplinary, goal-oriented research, innovation and post-graduate education in information technology. The School offers Ph.D. and M.S. (Research) programmes in Information Technology. The M.S. (Research) programme is a 60 credit (2-year) inter-disciplinary programme that admits students with various backgrounds in computing, engineering and applied sciences. The school also develops and offers academic courses in a variety of application areas.

**Experience:** School of Information Technology – IIT Delhi has 10 years of experience in research and education. The School undertakes research in diverse interdisciplinary areas where there is a significant application of Information Technologies.

**Human and Financial Capital:** Dept of CSE has around 18 PhD students with 15 faculties and 15 staff (research, lab and office). Funds have been received from Wellcome Trust UK, DIT, DST, Max-Planck Institute, Indian Academy of Science.

**Infrastructure:** School of Information Technology has state-of-the art laboratories for the use by all students and faculty members working in related areas, and encourages the participation of researchers from different disciplines and departments in such sponsored research activities. School of IT has general computing lab for research in the area of High Speed Networks, Sensor Networks, Web Based Computing and Bioinformatics and E-Governance Innovation Lab.

**Research Areas and Activities:** Internationally, IIT Delhi was ranked #222 in the QS World University Rankings (Quacquarelli Symonds) of 2013. IIT Delhi is ranked #38 in QS Asian Rankings and in the range of 351-400 in Times Higher Education ranking in 2013. In India, among engineering colleges, it ranked first by India Today in 2013, first by Outlook India in 2013. In the Mint Government Colleges survey of 2009, it ranked 3. Indian Institute of Technology- Delhi has been ranked No. 5 institute as per Careers360 research for the year 2014<sup>66</sup>.

The School initiates research in interdisciplinary Information Technology areas such as Scalable and Dependable Computing, Information Security, Information Storage and Retrieval, High Speed Networks, Web Based Computing, Multimedia Systems, E-Commerce, HCI (Human-Computer Interface), Robotics and Intelligent Systems, Embedded Systems and Sensor Networks, Geographical Information Systems, Optical Information Processing, Nanotechnology Modeling and Bio-informatics.

Some of the completed research projects:

- Opportunistic Communication for eGovernance (Sponsor NISG)
- Managing Secured Documents (Sponsor NISG)
- Understanding 3G Networks

<sup>66</sup> <http://www.university.careers360.com/articles/top-100-universities-in-india-2014>

**Networking and Collaborations:** Some of the collaborations are: CSIRO Australia, University of Michigan, Northern Ontario School of Medicine, Stanford School of Medicine, IIT Bombay and IIT Kanpur.

**Publications:** There are around 480 publications published by the faculties of the School of IT.

**Source/web link:** <http://www.sit.iitd.ac.in>

### 3. Department of Computer Science and Engineering (CSE) at IIT-B

**Overview:** Department of Computer Science and Engineering at the Indian Institute of Technology Bombay is one of the largest departments in India. The department started offering elective courses in Computers as a part of the UG and PG programmes in Electrical Engineering. In 1973, the department also started offering academic programmes in the form of an interdisciplinary M.Tech programme and a DIIT (Post Graduate Diploma of IIT) in Computer Science. During the period 1975 to 1980, the dept undertook several indigenous efforts to enhance both the software and hardware resources.

**Experience:** Department of CSE has 46 years of experience in offering B. Tech., B. Tech. Dual Degree, M. Tech., M. Tech. Dual Degree and Ph. D. programmes in Computer Science. Department of CSE is closely connected with an association – ‘Department of Computer Science and Engineering Association (CESA)’ which has great interaction between the students and the faculty members and organizes technical sessions, workshops and contests through a close tie-up with the industry and also assists in managing the resources and labs of the department.

**Human and Financial Capital:** The department’s teaching and research activities are handled by forty faculty members. Currently, about hundred Ph.D. students, more than two-hundred M.Tech students and more than two-hundred and fifty B.Tech students from the student pool of the department.

CSE at IIT- B has been receiving funding from Department of Information Technology (DIT), Ministry of Human Resource Development (MHRD), DST, ISRO, CSIR, CRDO, FICCI, Nokia India, Netapp India, Synopsys, IBM, Bill and Melinda Gates Foundation, European Commission, etc.

**Infrastructure:** Some of the Research Laboratories/Groups/Centers of CSE- IITB are: Centre for Formal Design and Verification of Systems, Centre for Indian Language Technologies, Database and Information Systems Laboratory, Embedded Real-Time Systems Laboratory, GCC Resource Center, Gigabit Networking Laboratory, Graphics and Vision Laboratory, Laboratory for Intelligent Internet Research, Systems and Networks Research Group and Geospatial Information Science & Engineering.

**Research Areas and Activities:** Indian Institute of Technology- Bombay has been ranked No. 2 institute as per Careers360 research for the year 2014<sup>67</sup>. Internationally, IIT Bombay is ranked #233, and No. 39 among Asian institutes in the QS World University Rankings (Quacquarelli Symonds) for 2013. IIT Bombay was ranked No. 3 in India by Outlook India in 2012.

The following are some of the research areas of CSE dept:

- Algorithms: Algorithms and complexity
- Programming languages and Compilers: Theory of code optimization, Optimizing and parallelizing compilers, Theory of programming languages
- Database and Information Systems: Object oriented, temporal and parallel databases, data dissemination systems, data warehousing and database and application security
- Artificial Intelligence and Natural Language Processing: Image processing, Natural language understanding, Machine learning and Neural networks.

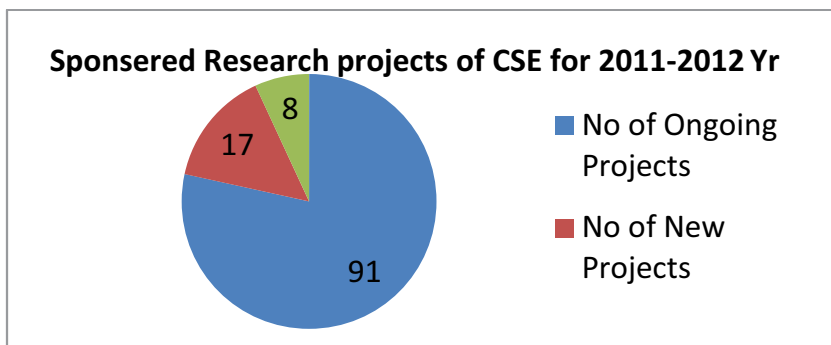
<sup>67</sup> <http://www.university.careers360.com/articles/top-100-universities-in-india-2014>

- Software Engineering: Object oriented software development, Component architectures
- Computer Networks: Performance modeling, analysis and design of wired and wireless networks
- Real-Time and Embedded Systems: Functional Programming Applications, Reconfigurable computing

Some of the ongoing research projects of CSE dept are:

- Design and Development of Gigabit Networking Solutions for C&I Applications
- BRNS/ Analysis of SCADE Lustre models: Runtime Monitoring & Testing
- High-Speed Switching Fabric for Transport Networks and Distributed Processor Interconnects
- Fiber to the home-key Ingredient Technologies for Energy Conservation and Bridging the Indian
- Digital divide
- Network Sanitization
- Immersive Digital Heritage
- Support for Cloud Computing related research
- Cloud collaboratory

The following chart shows sponsored research projects of CSE dept at IITB for 2011- 2012:



CSE dept at IIT-B has participated in the following European Commission FP7 projects.

Project Acronym	Project title	Challenge area
GEYSERS	Generalised architEcture for dYnamic infraStructure sERvices	ICT-2009.1.1 The Network of the Future
EUROINDIA	Euro-India ICT Co-operation	ICT-2007.9.1 International cooperation

**Networking and Collaborations:** CSE at IIT-B has collaborations with various organizations within India and outside. Many projects have been sponsored by the Indian govt. agencies such as DIT, DST, BARC, Netapp India Private Limited, Google, Nokia India Pvt. Ltd., Bangalore and Microsoft Research Lab India Pvt. Ltd. and many others.

**Publications:** There are around 1880 publications published by different faculties.

**Source/web link:** <http://www.cse.iitb.ac.in>

## 4. Computer Science & Engineering (CSE) - IIT Kharagpur

**Overview:** CSE at IIT- Kharagpur was formed in 1980. The Department provides an exceptional research environment complemented by higher teaching for its students to thrive in. Graduates from the department are heavily recruited by both academia and industry. All over the world, ex-students of the Department occupy top positions in both academia and industry. M.Tech and Ph.D. students who have passed the GATE examination receive institute scholarships as per UGC norms. In addition, there are other opportunities of financial support for students. Fellowships offered by a few reputed companies like IBM and Infosys are available to Ph.D. students.

**Experience:** CSE Dept at IIT- Kharagpur has 33 years of experience and has always been recognized all over the world for excellence in research and teaching.

**Human and Financial Capital:** Currently the CSE department has nearly 300 undergraduate students (BTech and Dual), nearly 60 postgraduate students (MTech) and around 60 research students (MS and PhD). Financial capital of EECE comes from students' admissions and various Sponsored / Consultancy Projects of DIT, DST, Central Institute of Indian Languages, Intel, SAC Ahmedabad, KCSTC IIT Kharagpur, General Motors, MHRD etc.

**Infrastructure:** Clusters of PCs running on Linux and Windows, connected to a 2Mbps Internet Link, Development and debugging toolkits, High end DEC Alpha Servers for basic computation, Large repository of integrated circuits and components, Microprocessor interfacing toolkits, NT / Windows 2000 servers, Powerful workstations from SUN, DEC, IBM, Silicon Graphics, HP; Round the clock accessibility.

**Research Areas and Activities:** Internationally, IIT Kharagpur is ranked 346 in the QS World University Rankings (Quacquarelli Symonds) of 2013 and 58 in the QS Asian University Rankings of 2013. IIT Kharagpur is ranked in the 351-400 range by the Times Higher Education World University Rankings of 2013-14. Recently, it was declared the top educational hub in India as per the Times Higher Education, Asia Rankings. It was ranked 439 in the University Ranking by Academic Performance (URAP). In India, among engineering colleges, it was ranked 3 by India Today in 2013. Indian Institute of Technology- Kharagpur has been ranked No. 3 institute as per Careers360 research for the year 2014<sup>68</sup>.

Major areas of research include VLSI CAD, Networking, Formal Verification, Database and Multimedia Systems, Information Security, Medical Informatics and Telemedicine, Hardware Design for Security, Digital Watermarking, VLSI Design and Methodologies, Image Processing, Medical Informatics, Bio-informatics program analysis and testing, Geometric Algorithms, Computer Graphics, Visual Pattern Recognition, Cryptography and network security, Machine Learning, Data Mining, Information Retrieval, Reliable and Fault Tolerant Systems, Online Social networks, Network Theory, Multiobjective Optimization & Evolutionary Computing, EDA & Embedded Systems, Multimedia Systems & Video Transcoding, Education Standards & Quality, Object Oriented Analysis Design, Computational Complexity Theory, Graph Theory Complex adaptive systems, Web-social media, Human language evolution and Complex networks.

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Some of the research projects are:

- Development of Infrastructure for Centre of Excellence in Information Assurance
- Fundamental Research in Information Assurance
- Strategies for power reduction during VLSI circuit testing
- Web enabled medical Information access using Handheld Devices in a Wireless Environment for Telemedicine Applications
- Cross Language Information Access
- Extending the Scope of Equivalence Checking in Complex Embedded System Design Verification
- Virtual Lab for Computer Organization & Architecture

Technologies Developed under CSE dept are:

- A cellular automate (CA) based authentication device for message communication system
- Mobile Application on Tourism
- System for an intuitive, customizable, Multilingual and reconfigurable Augmentative Communication

**Networking and Collaborations:** **CSE:** the Department has executed many projects for national and international clients such as National Semiconductors, Intel, Motorola, Lucent Technologies, Tata InfoTech, MHRD, Department of Science and Technology, C-DAC etc.

**Publications:** there are around 1780 publications by different faculties in the department.

**Source/web link:** <http://cse.iitkgp.ac.in>

## 5. Computer Science & Engineering (CSE) – IIT Madras

**Overview:** CSE dept at IIT Madras was started as the Computer Centre in 1973 with the acquisition of an IBM 370, perhaps the most powerful computer in India at that time. It offered M.Tech, M.S and PhD degree programmes. In 1983, the B.Tech degree programme was started.

**Experience:** CSE dept has 41 years of experience in research and education. It offers several attractive industry-sponsored fellowships for outstanding PhD scholars and liberally supports participation in top-ranking international conferences.

**Human and Financial Capital:** The CSE dept consists of over 50 full-time engineers work on R&D projects enriching the academic environment. Today, the department has a vibrant student body numbering about 400. Over 60% are postgraduate, mostly supported by scholarships.

Graduate students/Scholars are supported by teaching/research assistantships (HTTA/HTRA) or project. Apart from this, PhD scholars also receive industry fellowship from Microsoft, Infosys, IBM, Inautix etc. Apart from HTTA/HTRA PhD scholars also have the opportunity of getting industry fellowship from Microsoft, Infosys and IBM. The funding institution decides the final approval of the fellowship such as Microsoft India Ph.D. fellowship, Infosys fellowship and IBM Ph.D. fellowship.

**Research Areas and Activities:** Internationally, IIT Madras was ranked #312 in the QS World University Rankings of 2012 and 45 in the QS Asian University Rankings of 2012. In India, among engineering colleges, it ranked 4 by India Today in 2012. Indian Institute of Technology-Madras has been ranked No. 10 institute as per Careers360 research for the year 2014<sup>69</sup>.

CSE dept offers graduate programs leading to Computer Science degrees at the master's and doctoral level. The department offers three graduate programmes M.Tech, MS (By Research) and PhD-MS research programmes. Department is engaged in basic research, industry-oriented development, and socially relevant projects. The research labs of the department are: The Algorithms and Complexity Theory, Artificial Intelligence and Databases, Computer Vision, DONlab: Indic Computing and Communication Systems, High Performance Computing and Networking, Network Systems, Reconfigurable and Intelligent Systems Engineering, Software Systems Research Lab, Speech and Vision, Theoretical Computer Science, Visualization and Perception and (Programming, Architecture and Compilers Engineering) PACE Lab.

Research areas include:

- Hardware Systems: Reconfigurable Hardware Design, Design for testability.
- Human Computer Interaction: Speech Recognition and Synthesis, Image Processing
- Intelligent Systems and Knowledge Engineering: Artificial Intelligence, Machine Learning, Memory based Reasoning
- Networks and Distributed Systems: Wireless Networks, Optical Networks, Grid Computing, Traffic modeling,
- Programming Languages: Compiler Optimizations, Design of programming languages, Multicore systems, Program Analysis, Modular software design
- Theoretical Computer Science: Design & Analysis of Algorithms, Complexity Theory

<sup>69</sup> <http://www.university.careers360.com/articles/top-100-universities-in-india-2014>

**Networking and Collaborations:** CSE department has long-term research collaborations with various research organizations like Microsoft Research (MSR) India, IBM India Research Lab (IRL), DRDO.

**Publications:** There are around 785 publications of the department.

**Source/web link:** <http://www.cse.iitm.ac.in>



## 6. Department of Computer Science and Engineering (CSE) – IIT Kanpur

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**Overview:** Indian Institute of Technology Kanpur was the first Institute in India to start Computer Science education. The initial “computer-related” courses were started at IIT Kanpur in August 1963 on an IBM 1620 system installed in the nation’s first “computer classroom,” a novelty then even in many North American and European universities. Gradually, the Institute drew upon some of the brightest young Indians in Computer Science to serve on its faculty and initiated an independent academic program in 1971, leading to Ph.D. and M. Tech. degrees. The undergraduate program started later, with the first batch graduating in 1983. The department was formally established in 1984.

**Experience:** Dept of CSE – IIT Kanpur has around 30 years of experience in education and research. Department is actively involved in research in all current areas of Computer Science. The focus of the PhD program is on research training with a high degree of specialization.

**Human and Financial Capital:** Dept of CSE has around 30 faculties. The department admits about 30 students every year in the B.Tech. program and 50 students in the M.Tech. program. 15 students are admitted to the dual-degree program, which results in students getting both a BTech and an MTech degree at the end of 5 years. There are about 15 students registered in Ph.D. program at a time.

Funds have been received from MHRD, DIT, DST, AICTE, etc. Some projects are also funded by Industry. Infosys Technologies has setup two Infosys Fellowships for PhD students in the department. Det Norske Veritas (DNV) has setup one DNV Fellowship for PhD students.

**Infrastructure:** CSE lab is equipped with a 1 gbps switched network with a tree topology. Most of the servers and work stations are Linux based. Windows is also available as an option on lab workstations. Most of the servers are virtual hosts. The department offers key based authentication for user authentication and secure access to all its online services. Intranet website and MySQL server services are offered on a Linux server. The department has a small library, which houses important text books, conference proceedings and journals.

**Research Areas and Activities:** Indian Institute of Technology- Kanpur has been ranked No. 8 institute as per Careers360 research for the year 2014<sup>70</sup>. Internationally, IIT Kanpur has been ranked 295th in the QS World University Rankings of 2013, and 51st in the QS Asian University Rankings of 2013. In India rankings, among engineering colleges, it was ranked second by India Today in 2013.

Research areas include: Databases and Data Streaming, Mobile/Wireless, Computer Networks, Computer Architecture and Embedded Computing, Security, Compilers and Programming Languages

Natural Language Processing, Theoretical Computer Science, Discovery, Learning, and Cognition; Software Engineering, Algorithms, CAD and Graphics, VLSI Design and Testing; Graph Theory, Computational Geometry; Operating Systems, Grid and High Performance Computing; Biometrics and Vision and Internet and Web Technologies.

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<sup>70</sup> <http://www.university.careers360.com/articles/top-100-universities-in-india-2014>

Research projects are:

- Design and Development of a Gigabit Network Monitoring Tool
- Digital Gangetic Plains: 802.11 based Low-cost Networking for Rural India
- Language Technologies

**Networking and Collaborations:** Some of the collaborations are as follows: IIT Delhi, IIT Kharagpur, University of Delhi, Akashi National College of Technology, Japan; Dwight Look College of Engineering, Texas A&M University etc.

**Publications:** There are around 350 publications of the department.

**Source/web link:** <http://www.cse.iitk.ac.in>

## 7. Centre for Development of Advanced Computing (C-DAC)

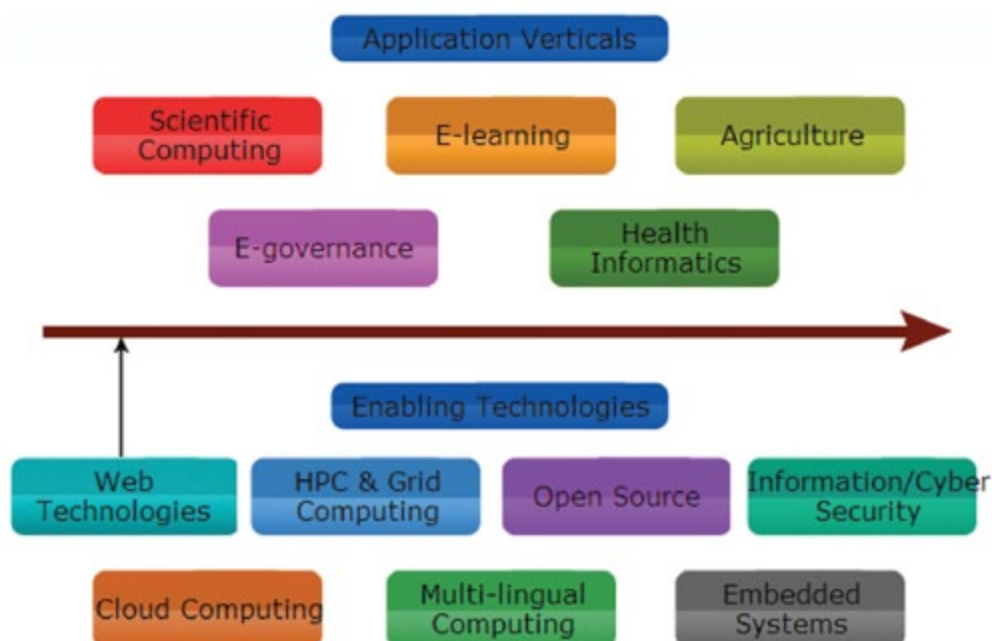
**Overview:** Centre for Development of Advanced Computing (C-DAC) is the premier R&D organization of the Department of Electronics and Information Technology (DeitY), in New Delhi, Ministry of Communications & Information Technology (MCIT) for carrying out R&D in IT, Electronics and associated areas. The setting up of C-DAC in 1988 itself was to build Supercomputers in context of denial of import of Supercomputers by USA. C-DAC started building Indian Language Computing Solutions with setting up of GIST group (Graphics and Intelligence based Script Technology); National Centre for Software Technology (NCST) set up in 1985 had also initiated work in Indian Language Computing around the same period. Electronic Research and Development Centre of India (ER&DCI) with various constituents starting as adjunct entities of various State Electronic Corporations had been brought under the hold of Department of Electronics and Telecommunications (now DeitY) in around 1988. The focus of CDAC is on various aspects of applied electronics, technology and applications. With the passage of time and as a result of creative echo system that got set up in C-DAC, more areas such as Health Informatics got created; C-DAC started its education & training activities in 1994 as a spin-off. With the passage of time, it grew to a large effort to meet the growing needs of Indian Industry for finishing schools.

**Experience:** C-DAC has 25 years of experience and has emerged as a premier third party R&D organization in IT&E (Information Technologies and Electronics) in India working on strengthening national technological capabilities in the context of global developments in the field and responding to change in the market need in selected foundation areas. C-DAC provides several courses in the field of advanced computing and software development. Among these are the HTC certification course and C-DAC Certified HPC Professional Certification Programme (CCHPCP). C-DAC organises advanced computing diploma programmes through the Advanced Computing Training School (ACTS) located all over India. The PG Diploma courses include specialisations in Embedded System Design, VLSI, etc.

**Human and Financial Capital:** C-DAC's Citizens/Clients Charter represents a systematic effort to focus on the commitment of the organization towards its Clients in respect of Standard of Services, Information, Choice & Consultation, Non-discrimination and Accessibility, Grievance Redress, Courtesy and Value for Money. The charter also includes expectations of the organization from the citizens/clients for fulfilling the commitment of the organization. Funding comes from DeitY, National Rural Health Mission - Government of Odisha, Indian Council of Medical Research (ICMR), Government of Tripura etc.

**Research Areas and Activities:** The primary activity in all centres of C-DAC is research and development in specific areas of information and communication technology and electronics (ICTE). Across all these centres, span a wide range of topics in ICTE.

- A centralized High Performance Computing Cluster has been established. This will be utilized for carrying out research activities in the scientific divisions: Physics of Energy Harvesting, Materials Physics & Engineering, Radio & Atmospheric Sciences, Time Frequency & Electrical Standards, Apex Level Standards & Industrial Metrology and Quantum Phenomena & Applications.
- C-DAC has done extensive research and development in the areas of Font, Cursor Movements (bi-di) rendering on Desktop, Web and Mobile Devices, development of Synonyms, Spellcheckers, Dictionaries, Thesauri, Localisation tools, Prediction Algorithms, Search Engine plugins, Transliteration and Machine Assisted Translation technologies for Urdu, Sindhi and Kashmiri.



The research of C-DAC has spread to: High Performance Computers, Grid Computing, Electronics, Speech and Natural Language Processing, Information and Cyber Security, Ubiquitous Computing, Bioinformatics and Geomatics.

C-DAC has participated in the following 6 European Commission FP7 projects.

Project Acronym	Project title	Challenge area
SYNCHORINSER	Synchronising the Research Policy Dialogue to the Indian Dimension	ICT-2009.9.1 International Cooperation
EUINEC	European Union and India enhanced cooperation framework for improved bilateral dialogue in the fields of science and technology	INCO-2007-2.1 Bilateral coordination for the enhancement and development of S&T Partnerships
EU-INDIAGRID2	Sustainable e-Infrastructures across Europe and India	INFRA-2009-3.3 Studies conferences and coordination actions supporting policy development in the context of international cooperation for e-Infrastructures
EUINCOOP	EU-INDia Fostering COOPERation in Computing Systems	ICT-2011.3.4 Computing Systems

Project Acronym	Project title	Challenge area
INDIA MENTOR	Mentoring Indian IT organisations in the participation in the ICT programme of FP7	IST-2005-2.6.4 Accompanying actions in support of participation in Community ICT research
INCITE	Indian networks co-operation in IST with Europe	IST-2004-2.3.6.2 To prepare for future international co-operation in IST

### Networking and Collaborations:

- C-DAC has realised a huge potential for research and development in weather domain. The joint initiatives by C-DAC and NCMRWF, Noida have led to the development and porting activities of weather models in PARAM Supercomputers.
- Open source parallel computing software and tools have significantly accelerated the pace of the research work.
- Regional atmospheric ocean coupled model strategy using Weather Research and Forecast (WRF) and Regional Ocean Modeling System (ROMS) developed at C-DAC under sponsorship of Department of Science and Technology,
- Government of India in collaboration with IITM to study air-sea interactions and its performance over Indian Summer Monsoon (ISM) region.
- Universal Speech Translation Advanced Research Consortium (U-STAR) is an international research collaboration entity formed to develop a network-based speech-to-speech translation (S2ST) with the aim of breaking language barriers around the world and to implement vocal communication between different languages.
- Collaborative Class Room (CCR) is envisaged as an application leveraging on distributed resources and high speed network connectivity to support key factors of online educational environments viz., visualization, interaction and appropriate learning pedagogies.
- MoU signed with KACST (King Abdulaziz City for Science & Technology) for joint research & development in Open Source.
- C-DAC entered a Memorandum of Understanding (MoU) with Space Application Centre (SAC), ISRO on 21 February 2011 at SAC, Ahmedabad, for enhancing technology collaborations.
- C-DAC entered a Memorandum of Understanding (MoU) with VSSC, Trivandrum on 18 August 2011 at VSSC, Trivandrum.
- C-DAC entered a Memorandum of Understanding (MoU) with Open Source Drug Discovery (OSDD), CSIR on 15 November 2011 at JNU, Delhi.

**Source/web link:** <http://cdac.in>

## 8. Department of Computer Science and Engineering (CSE) – IIT Roorkee

**Overview:** A separate Department of Electronics & Communication Engineering was established in 1964 to offer Bachelor of engineering degree in Electronics & Communication and Master of Engineering degrees in (a) Advanced Electronics and (b) Applied Electronics & Servomechanisms. In 1968, the postgraduate programme was restructured with specializations in the areas of Communication Systems, Control and guidance, Microwaves and Radar, and Solid State Electronics. Two new undergraduate and postgraduate programmes in Computer Science and Technology were started in the year 1982. Keeping in view the activities of the Department, the name was changed to Department of Electronics and Computer Engineering. In January 2013, the Department of Electronics and Computer Engineering was bifurcated into two separate departments i.e. 'Electronics and Communication Engineering' and 'Computer Science and Engineering'.

**Experience:** Dept of CSE has around 50 years of experience in education and research. Department has always been on a high growth path and to keep pace with the current technological trends, the Department has started an M.Tech programme in Information Technology. The Department has strong research groups in the broad areas of: Computer Science and Engineering and Information Technology.

**Human and Financial Capital:** Every year 50-60 students get admitted for post graduate, undergraduate and dual degree courses. Funding agencies include: Microsoft Inc., MHRD, NVIDIA Inc., IBM Inc., CSIR, ISRO, DST, MHRD, Adobe Research Lab, DeitY etc.

**Research Areas and Activities:** Internationally, IIT Roorkee was ranked 401–450 in general category and 194 in Engineering and Technology in the QS World University Rankings of 2011 and 65 in the QS Asian University Rankings of 2012. In India, among engineering colleges, it ranked 6 by India Today in 2012. Indian Institute of Technology- Roorkee has been ranked No. 20 institute as per Careers360 research for the year 2014<sup>71</sup>.

Some of the Research projects are:

- One-year academic passes for accessing Windows Azure Cloud,
- IMM-Developing Information Analytical Platform for Multi-Lingual Multi-Source News Media,
- NVIDIA CUDA Teaching Center,
- Applying Data Mining Techniques to NPP for Predictive Maintenance,
- Data Security and Privacy in Data Mining for BI,
- Energy Efficient Multimedia Cloud Service for Mobile Devices,
- SPIN: Socio-Physical Interaction Network to facilitate searching, tracking, and socializing between smart entities,
- Information Security Education and Awareness Project

**Networking and Collaborations:** Some of the collaborations are: Technische Universität München (TUM), Germany; Institut National des Télécommunications, France; University of Texas at Dallas, USA; New Jersey Institute of Technology (NJIT) at Newark, USA; University of Waterloo, Canada; University of Western Ontario, Canada etc.

**Publications:** There are around 600 publications of journals, conference papers, books etc.

**Source/web link:** <http://www.iitr.ac.in/departments/CSE/pages/index.html>

<sup>71</sup> <http://www.university.careers360.com/articles/top-100-universities-in-india-2014>

## 9. Department of Computer Science and Engineering (CSE) – IIT Guwahati

**Overview:** Department of Computer Science and Engineering at the Indian Institute of Technology Guwahati was formed in the year 1995 and provides an outstanding research environment complemented by excellence in teaching. The Department offers B.Tech., M.Tech., Ph.D. and Dual (M.Tech. + Ph.D.) degrees. The Department has a comprehensive curriculum on topics related to all aspects of Computer Hardware and Software with an emphasis on practical learning. The course structure is up-to-date and includes courses on nascent topics to equip our students with the latest developments in Computer Science and Engineering.

**Experience:** Dept of CSE has around 19 years of experience in education and research.

**Human and Financial Capital:** Every year nearly 100 students get admitted. There are around 28 faculties. Funding comes from DeitY, Indian Council of Medical Research (ICMR), DST and CSIR.

**Infrastructure:** Department has state-of-the-art infrastructure and computing equipment supported by high speed Ethernet and wireless networks. Various student organizations like ACM Chapter, ACS Chapter, CSEA, Linux and Open Solaris Community are active throughout the year. All the laboratories are connected to the Gigabit Network of the department which in turn is connected to the institute 10 Gigabit Network on optical fibre. Dept has Akash lab, multimedia lab, Robotics lab etc.

**Research Areas and Activities:** Internationally, IIT Guwahati was ranked 551–600 in the QS World University Rankings of 2011 and 89 in the QS Asian University Rankings of 2012. In India, among engineering colleges, it ranked 10 by India Today in 2012, 8 by Outlook India in 2012.

Research groups include:

- Theoretical Computer Science
- Computer Architecture & Embedded Systems
- Computer Networks & Security
- Machine Learning & Data Mining
- Distributed Systems
- Man-Machine Interfaces

There are around 58 sponsored projects and 41 consultancy projects of the dept. Some of them are:

- Interaction with inside view
- Integrated Modern Software System
- Modernization of Land Revenue Administration
- Development of Framework for Logging and Analysis of Network Traffic to Secure IT infrastructure
- Remote triggered digital system laboratory
- Multi-Modal Broadcast Analytics – Structured Evidence Visualization for Event of Security Concern
- Setting up Aakash Lab at IIT Guwahati

Technologies developed include:

- **Typhon:** This Mobile Agent Platform (MAP) runs on LPA Prolog's Chimera Agent System and supports mobility, dynamic code alterability, network management, partial security, etc
- **iSpeak For Children:** iSpeak for children is an interactive learning application for kids. With speech recognition technology and voice feedback system, learning alphabets, shapes, objects, calculations etc.

**Networking and Collaborations:** Some of the collaborations are: National Institute of Technology, Silchar, Assam; UNICEF; Gauhati University; Manipur University; Assam University; Helsinki University of Technology, Finland; North Eastern Development Finance Corporation Ltd; Meghalaya Industrial Development Corporation; State Bank of India.

**Publications:** There are around 650 publications of journals, conference papers, articles, books etc. There are around 3 patents filed and granted.

**Source/web link:** <http://www.iitg.ac.in/cse>



## 10. International Institute of Information Technology, Hyderabad (IIIT-H)

**Overview:** The International Institute of Information Technology, Hyderabad (IIIT-H) is an autonomous university in Hyderabad, Andhra Pradesh, founded in 1998. It was set up as a not-for-profit, public private partnership (N-PPP) institute and is the first IIIT to be set up (under this model) in India. IIIT-H was set up as a research university focused on the core areas of Information Technology, such as Computer Science, Electronics and Communications, and their applications in other domains. The institute evolved strong research programmes in a host of areas, with computation or IT providing the connecting thread, and with an emphasis on the development of technology and applications, which can be transferred for use to industry and society. IIIT-H runs IT courses and IT research projects and is heavily focused on research related to computation. It gives the students interaction with industry, preparation in entrepreneurship and personality development courses.

**Experience:** IIIT-H has 15 years of experience and combines pioneering research with top class education. An innovative curriculum allows the student flexibility in selecting courses and projects. Students, even at the undergraduate level, get to participate in ongoing research and technology development - an opportunity unprecedented in India. IIIT Hyderabad offers undergraduate, postgraduate and dual degree programmes.

**Human and Financial Capital:** IIIT-H has a dynamic group of more than 55 faculty members with multi-disciplinary background and interests and more than 100's of students graduate.

Financial capital comes from organizations such as DIT, DST etc. and through the student fees on various courses offered.

**Infrastructure:** IIIT-H is organized as research centres and labs, instead of the conventional departments, to facilitate inter-disciplinary research and a seamless flow of knowledge within the Institute. The institute has well-equipped, air-conditioned computer laboratories which are allocated batch-wise to the students.

**Research Areas and Activities:** IIIT-Hyderabad has been ranked #3 in the list of top technical schools in India by Dataquest. It was ranked #20 by the India Today Best Engineering colleges 2012, #14 by Outlook India Top Engineering Colleges of 2011. In rankings limited to private institutes it was ranked second by Mint in 'Top 50 Private Engineering Colleges' of 2009. In 2011 and 2012, IIIT Hyderabad was ranked first in Andhra Pradesh, by Careers360, a magazine of the Outlook group. Deccan Chronicle ranked IIIT Hyderabad second in their 2012 survey of Top Engineering Colleges in South India.

**IIIT- H includes the following Research centres:** Language Technologies Research Center, Speech and Vision Laboratory, Signal Processing & Communications, Search and Information Extraction Lab, Centre for Visual Information Technology and Image Processing, Centre for Data Engineering, Cognitive Science Lab, Center for Security, Theory & Algorithmic Research and Robotics Research Lab.

**Some of the projects under different research centres at IIIT-H are:**

**Signal Processing and Communications Research Center (SPCRC)** - Statistical and Adaptive Signal Processing, Wavelets and Multirate Signal Processing, Multi-Dimensional

Signal Processing, Signal Processing for Communications, Bio-Medical Signal Processing, Communication Theory, Communication Networks, Optical Communication, RF Integrated Circuits (RFIC)

**Data Engineering (CDE)** – CDE conducts research, facilitates technology transfer, and builds systems in the broad area of data engineering. Some focused research areas are

- Database systems - Query Optimization, Transaction Processing, and Performance Modeling and Simulation
- Data Mining and Data Warehousing & Text and Web Mining
- Data Dissemination and Personalization
- Electronic Contracts and Workflow Management Systems
- Multi Agent Systems and Complex Systems Simulation

**Language Technologies Research Centre (LTRC)** – LTRC addresses the complex problem of understanding and processing natural languages in both speech and text modes. LTRC conducts research on both basic and applied aspects of language technology. LTRC carries out its work through four labs, which work in synergy with each other. LTRC has developed a natural sounding text-to-speech (TTS) system for Indian Languages (Telugu & Hindi).

**Security, Theory and Algorithms (C-STAR)** – Crypto Toolkit, Security in VoIP, Secure log files, Acyclic Edge Coloring of Complete Graphs, Distributed Graph Coloring Algorithms, Geometric Algorithms and Data, Structures for Large Scale VLSI Layouts.

**Software Engineering Research Center (SERC)** – Innovative, non-conventional approaches to software engineering education, for academic and industry environments.

**VLSI and Computing system technology** – Low Power VLSI Design, Design for Testability, Self healing circuits, Analog and mixed signal design, Test and Verification of long scale VLSI designs and Multi-core (Processor) architecture for Embedded Systems.

**Networking and Collaborations:** Some of the collaborations of the IIIT-H are:

- Polycom, the global leader in open, standards-based unified communications and collaboration (UC&C), India has signed Memorandum of Understanding (MoU) with the International Institute of Information Technology (IIIT), Hyderabad in collaborative research for development of new video collaboration products and solutions. The MoU encompasses joint research in developing video technology solutions and through this collaboration, Polycom also aims to nurture the next generation of researchers and provide a marketplace for innovations and developments by IIIT students. Polycom and IIIT Hyderabad will also jointly engage with their respective Research & Development labs to develop unified communications-related programmes and projects which are of benefit to end-users.
- Master of Science in Information Technology (MSIT) is a Postgraduate program offered by a consortium of universities in collaboration with Carnegie Mellon University, USA with the support of State government of Andhra Pradesh. MSIT is currently offered at International Institute of Information Technology (IIIT-H), Hyderabad, School of IT, Jawaharlal Nehru Technological University Hyderabad (JNTUH), College of Engineering, Jawaharlal Nehru Technological University Kakinada (JNTUK) and College of Engineering, Jawaharlal Nehru Technological University Anantapur (JNTUA).

- IIIT-H and Yahoo tie up for cloud computing to accelerate research and development in cloud computing.
- CIT Program Launched at ALLURI institute in collaboration with IIIT Hyderabad.
- Centre for Visual Information Technology (CVIT), a research centre at the International Institute of Information Technology, Hyderabad (IIIT-Hyd), has developed Heritage App, a computer vision application on mobile phones.

**Publications:** IIIT-H has around 2000 publications with various research papers and books published.

**Source/web link:** <http://www.iiit.ac.in>

## 11. International Institute of Information Technology, Bangalore (IIIT-B)

**Overview:** International Institute of Information Technology Bangalore, abbreviated IIIT-B, is a graduate school in India. It was founded in 1999 with a vision to contribute to the IT world by focusing on education and research, entrepreneurship and innovation. It offers Integrated M.Tech., M.Tech., M.S. (Research) and PhD programs in the field of Information Technology. In February 2005, IIIT-B was conferred Deemed University status under Section 3 of the University Grants Commission (UGC) Act 1956. IIIT-Bangalore is promoted by the government of Karnataka and the IT industry. IIIT-B is managed by a Governing Body with S Gopalakrishnan (Kris), executive co-chairman, Infosys Ltd., as the chairperson. Since its inception, IIIT-B, with its unique model of education, research, and industry interaction, has grown in stature to become an institution of considerable repute in academic as well as corporate circles. The institute works in partnership with the corporate sector, while retaining the freedom of an academic institution.

**Experience:** IIIT-B completed its 15<sup>th</sup> year of distinguished existence and commitment. It marks a new milestone in generation of new ideas, focuses on building a deep understanding of technology. Areas of specialization include: Computer Science, Database and Information Systems, Software Engineering, Networking and Communication Systems, Embedded Systems Design, Information Technology and Society. IIIT-Bangalore offers four degree programmes: Doctor of Philosophy (PhD), Master of Technology (M.Tech.), Master of Science (Research) and Integrated M.Tech.

**Human and Financial Capital:** Every year about 300 students (around 150 in each year) are enrolled in the two-year full-time M.Tech programme. There are around 20 faculties.

Financial support has been given through various research projects funded by Dept of Information Technology, Department of Science and Technology, Microsoft, Sponsored by Nokia Research Center, University Relation, Finland, Liverhume Trust, HP, Infosys, Intel and the European Union.

**Infrastructure:** The infrastructure for IIIT-B's fully wired campus consists of a high-speed fiber-optic backbone connected to the internal network through a high-end gigabit Ethernet switch. The intranet enables knowledge sharing among students. IIIT-B is one of the few institutions in India to have an active wireless LAN; it was the first to have this technology. Almost all the seven labs at the institute have been funded by industry - like the Nokia-sponsored mobile computing lab, HP-sponsored multimedia sub-systems lab, Honeywell-sponsored automation lab, Intel-sponsored community PC lab, etc.

**Research Areas and Activities:** The IIIT Bangalore now ranks as India's one of the top B-schools. It has top class facilities for the students.

The institute has performed several research projects with industry interaction. As a result, there are now several research labs at the institute. These include the Siemens Vision Lab, HP IMS Lab, Intel Planet Lab, Intel Community PC Lab and Honeywell Automation Lab. IIIT-B has carried out several research projects in the following labs:

- Centre for Electronics and Embedded Systems (CEEMS) Lab's objective is to nurture talent by focusing on embedded computing, wireless communication and computer vision. CEEMS lab is funded by Govt. of Karnataka.
- Computational Sciences Lab (CSL) at IIIT-B is interested broadly in the areas of Algorithms, Optimization, and Robotics.

- Wireless Network Lab (WNL): Current research work focuses on evolving broadband wireless technologies in the areas of WiMAX, Wi-Fi as well as LTE. Recent major areas of work include device power management, media independent handover (MIH), seamless interoperability between WiFi and WiMAX, and scheduling schemes in WiMAX.
- Open Systems Laboratory (OSL) at IIT Bangalore was started in 2002. It works in the broad areas of data and information systems engineering.

Some of the research projects of IIT-B are:

- i. **Real Time Search (RTS):** Real Time Search project aims to build a search capability on mobile phones based on location and service.
- ii. **Spectrum Sensing Mechanisms:** Exploration and comparison of various spectrum sensing mechanisms to detect activity of 802.11, 802.15.4, digital TV transmission, microphone and radios in the 900MHz ISM band using an USRP based SDR platform.
- iii. **Cognitive Radio - Collective Learners** - The cognitive radio, built on a software-defined radio, is defined as an intelligent wireless communication system.
- iv. **Mobile Computing:** Environment to support Mobile Computing on Broadband Wireless Network and IMS services by IMSUE/Mobile-Devices and its performance evaluation.
- v. **Cloud Retail Services:** A reseller is a company or an individual that purchases goods or services with the intention of reselling them rather than consuming or using them.

IIT-B has participated in the following European Commission FP7 projects.

Project Acronym	Project title	Challenge area
INCITE	Indian networks co-operation in IST with Europe	IST-2004-2.3.6.2 To prepare for future international co-operation in IST
INDIA MENTOR	Mentoring Indian IT organisations in the participation in the ICT programme of FP7	IST-2005-2.6.4 Accompanying actions in support of participation in Community ICT research

### Networking and Collaborations:

- IIT-B has collaborated with Bitstat to develop innovative process automation & collaboration tools for enterprises by leveraging latest advancements in computation and communication technologies.
- Has collaboration with Kenapps to enhance education with Unified Knowledge Platform.
- Few other industry collaborations are: ABB, HP, Infosys, Seimens, Intel and HP Labs.
- Steel Authority of India Limited (SAIL) has signed Memorandum of Understanding (MoU) for academic collaboration with IIT, Bangalore with the focus of strengthening Industry-Academic interface keeping the objective of fostering collaboration between the two institutions to promote academic and research interactions.

**Publications:** There are around 585 publications of IIT-B.

**Source/web link:** <http://www.iitb.ac.in>

## 12. Tata Consultancy Services (TCS)

**Overview:** Tata Consultancy Services Limited (TCS) is an Indian multinational information technology (IT) services, business solutions and consulting company headquartered in Mumbai, Maharashtra. TCS operates in 44 countries and has more than 199 branches across the world. It is a subsidiary of the Tata Group and is listed on the Bombay Stock Exchange and the National Stock Exchange of India. It is one of India's most valuable companies and is the largest India-based IT services company during 2012 in terms of revenue generation. TCS offers a consulting-led integrated portfolio of IT and IT-enabled services delivered through its unique Global Network Delivery Model.

**Experience:** TCS was established in 1968 as a division of Tata Sons Limited. TCS Ltd. got incorporated as a separate entity on January 19, 1995. TCS builds on more than 45 years of experience, and adds real value to global organizations through domain expertise plus solutions with proven success in the field and world-class service. Some of the acquisitions of TCS are Aviation Software Development Consultancy India (ASDC), Cedge Technologies Limited, Swedish Indian IT Resources AB (SITAR), Tata Infotech, TCS Management, Computational Research Laboratories and Alti SA.

**Human and Financial Capital:** The company is the largest India-based IT services company by employee count. It has over 276,000 of the world's best-trained IT consultants in 44 countries. Some important statistics about the company are: Revenue - \$11.6 billion; up 13.7% over prior year; operating margin -27% and net income - \$2.6B; up 15.6% (fiscal year ending March 31, 2013).

**Research Areas and Activities:** Business solutions major TCS has topped the ranking for 2013, followed by Hindustan Unilever (HUL), ITC, and Infosys. TCS remained the highest ranked Indian IT firm, and globally it was ranked 16, the same as in 2011, with revenues of \$10,888 million as per NDTV, a prominent National Television News Channel, on May 28, 2013. TCS has also been ranked number one for customer satisfaction in a major survey conducted by Whitelane Research in the UK.

Some recent achievements are:

- 2013: Won Best Performing Consultancy Brand award in Europe
- 2013: Received Red Hat North America Awards for System Integrator Partner of the Year
- 2012: TCS China ranked amongst the top 10 global services providers in China

Scientists in TCS explore new and exciting areas in ICT.

Research areas include:

- **Application and System Testing:** objective of this research group is to investigate and develop methods and tools to reduce latencies in the test process and at the same time provide greater assurance on the quality of the software being tested.
- **Business Systems and Cybernetics:** The group specializes in developing methodologies using Systems Thinking principles towards designing business solutions and developing competencies that characterize the TCS way for end-to-end Consulting and Services.

- Enterprise Integration: is to investigate and come up with a set of architectures, models and methods that will help an enterprise achieve an integrated view of its processes and systems in a systematic manner.
- Human Aspects of Software Engineering and Management (HuEMan)
- Human Centric System Analysis and Design
- Integrated Computational Materials Engineering: The approach envisages using physics based models, empirical models and human expertise in an integrated manner to significantly reduce the time and cost of development of new materials and their manufacturing processes.
- Model-driven Enterprise, Requirements Engineering, Services Science
- Verification & Validation for Embedded Systems: The current focus is mainly on embedded code written in C/C++. There are three main threads towards this effort: Review Automation, Static Analysis and Testing

**Applications:** Computational Finance and Risk, Computational Life Sciences, Computational Materials Engineering, Data Analytics and Information Fusion, Decision Sciences and Algorithms, Human Centric System and Social Media, Mobility and Social Innovation, Multimedia, Graphics and Robotics, Speech and Natural Language and Web Intelligence and Text Mining.

**Systems:** Cyber-physical Systems, Human Systems and ICT Systems

**New services of TCS include the following:** mobility, connected marketing, social computing, big data and cloud.

TCS established the first software research centre in India, the Tata Research Development and Design Centre, in Pune, India in 1981. TRDDC undertakes research in Software engineering, Process engineering and Systems Research. Researchers at TRDDC also developed MasterCraft and have also resulted in the development of Sujal, a low-cost water purifier that can be manufactured. This product has been marketed in India as Tata swach, a low cost water purifier.

TCS has participated in the following European Commission FP7 projects.

Project Acronym	Project title	Challenge area
E2R II	End to End Reconfigurability (E2R) II	IST-2004-2.4.5 Mobile and Wireless Systems and Platforms Beyond 3G
MAGNET BEYOND	My personal adaptive Global NET and beyond	IST-2004-2.4.5 Mobile and Wireless Systems and Platforms Beyond 3G

**Networking and Collaborations:** TCS academic alliance links work at several levels. They may include university-based research parks and incubators, short and long-term research agreements, and exchanges of faculty and industry personnel. Current International

and domestic academic alliance partners include the following: Massachusetts Institute of Technology, Cambridge; University of California-Berkeley; Aalborg University-Denmark; Said Business School Oxford University; Purdue University, Indiana; Singapore Management University; Indian Institute of Technology - Bombay; Indian Institute of Technology-Madras and Indian Institute of Science, Bangalore.

**Publications:** TCS Research community has scientists who are furthering discoveries in several emerging technologies related to ICT. Several hundred papers are presented each year in premier conferences in the areas of Applications, Software and Systems. Publications include on Event, Conference and Journals of more than 6000 for the year 2013 which are categorized under Applications, Software and Systems.

**Source/web link:** <http://www.tcs.com>



## 13. Infosys Limited

**Overview:** Infosys (formerly Infosys Technologies) is an Indian multinational provider of business consulting, information technology, software engineering and outsourcing services. It is headquartered in Bangalore, Karnataka. Infosys was co-founded in 1981 by Narayan Murthy, Nandan Nilekani, N. S. Raghavan, S. Gopalakrishnan, S. D. Shibulal, K. Dinesh and Ashok Arora after they resigned from Patni Computer Systems. Infosys enables clients in more than 30 countries to outperform the competition and stay ahead of the innovation curve. Some of the services offered by Infosys are: Application Management, Application Outsourcing, Business Applications, Business Process Outsourcing, Cloud, Engineering, Infrastructure Management, Infrastructure Outsourcing, Management Consulting, Enterprise Mobility, Sustainability and Testing.

**Experience:** Infosys brings in 32 years of experience in helping enterprises transform and thrive in a changing world through strategic consulting, operational leadership and co-creation of breakthrough solutions in information technologies, including those in mobility, sustainability, big data and cloud computing.

**Human and Financial Capital:** Infosys had a total of 156,688 employees as on 31 March 2013, of which 34.7% are women. Its workforce consists of employees representing 89 nationalities working from 32 countries. Out of its total workforce, 79% are software professionals, 15% are working in its BPO arm and remaining 5% work for support and sales.

Infosys is the third-largest India-based IT services company by revenues in 2012. On 28 March 2013, its market capitalization was \$30.8 billion, making it India's sixth largest publicly traded company.

**Infrastructure:** Infosys Labs focuses on defining and driving the research and innovation agenda at Infosys. It is a dedicated research group comprising technology and domain-focused members and is built on the success of the award-winning Software Engineering and Technology Labs (SETLabs). Infosys has built the world's biggest corporate training facility for IT professionals in Mysore.

**Research Areas and Activities:** Infosys has consistently been honored by clients, industry bodies, media and other influencers. It was ranked No.19 amongst the world's most innovative companies by Forbes. Infosys was ranked number one among the best managed companies in Asia Pacific in the annual Euro money Best Managed Companies in Asia survey, 2013 and named a leader in The Forrester Wave. Infosys also won the Oracle Excellence Award for Specialized Partner of the Year – North America in both Financial Management and Human Capital Management categories, at Oracle OpenWorld2012.

Infosys R&D labs have expertise in areas such as network protocol implementation, embedded systems and device integration. Infosys have undertaken more than 1,000 projects. Infosys has not had a single IP infringement lawsuit in the 30 years since its inception.

Infosys Labs has set up:

- Centre of Innovation for Tomorrow's Enterprise (CITE), which manages research on the seven core themes for Building Tomorrow's Enterprise. The themes are focused on Digital Consumers, Emerging Economies, Healthcare Economy, Sustainable Tomorrow, New Commerce, Smarter Organizations and Pervasive Computing.

- Center for Enterprise Technology, Infosys Labs focuses on topics such as semantic technology, context-aware systems, intelligent sensing, multi-channel convergence, large data modeling and simulation, next-gen computing platforms visualization, and immersive experiences.
- Center for Services Innovation focuses on software engineering aspects such as software dependability, preventive maintenance, distributed service delivery, modernization, automation and optimization.

Infosys has its own innovation co-creation engine and platform called Infosys Labstorm. It is a rich media destination for Infosys clients and other stakeholders to experience tangible innovations and research concepts from Infosys and its partners. It enables collaboration and facilitates co-creation of ideas and innovative solutions among its community of users. Infosys Labs is a member of global research consortia including India-UK Advanced Technology Centre of Excellence in Next-Generation networks, systems and services, and Smart Services Cooperative Research Consortium, Australia. Infosys Labs has been investing in new thinking and technology that can help tomorrow's business leaders innovate. Research at Infosys Labs is focused on three dimensions: Revisiting the technology blueprint: to identify emerging technologies, Accelerating innovation: through co-creation, Creating new efficiencies: to bring in operational excellence. A Product R&D Centre has also been set up to accelerate design and development of cutting edge engineering innovation.

The overall R&D expenditure of Infosys for fiscal 2013 and 2012 is as follows:

R&D expenditure	In Crores Rupees	
	2013	2012
Revenue Expenditure	905	655
Capital Expenditure	6	5
Total	913	660
R&D expenditure/total revenue (%)	2.50%	2.10%

**Networking and Collaborations:** Infosys Labs collaborates with leading national and international universities such as the University of Southern California Viterbi School of Engineering, University of Cambridge, Indian Institute of Technology Bombay, IITB-Monash Research Academy, Purdue University, International Institute of Information Technology, Bangalore.

- Infosys Labs collaborated with University of Illinois, Urbana Champaign in dependable cloud computing to develop techniques and validation tools for high assurance cloud computing test bed.
- Infosys has signed a joint agreement with National ICT Australia (NICTA) to partner in innovation.
- Infosys has signed MoU with Queen's University Belfast to establish research, education and commercialization model, to develop solutions and IP combating cyber security threats.

**Publications:** There are more than 3000 publications with research paper, books, lab briefings and technology roundtables.

**Source/web link:** <http://www.infosys.com>

## 14. Wipro Limited

**Overview:** Wipro Limited is a global leader in providing IT Services, Outsourced R&D, Infrastructure Services, Business Process Services and Business Consulting. Wipro is an Indian multinational information technology (IT) consulting and services outsourcing company located in Bangalore, Karnataka in India. Wipro is the third largest IT services company in India. Its subsidiary, Wipro Enterprises Ltd., offers consumer care, lighting, healthcare and infrastructure engineering. In February 2002, Wipro became the first software technology and services company in India to be certified for ISO 14001 certification. Wipro also achieved ISO 9000 certification to become the first software company to get SEI CMM Level 5 in 2002. Wipro is globally recognized for its innovative approaches towards delivering business value and its commitment to sustainability. Wipro champions optimized utilization of natural resources, capital and talent.

**Experience:** Wipro Limited started in 1981, brings in 32 years of experience as a global provider of comprehensive IT solutions and services, including Systems Integration, Consulting, Information Systems outsourcing, IT-enabled services and R&D services. Today Wipro is a trusted partner of choice for global businesses looking to 'differentiate at the front' and 'standardize at the core' through technology interventions.

**Human and Financial Capital:** As of March 2013, the company has 145,000 employees serving over 900 clients with a presence in 57 countries. Wipro provides on boarding programs, leadership development programs, and industry centered cutting edge technology and domain programs for people.

Wipro's IT revenues stood at \$ 6.2 billion for the year ending March 31, 2013, with a repeat business ratio of over 95%.

**Infrastructure:** Wipro has 72 development centres across the globe. To achieve ecological sustainability, Wipro launched its Greenware range of toxin-free 100% recyclable desktops. Wipro Infrastructure Technology Solutions caters to IT infrastructure providing latest technology products and services at competitive costs. Wipro Desktops are built on industry standard architecture and open technologies offering business agility and flexibility to their customers.

**Research Areas and Activities:** Wipro was ranked 1st in the 2010 Asian Sustainability Rating (ASRTM) of Indian companies and is a member of the NASDAQ Global Sustainability Index as well as the Dow Jones Sustainability Index.

Wipro's R&D focuses on incubating and strengthening the portfolio of IT services across multiple new and emerging technology areas. This is driven with an agenda through its focus on **Applied Research, Customer Co-Innovation**, investing in developing services around defined **Advanced Technology Themes** (Intelligence Augmentation, Immersive Experience, Smart Systems, Ubiquitous Enterprise, & Next Generation Materials & Manufacturing), and **experimentation on Innovative Open Execution Models**.

**Applied Research:** Wipro's focus on Inclusive Innovation continues to be aimed at discovering where and how ICTs can address effective delivery of G2C (Government-to-citizen) and B2B services to rural citizens in Education, Health, Agriculture, and Rural Development sectors. Wipro set up 'Applied Research in Intelligent Systems Engineering (ARISE) lab in 2011 as an

open collaborative R&D initiative to address a growing demand for affordable and scalable innovative solutions for new and emerging markets and technologies across multiple domains.

**Advanced Technology Themes:** Wipro identifies and creates competencies and new IT Services in emerging areas of Technology and Industry Domains and incubates new Practices for continued business growth. Intelligence Augmentation, Immersive Experience, Smart Systems, Ubiquitous Enterprise and Next Gen Manufacturing and Materials are the technology themes identified.

**Customer Co-Innovation:** Wipro was involved in implementation of a web based unified customer view across lines of business using Semantic Web and Data Technologies for a large Insurance customer.

**Advanced Technologies – Cloud:** Wipro's Cloud practice includes:

- On-Cloud Services spans Process Transformation Advisory, Consulting, Implementation, Rollout, Migration and Application Support by leveraging Public SaaS
- Cloud Enablement Services delivers advisory and analysis for cloud amenability.

**Software Engineering Tools & Methodologies:** Wipro has launched Next Generation managed services platform named "ServiceNXT" with an integrated process and tools stack to enable managed services delivery across application and infrastructure operations.

**Networking and Collaborations:** Some of the academia collaborations of Wipro are as follows:

- Wipro Software Technology Academy (WiSTA) Programme consisting of an 8-semester (four years) off- campus collaborative MS Program with the Birla Institute of Technology & Science (BITS) Pilani-Rajasthan.
- A new Service line 'Analytics & Information Management' was formed with a view to maximize opportunities in the Analytics space - Partnerships with academia include collaborations with top universities with leading quant programs – Duke University, DePaul, Indian Statistical Institute, IIM-B and Carnegie Mellon.
- WistA (Wipro software technology Academy) is a new, work-integrated M.S. program in information technology for science graduates with non-mathematics disciplines. It is structured along similar lines as Wase, in collaboration with VIT university, Vellore (Tamil Nadu).

Wipro works with alliance partners to offer compelling business propositions for the customers - Actuate, Amazon Web Services (AWS), Amber Point, Texas Instruments, Teradata, The Portable Office Company, Apriso, Archer, Arcot Systems, Axiom, Getronics, Google, Oracle, DataFlux, Data Foundation, Sonic Software, Space-Time Insight, Sterling Commerce and many others.

**Publications:** There are more than 3000 publications of the company.

**Source/web link:** <http://www.wipro.com>

## 15. HCL Technologies

**Overview:** HCL is a global IT services company. Established in 1991, HCL Technologies Ltd is an IT services company providing enterprise and custom application, business transformation, infrastructure management, business process outsourcing and engineering services. It made its IPO in 1999 offers services including software-led IT solutions, remote infrastructure management, engineering and R&D services, and business process outsourcing (BPO). HCL Technologies, along with its subsidiaries, had consolidated revenues of US\$ 6.3 bn as on 14th September, 2013. HCL Technologies brings IT and engineering services expertise under one roof to solve complex business problems for its clients. Leveraging the extensive global offshore infrastructure, HCL provide holistic, multi-service delivery in such industries as financial services, manufacturing, consumer services, public services and healthcare. Today, HCL is a \$6.2 billion leading global technology and IT enterprise comprising two companies listed in India - HCL Technologies and HCL Infosystems. Founded in 1976, HCL is one of India's original IT garage start-ups. A pioneer of modern computing, HCL is a global transformational enterprise today. Its range of offerings includes product engineering, custom & package applications, BPO, IT infrastructure services, IT hardware, systems integration, and distribution of information and communications technology (ICT) products across a wide range of focused industry verticals. The HCL team consists of over 90,000 professionals of diverse nationalities, who operate from 26 countries including over 500 points of presence in India.

**Experience:** HCL Technologies has 22 years of experience in bringing IT and engineering services expertise under one roof to solve complex business problems for its clients and offers a solution that is sustainable and innovation-driven.

HCL growth to leaps and bounds:

- 1997: Was established with spun-off HCL's R&D business
- 1999: Launch of Initial Public Offering (IPO)
- 2006: Signed the largest ever software service deal with DSG
- 2012: Revenue crossed USD 4 billion

**Human and Financial Capital:** HCL has 90,000 employees with offices in 31 countries including over 500 points of presence in India. HCL Technologies has revenue of US dollar 6.3 billion as on 14th September, 2013<sup>72</sup>.

### Research Areas and Activities:

- 2013: Won IT Europa, European IT Excellence Awards and Asia Pacific Enterprise Leadership Award 2013
- 2012: Received Market Facing Innovation award at the NASSCOM Innovation Awards, 2011
- 2011: Received Operational Excellence & Quality award at BPO Excellence Awards 2010–11

HCL R&D also called "HCL Labs" has been setup with the mission to develop HCL IP businesses in a competitive edge with the respective markets. HCL Labs today is a strong team of 250 with five centers spread across Jaipur, Noida, Chennai and Pondicherry. During the year 2013, R&D has brought about standardization of design & development processes across its centers.

<sup>72</sup> [http://en.wikipedia.org/wiki/HCL\\_Technologies](http://en.wikipedia.org/wiki/HCL_Technologies)

HCL Engineering and Research Service (ERS) offers end-to-end engineering services and solutions in hardware, embedded, mechanical and software product engineering to industry leaders across industry verticals like - Aerospace & Defense, Automotive, Consumer Electronics, Industrial Manufacturing, Medical Devices, Networking & Telecom, Office Automation, Semiconductor, Servers & Storage, and Software Products. It successfully collaborates with other innovation partners, captive centers, universities, industry bodies, and manufacturing partners.

HCL Engineering and Research Service (ERS) offerings include the following: Hardware Product Engineering, Embedded Engineering, Mechanical Engineering, Software Product Engineering and Engineering Out of the Box.

Some of the solutions of Engineering and R&D Services (ERS) are:

- Advanced Mobile Technologies Research
- Aegis is a Machine to Machine (M2M) platform which enables easy monitoring and control of end devices by creating a connected environment
- Business Aligned Service Engineering (BASE): BASE is open standards based methodology which provides 360 degree monitoring and management of business service & applications.
- Device Test Automation Framework (DTAF): Device Test Automation Framework was created to meet the rapidly escalating quality needs of device OEMs with the advent of the app economy
- Natural User Interface (NUI): NUI comprises of components and frameworks for enabling enterprise applications to adopt the new breed of NUI technologies like speech recognition, gesture recognition, augmented reality etc.

Few research papers are:

- True Relationship Based Pricing Engine
- Mobile Micropayment: Opportunities and Technical Considerations
- Reaching Across: Guidelines for Globalizing Web Resources
- Rich Internet Applications in Perspective
- Semantic Web Beyond Science Fiction

### **Networking and Collaborations:**

Some of the collaborations are: Microsoft, Cisco, SAP, Oracle, IBM, HP, Teradata, Misys, Informatica, SAS, Day Software Practice, SECLORE, Top Image System, Microstrategy etc. HCL and EMC provide joint customers with HCL enterprise applications coupled with underlying EMC infrastructure solutions to meet changing business needs.

**Publications:** There are around 1000 publications in HCL Company.

**Source/web link:** <http://www.hcltech.com>

## 16. National Institute of Science Communication and Information Resources (NISCAIR)

**Overview:** National Institute of Science Communication and Information Resources (NISCAIR) was formed on 30 September 2002 with the merger of National Institute of Science Communication (NISCOM) and Indian National Scientific Documentation Centre (INSDOC). NISCAIR is an information science institute operating under the umbrella of the CSIR. Generally, the core activity of NISCAIR will be to collect/store, publish and disseminate S&T information through a mix of traditional and modern means, which will benefit different segments of society. NISCAIR are still operating from the earlier NISCOM and INSDOC campuses, bringing in a synergy and focus in various activities.

**Experience:** NISCAIR has 14 years of experience in information science. NISCAIR is one of the premier institutes serving the society using modern IT infrastructure. NISCAIR, since its inception, has been laying emphasis on reaping the benefits of information technology to effectively serve the national and international community to be an institution of international standard and repute in the areas of knowledge networking, databases on natural resources.

**Infrastructure:** NISCAIR is equipped with the necessary facilities and manpower to train and prepare science communicators, R&D personnel and library and information science professionals. NISCAIR have the facilities like DGPS, ERDAS and ArcGIS for geospatial survey and studies. Scientists of NISCAIR are associated with multidisciplinary task and will be highly beneficial to collect information related to different entity of climate change. Equipment at NISCAIR include

- ArcGIS 10
- ERDAS 2011
- SPSS 19
- DGPS trimble R3
- High Capacity Digital Information Resource Facility (DIRF)

**Research Areas and Activities:** National Institute of Science Communication and Information Resources has been ranked No. 1 among the CSIR labs as per "Ranking Web of World Research Centers", in Spain<sup>73</sup>.

One of the core activities of NISCAIR is to collect, organize and disseminate S&T information generated in India as well as in the world which has relevance to Indian S&T community. The institute is building wide-ranging set of S&T publications in print as well as in electronic form and disseminating through traditional as well as modern means benefiting different segments of the society. Major resources under this activity are National Science Library, Electronic Resources, Indigenous Databases and Raw Materials Herbarium and Museum.

Major projects are:

- Directory of S&T Awards in India (DSTAI) is being updated by NISCAIR under the sponsorship of National Science and Technology Management Information System (NSTMIS).

<sup>73</sup> <http://research.webometrics.info/en/CSIR>

- A database of intramural R&D projects has been developed by NISCAIR (erstwhile INSDOC) under the sponsorship of National Science and Technology Management Information System (NSTMIS).
- E-journal consortia: National Knowledge Resource Consortium (NKRC), established in year 2009, is a network of libraries and information centres of 39 CSIR and 24 DST institutes. NKRC's origin was in 2001, when the CSIR set up the Electronic Journals Consortium to provide access to 1200 odd journals.
- In-house applications developed at NISCAIR include: Document Management Information System (DMIS); Attendance Monitoring System (AMS); Reception Management Software; Vehicle Allocation System and Online Guest House Booking Software.

Recent Achievement includes:

- Implementation of Online Access of NISCAIR's Primary Journals: A solution called "NISCAIR ONLINE PERIODICALS REPOSITORY (NOPR)" has been implemented based on the open source digital repository system software.
- National Knowledge Resource Consortium (formerly CSIR e-Journals Consortium): NISCAIR is the nodal organization for developing a "Consortium for CSIR Laboratories for Accessing e-journals". The activity ranges from creation to monitoring of the access facility of scientific periodicals published by leading international institutions.

**Networking and Collaborations:** Some of the collaborations of the Institute are: CSIR-CMMACS, CSIR-NIO-Goa, CSIR-NGRI, CSIR-NIIST, CSIR-CSMCRI, CSIR- NEERI, CSIR-CRRI, CSIR- IGIB, IIT, Kharagpur, SAC, ISRO, University of Calcutta, Banaras Hindu University, IIT Chennai and University of Rajasthan.

**Publications:** There are nearly 6400 publications in NISCAIR including Research Journals, Natural Products Repository, Abstracting Journals and R&D Newsletters.

**Source/web link:** <http://www.niscair.res.in>





## 3.6 NANO TECHNOLOGY

### Sector Summary

Nanotechnology is combination of Bio- technology, Chemistry, Physics and Bio-informatics. Nanotechnology originated in India around 16 years ago. There are several career opportunities for students in domestic as well as international markets in the field of nano sciences and technologies. Several Indian institutes have introduced degree courses in Nanotechnology at both the UG and PG levels. The areas covered in the Nanotech are Food and Beverage, Bio-Technology, Forensic Sciences, Genetics, Space Research, Environment industry, Medicine, Agriculture and Teaching.<sup>74</sup> Nanotechnology in India is a government led initiative. India has sought to promote nanotechnology applications in sectors that are likely to have a wide impact, and influence the course of future development in the country. The three chief divisions of Nanotech are Nanoelectronics, Nanomaterials, and Nano-Biotechnology. Sectors such as health, energy and environment have received greater attention by various technology departments in the government<sup>75</sup>. Nano Mission - an umbrella programme was launched in May 2007 to endorse R&D in this emerging area of research in a comprehensive manner. The main objectives of the Nano Mission are - basic research promotion, infrastructure development for carrying out front-ranking research, development of nano technologies and their applications, human resource development and international collaborations. During the year 2010-11, Nano Mission continued to record expansion in its activities and also sustained to break new foundation in backing of R&D and human resource development in the ground of nanotechnology<sup>76</sup>.

The 15 Nano technology focused universities and research institutes covered in this report include:

1. Nanoscience and Nanotechnology in Nanofabrication Unit at – IIT Kanpur
2. Centre for Nano Science and Engineering (CeNSE) – IISc
3. Institute of Nano Science & Technology (INST)
4. Centre for Research in Nanotechnology & Science (CRNTS) – IIT - Bombay
5. Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR)
6. Centre for Nanoscience and Nanotechnology (CNSNT)
7. Amity Institute of Nanotechnology (AINT)
8. Centre for Nano Science and Technology (CNST) – K. S. Rangasamy College of Technology
9. Centre for Nanotechnology – IIT Guwahati
10. Nanophotonics Research Group – IIT-Delhi
11. Amrita Center for Nanosciences
12. CSIR-Advanced Materials and Processes Research Institute (AMPRI)
13. International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI)
14. SHAH-SCHULMAN CENTER FOR SURFACE SCIENCE AND NANOTECHNOLOGY (SSCSSN)
15. Center for Nano-Science and Technology-NIST

<sup>74</sup> <http://www.ukessays.com/essays/computer-science/studying-the-future-prospective-of-nanotechnology-computer-science-essay.php>

<sup>75</sup> <http://hyd-n-spook.blogspot.com/2012/03/nanotechnology-in-india.html>

<sup>76</sup> [http://www.dst.gov.in/about\\_us/ar10-11/PDF/c\\_7\\_nano%20.pdf](http://www.dst.gov.in/about_us/ar10-11/PDF/c_7_nano%20.pdf)

# 1. Nanoscience and Nanotechnology in Nanofabrication Unit at – IIT Kanpur

**Overview:** The basic thrust of the unit is in developing soft materials, structures and devices within 100 nm size based on soft (e.g., polymeric, biological, organic) materials and polymer-derived carbons and exploit their applications in three areas: energy, environment and bio-applications. The projects outlined herein all have in common, goals of fabrication of nanostructures in soft materials with a further emphasis on generation and use of carbon based multi scale NEMS/MEMS obtained by pyrolysis of the nanostructures fabricated in suitable polymer precursors. Broad objectives include:

- To provide a state-of-the-art facility and resources for carrying out research and development activities in the areas of soft nanofabrication.
- New and creative combinations of 'top-down and 'bottom-up, and ' wet ' and ' dry ' and 'soft' and ' hard ' are being explored to push the boundaries of su-100nm fabrication with an emphasis on multi-scale materials and devices in the context of energy, environment and biological applications.
- Applications of soft nanofabrication routes to fabrication of devices and structures in other final materials of use such as ceramics and carbon.
- Training of graduate students, research associates, post-doc fellows and faculty of other institutes/universities in this emerging area.

**Experience:** Nanoscience and Nanotechnology in Nanofabrication Unit/Centre has nearly 8 to 9 years of experience in developing soft materials, structures and devices with the applications in three areas: energy, environment and biology and health.

**Human and Financial Capital:** There are around 20 faculties and staff along with 25 PhD students. Funds come from DST and through several collaborative projects at national and international level.

**Infrastructure:** Some of the research equipments include: Pulse Laser for Thin Film Deposition System (PLD System), Optical Microscope, UV Visible IR Spectrophotometer, Imprint Lithography, Scanning Electron Microscope with E-beam Lithography etc. Few supporting equipments for preparation are: Glove Box, Plasma cleaners, Balance (6 decimal), Spin Coater, Graphitizing Furnaces and High Temperature Furnaces.

**Research activities and projects:** Some of the research projects of nanofabrication centre in 3 application areas are:

## Energy:

- 1 Lanthanide-doped nanomaterials: Applications in solid state lighting.
- 2 Large area surface and sub-surface patterning of soft interfaces harnessing the instabilities in nano-films.

3	Fast, large area nano-patterning of soft films
4	Investigation into development of low-cost nano structured organic solar cells with emphasis on life time and reliability issues.
5	Application of Nanotechnology to PEM Fuel Cell: A Novel Approach to solve Energy Problem.
<b>Biology and Health:</b>	
1	Nano engineered polymer and amorphous carbon particles/capsules: Versatile drug carrier and bioimaging agents.
2	Investigation of vell-materials interaction on nanoextured bioactive surfaces.
3	Fabrication of responsive surfaces with tunable nano-roughness and study of the wetting transitions.
4	Patterning of Proteins at Nanoscale Using Biotin-Avidin.
5	Biotic-Abiotic Interface at the Nanoscale.
<b>Environment:</b>	
1	Preparation and Characterization of carbon based nano adsorbents and nano catalysts for mitigation of gaseous, aqueous and biosystems.

### Networking and Collaborations:

- Some of the national level collaborations are: DST, S. N. Bose National Centre for Basic Sciences, Indian Institute of Technology, Guwahati etc.
- Few industry collaborations are: Proctor & Gamble, Hindustan Lever Research Centre
- Some of the international collaborations are: National Institute of Standards & Technology-Gaitherburg, University of Akron - USA, Cambridge University, and University of California Irvine - USA, University of Nottingham-UK.

**Patents and Publications:** The institution owns 277 publications and 8 patents.

**Source/web link:** <http://www.iitk.ac.in/nanoscience/index.html>

## 2. Centre for Nano Science and Engineering (CeNSE) - IISc

**Overview:** Centre for Nano Science and Engineering (CeNSE) was established in 2010 to pursue interdisciplinary research across several disciplines with a focus on nanoscale systems. CeNSE focuses on interdisciplinary research and education in the broad area of Nano Science and technology covering topics such as nanoelectronics, devices, materials, micro and nano electromechanical systems, bio and nanophotonics, bio-electronic interfaces and integrated small-scale systems. The Centre has state of the art nano-fabrication and characterization facilities to enable the development of cutting edge nanoscale technologies for various applications.

**Experience:** CeNSE has 3 years of experience in teaching and research activities. CeNSE offers admission for Ph. D. degree under two streams. The first stream Nano Science and Engineering (NE) is direct admission into the Centre run by the core faculty of the Centre. The second stream is an interdisciplinary program Nano Technology (NA) conducted by the Centre in conjunction with several other departments across the institute.

**Human and Financial Capital:** Apart from the 8 regular faculty members at CeNSE, almost 30 faculty members from different departments at IISc are associated in the academic and research activities at the centre. There are nearly 15- 20 PhD students every year.

Funding comes from various courses offered and through various collaborative research projects coming from DST, DIT etc.

**Infrastructure:** Some of the major facilities of CeNSE include: Nanofabrication Facility, MEMS Packaging Facility, Characterization Facility and Computational facility.

**Research Areas and Activities:** Some of the Research areas at CeNES include:

- Nanoelectronics: The phenomenal growth in the CMOS technology over the past four decades has enabled very high performance computing and storage systems, powering the information technology revolution.
- Neuroelectronics or Neurotechnology: New research discipline that broadly relates to interfacing the neurons of the nervous system with electronic devices.
- MEMS/NEMS: At CeNSE, the research in MEMS and NEMS devices is currently focused on sensor development for inertial, acoustic, chemical and biomedical applications.
- Nanobiotechnology: with a major thrust towards bio-molecular sensing and drug delivery
- Nanomaterials
- Nanophotonics
- Computational Nano engineering: Computational Nanoengineering (CoNe) group at the Indian Institute of Science (IISc) was formed in 2009 to bring together various modeling and design activities in IISc in the micro and nano areas.

Other major research topics currently pursued at CeNSE are: Nano-CMOS Transistors, Non Silicon Based Transistors, Novel Memory Architectures such as FeRAM, MRAM and Phase Change Memory, High - K Gate Dielectrics, Spintronics, Photovoltaic devices, Testing and Characterization of Nanoscale Phenomena, NEMS, Magnetic Materials for RF CMOS, Bio-Sensors and Actuators, Acoustic Sensors, Inertial Sensors, CMOS-MEMS Integration, Energy Harvesting and Power MEMS, Organic Electronic Devices and Sensors, Polymer and nanophotonic devices,

Soft Lithography, Self Assembled Monolayers (SAM), Shape Memory Materials and Devices, Ferroelectrics and Phase Shifters, Simulation and Modeling of Nanoscale Phenomena, RF MEMS, Novel System Architecture Paradigms, Optical MEMS, and Chemical and Gas Sensors.

### **Networking and Collaborations:**

- CeNSE had collaborations with companies such as: Tokyo Electron, IBM, Agilent, Applied Materials, Cranes Software International Limited (CSIL).
- They have collaboration with institutes as well: Amity Institute of Nanotechnology, IIT-Kanpur, NIT Bhopal and IIT-Roorkee are some of them.
- INUP (Indian Nanoelectronics User's Programme) is a joint program run by IIT Bombay and CeNSE, IISc for accelerating research and development in nanoelectronics in India.

**Source/web link:** <http://www.cense.iisc.ernet.in>

### 3. Institute of Nano Science & Technology (INST)

**Overview:** Under the broad objectives of Nano-Mission of Government of India to promote basic research by establishing centres of excellence in specialized areas, the Institute of Nano Science and Technology (INST) has been set up at Mohali (Punjab) as an autonomous institution under the Societies Registration Act, 1860. The institute aims to carry out research in all areas of nanoscience and technology with emphasis in the following areas: agricultural nanotechnology, biosensors, drug delivery, microfluidic chips, photovoltaics and photocatalysis, water purification etc. The institute is a part of the Department of Science and Technology family of scientific research institutions.

**Experience:** INST has good experience in nanoscience and technology and is the first and only institute funded by Government of India with a mandate of pursuing primarily nanoscience research and technology.

**Human and Financial Capital:** INST has around 12 scientists, 20 members (BOG) and around 12 people involved in administration.

INST has been established by the Department of Science and Technology, Government of India as a specialized centre of excellence to promote the growth of R&D, and exploit the application-potential of Nano Science and Technology.

**Research Areas and Activities:** Research emphasis is towards new discoveries and applications of nanoscale systems, which has resulted from innovative research work at the interfaces of chemistry, biology, materials science, physics, and engineering. Major interests are on the following areas: Agricultural nanotechnology, sensors, medical nanotechnology, microfluidics based technologies, nanotechnology based solutions for energy and environment, nanobiotechnology.

There has been a remarkable surge in potential applications of nanomaterials in fields as diverse as ophthalmic lenses to drug delivery. The dedicated research carried out in this institute will help to strengthen the understanding of the phenomena at the nanoscale and generation of products and devices based on nanotechnology in areas ranging from fuels, electronics, food and medicine.

Some of the research publications are:

- Efficient entrapment of dyes in hollow silica nanoparticles
- Self-assembling behavior of Pt nanoparticles onto the surface of TiO<sub>2</sub> and their resulting photocatalytic activity
- Core shell nanostructures: Design and applications
- Surface decoration through electrostatic interaction leading to enhanced reactivity : Low temperature synthesis of nanocrystalline chromium borides (CrB and CrB<sub>2</sub>)
- Nanostructured dimagnesium manganese oxide : control of size, shape and their magnetic and electrocatalytic properties

- Template based synthesis of mesoporous silica material and its application in removal of fluorescent dyes

**Networking and Collaborations:** Some of the collaborations of INST are: DST, Indian Institute of Technology- Delhi, Indian Institute of Technology- Bombay, etc.

**Patents & Publications:** The research faculty owns 26 patents and has produced more than 300 publications through national and international journals; Papers published in national and Referred International Conference Proceedings and also contributed and published 19 books.

**Source/web link:** <http://www.inst.ac.in>

## 4. Centre for Research in Nanotechnology & Science (CRNTS) – IIT – Bombay

**Overview:** IIT Bombay has recently consolidated its Nanotechnology research activities through the formation of a Centre for Research in Nanotechnology & Science (CRNTS). IIT Bombay has been selected as one of the two institutions in India for setting up a 'Centre of Excellence in Nanoelectronics' by the Ministry of Communications & Information Technology (MCIT), Government of India. Academic Programmes in Nano at IIT Bombay includes: Ph.D. in Nano Science & Technology.

**Experience:** CRNTS with its good experience has strengthened the Nanotechnology infrastructure and research activities at IIT Bombay with state of the art facilities for Nanotechnology research and has identified potential industry partners for commercialization of Nanotechnology research.

**Human and Financial Capital:** CRNTS works closely with industry and alumni to strengthen the Nanotechnology infrastructure at IIT Bombay and help commercialize some of the technologies developed at IIT Bombay. Currently, over 45 faculty members from 9 different departments/schools are working together in the broad areas of Nanotechnology, with support from various government agencies and private industries. There are around 62 PhD students from 2007 till 2013.

CRNTS have received funding from DST, DBT and DIT and few other govt. agencies.

**Infrastructure:** Some of the facilities available at CRNTS are: Class 1000 Clean Room (class 100 work areas) with facilities for complete IC manufacturing (Optical & Electron Beam lithography, Reactive-Ion-Etch, Deposition, Sputter, RTP, Furnace facilities), MEMS/Nanoelectronics fabrication facility, Scanning mobility particle sizer, Dip Pen lithography, Cell Sorter/FACS, Tissue Culture room.

**Research Areas and Activities:** IIT Bombay is one of the leading institutions in the country for research in the area of Nanotechnology. Research Domains for PhD programme include: Nanomaterials, Nanobiotechnology, Nanofluidics, Nanoelectronics, Nanomanufacturing, Nanosensors, Computational research in Nanosystems etc.

### Research activities

R&D of Engineered/Hybrid Nanomaterials for Healthcare, Scientific and Engineering Applications

Healthcare Applications, Engineering Applications, Novel Preparation Techniques, Nanophotonics, Polymer Nanocomposites, Magnetic and Magneto-optic garnet materials (thin films)

Nanobiotechnology for Therapeutic Applications

Novel surfactants nanoparticles for respiratory disease, Cellular and Molecular Engineering for Nano-biotechnology, Controlled drug delivery systems



Research activities	
Nanoelectronics for Healthcare Monitoring and Diagnosis	Nano-device Fabrication, Nanosystems for Healthcare and Environmental Monitoring
Vibration, Fatigue, Fracture, and Reliability Testing Systems for Micro/ Nano-Devices	Fatigue testing facility, Laser Doppler Microscope Scanning Vibrometer
Micromagnetics simulation and study of magnetic structure	Magnetic nano-elements have great potential for technological applications, like magnetic disks and Magnetic sensors.
Studies on understanding flow in microchannels	Carrying out research activities in the areas of Nanomaterials, Nanoelectronics and Nano-biotechnology leading to specific deliverables

Major areas of nanoworld are Energy: Solar cells, Fuel Cells, storage battery; Environment; Health; Security; Sensors; Regenerative medicine and drug delivery.

### Networking and Collaborations:

- Centre of Excellence in Nanoelectronics (CEN) at Indian Institute of Technology Bombay was established in the year 2006. **CEN is a collaborative project between IIT Bombay and IISc Bangalore.** It is funded by Department of Electronics and Information Technology (DeitY). CEN focuses on the design, fabrication and characterization of traditional CMOS nanoelectronic devices, novel material based devices (III-V compound semiconductor, spintronics, opto-electronics), micromechanical systems, Bio-MEMS, solar photovoltaics and polymer based devices. Some collaborations of CEN are: TCS, Texas instruments, University of Cambridge, IBM etc.
- Some of the other collaborations of CRNTS are with Ministry of Human Resources Development, Intel USA, International Agency, IME Singapore, Synopsys, TCS, ISRO, DBT, BARC, DeitY etc.

**Publications:** This research has resulted in over 400 high quality publications in the last 5 years in international journals and conference proceedings and a large number of patents.

**Source/web link:** <http://www.iitb.ac.in/~crnts/Home.html>

## 5. Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR)

**Overview:** JNCASR was established in 1989 by the Department of Science and Technology of the Government of India, to mark the birth centenary of Pandit Jawaharlal Nehru. It is a multidisciplinary research institute located in Jakkur, Bangalore, India. Its mandate is to pursue and promote scientific research and training at the frontiers of science and engineering. At present Prof. M. R. S. Rao is the president of the JNCASR and Prof. C. N. R. Rao is the honorary president and Founder of the institute.

Researchers at the centre are divided into six units: Chemistry and Physics of Materials, Engineering Mechanics, Evolutionary and Organismal Biology, Molecular Biology and Genetics, Theoretical Sciences, Educational Technology and Geodynamics. There are two off-campus units: Chemical Biology and Condensed Matter Theory. **In Karnataka, JNCASR is one of the main research institutes to support nano park initiative.**

**Experience:** JNCASR has 24 years of experience in scientific research and training at the frontiers of science and engineering with several research units. One of the Units is on **Nanoscience** which is supported by DST and it pertains to the synthesis, characterization, exploration and utilization of nanostructured materials, which are characterized by at least one dimension in the nanometer range. These constitute a bridge between single molecules and bulk systems.

**Human and Financial Capital:** JNCASR has a faculty-to-student ratio of about 1:4 and state-of-the-art experimental, computational and infrastructural facilities. It offers Ph.D. programmes, as well as an Integrated Ph.D. (post-bachelor's degree) programme in Materials Science. JNCASR has around 50 faculties with 200 students.

JNCASR was supported by DST and receives funding from various courses offered and through collaborative projects from agencies such as RRCAT, DST, DBT, INSA, DRDO, CSIR, ADE, BARC, ICMR etc.

**Infrastructure:** JNCASR is equipped with good quality Library, an excellent computer support facility, Chemical Education Laboratory, online journals and Veeco Instruments laboratory which houses Optical Profilometer and Scanning Probe Microscopy tools for nanoscience research etc. Some research facilities include: Surveillance System, Semiconductor Characterization System, Huffle furnace upto 1000°C & ceramic furnace tubes.

**Research Areas and Activities:** There are ongoing research programmes in several frontier, interdisciplinary areas of science and engineering. The main areas of research interest at present are:

Molecular modelling of materials; Nanomaterials and catalysis; Nanomaterials, nanofabrication, molecular crystals; Synthesis, structural, electrical, and magnetic properties of nanomaterials; Functional materials based on Metal-Organic Frameworks (MOFs); Organic electronics: device physics & photophysics; Computing micro and nanoscale flows; Physics and chemistry of nanomaterials; Atomic and electronic structure of nanoclusters and nano-wires; Nanomaterials and renewable energy; Novel physics and chemistry at nanoscale.

Some of the research projects sponsored by DST are:

- Thematic Unit of Excellence on Nanochemistry at JNCASR
- Theoretical Investigation of Oxide Supported Metal Nanoparticle Catalysts
- Development and evaluation of active polymer nanocomposite packaging materials for food contact applications
- Targeting protein lysine acetylation in oral cancer and neurodegenerative disorders using nanomaterials

JNCASR has participated in the following European Commission FP7 projects.

Project Acronym	Project title	Challenge area
<b>ATHENA</b>	Advanced theories for functional oxides: new routes to handle the devices of the future	NMP-2008-2.6-2 Computational Material Science - Coordinated Call with India
<b>MONAMI</b>	Modeling of nano-scaled advanced materials intelligently	NMP-2008-2.6-2 Computational Material Science - Coordinated Call with India

**Networking and Collaborations:** JNCASR has research collaborations with several national and international institutions such as University of Hyderabad, Massachusetts Institute of Technology, VIT - Tamil Nadu.

Some of the collaborative research projects:

- Memorandum of Understanding between JNCASR & Raja Ramanna Centre for Advanced Technology on " High Pressure XRD Measurement System"
- Indo-Italian Research Project: "Innovative catalytic patterns for nanowire growth"
- Indo-Spanish Joint Programme of cooperation in S&T entitled "Synthesis and properties of nitride-based nanomaterials"
- Memorandum of Understanding between JNCASR and NCI (Nippon Chemical Industrial Co. Ltd.) on project "Develop inorganic nanomaterials for drug release"
- Memorandum of Understanding between BARC and JNCASR "Development of Test Facility for Thermal Hydraulics studies/Basic research Salt Water/Fine
- Hydrogen Bubble Test Facility for simulation of Hydrogen Transport - Management/ Fire safety behaviour / Containment thermal hydraulics/pollution dispersion studies".

**Publications:** The institute has produced 3194 publications through national and international journals.

**Source/web link:** <http://www.jncasr.ac.in>

## 6. Centre for Nanoscience and Nanotechnology (CNSNT)

**Overview:** CNSNT was established in January 2006 at the University campus to accomplish the goal of enhancing advanced research in the areas of Nanoscience and Nanotechnology. The centre is a joint initiative of Indira Gandhi Centre for Atomic Research (IGCAR) and Sathyabama University. The leading area of research includes nanomaterials, nanotechnology, nanocomposites, nanoelectronics, nanofabrication. In addition to research, the centre also conducts training and awareness programmes, workshops at national and international conferences on recent trends and developments of Nanoscience on various themes of national interests. The centre is undertaking research and development projects from various agencies and is offering consultancy services to industries and research organizations in India and abroad.

**Experience:** CNSNT has 7 years of experience in research activities such as nanomaterials, nanotechnology, nanomedicine, nanocomposites, nanoelectronics, nanofabrication etc.

**Human and Financial Capital:** There are around 15 scientists involved in different areas of nanosciences and nanotechnology research.

Funds have been received from Indira Gandhi Centre for Atomic Research- Dept of Atomic Energy, ADE-DRDO, Vikram Sarabhai Space Centre, DBT-Nanobiotechnology, DBT-IDB Medical Biotechnology, DBT- Bioremediation and Board of Research in Nuclear Sciences (BRNS).

**Infrastructure:** Some of the facilities of CNSNT are: Pulsed Laser Deposition (PLD) - Microtech Srl, Italy; RF Magnetron Sputtering - Plassys, France; DC Magnetron Sputtering - Hind High Vacuum, Bangalore; Thermal Evaporator - Hind High Vacuum, Bangalore; Chemical Vapor Deposition (CVD) - Mansha Vacuum Technologies, Bangalore; E-Beam Evaporator - Plassys, France; X-Ray Diffractometer (XRD-SMART lab) - Rikagu, Japan; Field Emission Scanning Electron Microscope (FESEM-SUPRA 55) - CARL ZEISS, Germany; Atomic Force Microscope (AFM) - NTMDT, Ireland etc.

**Research Areas and Activities:** Some of the research activities are:

- **Nanobiotechnology:** Thin Film Coating to control Biofiling, Antimicrobial activities of Nanoparticles, Biocorrosion, Bionanomaterials, Controlled Drug Delivery, Nanomedicine and Bionanosensor
- **Material Science:** Synthesis of Thin Films, Characterization of Nanomaterials, Microstructural and Compositional Analysis, Mechanical and Magnetic Property Characterization
- **Physics:** Synthesis of Nanomaterials, Nano Semiconductors, Nano Surface Modification by Ion Implantation, Physics of Carbon Nanotubes
- **Chemistry:** Synthesis of Polymer Nanoparticles, Nanoparticles Surface Modification, Processing of Polymer Nanocomposites, Polymer Nanocomposites Characterization Behavior & Performance
- **Nanocomputing & Nanoelectronics:** Nanosensors, Nano Electronic Devices, Quantum Dots and VLSI & Nanoelectronics

Centre is undertaking following sponsored research projects from various agencies:

Some ongoing projects:

- Synthesis of Carbon Nanotubes For Gas Sensor Application
- Development of Carbon Nanotube Based Epoxy Composites
- Novel Metal Complex Photocatalyst System for Carbon Dioxide Splitting
- Infectious Disease in Zebra Fish Model
- Bio-Waste Modified Concrete Structures
- Nanophase Modifications of Concrete
- Thermal Barrier Coatings

Completed projects:

- Detail Investigations of Microbiological Aspects of Biodeterioration / Biodegradation Of Concrete Of Sulphur Oxidizing Bacteria/Fungi
- Improving the Antimicrobial Properties Of Condenser Material By Surface Modification Using Nanotechnology
- What about network and collaboration.

**Patents & Publications:** The institution has produced 20 Journal Publications since 2008, 34 Publication in Proceedings, 4 books, 2 articles and 3 filed patents recently.

**Source/web link:** <http://centrefornanotechnology.com>

## 7. Amity Institute of Nanotechnology (AINT)

**Overview:** Amity Institute of Nanotechnology (AINT), Noida was established in 2003 and is part of Amity University. The institute has been managed under the aegis of Ritnand Balved Education Foundation. The institute has started M. Tech Course in Nanotechnology and the program comprises of conceptual knowledge of nanoscience and nanotechnology, including preparation of nanomaterials, their characterization and applications.

The eminent faculty at the institute takes care of teaching and training the students in the frontier areas of nanotechnology and they have drawn a noteworthy syllabus for the entire course such as:

- **Graduate:** B.Tech + M.Tech. - Nanotechnology (Dual Degree) B.Tech – Nanotechnology;
- **Post Graduate:** M.Sc. - Nanoscience by research + M.Tech. - Nanotechnology (Dual Degree) M.Sc. - Nanoscience by Research M.Sc - Forensic Nanotech M.Sc - Nanobiotechnology M.Tech. – Nanotechnology;
- **Ph.D Programme:** Ph.D in Nanoscience and Nanotechnology Ph.D in Nanoscience and Nanotechnology (Part Time).

AINT has started a quarterly magazine entitled 'Amity Nanotechnology Update' highlighting the latest developments in the area of nanotechnology. The first step of teaching & training in Nanotechnology has been taken up.

**Experience:** AINT has 10 years of experience teaching, training the students in the frontier areas of nanotechnology and research.

**Human and Financial Capital:** There are nearly 20 faculties along with 30 graduates, 20 post graduates and 20 PhDs. Funding comes from various courses offered and through research programmes.

**Infrastructure:** Facilities at Amity Institute of Nanotechnology includes - Library, Laboratories, Internet and Placement Cell.

**Research Areas and Activities:** Amity University was Ranked No. 1 by Times of India during 2012. Amity University has been ranked the no. 1 private University (Source: Education Times) during 2012<sup>77</sup>.

AINT has initiated research programmes in the following areas:

- Synthesizing of Carbon Nanomaterials
- Development of Nanophosphors
- Drug/Vaccine Delivery
- Water Purifications by nanoparticles & composites
- Development of Nano-oxides-Al<sub>2</sub>O<sub>3</sub>, TiO<sub>2</sub> etc

<sup>77</sup> [http://www.amity.edu/admission/top\\_rank.asp](http://www.amity.edu/admission/top_rank.asp)

Some research papers are:

- Nanometer-Scale Patterning of Alkali Halide Surfaces by Ion Bombardment
- Swift heavy ion induced epitaxial crystallization of buried Si<sub>3</sub>N<sub>4</sub> layer
- Recent advances in carbon nanotube based biosensors
- Creating surface nanostructures in GaAs by MeV Au<sup>2+</sup> ions
- Recent advances in carbon nanotube based biosensors
- Swift heavy ion induced modification in Frequency dependent C-V and I-V characteristics of Pd/n-GaAs Schottky barrier diode

**Networking and Collaborations:** Amity Institute of Nanotechnology has close linkage with national scientific institutions in India like National Physical Laboratory, Solid State Physics Laboratory (SSPL), Bhabha Atomic Research Centre (BARC), Tata Institute of Fundamental Research, Central Scientific Instruments Organization and Defence Materials and Stores Research and Development.

**Publications:** The institute has produced 27 Research Papers published / accepted in peer reviewed International/ National Journals.

**Source/web link:** <http://amity.edu/aint/default.asp>

## 8. Centre for Nano Science and Technology – K. S. Rangasamy College of Technology

**Overview:** K. S. Rangasamy College of Technology (KSRCT), started under the KSR Group of institutions in the year 1994, has come up with all basic and advanced modern infrastructure facilities, excelling both in academic and research activities. It is an autonomous institution, affiliated to Anna University of Technology Coimbatore, approved by the All India Council for Technical Education (AICTE), New Delhi, accredited by National Board of Accreditation, New Delhi (certified by ISO 9001-2000, TÜV Germany). The management established the unique and offshore research **Centre for Nano Science and Technology (CNST)** with dedicated team of faculty and scientists. CNST caters to the academic and industrial needs in collaboration with a wide range of national/international universities/research centres/industries. CNST has filed 13 patents in nano metal oxides from natural minerals, nano silica from rice husk, and nano particles from herbal plants for various industrial applications. The focus of KSRCNST is to work on technology transfer oriented projects. The center initiated collaborations with both industries and R&D centers from India and abroad.

**Experience:** CNST with its dedicated team and faculty have good experience in academic and research activities. CNST offers courses in Ph.D. – Nanoscience and Technology and M.S / M.Tech. – Nanoscience and Technology.

**Human and Financial Capital:** There are around 10 faculties with 3 senior research fellows and 7 junior research fellows. Funding comes from various courses and sponsored research projects from govt. organizations such as: DST, DRDO and DAE-CSR and IGCAR.

**Infrastructure:** At KSRCT-CNST a world class-of-the art facilities have been established. Some of the facilities of CNST are: Nano Materials Synthesis Lab which includes Spray Pyrolyser, Elcetrospining, Sonicator, hydrothermal High pressure Autoclave, Atomic Force Microscope (AFM) Lab which includes large area scanner, liquid imaging option, Piezo response measurement Platinum/Iridium tips, and Gold coated contact searching low noise performance.

**Research Areas and Activities:** Some of the sponsored research projects of CNST are:

- Development and characterisation of nanometal oxides for biomedical applications
- Strategy to improve the growth and yield of maize crop employing nano silica powders
- Nanobioactive glass coated implants for biomedical applications
- Development of nano protected fabrics for army and medical application
- Mono Dispersed colloidal and Cocoon Shaped Nano Silica Particles for abrasive applications
- Development of nano metal oxides incorporated refractories for refractory applications

**Networking and Collaborations:** CNST have signed MoU with Kaiserslautern University Germany, Jomo Kenyatta University of Agriculture and Technology Kenya, Chonbuk National University South Korea, University of Missouri USA, MINTEK Randburg South Africa, University of Aveiro Portugal, Edith Cowan University (ECU), Western Australia Centre d Investigacio en Nanociencia i Nanotecnologia (CIN2, CSIC) Spain, University of HYOGO Japan, University of Liverpool UK, National University of Singapore, Ranbaxy Labs Ltd. New Delhi

**Patents & Publications:** CNST owns 16 patents and has produced several publications through Peer Reviewed Journals and conferences. There are 286 international and 31 national Peer Reviewed Journals and 190 international and 35 conference proceedings. CNST has also produced 78 text and R&D books

**Source/web link:** <http://www.nanotech.ksrct.ac.in/index.php>



## 9. Centre for Nanotechnology – IIT Guwahati

**Overview:** Centre for Nanotechnology, IITG was established in the year 2004. It has a vision to foster the development of research and education in the multi-disciplinary area of Nanotechnology at IIT Guwahati, to develop human resources gifted with leading-edge competitive advantages in the multi-disciplinary area of Nanotechnology required for meeting the future challenges, and to augment academic partnerships with industry in the area of Nanotechnology.

**Experience:** Centre for Nanotechnology has 9 years of experience in identifying the relevant areas pertaining to Nanotechnology from the multi-disciplines to create the state-of-the-art infrastructure facilities which include laboratories, equipments and supporting staffs, to operate Ph.D programs in Nanotechnology.

**Human and Financial Capital:** There are around 11 faculties, 4 staff with 7 students for 2012 batch.

Funding comes from some courses and through sponsored research projects by DBT, DST, Dr.Reddy's Laboratories Ltd and Board of Research in Nuclear Sciences (BRNS).

**Infrastructure:** Centre for Nanotechnology has following facility such as microscopy, computation, synthesis and characterization.

### Research Areas and Activities:

- Controlled growth and studies on semiconductor nanowire heterostructures for solar photovoltaic applications
- Novel nanoscale materials targeted towards antimicrobial and anticancer activities
- Development of Nanoscale Materials for Bacteria Removal from Surface Water
- Design and Development and Fabrication of OLED Organic Solar club and organic TFTs based on Molecular Polymeric and composite materials
- A combined experimental and theoretical study on the instability and patterning of thin liquid crystal film
- Fabrication and Characterization of Organic thin film transistor
- Nanoscale materials with therapeutic implications
- Engineering Nanoscale Materials and their Applications in nanotechnology
- Novel Nanoscale Materials: Generation, Characterization and Device Applications
- Newer Chemical and Physical Methods of Engineering Devices Consisting of Nanoscale Functional Components.

**Publications:** The center has produced 261 publications in journals and 84 publications in conferences since 2008 and 24 recent publications in Peer Reviewed Journals.

**Source/web link:** <http://www.iitg.ac.in/nano/index.html>

## 10. Nanophotonics Research Group – IIT-Delhi

**Overview:** Nanophotonics research group is the new emerging paradigm where light interacts with nano-scaled structures and brings forth the mysterious world to research. The combination of Photonics and Nanotechnology giving birth to “Nanophotonics” which compliments and benefits from each other in terms of new functions, materials, fabrication processes and applications. Nanophotonic research activity has been initiated in IIT Delhi in 2005. Recently IIT Delhi has recognized this research as one of the “High-impact research activity”.

**Experience:** Nanophotonics research group has 8 years of experience in studying the synthesis and photonics of nanoparticles and nano-structures in the limits of sizes, where their structural, physical and optical features are enormously modified.

**Human and Financial Capital:** Nanophotonics research group has 1 faculty with 4 PhD students and 4 postgraduate students.

Funding comes from various courses and from several projects of DST, UKIERI (British Council UK and Govt. India), DST, Indo- Ireland S&T Programme of Cooperation, IIT Delhi, Royal Society (UK) grant for short visit.

**Research Areas and Activities:** Some of the research projects are:

- Design and development of naturally self-assembled Inorganic- Organic hybrids for photonic applications
- UltraFastOptics (UFO) Research Facility
- Inorganic-organic electroluminescent devices
- Silicon nanocrystal based solar cell devices with Dublin City University, Ireland
- R&D of Nanophotonic materials
- Nano fab facility
- Environmentally –focused low cost nanostructures
- New photonic microcavities: strong exciton-photon coupling

**Networking and Collaborations:** Some of the collaborations are: Nanophotonics Centre, Cavendish Laboratory, University of Cambridge – UK, Nanophotonic Portfolio Centre, University of Southampton –UK, Toyota Technological Institute – Japan, University of Trento – Italy, Dept. of Material.Science. Eng., National Taipei University of Technology (NTUT) – Taiwan, Università Politecnica delle Marche – Italy, RR-CAT, Indore – India, School of Physics, University of Hyderabad-India, Department of Chemistry, University of Delhi-India, NPL –India, SAMEER, Mumbai – India.

**Publications:** The institute has produced 64 journals and 3 books till date.

**Source/web link:** <http://nanophotonics.iitd.ac.in/index.html>

## 11. Amrita Center for Nanosciences

**Overview:** Amrita Center for Nanosciences & Molecular Medicine, established in February 2006, is at present recognized as a key player in Nanotechnology, Molecular Medicine, Solar Cell research and education. The Center also hosts a Nano Solar Center for Excellence which has expertise in innovative product development in photovoltaics and storage devices using nanomaterials. The Center is located on Amrita's healthcare campus that also has Schools of Medicine, Dentistry, Nursing and Pharmacy. In February 2009, it hosted NanoBio Conference - the world's first conference in tissue engineering and stem cell research.

Amrita Center for Nanosciences is the first nanotechnology center established with support from the Government of India in the biomedical area, the center is pioneering work in the development of natural tissues and organs without the need for using synthetic implants or searching for donors. The center is also developing new Nano materials for applications in cancer, diagnostics and therapy, new delivery systems, sensors and photovoltaics.

**Experience:** The center has 9 years of experience in providing education and doing research in Nanotechnology, Molecular Medicine and Solar Cell research and also involved in innovative product development in photovoltaics and storage devices using nanomaterials.

**Human and Financial Capital:** The Center has a team of highly talented faculty, many of whom have trained with premier international institutions. There are 21 academic professors; 9 associate medical faculty members, 1 director and 71 research scholars since 2007. The Center also has several talented PhD students. Agencies that fund extramural grants for the Center's breakthrough research are Council of Scientific and Industrial Research (CSIR), Department of Bio-Technology (DBT), India, Department of Science & Technology (DST), New Delhi, India, Indian Council of Medical Research (ICMR), New Delhi, India, Ministry of Food Processing Industries (MFPI), University Grants Commission (UGC) of India, Indo - US Science & Technology Forum (IUSSTF)

**Infrastructure:** Amrita Vishwa Vidyapeetham is accredited with the highest grade of A by the National Accreditation and Assessment Council of India (NAAC). Originally established as an engineering college in 1994, the institution has now grown into a five campus university offering bachelor's, master's and doctorate level programs in engineering, management, medical sciences, ayurveda, dentistry, pharmacy, nanosciences, biotechnology, nursing, journalism and arts and sciences. The Amrita Center for Nanosciences is an independent center in the university that has both research and academic components. The Center has over 40 students currently pursuing their M Tech or Ph D degrees in Nanosciences.

**Research Laboratories:** Amrita Center for Nanosciences has research labs devoted to various aspects of Nanosciences and their research activities

**The Center has the following research labs:-** Infectious Diseases Lab, Cell Culture & Stem Cell Lab, High Resolution Microscopy Lab, Nanocharacterization Lab, Nanotoxicology Lab, Nanochemistry Lab, Wet Chemistry Lab I & II, Spectroscopy Lab, Polymer Processing Lab, RNAi Lab, CVD La, Thin Film Processing Lab, Mechanical Testing & X - ray Diffraction Lab, Nanodrug Delivery Lab Tissue Nanoengineering Lab, Characterization Lab, Central Facility, Nanofiber & Surface Modification Lab, Polymer Chemistry Lab, Nanomedicine Lab, XPS (X - ray Photoelectron Spectroscopy) and Ellipsometry Lab

**Research Areas and Activities:** The center research goal is to develop affordable products of high quality that utilize the novel properties of nanomaterials. The main focus is on tissue engineering and stem cell research using nanomaterials as well as on photovoltaics and storage devices using nanomaterials. In addition, there are funded programs in cancer diagnostics and drug delivery using nanoparticles, nanosurface modification of biomaterials for implant applications, nanotoxicology and processing of nanostructured thin films for sensors and photovoltaic applications. India's first NANOBIO center, Amrita Center for Nanosciences & Molecular Medicine, is recognized today as a leader in *Nanotechnology, Molecular Medicine* and *Solar Cell* research and education. ACNS offers a variety of interdisciplinary programs that provide expertise in nanomaterials and nanomaterials processing, bio-nanotechnology, nano-medical sciences and molecular medicine.

**Some of the research projects are:**

- Characterization of Anti - Microbial Compounds and Producing Adhesins
- Identification of Auto antigens in Rheumatoid Arthritis using Unbiased Clinical Proteomics
- Role of Pathogen Associated Molecular Patterns in Septic Arthritis
- Nano-Fibre Scaffold Electrodes for High Performance Storage Device

**Networking and Collaborations:** The Amrita Center for Nanosciences has received support from the Indo US Science and Technology Forum as well. International research collaboration is strongly encouraged. The center will also establish an International Center for Electrochemical Nanoprocessing at Amrita which will be done in collaboration with the University of California, Riverside and State University of New York at Binghamton.

The amrita center has also developed research collaborations with Kansai University, Osaka, Japan, Institute of Inorganic Chemistry, University of Zurich, Switzerland, University of Porto, Portugal, ERASMUS University Medical College, Rotterdam, The Netherlands, Leiden University Medical Center, Leiden, The Netherlands.

**Publications:** The center has 10 granted patents and 59 scientific publications from 2005 to 2013.

**Source/web link:** <http://amrita.edu/acns/index.php>

## 12. CSIR-Advanced Materials and Processes Research Institute (AMPRI)

**Overview:** CSIR-Advanced Materials and Processes Research Institute (AMPRI), Bhopal was instituted in May 1981 as “Regional Research Laboratory” (RRL) and officially started functioning from CSIR, New Delhi. The overall objective of AMPRI is to achieve a world-class status in the area of engineering materials, component and process development. AMPRI is committed to develop innovative, cutting edge, internationally competitive, energy efficient and environmental friendly technologies/ products in the area of advance materials for societal benefits and to assist the nation’s economy

**Experience:** The Advanced Materials and Processes Research Institute, Bhopal, formerly was known as the Regional Research Laboratory. It was established in 1982. The name change from Regional Research Laboratory, Bhopal to Advanced Materials and Processes Research Institute (AMPRI) is effective from March 6, 2007. In consonance with the new distinctiveness, R&D programmes in lightweight materials such as Al and Mg alloys, metallic and polymer based composites, foams, and functional materials; nano-materials; new materials based on industrial wastes such as fly ash and red mud have been undertaken. These programmes have industry/ user link from inception stage. A state of the art processing and characterization facility and simulation modelling capabilities are being set up to trigger new materials development, innovations and improvements.

**Human Capital:** The present manpower includes 43 scientists (against the sanctioned strength of 56) that are well trained in different disciplines of materials science and other related areas along with 86 supporting staff. The number of scientists is planned to increase to ~80 in the near future in view of the widened range of R&D activities.

**Infrastructure:** CSIR-AMPRI is equipped with up to date R&D facilities in the area of material synthesis, processing and characterization. Some more sophisticated facilities are also in a process of being set up at the institute in order to carry out material processing and characterization with an improved degree of precision, especially with regard to nanostructured material development. Keeping application in mind, the R&D facilities have been grouped as the ones meant for mechanical, physical, chemical, thermal, electrical, rheological & tribological property characterization. Other sets of facilities include those for powder processing, primary processing like melting, secondary processing such as heat treatment & deformation, and microstructural studies. AMPRI is equipped with modern facilities for material synthesis, processing and property characterization such as SEM, pressure die casting machine, semisolid processing unit, rolling mill, Mg melting unit etc. FESEM, cryomilling unit and those related to nanoscale R&D are also established.

**Research Areas and Activities:** The current activities of AMPRI are broadly categorized under:

- Lightweight Materials
- Nanostructured Materials
- Smart and Functional materials
- Waste to Wealth
- CSIR-800

In the category of lightweight materials, important activities relate to Al metal matrix composites, polymer matrix composites, Al foam and Mg-based alloys. AMPRI has laid a major

emphasis on lightweight materials development like Al foam, Mg-based alloys, in-situ MMCs and nanostructured materials. Also, activities on electromagnetic forming, smart and functional materials, steel and Ti foams, and materials modelling and design are in the offing.

In the area of Waste to Wealth, the institute largely worked on the utilization of flyash and Redmud. The institute has developed wood substitute technology using redmud, flyash and natural fibers and has potential applications for making doors, panels, partitions and furniture. AMPRI has developed Radiation Shielding Materials from Red Mud and holds a US Patent on the work. The potential applications of this technology will be for the shielding of gamma and neutron in nuclear power plants and for diagnostic X-ray shielding in X-ray and CT scan rooms.

AMPRI has worked on various rural development and dissemination activities which will have large implications for CSIR-800.

**Patents & Publications:** The institution has 48 patents and 150 publications from 2007-2010.

**Source/web link:** <http://www.ampri.res.in/eng>

## 13. International Advanced Research Centre for Powder Metallurgy and New Materials

**Overview:** International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI) established in the year 1997 is an Autonomous Research and Development Centre of Department of Science and Technology (DST), Government of India with main campus at Hyderabad spread about 95 acres of land and with operations in Chennai and Gurgaon.

### ARCI's mandate is

- Development of High Performance Materials and Processes for Niche Markets
- Demonstration of Technologies at Prototype / pilot scale
- Transfer of Technology to Indian Industry

**Experience:** ARCI has 17 years of experience in Developing innovative High Performance Materials and Processes for Niche Markets. The activities are pursued through 11 Research Centre's, with main focus on development of nationally unique technologies and application oriented programmes. Synonymous to its name, ARCI is also open to collaborate with Indian and foreign laboratories, universities and industries for successful achievement of its goals. ARCI has so far successfully transferred 15 technologies to 25 entrepreneurs.

**Human and Financial Capital:** The Human Resource Development (HRD) center looks into recruitment of talented work force for ARCI. It provides support in Assessment and promotion process of the staff members every year depending upon their eligibility. It also looks into the employee training, career advancement, performance management and development. Apart from the above, it looks into promoting of young researchers and fellows under various Schemes. ARCI continues to sponsor fellowship programmes at Indian, Institute of Technology (IIT) – Bombay, IIT-Hyderabad and IIT-Madras. As a part of these ARCI – IIT Fellowships, ARCI supports the doctoral study of talented students selected as ARCI Fellows to work in areas of immediate interest to ARCI under the expert guidance of an identified Faculty member. The institution receives grants from DST, Government of India and also from other sources like DBT, and Industrial funding for sponsored projects.

Parameters	2011-2012	2012-2013
Number of Employees	170	173
Number of Scientists	67	71

**Infrastructure:** The Main Campus of ARCI is located at Balapur, Hyderabad, Andhra Pradesh. ARCI's Centre for Fuel Cell Technology (CFCT) and Centre for Automotive Energy Materials (CAEM) are located at Chennai. Centre for Knowledge Management of Nanoscience and Technology (CKMNT) is at Tarnaka, Hyderabad and ARCI's liaison and patent facilitating office is located at Gurgaon, Haryana. The institution has established separate centers to look after the activities of the institution. There are 3 main centers like R&D centers, technical & support centers and administration. The R&D center has 11 sub centers to look after the research activities and development. The Technical and administration has 7 sub centers each to supervise the overall administration and cater its services for the fulfillment of the Mandate of the Centre.

**Research Areas and Activities:** The Institution has 11 separate R&D centers. The Center for Nanomaterials have made substantial progress not only in establishing a vast array of synthesis, processing and characterization facilities but also in application development in the

areas of nanosilver for drinking water disinfection and antibacterial textiles, nano-ZnO for electrical varistors, nano-titania for self-cleaning textiles, aerogels for thermal insulation applications, photocatalytic splitting of water for hydrogen generation, Nano-sheets of WS<sub>2</sub> for solid lubricant applications, electrospun polymer nano-fibers for high performance filtration applications etc.

### Technologies Transferred

Based on the perceived market size of products/services based on ARCI technologies, ARCI has adopted exclusive and non-exclusive modes of technology transfer to facilitate healthy competition in the market. So far, ARCI has successfully transferred 15 technologies to 27 technology receivers.

**Networking and Collaborations:** the institution has established a separate center called "Centre for Technology Acquisition Transfer and International Cooperation (CTATIC)" to catalyze ARCI's effort to make nationally unique advanced materials technologies available to Indian companies. With regard to this, several national and international collaborations have been established. The institution also works closely with many local and international industries and identifies the start-ups/established companies to commercialize ARCI's technologies through various direct and indirect channels such as participation in industrial exhibitions, business opportunity workshops, and also through web and tele-marketing. ARCI also facilitates patent related services such as prior art searches for patent filing, research planning, market research etc and coordinates patent drafting and patent filing activities. List of foreign and Indian collaborations are given below:

**Foreign collaborations:** Aerovironment, USA, Ceramtec Inc., USA, Centre for Environment and Sustainability Carl von Ossietzky University (COAST), Germany, EPG (Engineered nanoProducts Germany), GmbH, Germany, Entegris, Israel, Fraunhofer Institutions, Germany, AVH Foundation, Germany, Hoganäs AB, Sweden, Harris Environmental Systems, USA, Industrial Materials Institute of National Research Council of Canada (NRC-IMI), Canada, Institute for Problems of Materials Science (IPMS), Ukraine, International Centre for Electron Beam Technologies, Ukraine, National Institute for Materials Science, Japan, McGill University, Canada, MPA Industries, France, PACT, France, Pratt & Whitney, USA, Powder Metallurgy Institute, Belarus, Rofin Laser Tech, Germany, Toda Kogyo Corp., Japan, University of Central Florida, USA, University of North Texas, USA, University of Stuttgart, Germany, University of Bremen, Germany, ZBT GmbH, Germany, Zoz GmbH, Germany

**Indian collaboration:** Andhra University, Ashok Leyland, Atria Power Corporation Limited, Ananya SIP Technologies Pvt. Ltd., Bharat Electronics Limited, Bharat Heavy Electricals Limited, Bimetal Bearings Limited, Boron Carbide India Pvt. Ltd., Carborundum Universal Limited, Central Scientific Instruments Organization, Central Institute, Plastics Engineering and Technology, Clutch Auto Limited, Cummins Technologies India Limited, Central Glass and Ceramics Research Institute, Defense Research and Development Organization, Fleetguard Filters Pvt. Ltd, General Cables India, GE India Technology Centre Pvt. Ltd., Hindustan Aeronautics Limited, Energy Materials Research Laboratory, Honeywell Technology Solutions Lab Pvt. Ltd., Indian Space Research Organization, Indira Gandhi Centre for Atomic Research, IISc-B, IIT-Bombay, IIT-Madras, IIT-Kanpur, IIT-Karagpur, IIT-Hyderabad, Infinity Microsystems, Larsen and Toubro, Mahindra and Mahindra, Magod Laser Machining Pvt. Ltd., National Institute of Technology, Warangal, Osmania University, Pacific Scientific Systems, Plastco Products, Redson Engineers Pvt. Ltd., Resil Chemicals Pvt. Ltd., Siemens Technology and Services Pvt. Ltd., Tata Steel Limited, Tata Consultancy Services Limited, Thermax Limited, Titan Industries, University of Hyderabad, VEM Technologies Private Limited, Walchandnagar Industries Limited.

**Source/web link:** <http://www.arci.res.in/index.php>



## 14. Shah-Schulman Center for Surface Science and Nano technology (SSCSSN)

**Overview:** Shah-Schulman Center For Surface Science And Nano Technology (SSCSSN) is established from January, 2008 under the leadership of Dr. Dinesh O. Shah in the Faculty of Technology, Dharmsinh Desai University (formerly known as DDIT), Nadiad (Gujarat), India. SSCSSN is established to provide research facilities for training Under Graduate, Graduate and Doctoral students in the areas of fundamental and applied aspects of Surface Science and Nanotechnology. The focus is on identifying and solving problems of various industries and developing new processes and technology, which can be implemented in industries.

This Center has an inherent advantage of being a part of DDU, since it has full-fledged Faculty of Technology, Faculty of Dental Science, Faculty of Pharmaceutical and Faculty of Management. Moreover, Faculty of Medical Science is also being established at DDU. The SSCSSN also welcomes specific research and development projects from industries on a contract basis.

**Experience:** The Center was established in 2008 and have acquired in depth experiences of industrial consulting and handling research activities in the areas of fundamental and applied aspects of Surface Science and Nanotechnology.

**Human and Financial Capital:** The Government of Gujarat has already sanctioned a grant of Rs. 3.5 crores (USD 780,000) to Shah-Schulman Center for Surface Science and Nanotechnology at DDU, Nadiad, Gujarat. In addition, DDU has sanctioned 3.5 crores for Faculty and Staff of SSCSSN. In addition Rs. 1.5 crores (USD 335,000) is provided by a consortium of 10 Companies in different technology sectors. There are 5 core faculty and staff, 6 associate faculty and 7 research scholars.

### Infrastructure:

- The Center has "state of the art" Instrumentation Facility which houses about 20 highly sophisticated Instruments.
- Sophisticated instruments are available under single roof at SSCSSN obtained from a grant of Rs. 3.5 Crores from Industry and Mines Department, Government of Gujarat.
- The SSCSSN research facilities meet the needs of scientists and research personnel engaged in multidisciplinary research using Surface Science and Nanotechnology approach.
- Sophisticated instruments for characterization are vital for pursuing research in many areas of modern science and technology.
- These Instruments shall provide the characterization facilities to research personals in general and especially from those Institutions and Industries who do not have access to such instruments, to enable them to pursue R&D activities.
- The SSCSSN also conducts Short Term Training Program (STP) in various areas of Surface Science and Nanotechnology as well as Surface and Bulk Characterizations techniques.
- SSCSSN Laboratories provides characterization services to Industries and Academia in India as well as abroad.

**Research Areas and Activities:** The SSCSSN's Core Expertise is in following Areas of Research:

- Surface Science & Nanotechnology
- Nano Particle Formation & Catalysis
- Heterogeneous, Micellar & Photo catalysis
- Molecular Thin-films and Monolayers
- Surface Modifications and Coatings
- Surfactants and Microemulsions
- Textiles, Fibers Nanotechnology
- Polymeric Materials and dispersions
- Green Chemistry & Environmentally Renewable Bio-Nano technology
- Drug Delivery & Pharmaceutical Applications of nano-materials
- Materials Science

**Current Research Interests Include:**

Monomolecular Films, Foams, Wettability and Contact Angle, Microemulsions, Liquid Crystals enhanced Oil Recovery, Combustion of Coal, Dispersions in Oils, Aqueous Media Surfactant-Polymer Interactions, Lubrication and Surface Phenomena in Magnetic Media, Preparation of Nano-Particles using Microemulsions, Synthesis of ordered mesoporous materials using template sol-gel method.

Synthesis of silica supported catalysts for various organic transformations, enhanced filtration of viruses and nano-particles by surface modification of filters, enzymatic reactions in micellar microemulsions and liquid-crystalline systems, surface phenomena in membranes, lungs, vision, transdermal drug delivery and anesthesia, nano particles for detoxification of blood Nanomedicine.

**Activities of the Centre:**

- To undertake Research on basic and Applied Surface Science and Nanotechnology
- Collaborative Research Programs with Industries and Universities
- Research & Development Projects for Industries
- Organize short courses, workshops, symposia and training programs
- Collaboration with overseas Research Institutes

**Networking and Collaborations:** The center works on specific research and development projects from industries on a contract basis. Some of the industrial collaborations are Asian Paints Limited, Alps Chemicals Pvt. Ltd, Colourtex Pvt. Ltd, Deepak Nitrite Limited, Galaxy Surfactants Ltd, Jasubhai Group of Industries, Sun Pharmaceutical industries Ltd, United Phosphorus Ltd, Universal Medi-Caps Ltd., Zydex Industries Ltd.

**Publications:** The center has developed 16 publications till date.

**Source/web link:** <http://www.ddu.ac.in/sscssn>

## 15. Center for Nano-Science and Technology-NIST

**Overview:** The Center, based at Berhampur, Orissa carries out basic and applied research in the interdisciplinary areas of Nanosciences and Technology. Its objective is to build a public technological platform and research base for Nanosciences and Nanotechnology. The focus of the Center is to create a dynamic teaching and research atmosphere that will promote interaction and synergies among the different groups of scientists working in the field of Nanoscience & Nanotechnology. The center provides opportunities for international exchange of scientists and students, and makes collaborative arrangements within India, particularly for those who are deprived of such facilities. It also conducts summer school programs and internship programs for graduate and post- graduate students to create awareness about recent developments in nanotechnology.

**Human and Financial Capital:** The center has 18 research scientists and it receives grants from various Govt. departments like DRDO, DST, DBT, AICTE, OREDA, RESPOND ISRO, CSIR and also from private sources for the sponsored projects.

**Infrastructure:** The center has all the facilities that will provide researchers to access advanced scientific equipments for characterization and preparation of nanomaterials for Nanotechnology applications.

### Facilities Available:

Nano particle Synthesis and Characterization:

- UV-Vis spectrophotometer
- Fluorimeter
- Vacuum Coating Unit
- Oxidation Unit
- Spin Coater
- Milipore
- Cyclic-voltameter
- Antenna Fabrication
- LCR Meter VNA
- Power meter

The center has immediate plans to acquire FTIR, Laser-Raman Spectrometer, XRD, AFM, particle analyzer and different monochromators.

**Research Areas and Activities:** The Center is focused on the following thrust areas of Nanomaterials research:

- Semiconductor and metal nanostructures, nanowires and carbon nanotubes
- Polymer Nanocomposites.
- Catalysis Nanosciences.
- Nanoelectronics.
- Modeling and simulation.
- Nano-sensors including biosensors, chemical sensors and temperature sensors.
- Solar fuel cells.
- Plasmonic solar cells and heterojunction solar cells,
- Core/shell nanocomposites

**Networking and Collaborations:** The Center has developed international collaborations through Memorandum of Understanding (MoU) and collaborations with national research institutes of India.

National Institute of Science and Technology, Berhampur has tied up with Institute of Atomic and Molecular Sciences Academia Sinica, Taipei, Taiwan (through MOU) and The University of Electrocommunications Chofu-shi, Tokyo, Japan (through MOU).

National Institute of Science and Technology, Berhampur has tied up with Indian Institute of Technology, Madras, Indian Institute of Technology, Guwahati, Institute of Physics, Bhubaneswar and Institute of Life Science -Bhubaneswar.

**Publications:** The center owns 37 publications since 2009.

**Source/web link:** <http://www.nist.edu/NanoScience/index.html>



## 3.7 SOCIAL SCIENCES AND HUMANITIES

### Sector Summary

Social science refers to the academic disciplines concerned with the society and the relationships of individuals within a society, which primarily rely on empirical approaches. It is commonly used as an umbrella term to refer to anthropology, economics, political science, psychology and sociology. In a wider sense, it may often include humanities such as archaeology, area studies, communication studies, cultural studies etc.<sup>78</sup> Indian Council of Social Science Research (ICSSR)<sup>79</sup> is the main research council established in the year of 1969 by the Government of India to promote social sciences research in India. It supports a network of 27 ICSSR research institutes, including: Institute for Social and Economic Change (ISEC), Bangalore Institute of Public Enterprise, Hyderabad Institute of Studies in Industrial Development, New Delhi Govind Ballabh Pant Social Science Institute, Allahabad Centre for Studies in Social Sciences, Centre for Policy Research (CPR), New Delhi.

Sixteen major Social Sciences universities and research institutes covered in this report include

1. Department of Humanities and Social Sciences (DoHSS) – IIT Madras
2. Department of Humanities
3. Humanities and Social Science Department – IIT Delhi
4. Department of Humanities and Social Sciences (DHSS) – IIT Kanpur
5. Dept of Humanities and Social Sciences (DHSS) – IIT Kharagpur
6. Department of Humanities and Social Sciences (DHSS) – IIT Roorkee
7. Department of Humanities and Social Sciences (DHSS) – IIT Guwahati
8. School of Humanities and Social Sciences (SHSS) – IIT Indore
9. Institute for Social and Economic Change (ISEC)
10. National Institute of Advanced Studies (NIAS)
11. Institute for Research in Social Sciences and Humanities (IRISH)
12. Center for Economic and Social Studies (CESS)
13. Centre for the Study of Developing Societies (CSDS)
14. Tata Institute of Social Sciences (TISS)
15. Institute of Social Sciences (ISS)
16. Centre for Policy Research (CPR)

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<sup>78</sup> [http://en.wikipedia.org/wiki/Social\\_science](http://en.wikipedia.org/wiki/Social_science)

<sup>79</sup> <http://www.icssr.org>

## 1. Department of Humanities and Social Sciences (DoHSS) – IIT Madras

**Overview:** Department of Humanities and Social Sciences has a vibrant research community. Founded in 1959 the Department of Humanities and Social Sciences is one of the oldest in IIT Madras. Department's essentially inter-disciplinary nature is its distinguishing factor. This allows students to develop an appreciation for a very diverse set of fields, including Development Studies, Economics, English Studies, Environmental Studies, History, International Relations, Philosophy, Political Science, and Sociology. Department's unique five year integrated programme, launched in 2006, leads to Master of Arts (M.A.) degree in three major streams - Development Studies, Economics and English Studies. DoHSS's Ph.D. admissions are carried out twice a year, in January and August.

**Experience:** The department has 54 years of experience in inter-disciplinary research and admits students with diverse educational qualifications to the Doctoral Programme. The dept offers both Master's and Doctoral programmes, as well as electives for B.Tech and M.Tech students.

**Human and Financial Capital:** There are around 45 institute faculties, 3 part time and 3 distinguished faculties with around 60 students.

Funding comes from various courses offered and through research projects sponsored by DST.

**Infrastructure:** DoHSS Multimedia Language Laboratory which was set up with DAAD (German Academic Exchange Services) funding is a self-access facility for students who wish to hone their language skills. A V Krishna Rao Library offers good collection of books, journals and publications in the areas of Humanities, Social Sciences, Management and related subjects, and Department Computer Facility is equipped with powerful software packages for statistical analysis, optimization and simulation apart from basic software programme and database development in different platforms and languages.

**Research Areas and Activities:** Internationally, IIT Madras was ranked #312 in the QS World University Rankings of 2012 and 45 in the QS Asian University Rankings of 2012. In India, among engineering colleges, it ranked 4 by India Today in 2012, 5 by Outlook India in 2012, and 2 by Dataquest in 2011. In the Mint Government Colleges survey of 2009 it was ranked 5.

Research topics for PhD programme encompasses fields as diverse as Agricultural Policy, Linguistics, German Studies, African / American / English / Indian Literature, Discourse Analysis, English Language Teaching, Economics, Health Care Policy, Philosophy, Sociology, Indian History and Theatre and Film Studies.

Some areas of research and teaching are:

- Cognitive aspects of language learning and multilingualism
- Sociolinguistics and English Language Teaching
- Healthcare Economics, History of Healthcare in South India and Environmental Health Policy
- Sociology of science and technology, technology transfer, Built Environment and Society
- Financial Economics, Health Economics, and application of quantitative tools for policy analysis
- Postcolonial historiography, Political history, Cultural Studies and Alternative Development
- Women's writing, literature in translation and creative writing

- Religion & Science, Technology & Rural Participation and History of Science
- Industrial Economics and Applied Macroeconomics
- Macro-Monetary Economics, International Economics and Health Policy

The Department has created a Centre for Comparative EU Studies (CCEUS). The Centre is funded by a research grant from the European Union under the India-EU Study Centre Programme. The Department of Sociology at Sussex University, United Kingdom is the EU partner for the project<sup>80</sup>. Two identified focus areas are further split into the following research tracks:

- Globalization and International Relations: (a) Questions of sovereignty as understood within the framework of regionalism in EU and South Asia. (b) Regional Security Architecture in EU and South Asia in the context of the emerging world order.
- Democracy and Development Studies: (a) Multiculturalism and minority politics: Case of EU and India. (b) Political Development in EU and India: A Comparative Analysis.

### **Networking and Collaborations:**

- Department of Sociology at Sussex University - United Kingdom, Centre for Research on Architectural Design (ROAD), National Tsing Hua University (NTHU) in Taiwan etc
- MoU has been signed with Nissan's R&D Centre in India titled the 'Nissan Support Program' an initiative aimed to support Research & Development Project at IIT-M in the area of Engineering, Science, Management, Humanities and Social Sciences, which will contribute to Automobile Sector in the future.

**Publications:** Dept of Humanities and Social Sciences has around 475 publications.

**Source/web link:** <http://www.hss.iitm.ac.in>

## 2. Department of Humanities and Social Sciences (DHSS) – IIT Bombay

**Overview:** Department of Humanities and Social Sciences was founded in 1958. The Department has five disciplines namely, Economics, English, Philosophy, Psychology and Sociology and a Cell for Indian Science & Technology in Sanskrit. Its faculty offers a wide spectrum of courses at the B.Tech, M.Tech, M.Phil. and Ph.D. levels. The Department of Humanities and Social Sciences plays a unique and distinctive role in an institute where the ethos of science and technology prevails. It is believed that engineering and science are by their very nature, humanistic and socially derived enterprises. Hence a complete science and technology education must include liberal arts, economics, social and behavioral sciences where the students unites application of scientific principles along with human, moral and social understanding.

**Experience:** The department has 56 years of experience in inter-disciplinary research and education. Since 1973, the Department has been running the Ph.D. programme in all the five disciplines with an emphasis on inter-disciplinary topics. At the Postgraduate level the Department launched a four semester inter-disciplinary M.Phil programme in Planning and Development in July 1993.

**Human and Financial Capital:** There are around 45 institute faculties with more than 60 students.

Funding comes from various courses offered and through research projects sponsored by DST, RBI, EU, Ford Foundation-USA, Tata Economic Services etc.

**Infrastructure:** Dept has infant language centre is the first of its kind in India focuses on early word learning and the strategies infants adopt to learn words. Dept Library is the main attractions are the disseratations of the M. Phil and Ph.D students. It can also boast of various old issues: The Economist, Economic and Political weekly, and the Times Literary supplement. Dept language lab has the Tandberg Educational system which offers a variety of functions such as Recording, High Speed Copying, Test Preparation, Intercom, Student Monitoring, Teacher/ Student Call, Group Conferencing etc.

### Research Areas and Activities:

Research topics include: Research Methods in Social Sciences, Managerial economics, Monetary economics, Applied Econometrics, Cost Benefit Analysis, Sociology of Social Stratification in India, Structure of language and its applications etc.

Some of the research projects are:

- Economics of Small Businesses in Developing Countries, National Entrepreneurship Network.
- Start-up Dynamics of IIT Bombay Incubating Companies.
- Trade, Industry and Anti-Dumping: A Comparative Study of India, US and the EU, for UNCTAD, New Delhi.
- Globalisation, ICT and Industrial Restructuring in India, with financial support from IIT Bombay.
- Inflation in India: Nature and Causes A Study
- Co-investigator on BASIC Project (Building & Strengthening Institutional Capacity on



- Climate Change)
- "Gender dimensions in technology adoption, and build up of social capital"
  - Co-investigator in Project on "Needs Assessment and Socio-economic feasibility of rural technologies"

**Networking and Collaborations:** Some of the collaborations are: Institute of Development Studies, Sussex; Australian National University; ICRISAT; Consultative Group on International Agricultural Research (CGIAR) etc.

**Publications:** Dept of Humanities and Social Sciences has around 300 publications published under different faculties of the dept.

**Source/web link:** <http://www.hss.iitb.ac.in>

### 3. Humanities and Social Science Department – IIT Delhi

**Overview:** Department currently offers courses in five subjects: Economics, English Literature and Linguistics, Philosophy, Psychology and Sociology. Whatever their individual branches of scholarship, it is the concern of all faculty teaching in these areas to continue to meet and to extend the intellectual challenges projected in the charter of the IITs.

**Experience:** The department has 54 years of experience in inter-disciplinary research and education. Department of Humanities and Social Sciences in IIT Delhi offers the following teaching programmes such as PhD and undergraduates. PhD course offers: Social Psychology, Social Research Methods, Sociology of India, Philosophy of Social Sciences, Sociology of Science, International Economics etc. Undergraduates such as: Introduction to Economics, Microeconomics, Macroeconomics, Econometric Methods, Personality and Society, Sociology: The Science of Praxis etc.

**Human and Financial Capital:** There are around 40 institute faculties with more than 60 undergraduates and post graduates students.

Funding comes from various courses offered and through research projects sponsored by DST, International Development Research Centre, Canada; Institute for the Future, USA; Industrial Research & Development, IIT Delhi; H.P India.

**Research Areas and Activities:** Original contributions to research and to ongoing debates in ethics, cultural anthropology, critical theory, cognition, ideology, development policy, organizational behavior and economic activity, environmental and gender studies, the history of science and technology, the philosophy of culture, and indeed to the nature of theory itself are crucial within a Department like HSS.

Some of the research projects are:

- Center-for-global or Local-for-global an examination of FDI in R&D Centers of IT MNEs in India
- ICT's and Urban Micro-enterprises: Identifying and Opportunities for Economic Development
- Psychological Tests on Positive Psychological Constructs
- Language, Emotion and Culture
- Ethnographic Study of Changing Behavior and Attitudes in the Domains of Security, Local Communities, Intimacy and Entrepreneurship
- Cosmopolitanism and Locality along India's Western Coast: Maritime Histories from Kachch, Gujarat
- A Survey of the Public Distribution System in Indian States

**Networking and Collaborations:** Some of the collaborations are: Jawaharlal Nehru University, IIT Bombay, IIT Roorkee, Aston University, Imperial College, American Psychological Association, Association for Psychological Science, International Association of Cross-cultural Psychology, International Society for Justice Research etc.

**Publications:** Dept of Humanities and Social Sciences has around 100 publications.

**Source/web link:** <http://hss.iitd.ac.in>

## 4. Department of Humanities and Social Sciences (DHSS) – IIT Kanpur

**Overview:** Humanities and Social Sciences is one of the academic departments of IIT Kanpur. It is multi-disciplinary and consists of six disciplines: Economics, English Literature and Linguistics, Fine Arts, Philosophy, Psychology, and Sociology. The Department offers undergraduate courses to engineering and science students. These were first introduced in the curriculum in July 1963.

**Experience:** The department has 51 years of experience in inter-disciplinary research and education. M.Sc. Economics Program is guided. The Ph.D. programme was started in 1964 is offered in the following disciplines: Economics, English Literature and Linguistics, Philosophy, Psychology, and Sociology.

**Human and Financial Capital:** Around 31 faculties are present in HSS- IIT Kanpur. There are currently 41 PhD students in the programme and 50 M.Sc. students.

Funding comes from various courses offered and through research projects sponsored by WIZMIN Management Consultants, Ministry of Rural Development, ICSSR, Media Lab-Asia in collaboration with the Media Lab- MIT-USA, Artificial Limb Manufacturing Corporation, MHRD, SIEMAT etc.

**Infrastructure:** Art and Design Studio: The studio is a hub of art and interdisciplinary studio activity. It provides facilities for drawing and painting classes, surface painting, printmaking. New Language Lab: The New Language Laboratory installed with the state-of-the-art Robotel New SmartClass Digital technology. It provides an advanced language laboratory teaching/learning experience. Psychology lab: The psychology laboratory offers adequate facilities for conducting experimental research in perception, memory, psychomotor and intellectual abilities, personality, and group dynamics. Other Facilities/ Computer Lab and Library: The department has access to several computer software, such as SAS, SPSS, and MATLAB.

**Research Areas and Activities:** Internationally, IIT Kanpur has been ranked 295<sup>th</sup> in the QS World University Rankings of 2013, and 51<sup>st</sup> in the QS Asian University Rankings of 2013.

**Economics:** The teaching and research interests of the Economics are diverse: Microeconomics, Macro-Money, Industrial Organization, Regional Economics, Environmental Economics, Development Economics, Law and Economics, Transport Economics, Econometrics, Input-Output Analysis, and Project Economics.

**Philosophy:** The Philosophy Discipline has contributed significantly in the areas of Moral Philosophy, Philosophy of Logic and Language, and Phenomenology.

**Psychology:** The Psychology discipline has been able to create substantial impact through teaching, research, projects, and consultancy. The discipline is active in the areas of Social Psychology.

**Sociology:** The discipline of sociology offers undergraduate courses for students of engineering, science and social science and runs a Ph.D. programme in sociology.

Some of the research projects are:

- Mapping of HRGs in Bihar: Estimation of FSWs, MSM and IDUs for all the districts of Bihar
- Planning for Rural Youths, a Project of Banwasi Seva Ashram, Sonbhadra, in Selected Districts of Uttar Pradesh, under Yuva Samvad Sangoshthi
- Subjective Analysis of Facial Expressions: Inputs from Behavioural Research for Automated Systems
- District Level Monitoring of Total Sanitation Programme in Haryana
- Situation Analysis of Girls' Education in Jhabua District
- Innovative Stream for Rural Housing and Habitat Development in India

Few research papers are:

- Economic Growth and Convergence in Selected South Asian and East Asian Economies: A Data Envelopment Analysis
- Global Economic Trends and South Asia
- Perspective of Economic Growth and Convergence in Selected South Asian and East Asian Economies

**Networking and Collaborations:** Joint Call for proposal Saint-Gobain – Cefipra; ANR-DST Joint Call for funding Indo-French Research Projects; India-Taiwan Programme of Cooperation in Science & Technology Project, Akashi National College of Technology - Japan, Deakin University.

**Publications:** Dept of Humanities and Social Sciences has around 75 publications.

**Source/web link:** <http://www.iitk.ac.in/hss>

## 5. Department of Humanities and Social Sciences (DHSS) – IIT Kharagpur

**Overview:** The Department started with the very inception of IIT Kharagpur in 1951. Its objective was to provide value-based liberal education to budding scientists and engineers so that they can become professionals with a difference to understand the social realities, the human beings, and work with them effectively. The Department teaches communication skills to all the undergraduate students and technical writing skills to all the research and doctoral students. The undergraduate and post-graduate students acquire knowledge and skills in one or more subjects of humanities and social sciences as depth and/or breadth subjects. The Department takes up projects from public and private agencies to address the challenges they face and provides solutions. In keeping with its multidisciplinary character, it carries out research in diverse and emerging areas of human interest and social concern.

**Experience:** DHSS has around 62 years of experience in teaching, research, training, outreach activities, and runs its own masters programmes.

**Human and Financial Capital:** There are around 15 faculties and 30 students in the institute. Funding comes from various courses offered such as M.Sc Economics, MHRM, PhD and through several projects sponsored by Rubber Research Institute of India, UNDP - New Delhi, ICAR, Indo-Canadian Shastri Institute, Indian Council of Social Sciences Research (ICSSR), Defence Institute of Psychological Research, Swedish Research Council, National Oilseeds and Vegetable Oils Development (NOVOD) Board, Central Sahitya Akademia, MOEF, World Bank etc.

**Infrastructure:** The Dept has library with more than 1000 books related to humanities and social sciences, and has laboratory facilities.

**Research Areas and Activities:** Some of the research areas of the dept are: Human Resource Management and Development; Social Sector Development, International Finance, Agricultural Economics, Labour Market Dynamics; Communication Studies and skills; Translation; Postmodernism; Culture Studies; Postcolonial Literatures and Theory; Media Studies; Economics of Biofuels; Philosophy of Mind; Bioethics; Business Ethics; Logic and philosophy of Logic; Indian English Literature and Environment and Natural Resource Economics.

Some of the sponsored and consultancy research projects of the dept are:

- Appraisal of Process and Procedures of NREGA
- Comprehensive Socio-Economic Survey of Pakri-Barwadih Coal Mining Project
- English translation of Sakshra Dariya Savira Hejje, as a Million Steps of Literacy Mission
- Setting up of the Indian Institute of Corporate Affairs
- Design of Course for Group Discussion and Personal Interview (GDPI)

**Networking and Collaborations:** Some of the collaborations of the institute are: NTPC, Centre for Economic and Social Studies -Hyderabad, Ministry of Rural Development, National Literacy Mission, Birla Foundation and Ministry of Corporate Affairs etc.

**Publications:** There are around 400 publications of the dept.

**Source/web link:** <http://www.hss.iitkgp.ernet.in>

## 6. Department of Humanities and Social Sciences (DHSS) – IIT Roorkee

**Overview:** Department of Humanities and Social Sciences was established in 1966 for teaching English and Social Sciences to engineering students. Dept. attempts to integrate human values and social concerns with technical education. It undertakes teaching and research programmes in the areas of English, Economics, Psychology, Philosophy, Sociology, IPR, Fine Arts and related interdisciplinary subjects over the years, it has grown into a full-fledged and dynamic department, teaching core and elective subjects across B.Tech, B.Arch, M.Tech, MBA and MCA classes.

**Experience:** The department has 48 years of experience in inter-disciplinary research and education. Dept has grown into a vibrant department with teaching and research programmes encompassing almost all the departments of the institute with its core, elective, and Pre-Ph.D. papers. There are, evening courses in German and French languages.

**Human and Financial Capital:** Around 15 faculties are present in HSS- IIT Roorkee. There are currently 50 students.

Funding comes from various courses offered and through research projects sponsored by MHRD, SIEMAT, AICTE, NIRD-Hyderabad, PRC- Institute of Economic Growth etc.

**Research Areas and Activities:** Internationally, IIT Roorkee was ranked 401–450 in general category and 194 in Engineering and Technology in the QS World University Rankings of 2011 and 65 in the QS Asian University Rankings of 2012.

Research courses include: Research Methods in Psychology, Communication Skills etc.

Some of the research projects are:

- Under Decentralized Framework Efficiency and Productivity of Sugar Mills Application of Non-Parametric Models
- Management of Rural Development Under Decentralized Framework
- Growing Rural-Urban Disparity in U.P.
- Son Preference and Gender Bias in Demographic Behaviour: A Report on Jharkhand
- Human Values and the Technological World Order

**Networking and Collaborations:** Some of the collaborations are: BHU, Varanasi; Institute for Human Development and Giri Institute of Development Studies, Lucknow; Jadavpur University; Giri Institute of Development Studies - Lucknow; GB Pant Social Science Institute Allahabad; Indian Council of Philosophical Research; Univ. of Western Ontario etc.

**Publications:** Dept of Humanities and Social Sciences has more than 250 publications.

**Source/web link:** <http://www.iitr.ac.in/departments/HS/pages/index.html>

## 7. Department of Humanities and Social Sciences (DHSS) – IIT Guwahati

**Overview:** Department of Humanities and Social Sciences, IIT Guwahati is multidisciplinary in its orientation and has expertise in eight disciplines: Economics, English, Linguistics, Philosophy, Psychology, Sociology, History & Archeology and Political Science. Apart from its undergraduate programme, which includes highly innovative syllabi, it aims to cover the inter-disciplinary areas in its MA and PhD programmes. The MA Programme in Development Studies is a multi-disciplinary programme and was initiated in the year 2009. The programme is designed to provide an understanding of various perspectives of development issues, through rigorous course works and guided research. The perspectives are drawn from different disciplines of the Humanities and Social Sciences.

**Experience:** The department good experience in inter-disciplinary research and education.

**Human and Financial Capital:** There are around 30 faculties are present in HSS- IIT Guwahati. There are around 30 research scholars, 30 M.A. students.

Funding comes from various courses offered and through research projects sponsored by Maulana Abul Kalam Azad Institute of Asian Studies; AICTE; National Informatics Centre, Ministry of Communications and Information Technology; Swedish Research Council, ICSSR, ESRC-UK etc.

**Research Areas and Activities:** Internationally, IIT Guwahati was ranked 551–600 in the QS World University Rankings of 2011 and 89 in the QS Asian University Rankings of 2012.

Some of the research projects are:

- Situation of the Internally Displaced Persons in Assam and their Rehabilitation by Government
- Cultural Theory and Practice
- Community Information Centres in Assam: Achievements and Expectations
- Gender and Enterprise in South Asia
- Lecture Notes on Language and Communication
- Developing a Measure for Inequitable Household Access to Water in Urban India

**Networking and Collaborations:** Some of the collaborations are: Indian Council of Social Science Research, Indian Council of Historical Research, IIT Bombay and IIT Roorkee etc.

**Publications:** Dept of Humanities and Social Sciences has around 250 publications.

**Source/web link:** <http://www.iitk.ac.in/hss>

## 8. School of Humanities and Social Sciences (SHSS) – IIT Indore

**Overview:** The School of Humanities and Social Sciences in its present outline includes the disciplines of Economics, English Literature, Philosophy and Psychological Science; and Sociology is expected to be added in the near future. The School's primary focus is research and all the disciplines have Graduate programs. The areas of concern range from issues pertaining to food security and climate change to error intrusion in human machine interface and from narratology and story design to the idea of resistance and change as epistemic occasion.

**Experience:** The department has good experience in inter-disciplinary research and education.

**Human and Financial Capital:** There are around 10 faculties in HSS- IIT Indore. The school as a research-intensive establishment currently offers doctoral program. There are around 10-12 students pursuing PhD. Funding comes from various courses offered and through research projects sponsored by AICTE; Ministry of Science and Technology.

**Research Areas and Activities:** IIT Indore is considered as among top 5 colleges in Madhya Pradesh.

Focused research includes:

- a. **Human Factors:** Human factors (or ergonomics) relates to the interaction of humans and technical systems. The field of human factors engineering dissects tasks and considers each component in relation to a number of factors specifically focused upon interactions among various components.
- b. **Rural Technology and Development Studies Group:** The group in its nascent frame is aiming towards contributing positively and directly to rural development by undertaking projects on
  - Strengthening rural institutions for development.
  - Technology transfer and mutual exchange on local solutions to local problems and
  - Undertaking policy and evaluation based research for creating effective interactions on different platforms.
- c. **Sustainable Policy Group:** This is a School of HSS initiative looking forward to providing an active podium for researchers, policy makers, action research workers, government and non-governmental forums to discuss and present their views on raising sustainability issues and solutions thereupon, particularly in the areas of
  - energy
  - climatic vulnerability,
  - threats due to inappropriate waste disposals
  - water rights

**Networking and Collaborations:** Some of the collaborations are: Banaras Hindu University, Delhi University, IIT Bombay, IIT Madras, IIT Mandi and IIT Roorkee.

**Publications:** School of Humanities and Social Sciences has around 115 publications.

**Source/web link:** <http://hss.iiti.ac.in/index.html>



## 9. Institute for Social and Economic Change (ISEC)

**Overview:** ISEC is a social science research institute in Bangalore, India. Founded in 1972, it is the largest among the 27 institutions supported by Indian Council of Social Science Research (ICSSR). ISEC is one of the three major institutions established by Prof. V. K. R. V. Rao, along with the Delhi School of Economics and the Institute of Economic Growth, Delhi. ISEC is registered as a Society under the Karnataka Societies Registration Act, 1960, to create a blend of field-oriented empirical research and advances in social science theories leading to better public policy formulation. The thrust of the institute is to integrate the social science research skills in initiating, complementing, participating and furthering the social, economic and political changes of the societies with an emphasis on equity and justice. ISEC's concern for the social and economic welfare of the poor and disadvantaged groups reflects strongly in the large number of studies it has undertaken to understand the various dimensions of poverty and human development.

**Experience:** ISEC has 41 years of experience in social science research and has developed some very prestigious and valuable research linkages.

**Human and Financial Capital:** ISEC has a well qualified faculty of 45 from different areas of social and life sciences with 13 administrative staff and nearly 250 students.

ISEC receives annual grant-in-aid from Government of India (Ministry of Human Resources Development through ICSSR and Ministries of Agriculture and Health and Family Welfare), Government of Karnataka (Departments of Education and Finance) and Reserve Bank of India (RBI). The Institute also receives grants for specific research assignments from various Indian, international and bilateral agencies.

**Infrastructure:** ISEC has the state of art infrastructure that includes one of the best libraries, Data Bank, Digital Sources of Information, Excellent Seminar halls. V.K.R.V. Rao Library at ISEC has an impressive collection of two lakh titles, 400 microfiche copies of periodicals, official and non-official documents and back volumes of professional journals and periodicals.

### Research Areas and Activities:

- Agricultural Economy in the context of WTO and Globalization – Implications and imperatives. Decision-making at Micro and Macro-level in Agricultural and horticultural Production and Processing sectors
- Understanding the Growth Process at the State level: Study of Investment in industry. Review of Studies and Developing a Framework for Modeling of the Service Sectors.
- Bio-diversity at village and taluk levels and related implications; Livestock and environment interactions
- Universalisation of primary education: Challenges, dynamics and prospects; Planning and management of school education - Issues & Concerns; Promotion of equity and justice in school participation and utilisation of facilities
- Role of rural local organisations in social sector development; Natural resource management and basic services. Theory of collective action and functions of local organisations
- Challenges and Potentials to Collective Action and Life in a Globalising City; Backward Castes; Dalits and Women in a Rapidly Changing Society; Society Politics and Decentralised Governance.

- Governance (including Democracy, Decentralisation and Ethics) and Development. Development Politics and Development Administration.
- Reproductive Child Health (RCH); District Level Rapid Household Surveys under RCH project in Karnataka, Kerala and Goa; Maternal Mortality at district level for RCH programmes

Some of the research ongoing projects are:

- Study of Tanks in Watershed Development Area in Karnataka
- Determinants of Stagnation in Productivity of Important Crops in Karnataka
- Evaluation of Housing Schemes Implemented by Rajiv Gandhi Rural Housing Corporation (RGRHC)
- New Economic Context and Changing Migration Patterns in India
- Comprehensive District Development Plan (CDDP)
- Forest Resources and Economic Growth: An Enquiry into the Growth Linkages of Forest Cover in Indian States
- Institutional Structure and Performance of Agriculture in North East India
- Socio-Economic Analysis of Increasing Resilience of Coffee Production to LRD

**Networking and Collaborations:** Some of the collaborations are with: NORDIC Centre, Netherlands, Maastricht University, World Bank, Asian Development Bank, UNFPA, UNDP, USAID, European Commission, The Swedish C-Dot, DANIDA and Ford Foundation, Department of Anthropology -Kannur University (Kerala), Kerala Institute of Research and Training and Development, Studies of Scheduled Castes and Scheduled Tribes, Bangalore University, MOEF, BARC, University of Oxford and the London School of Economics, UK, GTZ, Germany; ADA, Luxembourg; and BRS, Belgium, University of Southampton and CEDEPLAR, Federal University of Minas Gerais, Brazil, Institute for Applied System Analysis (IIASA), Austria, Centre for Economic and Social Studies (CESS) Hyderabad, TIFAC - New Delhi, University of Warsaw and FKCCI.

**Publications:** There are around 440 publications including books, journals, monographs, working papers published etc.

**Source/web link:** <http://www.isec.ac.in>

## 10. National Institute of Advanced Studies (NIAS)

**Overview:** National Institute of Advanced Studies (NIAS) was conceived and established by the vision and initiative of the late Mr. J. R. D. Tata. NIAS is a research institute in India. NIAS is a private society registered on 20 June 1988 under the Karnataka Societies Registration Regulation Act. The objective of the NIAS has been to nurture a broad base of scholars, managers and leaders who may contribute effectively to tackling the complex problems facing contemporary India with intelligence, sensitivity, confidence and dedication. NIAS is one of the unique institutions in the country conducting research in multidisciplinary areas.

**Experience:** NIAS has 25 years of experience in conducting research in multidisciplinary areas and is unique in its integrated approach to the study of intersections between science and technology, social issues and leadership.

**Human and Financial Capital:** NIAS has around 30 faculties and 15 staff with around 100 students.

Funding comes from various educational courses and through research projects sponsored by World bank, Spencer Foundation (Chicago), Govt. of Karnataka, Sir Ratan Tata Trust (Mumbai) etc.

**Research Areas and Activities:** Researches are conducted in the following specific areas: Education, National security, strategic ideas, Animal behavior ecology, cognitive ethology, conservative biology, Energy and environment, Urban studies, Sociology/Social anthropology, Indian psychology and philosophy, consciousness studies, Cognitive science, Bio-security, Agro ecology, Art and archaeology, Materials heritage, Philosophy of Science.

Research studies conducted by the faculty of the Institute are disseminated through publications in peer-reviewed journals, edited volumes, books, Institute's reports, and lectures & technical seminars.

- School of Humanities: is engaged in research in the broad areas of philosophy, psychology, literature, fine arts, and culture. Research in the School currently focuses on philosophical foundations of sciences; cognitive sciences; scientific and philosophical studies of consciousness; Indian psychology and philosophy; history and philosophy of biology.
- School of Social Sciences: is engaged in activities that include research, teaching, outreach, advocacy and consultancy. The faculties are drawn from sociology and social anthropology, gender studies, educational studies, economics, and energy studies, and have conducted several research-cum-outreach projects in the fields of education, gender, governance and development. Current areas of interest are in forging inter-disciplinary work to understand and address issues in the areas of water, energy, and education.
- School of Natural Sciences and Engineering: covers research in the fields of engineering, mathematics, agriculture, ecology and conservation biology. Current research interests include various aspects of signal processing; number theory; artificial intelligence; soft computing; language engineering; mathematical modelling of complex chaotic systems; studies on agro-ecology; natural resource conservation, particularly soil and water conservation; pesticide stewardship; conservation of wildlife; primate behaviour and cognition.

- International Strategic & Security Studies Programme, was started at NIAS in 1996 with the broad objective of conducting academic and policy research related to national and international security issues.

**Networking and Collaborations:** Some of the collaborations of NIAS are: Tata Institute of Fundamental Research, IISc, Exeter University, Kerala Council for Historical Research, Oxford Research Laboratory for History of Art and Archaeology, Archaeological Survey of India, RRI - Bangalore, IIT-B, University of Hyderabad, University of Amsterdam, British Museum, University of Chicago, Tokyo University of Arts, Toyoma University, University of Michigan and University of Chicago, USA.

Collaborative Research Programme is undertaken in Archaeology & Drama between NIAS & Exeter University-UK. NIAS and the University of Exeter - UK were awarded funding for two projects, (under the British Council funded UKIERI-II open competition funding scheme).

**Publications:** There are around 255 publications of the institute.

**Source/web link:** <http://www.nias.res.in>

## 11. Institute for Research in Social Sciences and Humanities (IRISH)

**Overview:** IRISH was founded by Professor K.S. Mathew and was formally inaugurated in 2002. It was recognized as a research centre by the Kannur University in 2004 for History, Economics and Malayalam. IRISH is the research wing of the Malabar Education Society for Human Resource Development and Research (MESHAR) registered under the Government of India Act. It has been recognized by Kannur University, Indira Gandhi National Open University (New Delhi) and the Central University of Kerala (Kasergode). IRISH has also a regular study centre of IGNOU for undergraduate and post-graduate studies under the distance education mode.

**Experience:** IRISH has 11 years of experience in education and research and collectively takes up research projects from various governmental and non-governmental agencies and affiliates to individual researchers for Post doctoral Research programmes. IRISH conducts international, national and regional seminars from time to time and publishes the proceedings.

**Human and Financial Capital:** There are nearly 25 research scholars. Regular Study Centre of IGNOU attached to IRISH has over 500 students doing different undergraduate, post-graduate and diploma courses in distance mode. IRISH receives funding from various research projects and through various courses. IRISH gets publication grants from governmental and non-governmental agencies.

**Infrastructure:** IRISH has library with 3000 books donated by Professor Dr. K. S. Mathew, the founder director of IRISH and a number of other books. It has Multi-lingual language lab for learning languages like English, Dutch, German and Portuguese.

**Research Areas and Activities:** A large number of Research Scholars are affiliated to IRISH. As of now, three research scholars attached to IRISH have been awarded Doctoral degrees in History by the Kannur University. Some of the Ph.D. scholars were awarded research fellowships by the Indian Council of Historical research while others were given fellowships from Kannur University, Scheduled Caste Welfare Department, Govt. of Kerala, and the UGC. Some of the research projects of IRISH are:

- Decolonization of the Portuguese Pockets in India and the Indian National Leaders
- Economy and Society in Malabar and the Portuguese
- French Settlements in south India: Social and Cultural Changes
- Regressive Effects of Tribal Poverty and Hidden Hunger – Need for an Effective Strategy
- Human Development and Economic Growth: A Study with respect to Kerala
- Education in Colonial and Post Colonial Malabar: A Socio-Economic Study
- Ship Building and Navigation on the Western Coast of India with Special Reference to the Malabar Coast during the Sixteenth and Seventeenth Centuries
- Time as an Economic resource: Valuation and Use pattern in Households at various Stages of Development.

**Networking and Collaborations:** Some of the collaborations are: Indian Council of Historical Research -New Delhi, University Grants Commission, Indian Council of Social Science Research, Maulana Abdul Kalam Azad Institute- Kolkata, Nirmalagiri College, St.Thomas College, St. Mary's Malankara Major Seminary etc.

**Publications:** There are around 55 publications of the institute.

**Source/web link:** <http://irish-meshar.org>

## 12. Centre for Economic and Social Studies (CESS)

**Overview:** Centre for Economic and Social Studies (CESS) is an Indian autonomous research institute, established in 1980 to facilitate research activity in Economics and Social Sciences. It was a brain child of B.P.R. Vithal, a former Principal Secretary to Government of Andhra Pradesh, Finance and Planning Department. The campus is situated at Begumpet, in Hyderabad. The Centre has evolved a unique teaching–cum–research training programme leading to M.Phil and Ph.D in development Studies.

**Experience:** CESS has 33 years of experience in research activity in Economics and Social Sciences.

**Human and Financial Capital:** The Centre has so far admitted 14 batches of Ph.D scholars. Twenty-five Scholars have been awarded the Ph.D degree. The Centre has till now admitted 19 batches of M.Phil students. So far 90 scholars completed their dissertations under the supervision of the faculty and were awarded the M.Phil degrees.

CESS has been receiving maintenance grants from the State Government and the ICSSR and project –specific grants/consultancies from the state government, central government, Planning Commission, Asian Development Bank, World Bank, IRC, Netherlands, TATA Trust, UNICEF, Ford Foundation, European Union and other International Organizations.

**Infrastructure:** The Centre’s library has a total collection of over 30,000 books and other volumes. It receives about 150 plus Indian and foreign periodicals. The library has a collection of 2737 bounded volumes of journals. The Center is equipped with advanced computer system and networking facilities and Video Conferencing Equipment. The Cartography Cell attached to the Center, completed several cartographic studies, viz. “Spatial Framework for Planning and Development Administration”, “Godavari Valley Development Plan etc.

**Research Areas and Activities:** Some of the sponsored and consultancy research projects of CESS are:

- Indigenous Environmental Knowledge and Sustainable Development: A case of Konda Reddy Tribe in AP
- Endline Surveys of Children in Difficult Circumstances (CIDC) of Universal Birth registration (UBR) Programme
- National Rural Employment Guarantee Scheme (NREGS) in Andhra Pradesh
- SHIVA Project: Socio Economic analysis of farming systems and farmers vulnerability impact in watersheds of south India
- A Study on Livelihoods and Livestock in the Forest based Communities of Andhra Pradesh
- Livelihood Linkages and Tradeoffs in the Downstream Flood Plains of River Basins. A Study of Kole Lands in Trissur.
- Costs of Providing Sustainable Water, Sanitation and Hygiene service in Rural and Peri Urban India
- Non Pesticide Management of Pests: An Empirical Analysis
- Soil Fertility Management in Semi Arid India: the Livelihood, Socio–cultural, Economic and Ecological Dimensions of Farmers Practices

Some recent research publications of CESS are:

- Political Economy of Watershed Management
- Biotechnology in Indian Agriculture: Potential, Performance and Concerns
- Water Security and Management: Ecological Imperative and Policy Options
- India Perspectives on Equitable Development
- Human Development in Andhra Pradesh: Experiences – Issues and Challenges

### **Networking and Collaborations:**

- CESS is conducting M.Phil. and Ph.D. Programmes in Development Studies in specific areas of Economics, Commerce, Development Statistics, Political Science & Public Administration, Sociology and Geography in collaboration with Dr. B.R. Ambedkar Open University (Andhra Pradesh Open University), Hyderabad.
- CESS has conducted fieldwork and data processing of the Savings and 'Credit Cooperative Society (SACCO) Sustainability Study in collaboration with Oxford Policy Management (OPM)
- CESS has conducted "Baseline and a Sector Data Base for the Reinforcement of the Planning, Monitoring and Evaluation within Ministry of Infrastructure in the framework of Economic Development and Poverty Reduction Strategy " survey in collaboration with ADA Consultants, a Canadian company

**Publications:** There are around 217 publications of the institute.

**Source/web link:** <http://www.cess.ac.in>

## 13. Centre for the Study of Developing Societies (CSDS)

**Overview:** Centre for the Study of Developing Societies (CSDS) is an Indian social science and humanities research institute. It was founded in 1963 by Rajni Kothari and is largely funded by the Indian Council of Social Science Research (ICSSR). It is located in New Delhi. The Centre provides a unique institutional space which seeks to nurture intellectual interests outside the entrenched boundaries of academic disciplines. This simultaneously gives the Centre a sense of intimacy with and distance from universities. Therefore, the Centre has deliberately chosen not to duplicate the structure of university department. This also allows the Centre to support and nurture interdisciplinary modes of enquiry. Over the years, the Centre has also managed to generate and utilize a productive tension between rigorous scholarly work and social movements, between academic commitment and political practices.

**Experience:** CSDS has nearly 50 years of experience in new types of research in survey work and ethnographic methods and addresses new publics—from educationists to students—through media and legal practitioners, policymakers, and civil society agencies.

**Human and Financial Capital:** CSDS has around 20 faculties, 5 visiting fellows with 25 PhD students, internship students and others.

CSDS is largely funded by the Indian Council of Social Science Research (ICSSR) under the Ministry of Human Resource Development. It received a major endowment from the Ford Foundation in 2000 and a four-year grant from the International Development Research Centre (IDRC), Canada in 2010.

**Infrastructure:** Library at CSDS has collection consists of about 29,000 books and 5,000 bound volumes of journals and a modest set of reports and booklets. More than 130 journals are received regularly. CSDS Data Unit, established in 1965, maintains an archive of social scientific survey data on political behaviour and attitudes, spanning over four decades. The Data Unit also holds a number of secondary data sets, especially on elections in India.

**Research Areas and Activities:** Ongoing research programmes in CSDS include:

- Lokniti Programme for Comparative Democracy: It houses a cluster of research initiatives that seeks to engage with national and global debates on democratic politics by initiating empirically grounded yet theoretically oriented studies.
- The Sarai Programme: has arguably been South Asia's most prominent and productive platform for research and reflection on the transformation of urban space and contemporary realities, especially with regard to the interface between cities, information, society, technology, and culture.
- Programme in Social and Political Theory: is concerned with theorizing the complex present and the wide range of new experiences it throws up as these seem to reveal the limitations of many of our received theories and theoretical categories.
- Indian Language Programme: Indian Languages Programme (ILP) started in 2001 and over the years it has emerged as a distinct locus of activity with a number of books and publications to its credit. ILP has been engaged in thinking about the entire question of social sciences and what it might mean to 'do social sciences in Indian languages'.



Research Themes studied at the institute include: Culture, Information, Media; Ethnographies of the Present; Social and Political Thought; Developmental Paradigms and Practices; Democratic Politics and its Futures; Indian Languages and Social Sciences; Diversity, Identity, Violence.

**New research initiatives include:**

**Law and Society:** The crossover between studies of legal concepts and those focused on the social life of law has allowed for several cross-disciplinary engagements such as research on political modernity and the project of law, the relationship of the legal to non-legal and the paralegal; law and community formations in India.

**Publics and Policies:** The aim of the Publics and Policies initiative is making the Centre's engagement with the public and policy spheres more relevant and deliberative by reinforcing its legacy of public intellectual interventions.

CSDS has participated in the following European Commission FP7 projects.

Project Acronym	Project title	Challenge area
AEGIS	Advancing knowledge-intensive entrepreneurship and innovation for growth and social well-being in Europe	SSH-2007-1.1-01 Interactions between knowledge, economic growth and social well-being
INGINEUS	Impact of networks, globalisation, and their interaction with EU strategies	SSH-2007-1.2-01 Globalisation and its interaction with the European economy

**Networking and Collaborations:** Some of the collaborations of the institute are: World Future Studies Federation, United Nations University (UNU), World Institute for Development Economic Research (Helsinki), the International Network on Cultural Alternatives to Development (Montreal), Sustainable Development Policy Institute (Islamabad), the International Centre for Ethnic Studies (Colombo), the Bangladesh Study Group in Alternatives (Dhaka), South Asia Dialogues on Ecological Democracy (SADED), and Meigaku University.

**Publications:** There are around 135 publications of the institute.

**Source/web link:** <http://www.csd.s.in>

## 14. Tata Institute of Social Sciences (TISS)

**Overview:** TISS is a social sciences institute with its main campus based in Deonar, Mumbai, India. TISS also operates out of campuses in Hyderabad, Guwahati and Tuljapur. TISS was established in 1936, as the Dorabji Tata Graduate School of Social Work, the first school of social work in India. It was renamed to its current name in 1944. It was recognized as a Deemed University in 1964 by the University Grants Commission of India. Since its inception, the vision of TISS has been to be an institution of excellence in higher education that continually responds to changing social realities through the development and application of knowledge, towards creating a people-centered, ecologically sustainable and just society that promotes and protects dignity, equality, social justice and human rights.

**Experience:** TISS has 77 years of experience in education, research, field action and extension & dissemination action.

**Human and Financial Capital:** There are around 200 faculties with 2000 students for the year 2012-13. Funds have been granted by Corpus Fund, Capital Grants, Endowment Fund, Grants from UGC-State Governments (Non Plan) etc.

Most of the researches received funding from national and international organisations; Central Ministries & State governments; NGOs & Trusts; national & international agencies like the UGC, BARC, British Council, DFID, Ford Foundation, WWF; UN agencies, WHO & Global Fund to Fight Against TB & Malaria, universities like the London School of Economics (LSE), MIT, Kyoto University, University of Zurich, University of Western Sydney; corporates like Tata, ICICI, HUL, etc.

**Research Areas and Activities:** The institute has been given 5 stars and has been considered as top specialized universities in India as per Career360.com<sup>81</sup>.

Research in basic and applied social sciences is one of the core components of the academic work of TISS. One of the specific characteristics of the research activity of the institute is its orientation to development in that, much of it is centered on social issues or has policy implications for social development. A number of research projects undertaken at the institute have been evaluative and have had direct implications for development and social welfare.

Some of the research projects of TISS are:

Project Title	Sponsor	Status
Urban India Research Facility: Housing	Ford Foundation	Ongoing
Spaces of Deprivation and Spaces of Radical Politics	ICCG and TISS	Ongoing
Developing Advocacy Strategy on Building Knowledge Base on Ageing in India	Institute for Social and Economic Change	Ongoing

<sup>81</sup> <http://www.university.careers360.com/articles/top-specialized-universities-in-india-2013>

Project Title	Sponsor	Status
Equalisation Grants for Higher Education in India	Centre for Public Policy and Governance	Ongoing
Collaborating for Quality Education	British Council: Internationalizing Higher Education	Ongoing
Migration, Poverty and Access to Healthcare	ICMR	Ongoing

Some research publications of the institute are:

- Women: Leadership and Learning in Development Planning, Organising and Social Change
- Maximum Cities: Review of Urban Challenges in India
- Social Networks of Migrant Construction Workers in Goa
- Governance, Autonomy and Social Science Research
- Higher Education in India: An Overview in the Global Context
- Diversity and Social Integration on Higher Education Comprises in India and UK
- Community Practice Skills: Local to Global Perspectives
- Therapeutic Work and Police Social Work
- Social Conflict (Oxford in India Readings in Sociology and Social Anthropology)

**Networking and Collaborations:** Some of the collaborations of the institute are:

- TISS entered an MoU with the APARD in 2009 for 3-month certificate course in Rural Development and Decentralized Planning (RD&DP).
- TISS entered into an MoU with Osmania University in 2010 to strengthen social sciences education and strengthen collaborative research.
- TISS entered an MoU with Azim Premji Foundation since 2011 to facilitate the promotion of initiatives of education, research in all areas of institutional activities.

Some of the international collaborations are: -James Madison University, Virginia, USA; University of South Carolina, Columbia, USA; George Warren Brown School Of School Work, St. Louis, USA; The New School, New York , USA; Wells College, Aurora, New York, USA; University Of Delaware, Delaware, USA;

Foundation Nationale Des Sciences Politiques, France; Institut d'Etudes Politiques de Lille, France; London School of Economics, London; Management Centre Innsbruck, Innsbruck, Austria; Tampere University, Finland; Charles Stuart University, Australia; Victoria University, Australia.

**Publications:** There are around 209 publications of the institute.

**Source/web link:** <http://www.tiss.edu>

## 15. Institute of Social Sciences (ISS)

**Overview:** Institute of Social Sciences was registered under the Societies Registration Act of India 1860 on 28 August 1985 located in New Delhi. D.T. Lakdawala, renowned economist and former Deputy Chairman of the Planning Commission, Government of India was the first Chairman and Dr. George Mathew was the Founder Director of the Institute. Institute of Social Sciences studies social, political and economic issues of contemporary relevance. It provides inputs to the policy makers and civil society organisations. ISS is a think tank and a resource centre on local democracy, democratic decentralization, human rights and women's political empowerment at grassroots level. Its numerous researches, advocacy through conferences, seminars and workshops, monitoring of government policies through public interest litigations and other direct forms of interventions have received considerable acclaim nationally and internationally.

**Experience:** ISS has 28 years of experience in research, training and outreach programmes on participatory democracy and local governance; gender equity; human rights; and issues related to poverty, unemployment, socio-cultural deprivations and the like.

**Human and Financial Capital:** There are around 50 faculties and researchers with 20 administrative staff.

Funds come from Indian Council of Social Science Research and several ministries and state govt. and other national and international institutions such as National Human Rights Commission (NHRC), United Nations Development Fund for Women (UNIFEM), Sir Dorabji Tata Trust, United Nations Population Fund (UNFPA) and Ministry of Health and Family Welfare, Swedish International Development Cooperation Agency (SIDA), National Institute of Public Cooperation and Child Development, Sulabh International, V.V. Giri National Labour Institute, Xavier Institute of Development Action and Studies, Deccan Development Society, National Foundation for India, Swiss Agency for Development and Cooperation (SDC), The British High Commission, The Ford Foundation, The World Bank etc

**Infrastructure:** ISS has regional centres in Bangalore, Bhuvaneshwar, Chennai, Kolkata, Pondicherry, Thiruvananthapuram and ISS comprises a state-of-the art, computerized multimedia library. The Centre focuses on developing a specialised information base on all thrust areas of the Institute including local governance, decentralisation, urban and rural issues etc., and also lays emphasis on building up a good collection on social sciences and other allied disciplines.

**Research Areas and Activities:** Research thrust areas include:

- Governance: Rural and Urban Decentralization
- Federalism
- Development Studies
- Urban Studies and Rural Studies
- Human rights
- Women Studies
- Labour Studies

Some of the research projects of the institute are:

Title of the Project	Donors to the Project
Human Rights and Good Governance	Tata Trust
Child Protection Policy: Support to Government Activities in Karnataka	Plan International
Improve Access to Land of Socially Excluded Communities for Livelihood Security in Keonjhar and Mayurbhanj Districts of Orissa	PACS project of DFID, UK
A Comparative Study of Yield, Income and Employment of Organic Farmers vis-à-vis Conventional Farmers in Punjab	Indian Council of Social Science Research (ICSSR)
Capacity Building for the Promotion of Labour Rights for Vulnerable Groups of Workers	European Union
Khap Panchayats (Self-Styled Community Council) and its Legal and Social Ramifications	Indian Council of Social Science Research (ICSSR)

### Some of the latest Books and Reports Published are:

#### Books 2011 - Published

- Two Decades of New Panchayati Raj in Karnataka
- Parliament for the People
- Local Governance: Search for New Path
- Induction of Women in the Central Police Forces: Their Impact on the Forces

#### Report 2011 - Published

- Kerala's Participatory Planning and Porto Alegre's Participatory Budgeting
- Vaishali Gantantra Yatra: Women March to Vaishali Strengthen Grassroots Democracy

**Networking and Collaborations:** Some of the collaborations of the institute are: Global Network on Local Governance (GNLG), Association of Local Governance of India (ALGI), India, Brazil, South Africa Local Governance Forum (IBSA), the Institute also works closely with other networks like: Forum of Federations (Ottawa, Canada), National Endowment for Democracy (Washington, USA), World Movement for Democracy (Washington, USA), South Asia Partnership International (Nepal), European Institute for Asian Studies (Brussels, Belgium), Uppsala University (Sweden), and Indian Sociological Society (New Delhi, India).

**Publications:** There are around 100 publications of the institute.

**Source/web link:** <http://www.issin.org>



## 3.8 TRANSPORT

### Sector Summary

India's transport sector is large and diverse which includes roads, railways, ports and airports. It caters to the needs of 1.2 billion people. Transport sector forms major part of the Indian economy occupying an estimated land area of approximately 3,287,240 km<sup>2</sup>.

- **Railways:** Indian Railways is one of the largest railways under single management. The Indian Railways transported over 8 billion passengers in 2013, and 1.01 million tonnes of freight. Indian Railways is the world's largest commercial or utility employer, with more than 1.4 million employees. As to rolling stock, Indian Railways owns over 200,000 (freight) wagons, 50,000 coaches and 8,000 locomotives.<sup>82</sup>
- **Roads:** Roads are the dominant mode of transportation in India. As per the National Highways Authority of India, about 65% of freight and 80% passenger traffic is carried by the road. The value of total roads and bridges infrastructure in the country is projected to grow at a compound annual growth rate (CAGR) of 17.4 per cent over FY 12–17. India's roads and bridges infrastructure was valued at EUR 5.07 billion in 2009 and is expected to reach EUR 14.11 billion by 2017.<sup>83</sup>
- **Ports:** India has 12 major and 187 minor and intermediate ports along its more than 7500 km long coastline. These ports serve the country's growing foreign trade in petroleum products, iron ore, and coal, as well as the increasing movement of containers.
- **Airports:** India has 125 airports, including 11 international airports. As of 2012, there are 352 civilian airports in India - 251 with paved runways and 101 with unpaved runways. Passenger throughput increased to 159 million and cargo to 2.19 million metric tonnes (MMT) in FY 2013.

Twelve transport universities and research institutes covered in this report include:

1. CSIR-Central Road Research Institute (CRRI)
2. Centre for Railway Research – Indian Institute of Technology Kharagpur
3. Research Design and Standards Organization (RDSO)
4. Centre for Railway information systems (CRIS)
5. Department of Aeronautical Engineering – IISc
6. Institute of Urban Transport India (IUT)
7. Central Institute of Road Transport (CIRT)
8. Institute Of Road and Transport Technology (IRTT)
9. Institute of Road Transport (IRT)
10. The Center of Excellence in Urban Transport, CEPT University (CEPT-CoE)
11. Center for Transportation Systems (CTRANS) – IIT Roorkee
12. The Center for infrastructure, Sustainable Transportation and Urban Planning (CiSTUP) of Indian Institute of Science (IISc)

<sup>82</sup> <http://cistup.iisc.ernet.in/Workshop%20on%20Indias%20Transport%20Network%20Vision%202020%20-%20Overview%20ver2.pdf>

<sup>83</sup> <http://www.ibef.org/industry/roads-india.aspx>

# 1. CSIR-Central Road Research Institute (CRRI)

**Overview:** CSIR-Central Road Research Institute (CRRI), a premier national laboratory established in 1952, constituent of Council of Scientific and Industrial Research (CSIR) is engaged in performing research and development projects on design, construction and maintenance of roads and runways, traffic and transportation planning of mega and medium cities, management of roads in different terrains, improvement of marginal materials, utilization of industrial waste in road construction, landslide control, ground improvements, environmental pollution, road traffic safety and analysis & design, wind, fatigue, corrosion studies, performance monitoring/evaluation, service life assessment and rehabilitation of highway & railway bridges. CRRI provides technical and consultancy services to various user organizations in India and abroad.

**Experience:** CRRI has 61 years of experience in carrying out applied research for investigation, construction and maintenance of different types of roads and runway including studies on related materials such as aggregates, cement, etc., with a view to effecting economy and achieving greater serviceability.

**Human and Financial Capital:** There are around 120 faculties and more than 500 students with mix of undergraduates and post graduates.

Funding comes from various agencies such as Ministry of Road Transport & Highways (MORTH), National Highways Authority of India (NHAI), Ministry of Rural Development (NORD), MOEF, Border Roads Organization (BRO), Central Public Works Department (CPWD), DST, CES -New Delhi, CPWD-Punjab, MCD – Delhi, NTPC, Gujarat Panchayat R&B Department and Hindustan Construction Company.

**Infrastructure:** Some of the R&D facilities of CRRI are: Accelerated Pavement Testing Facility, Bump Integrator, Dipstick Road Profiler, Dynamic Heavy Testing, Expansion Joint Testing, Falling Weight Deflectometer, Mobile Bridge Inspection Unit and Geosynthetic Pull-out Test Apparatus.

## Research Areas and Activities:

Some of the R&D areas and sub areas of CRRI are:

R&D areas	Sub areas
<b>Bridges &amp; Structures</b>	Development of Bridge Management System for Highway Bridges
	Design and Development of Mobile Bridge Inspection Unit
	Field Instrumentation and Health monitoring of Bridges
<b>Environmental Science</b>	Measurement, Monitoring and Modelling of Air Pollution due to Road & Road Transport
	Fuel Consumption & Exhaust Emission Related Studies
	Carbon Footprint and LCA Perspectives in Transport Sector

R&D areas	Sub areas
<b>Flexible Pavements</b>	Mineral Aggregates: Characterization and Beneficiation
	Industrial Wastes and Artificial Aggregates: Use in Bituminous mixes
	Additives for Bituminous Binders (Anti-stripping Agents, Antioxidants, Polymers and Warm Mix Additives)
<b>Geotechnical Engineering</b>	Sub-soil investigations for highways including minor and major bridges.
	Computer Aided Design/Stability Analysis of High Embankments on Normal/Soft/Expansive Soils
	Design and construction of road embankments in flood and cyclone prone areas
<b>Rigid Pavements</b>	Design, Construction, Evaluation and Maintenance of Concrete Pavements
	Innovation in Concrete Technology
	Development of New Binders for Concrete
<b>Traffic Engineering and Safety</b>	Road Safety Audit Studies
	Road User Behaviour Studies
	Safety of Vulnerable Road Users

**Networking and Collaborations:** Some of the collaborations are as follows:

- CRRRI and the Delhi Technological University (DTU) has signed a MoU with the purpose of jointly taking up projects in the fields of design development, research, indigenization of technology etc.
- CSIR-CRRRI has signed the MoU with FINER (Federation of Industries & commerce of North Eastern Region) at Guwahati on 16th August 2013 to establish a working relationship between CSIR-CRRRI and FINER in areas of road and transportation industry and skill development of involved manpower so as to achieve overall productivity improvement for the industry.
- MoU between CRRRI and the University of Science and Technology-Meghalaya (USTM) a unit of ERD Foundation has been signed on 03/05/2012 for promoting research, development and innovation in the region in the areas of roads and bridges, traffic & transportation, ground improvement and geotechnical engineering, rural roads, pavements design, environment and road safety.
- Assam Public Works Roads Department (PWRD) had launched a 'Green Roads Mission' for the State in association in 2010 with CRRRI and Bitchem Asphalt Technologies Limited.

**Publications:** the institution has produced 61 research papers in journals and 54 Research Papers were published in Seminars/Conferences.

**Source/web link:** <http://crridom.gov.in>



## 2. Centre for Railway Research – Indian Institute of Technology Kharagpur

**Overview:** Centre for Railway Research (CRR) was set up at IIT Kharagpur based on the MoU signed between the Ministry of Railways and Indian Institute of Technology Kharagpur on February 13, 2010, to develop a long-term framework for research collaboration. This is the first such research centre set up in an academic institute with direct and full funding by the Indian Railways. Indian Railways is the nation's premier organization for providing transport service. Ministry of Railways is operating one of the largest railway systems in the world. Its countrywide network of approximately 64460 kms carries over 7651 million passengers per annum and moves 922 million tonnes of freight traffic.

**Experience:** Centre for Railway Research (CRR) has 3 and half years of experience to carry out research as well as specialized training through a variety of projects and programmes in railways.

**Human and Financial Capital:** There are around 40 faculties, consultants and staff and around 75 students. Funding and support comes from the Ministry of Railways.

**Infrastructure:** CRR has experimental, computational facilities along with new building and conference room.

**Research Areas and Activities:** The following have been identified as core areas of research focus:

- **Advanced Materials and Manufacturing:** to enable some of the advanced technological products to be developed, new material research is considered to be essential.
- **Heavy Haul Technology:** To obtain 10% annual growth in profit targeted in the Vision 2020 document, it is imperative that the haulage of freight trains must be increased along with their speed.
- **High Speed Rail:** An array of rolling stock design aspects to be addressed, such as, aerodynamic design of rolling stock, vehicle dynamics, vibration and noise control, advanced control of electric loco drives, static and dynamic analysis of railway bridges etc.
- **Advanced Maintenance and Operation:** Indian Railways has to operate and maintain a vast array of engineering assets such as Bridges and Structures, Rolling Stock, Track and Overhead Equipment (OHE) and Signaling equipment, which are critical for efficient, safe and reliable operation of the Railways.

Some of the research projects are:

- Creep and Warping (Including Gauge Widening) Analyses of Hot-running Loco Wheels Towards Development of Design Guidelines Against Gauge Widening
- Development of Provisions for Design of Steel Concrete Composite Railway Bridges for Normal Speed and Special Provision for High Speed Passenger Traffic
- Development of Railway Bridge Health Monitoring System With Wireless Sensor Networks
- Online Monitoring System for OHE Traction Parameters

**Source/web link:** <http://www.crr.iitkgp.ernet.in>

### 3. Research Design and Standards Organization (RDSO)

**Overview:** Research Design and Standards Organisation (RDSO) is an ISO 9001 research and development organisation under the Ministry of Railways of India, which functions as a technical adviser and consultant to the Railway Board, the Zonal Railways, the Railway Production Units, RITES and IRCON International in respect of design and standardization of railway equipment and problems related to railway construction, operation and maintenance. To enforce standardization and co-ordination between various railway systems in British India, the Indian Railway Conference Association (IRCA) was set up in 1903. It was followed by the establishment of the Central Standards Office (CSO) in 1930, for preparation of designs, standards and specifications. After independence, a new organisation called Railway Testing and Research Centre (RTRC) was set up in 1952 at Lucknow, for undertaking intensive investigation of railway problems, providing basic criteria and new concepts for design purposes, for testing prototypes and generally assisting in finding solutions for specific problems. In 1957, the Central Standards Office (CSO) and the Railway Testing and Research Centre (RTRC) were integrated into a single unit named Research Designs and Standards Organisation (RDSO) under the Ministry of Railways with its headquarters at Manaknagar, Lucknow. The status of RDSO was changed from an "Attached Office" to a "Zonal Railway" in April 2003, to give it greater flexibility and a boost to the research and development activities.

**Experience:** RDSO has 57 years of experience in R&D and functions as the technical advisor to Railway Board, Zonal Railways and Production Units. It develops new and improved designs, develops, adopts, absorbs new technology for use on Indian Railways and develops standards for materials and products needed by the Indian Railways and inspects critical and safety items of rolling stock, locomotives, signalling & telecommunication equipment and track components.

**Human and Financial Capital:** RDSO has nearly 3085 staff/employees with 32 directorates in various divisions such as Bridges & Structures, CAMTECH, Carriage, Engine Development etc. RDSO gets funding from Ministry of Railways and through various collaborations.

**Infrastructure:** RDSO has a number of laboratories which are well equipped with research and testing facilities for development, testing and design evaluation of various railway related equipments and materials. Some of these are: Air Brake Laboratory, Brake Dynamometer Laboratory, Diesel Engine Development Laboratory, Psycho-Technical Laboratory, Signal Testing Laboratory, Mobile Test Facilities and Vehicle Characterization Laboratory.

**Research Areas and Activities:** Some of the research projects of RSDO are:

- Development of a new crashworthy design of 4500 HP WDG4 locomotive incorporating new technology to improve dynamic braking and attain significant fuel savings.
- Development of Drivers' Vigilance Telemetric Control System which directly measures and analyses variations in biometric parameters to determine the state of alertness of the driver.
- Development of Train Collision Avoidance System.
- Development of Computer Aided Drivers Aptitude test equipment for screening high speed train drivers for Rajdhani/Shatabdi Express trains to evaluate their reaction time, form perception, vigilance and speed anticipation.
- Assessment of residual fatigue life of critical railway components like rail, rail weld, wheels, cylinder head, catenary wire, contact wire, wagon components, low components etc to formulate remedial actions.

- Development of 4500 HP Hotel Load Locomotive to provide clean and noise free power supply to coaches from locomotive to eliminate the existing generator car of Garib Rath express trains.
- Field trials conducted for electric locomotive hauling Rajdhani/Shatabdi express trains with Head On Generation system to provide clean and noise free power supply to end on coaches.
- Development of WiMAX technology to provide internet access to the passengers in running trains.
- Modification of specification of Electric Lifting Barrier to improve its strength and reliability
- Design and development of modern fault tolerant, fail-safe, maintainer friendly Electronic Interlocking system.

Some of the research achievements are:

Research Achievements	
Development of improved oscillation monitoring system	Oscillation Monitoring systems (OMS) equipment is extensively used by zonal railways to monitor the quality of track through ride index and vertical & lateral acceleration measured on vehicle floor.
Development of Double Decker Coach Design	RDSO has developed design of AC Double Decker coach with an entirely new shell design.
Track Side Bogie Monitoring System	System developed uses a laser rangefinder to measure the angle-of-attack (AOA), and tracking position (TP) of every passing wheel from which the inter-axle misalignment (IAM) and tracking error (TE) of wheel.
Sensors for Detecting Hot Box, Hot Wheels	Project is another way side detection system for detecting hot box and hot / cold wheels to prevent unsafe condition of rolling stock i.e. hot wheels, axle boxes & hot wheel including brakes.
Completion of Technology Mission for Railway Safety (TMRS)	Technology Mission for Railway Safety was setup in collaboration with the Ministry of Railways (through RDSO), & Department of Science & Technology, (through IIT Kanpur) to comprehensively address safety-related issues in Indian Railways.

**Networking and Collaborations:** Some of the RSDO collaborations are: IIT-Mumbai, IIT- Roorkee, IIT- Kharagpur, and IIT Kanpur.

- Electronic Fuel Injection (EFI) was developed by RDSO in collaboration with IIT Kanpur
- Research, Design and Standards Organization (RDSO) in collaboration with HBL Power Systems, India, has carried out field trials using a new domestically-developed train protection system
- A unique collaborative alliance is formed between IIT-Kanpur, Indian Railways arm, Research Design and Standards Organization and Steel Authority of India to develop cost effective corrosion resistant rails for the first time in the country.

**Source/web link:** <http://www.rdso.indianrailways.gov.in/index.jsp?lang=0>

## 4. Centre for Railway Information Systems (CRIS)

**Overview:** Centre for Railway Information Systems (CRIS) is an autonomous organization under the Ministry of Railways. It develops and manages the information technology applications of the Indian Railways. CRIS also provides IT applications for non-Railway Government and Public Sector organizations. CRIS was established in July 1986 headquartered in New Delhi, with Regional offices in Delhi, Kolkata, Mumbai, Chennai and Secunderabad. CRIS currently develops systems to cover emerging needs of the Railways including the protection of Railway assets, energy management, and management of the overhead electrification system, parcel management, employees' health management, and a comprehensive financial management system.

**Experience:** CRIS has 27 years of experience in providing consultancy and Information Technology services to Indian Railways as partners to conceptualize and realize technology initiatives, to build new products or services and to implement prudent business and technology strategies.

**Human and Financial Capital:** CSIR has around 800 employees including IT professionals whose skill sets consist of system architecture, system analysis and design, and program development, complemented by an experienced group of serving and former Railway personnel with domain knowledge and system implementation skills as per data of 2012.

**Research Areas and Activities:** The progress of computerization of various railway projects undertaken by CRIS:

- National Train Enquiry System (NTES): It aims at providing prompt and reliable information to general public through user friendly interfaces and PAN India accessibility. The information is now conveniently available to public all over the country through various delivery channels like web browsing, mobile phone, etc. NTES was given National e-Governance Silver Award on 9.2.2011.
- Terminal Management System (TMS): TMS generates on-line Railway Receipts and has been deployed at 631 field locations during 2010-11. Total deployment of TMS at 2,000 locations captures about 99% of goods traffic.
- Passenger Reservation Services (PRS): Countrywide Network of Computerized Enhancement Reservation and Ticketing (CONCERT) have been installed at more than 2,355 locations having 8,277 terminals for reserved segment of ticket bookings. IR's Source/web link<sup>84</sup> facilitates internet-based rail reservation related enquiries.
- Unreserved Ticketing Services (UTS): UTS has been made functional at 4,906 locations with 8,880 terminals as on 31st May, 2011.
- Integrated Coach Management System (ICMS): Mobile version of ICMS for monitoring punctuality of trains has been released as trial version.
- Control Office Application (COA): COA has gone live in all the 77 Divisions/Area Control Offices of Indian Railways.

<sup>84</sup> [www.indianrail.gov.in](http://www.indianrail.gov.in)

- Track Management System (TMS): TMS was introduced in the works programme 2008-09 as a pilot project and has been implemented in 6 divisions in 2010.
- Freight Operations Information System (FOIS) Phase-II (TMS Expansion): with non-device locations enabled under nodal concept, more than 99.9% RR's are booked through TMS.
- Crew Management System (CMS): CMS manages around 90000 crew online at 317 crew lobbies
- E-Procurement System (EPS): EPS has been implemented to improve efficiency and transparency in materials purchases thus reducing the cost of material/purchase.

**Networking and Collaborations:** An MoU was signed between DB System and CRIS at Berlin, Germany to explore joint business opportunities and to cooperate closely in consulting and development of railway IT, on a non-exclusive basis.

**Source/web link:** <http://www.cris.org.in>

## 5. Department of Aeronautical Engineering – IISc

**Overview:** Department of Aeronautical Engineering was started in December 1942. After the department of Electrical Technology, the Department of Aeronautical Engineering is the oldest engineering department at the IISc. The services of Dr. V.M. Ghatage, one of the few trained aeronautical engineers in the country at that time and who was working in HAL, were lent to the institute during 1942-1947.

**Experience:** Department of Aeronautical Engineering at IISc has 71 years of experience in academics and offers degree courses and PhDs and conducts research activities in fields of aerodynamics, structures, combustion and propulsion.

**Human and Financial Capital:** Every year nearly 55 students get admitted for Degrees and PhDs in Aerospace Engineering. There are more than 35 faculties and staff.

Funding comes from large number of sponsored and consultancy projects from agencies like DST, ISRO, DRDO, UGC, Office of Naval Research, The Air Force Office of Scientific Research and Aeronautical Development Agency.

**Infrastructure:** The Aerospace Engineering department has almost completed the process of establishing various laboratories and workspaces. Improved and modern infrastructure has helped in initiating new research activities. Aerospace Engineering department has following labs: Advanced Materials and Processing Lab (AMPL), Laboratory for hypersonic and shock wave research, Laboratory for turbulence computations etc.

**Research Areas and Activities:** The broader contours of research activities of the department may be identified in terms of four dominant streams:

**Aerodynamics:** The Aerodynamics Group of the department of Aerospace engineering (TAG) historically happens to be a group which pioneered basic fluid dynamic research and aerodynamic configuration. TAG has grown and now presents expertise in various fields; from areas where it is traditionally known to be stronger like low speed aerodynamics, turbulence and transition research to Computational Fluid Dynamics and Hypersonics research.

**Structures:** Structures group has always had the legacy of making significant contributions to the growth of aerospace structures activity. The areas of research include: Structural Health Monitoring, Smart Materials and Structures, Composites Mechanics, Materials and Manufacturing, Fatigue, Oscillating Airfoil Aerodynamics, Variational Asymptotic Method, Computational intelligence and MEMS Damage tolerance of Aircraft Structures and Non-Destructive Testing.

**Combustion & Propulsion:** Some examples of current research topics are as follows -

- Flame propagation, extinction and ignition in boundary layer flows
- LES/DNS of turbulent combustion
- Atomization and spray formation
- Electric propulsion for space applications
- Magnetoplasmadynamic thrusters and Biomass gasification

**Guidance & Control:** This group in the initial years devoted to studies in radar systems, missile guidance and other related problems and lead to significant contribution both in terms of academic research as well as applications to aerospace industries. 1980s onwards the computing power has increased and led to development of control and guidance algorithms for various applications. Currently, the faculties of this group are very active and are working in various core and branch areas such as navigation & guidance of aerospace and autonomous vehicles, optimal and robust control system design (both linear and nonlinear), system identification, collision avoidance, trajectory optimization, remote sensing, evolutionary computing etc.

**Networking and Collaborations:** Some of the collaborations of the dept are with Boeing and Pratt&Whitney and have research collaborations with eminent researchers from countries such as USA, UK, France, Germany, South Korea, Australia etc.

**Publications:** The faculty of the institution has produced several publications through national and international journals, conference papers and books. There are more than 300 journal papers, 50 conference papers and 10 books.

**Source/web link:** <http://www.aero.iisc.ernet.in>

## 6. Institute of Urban Transport India (IUT)

**Overview:** Institute of Urban Transport India (IUT) was established in May, 1997 as a professional body under the purview of the Ministry of Urban Development (MOUD). A premier professional non-profit making organization, the objective of IUT is to promote, encourage and coordinate the state of the art of urban transport including planning, development, operation, education, research and management.

**Experience:** IUT has 16 years of experience. IUT offers advisory service in matters relating to urban transport to State and Local Governments of India. State and City Governments can appoint IUT as knowledge partners for seeking technical advisory from IUT experts on reviewing policy documents, organizing consultants and project monitoring.

**Human and Financial Capital:** IUT India is controlled, administered and managed by the governing council which is headed by the President (Secretary, Ministry of Urban Development). IUT has more than 60 institutional members, 1300 individual members and 70 Associate Members. There are around 35 plus staff with 6 additional experts.

Funding comes from various courses offered and through several R&D projects sponsored by Unified Metropolitan Transport Authority, Ministry of Urban Development, Jawaharlal Nehru National Urban Renewal Mission, ADB, Department for International Development and World Bank.

**Infrastructure:** IUT has library with over 1500 national and international books, journals, magazines, guidelines, handbooks and reports related to urban transport. Under the Sustainable Urban Transport Project (SUTP), a Knowledge Management Centre (KMC) as a learning repository including a data base has been set up for use by all the stakeholders working in the domain of Urban Transport.

**Research Areas and Activities:** IUT is required to manage country wide research. Accordingly, IUT has been proposing a countrywide agenda for research in the country to the MOUD for appropriate action. In addition, IUT undertakes research activities as a part of its routine activities. Current research studies with IUT are as follows:

- **Review of NUTP Policy:** IUT had taken up the task of reviewing the implementation of the National Urban Transport Policy, 2006 (NUTP) in 20 cities.
- **Review of Urban Mobility India awarded projects:** Urban Mobility India awards for excellence were given away to cities for the very first time in 2008. Since then there has been a continuous process of methodically selecting projects that stand out in terms of their exclusivity, ingenuity reliability and the project's scope for replication in other cities.
- **Service Level Benchmarks (SLB):** Ministry of Urban Development (MoUD) launched the Handbook on Service Level Benchmarks (SLB) in 2011 which directs all JnNURM cities to identify their Level of Service (LoS) in Public Transport Facilities, Pedestrian Infrastructure Facilities, Non-Motorized Transport (NMT) Facilities, Level of usage of Intelligent Transport System (ITS) facilities, Travel speed along major corridors and Parking facilities.
- **Study on Status of Unified Metropolitan Transport Authority in India:** National Urban Transport Policy (NUTP) of 2006 recommended setting up of a Unified Metropolitan



Transport Authority for all million plus cities in India in order to ensure that urban mobility is planned in a holistic and integrated manner. Since 2006, several cities have moved towards setting up of such authorities either at the city/metropolitan level or at the state level.

Some of the projects are:

- **Institutional merger study for Jaipur:** Jaipur Metro Rail Corporation (JMRC) had entrusted IUT to study the feasibility of the merger of JMRC & Jaipur City Transport Services Limited (JCTSL) into one JTA (i.e. Jaipur Transport Authority); in order to achieve the goal of providing better & efficient urban mobility to commuters in Jaipur. The study showed that urban mobility depends on a very large number of elements and all needs to be tackled in a holistic manner to bring about lasting improvement in urban mobility.
- **Review of BRTs in India:** A review was undertaken by the Institute of Urban Transport for studying the status and progress of Bus Rapid Transit Systems (BRTS) projects in India and their expected efficiencies. The study does a review of the implementation issues and problems as well as the success stories in BRTs projects. It focuses on offering guidance in anticipating implementation problems and developing strategies to solve them along with highlighting the physical and financial status of all the BRTs projects.

**Networking and Collaborations:** Some of the collaborations of UTI are: World Bank (India), ADB, United Nations Development Programme, Ministry of Urban Development, NIT Warangal, Center for Environmental Planning and Technology, IIT Delhi, IIT Chennai, Central Road Research Institute etc. It is involved in networking with organizations such as: Society of Indian Automobile Manufacturers (SIAM), TERI, Japan International Cooperation Agency, and German Agency for Technical Cooperation (GTZ), MNRE, FICCI and EBTC.

**Publications:** There are 12 UTI publications, 10 research reports, 6 MOUD publications and 2 policy documents.

**Source/web link:** <http://www.iutindia.org>

## 7. Central Institute of Road Transport (CIRT)

**Overview:** Central Institute of Road Transport (CIRT) was established in 1967 on the joint initiative of the then Ministry of Shipping and Transport, Government of India, and the Association of State Road Transport Undertakings (ASTRU) recognized by the Bureau of Indian Standards for testing a wide range of automobile components and testing of vehicles. The main aim of CIRT is to help in improving the quality of public transport through management development, research, testing and consultancy activities. CIRT established an Engineering Research Centre consisting of Automotive, Electrical, Chemical and Metallurgical laboratories. CIRT is administered by a Governing Council consisting of chief executives of the State Transport Undertakings (STUs) and officials of the government. CIRT offers management development programmes covering general management, transport operations and maintenance engineering. The programmes are meant for practicing managers in State Transport Undertakings (STUs), other organizations operating transport services besides road transport officials. CIRT undertakes consultancy and research assignments on transport policy, transportation planning, traffic management, maintenance management, materials management, human resource management and management information systems.

**Experience:** CIRT has 46 years of experience in management of public transport, research, testing and consultancy activities. CIRT conducts specific organization-oriented programmes for State Transport Undertakings such as Foundation Courses, Management Appreciation Programmes, Short Duration Functional Programmes and In-Situ Programmes.

**Human and Financial Capital:** The faculty of CIRT is clustered into three groups: Engineering, Management and Operations. Each group interacts with the other two in carrying out training, research and consulting. CIRT has a capability of 240 employees of whom 70 are from professional body.

CIRT sought and received financial support not only from ASRTU but from the Ministry of Surface Transport. In addition, the Ministry of Industry has been allocating funds from the R&D cess for purchase of expensive and sophisticated equipment from abroad. Some extra funds through trainings have been received from State Health Transport, Bureau of Police Research & Development, Ghatge Patil Transport Ltd, and Maharashtra Small Scale Industries Development Corporation.

**Infrastructure:** CIRT library has over 10000 titles, 100 professional journals and several educational films and video cassettes covering all aspects of transportation and management. CIRT has a modern automobile component testing laboratory, where samples of spare parts used in heavy vehicles are tested for quality. The tests so carried out enable the Standing Committee (Supplies and Contracts) of ASRTU to issue rate contracts at competitive prices on firms which supply spare parts to STUs.

**Research Areas and Activities:** CIRT undertakes research on various aspects of road transport industry. It has conducted studies of urban planning and transportation in 15 major cities in the country. The members of faculty do personal research in areas of their interest and publish papers and articles in professional journals. The Institute is a recognized centre for doctoral studies for degrees awarded by the University of Pune.

The testing laboratories have also been recognized by the Bureau of Indian Standards and identified by the European Union for certification of automobile components earmarked for export to Europe.

Research & Consultancy activities are extensively involved in carrying out studies on the following themes:

- Comprehensive Traffic & Transportation study.
- Traffic management and parking study.
- Planning and design for bus rapid transit (BRT) and bicycle network.
- Sustainable urban transport study.
- Access audit for bus terminals/stops for persons with disabilities.
- Planning for tracks and other allied infrastructure for Driver training institutes.
- Planning and designing for integrated border check post.
- Innovative Driving Test System (IDTS) using Radio-frequency identification (RFID) technology.

Some recent projects undertaken by the institute are:

Projects	Clients
<b>DTC – Bid Process Management</b>	Delhi Transport Corporation
<b>DPR for Integrated Depot Management System in PRTC</b>	PEPSU Road Transport Corporation
<b>DPR for Computerization in Sikkim Nationalized Transport</b>	Sikkim Nationalized Transport
<b>Preparation of Corporate Plan for UPSRTC</b>	Uttar Pradesh Road Transport Corporation
<b>PMPML Staffing Requirements</b>	Pune Mahanagar Parivahan Mahamandal Limited (PMPML), Pune
<b>Success Story of Volvo Buses in BMTC</b>	Volvo Bus India Limited
<b>Model DPR for Implementing ITS Applications in State Road Transport Undertakings</b>	Ministry of Road Transport & Highways
<b>Study on the Performance of Volvo Intercity Bus Operations</b>	Volvo Bus India Limited
<b>Preparation of Tender Documents for Procurement of Buses by KDMTU</b>	Kalyan Dombivli Municipal Transport Undertaking, Kalyan
<b>Master Plan for Bus Rapid Transit System integrated with Bicycle Network in Pune</b>	Pune Municipal Corporation, Pune

Some of the notable studies carried out under Centre for Road Safety are as follows: Accident Analysis of Bangalore City, Accident Analysis of Chennai, Accident Analysis on National Highway No.4, Road Accidents on NH 8 Maharashtra State etc.

**Networking and Collaborations:** Some of the national collaborations with institutes are: Uttar Pradesh Road Transport Corporation, Pune Mahanagar Parivahan Mahamandal Limited

(PMPML), Pune, Volvo Bus India Limited, Ministry of Road Transport & Highways, Airport Authority of India, New Delhi and Pune, Railway Staff College, Bajaj Auto Limited etc.

Some of the international collaborations are:

- Transport Research Laboratory of the United Kingdom has undertaken several research projects in collaboration with CIRT and there is a constant exchange of professional staff between the two institutions.
- The Universities of Westminster, Newcastle and Loughborough have hosted programmes for CIRT faculty, and faculty from these universities visit CIRT to give lectures and seminars on topics of mutual interest.
- CIRT has entered into memoranda of understanding with TUV in Munich, Germany, and with UTAC in Paris, France. Under a scheme supported by the European Union, scientists from these two renowned automobile laboratories visited CIRT and helped in upgrading testing facilities.
- Collaborative efforts are being made in the areas of road safety with appropriate institutions in Australia, Europe, Japan and USA.

**Publications:** CIRT Publishes research articles, papers and information related to the field of transportation and its management and also Publishes Quarterly and Annual Physical and Financial Performance Statistics of State Transport Undertakings (STUs). There are total on of 50 publications. In addition, the Institute publishes a large number of reports, notable among them being the annual publication - STUs: Profile and Performance. Proceedings of seminars and workshops conducted by the institute on various topics related to transport policy and management are regularly published and are offered for sale.

**Source/web link:** <http://www.cirtindia.com>

## 8. Institute of Road and Transport Technology (IRTT)

**Overview:** Institute of Road and Transport Technology (IRTT) was established in 1984. It is run by All Transport Corporations of Government of Tamil Nadu and affiliated to Anna University. The institute offers 7 Under Graduate Degree courses in engineering (B.E. and B.Tech) in various disciplines such as Automobile Engineering, Civil Engineering, Computer Science and Engineering, Electrical and Electronics Engineering, Electronics and Communication Engineering, Information Technology, Mechanical Engineering and 2 post graduate courses M.E Structural engineering and Master of Computer Applications (MCA).

**Experience:** Institute of Road and Transport Technology (IRTT) has 29 years of experience in teaching and research activities.

**Human and Financial Capital:** There are nearly 300 graduates and post graduates.

Funding comes from various courses offered and through several R&D projects sponsored by DST, DSIR, and AICTE etc.

**Infrastructure:** IRTT has excellent infrastructure, well-equipped laboratories, library and highly qualified faculty members. IRTT is well known for its technical excellence, modern facilities, good performance track record and resourcefulness.

### Research Areas and Activities:

Some of the research projects of IRTT are:

- Indigenous Resource Utilization Development of Diesel-Ethanol – vegetable oil hybrid fuel blends and testing in commercial transport vehicles
- Design and Development of Dynamic Facility Layout design toolkit
- Experimental Investigations of the Technical Viability of Using Ethanol in Diesel Engines
- Design and Development of Dynamic Facility Layout Design Toolkit
- Quality of STU bus services in Tamil nadu
- Capacity Building in Urban Transport Sector

**Networking and Collaborations:** Memorandum of Understanding (MoU) is signed with the following industries to achieve the objectives of IIP Cell: IBM, Bharat Sanchar Nigam Limited (BSNL) Chennai, Infosys Bangalore, Sutherland Global Service Private Limited Chennai, Tractors and Farm Equipment Limited (TAFE) Chennai, WABCO TVS Chennai, Society of Automotive Engineers INDIA Chennai etc.

**Source/web link:** <http://www.irttech.ac.in>

## 9. Institute of Road Transport (IRT)

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**Overview:** The Institute of Road Transport was established in 1976 under the Control of Government of Tamil Nadu and has been registered as a society under the Indian Societies Registration Act 1860. The prime objective of IRT is to conduct research studies on the various issues relating to Road Transport sector with a view to improve the performance of bus transportation by updating and adopting the latest developments that are taking place around the world.

The aim of the Institute is to disseminate knowledge on various aspects of technology developments and transport management to the officers and supervisory staff of State Transport Undertakings in Tamil nadu by organizing training courses, seminars, workshops and circulation of journals.

**Experience:** The institute has 38 years of experience in conducting research studies on the various issues relating to Road Transport sector with a view to improve the performance of bus transportation by updating and adopting the latest developments that are taking place around the world.

**Infrastructure:** Transport Undertakings of Tamilnadu are its members, besides it has one Institutional member and an ordinary member. The institute is managed by a Governing Council and the Secretary to Government, Transport Department, Government of Tamilnadu is the Chairman of the Governing Council. The Director of the Institute is the member Secretary of the Council.

**Research Areas and Activities:** Research is being done to improve the automobile components to ensure road safety. The research work has been grouped into three specialized areas viz.

- Traffic and Transportation
- Road safety
- Bus system management

In order to guide and evaluate the research projects, research sub-committees each consisting of four specialists/experts in the respective area of study drawn from various agencies like Government of India, IIT (Chennai), Anna University, Highways, STUs, CIRT have been constituted.

**Networking and Collaborations:** Institute of Road Transport encourages Industries-Institute linkages through various research and consultancy projects. A few feathers in the cap of the Institute of Road transport are companies like Indian Institute of Technology, Chennai, Bharat Petroleum, Chennai Petroleum Corporation Ltd, Simsons, Ashok Leyland, Airport Authority of India, WABCO, Government of Pondicherry

**Source/web link:** <http://www.irtchennai.in>

## 10. The Center of Excellence in Urban Transport, CEPT University (CEPT – CoE)

**Overview:** CEPT University takes its name from the 'Center for Environmental Planning and Technology' (CEPT). CEPT and the various schools that it comprised were established by the Ahmedabad Education Society with the support of the Government of Gujarat and the Government of India. The Center of Excellence in Urban Transport, CEPT University (CEPT-CoE), established in 2009 is an initiative of the Ministry of Urban Development (MoUD), Government of India and is supported by the Ahmedabad Municipal Corporation. CEPT-CoE has been envisaged as a resource centre for dealing with issues in urban transport planning and management. It has a mandate to cover three aspects of capacity building in urban transport - human resource development, knowledge management and technical assistance & advisory. The Center set up a Masters Program in Planning with specialization in Urban Transport Planning and Management in 2009. It also introduced the "Leaders Program in Urban Transport Planning and Management" - a certificate course for in-service urban transport professionals in July 2012, in collaboration with the World Bank and the MoUD.

**Experience:** The center has 5 years of experience and has been haling issues related to urban transport planning and management. Several national and international projects are undertaken.

**Human and Financial Capital:** The centre consists of 10 executive council members, 5 core faculty members, 36 associates and 2 training and administrative staff.

**Research Areas and Activities:** The center has been working on several national and International projects. Some of the ongoing projects are listed below:

- Managing urban logistics in an expanding city - case study of Ahmedabad
- BRTS Bus Stations: Design Guidelines
- Ahmedabad Janmarg: Design Evolution
- Road Safety in Ahmedabad
- Urbanization Trends and Impacts in India
- Strategic Urban Planning
- Estimating Urban Transport Investment Requirements

**Networking and Collaborations:** The Centre aims at furthering research by establishing, networking and strengthening partnership with strategic institutions in learning, research and innovation in areas related to urban transport planning. The Centre collaborated with other national and international institutes for academics and urban transport related research and academic cooperation.

- The Centre signed a Memorandum of Understanding (MoU) with the Institute for Transport Studies (Leeds, UK) for academic co-operation on various research areas in transport in July 2012.
- The Centre has signed an MoU with EMBARQ for a research study on health impact benefits of BRT in Ahmedabad in the year 2010.
- MoU with GIZ on collaborative research in the area of urban transport
- An MoU with Land Transport Academy, Singapore is in process

**CoE-UT is also a part of the following committees:**

- Member, Expert Committee on Urbanization of the National Development Committee, Ministry of Urban Development and Ministry of Housing and Urban Affairs
- Member, Sub-Committee of the National Transport Development Policy Committee on Urban Transport, Government of India, Ministry of Urban Development, Government of India.
- Member, National Steering Committee on Intelligent Transport System (ITS), Government of India, Ministry of Communication & Information Technology
- Member, Sub-Committee on National Sustainable Habitat Mission (NSHM), Government of India, Ministry of Urban Development, Government of India.
- Member, Sub-Committee for Development of National Sustainable Habitat Parameters in the field of Urban Transport, Ministry of Urban Development, Government of India
- Member, Working Group on Urban Transport for 12th Five Year Plan, Ministry of Urban Development, Government of India.
- Member, Committee on Urban Bus Specifications for Ministry of Urban Development

**Source/web link:**

<http://cept.ac.in/184/195/center-for-excellence-in-urban-transport-coe-/about-us>



## 11. Centre for Transportation Systems (CTRANS) – IIT Roorkee

**Overview:** CTRANS is a Centre of Excellence of IIT Roorkee in the area of Transportation Systems. The Centre aims to evolve a holistic approach for study of transport systems. CTRANS is mainly a multi-disciplinary scheme with joint participation of Engineers, Scientists and Researchers from Science & Technology, Humanities and Social Sciences, Architecture & Planning and Management background. The plan of CTRANS is also to support multidisciplinary research and education for manpower development in transportation systems surrounding all modes of transport such as Road Transport, Rail Transport, Inland Water Transport, Air Transportation and Pipeline Transport.

**Experience:** CTRANS aims to promote multidisciplinary research on transportation systems and provides technological support to national projects related to the growth of Transportation System in India and further establishes international linkage for collaborative research in the frontier areas.

**Infrastructure:** CTRANS has the following equipment facilities: Road measuring data acquisition system (ROMDAS), Portable automatic traffic counter cum classifier, Electro dynamic vibration exiter system, Robotic total station, Falcon handheld stationary radar with data logger, Noise level meter, Portable falling weight deflectometer (loadman), Ground penetration radar (GPR), Bioreactor, and Binary gradient high performance liquid chromatography.

Software facilities include:

Sound PLAN	Analysis of Road & Rail Transport Noise
TransCAD	Software for handling Transport Network Data
HEADS	Geometric Design Aspects of Transportation Systems
HDM 4	Highway Development & Management (Two Full License Versions)
Arc GIS	Designing and Managing Solutions through the application of Geographic Knowledge
ERDAS	Remote Sensing and Image Processing Application
VISSIM	Microscopic Multi-Modal Traffic Flow Simulation Software
VISUM	Software for Public Transport Planning
Mx Road	String-based Modeling for Road and Highway Design

**Research Areas and Activities:** Research areas of CTRANS include: Urban Transportation Policy & Research; Vehicle Technology; Environmental Analysis of Transportation Systems; Study on Alternate Fuel; Pavement Management System; Remote Sensing, GPS and GIS Applications in Transportation System; Information Technology for Efficient Operation of Transportation System; Optimization of Public Transport Operation; Visual Communication & Design for Aesthetic & Comfort, Ergonomics; Health Hazards and Mitigative Measures, Accident Modelling and Road

Safety; Economic Appraisal of Transportation System; Multiplier Effect of Transportation Studies System for Urban & Rural Development; Innovative Instrumentation System; Management of Transport System including Project Management, Technology Management, Business Process Reengineering, Knowledge Management, Manpower Planning, Human Re-engineering, Value Engineering; Traffic Management; Underground Space Technology for Transport System; Public Transportation System including Inter Modal Transportation; Inland Water Transport.

**Networking and Collaborations:** CTRANS has signed Memorandum of Understanding with:

- Queensland University of Technology (QUT), Brisbane, Australia
- Housing & Urban Development Corporation (HUDCO), New Delhi
- Central Institute of Road Transport (CIRT), Pune

**Publications:** There are around 28 publications from CTRANS

**Source/web link:** <http://www.iitr.ac.in/centers/CTRANS/index.html>

## 12. The Center for Infrastructure, Sustainable Transportation and Urban Planning of IISc

**Overview:** The Center for infrastructure, Sustainable Transportation and Urban Planning (**CiSTUP**) of Indian Institute of Science (IISc) is established in the year 2009 during the centenary celebrations of Indian Institute of Science, with inputs from many visionaries, organizations and has plans and road map to be one of the finest centers of advanced research and training in the field of transportation engineering in India and abroad.

**Experience:** The center has 5 years of experience in doing advance research and training in the field of transportation engineering.

**Human and Financial Capital:** The center consists of 20 faculty members, 28 students, 10 technical staff and 7 office staff members.

**Research Areas and Activities:** the research areas are listed below:

- Traffic and transportation engineering
- Urban Infrastructure, Building & Construction Engineering
- Urban Sprawl and planning
- Tunneling engineering and underground space utilization
- Climate Change, Geohazards and disaster mitigation
- Environmental Impact Assessment
- ICT for Transportation / Infrastructure
- Urban economics and social issues

The centre conducts training programmes, capacity building and also develops expertise and provide complete technological and planning solutions for urban renewal and development programmes related to urban transportation and infrastructure engineering. The main areas of Specialization and Interest are Infrastructure, Sustainable URBAN Transportation and Urban Planning. Among these areas, Sustainable urban transport is the prime focus for the activities of the center.

**Publications:** There are around 38 Paper publications from CiSTUP Funded Projects

**Source/web link:** <http://cistup.iisc.ernet.in>

## CONCLUSION

This compilation of science and technology research players in India has been meticulously done keeping in mind the purpose of the report, which is to furnish a detailed profiling of *potential research organizations across major S&T sectors*, which is expected to provide European business and research entities, a clear insight and understanding of the Indian research expertise and capabilities. This mapping exercise is expected to be beneficial for the EU entities looking at business and research partnerships with Indian entities.

Detailed profiling of 125 research organizations in 8 different sectors has been furnished. The number of entities covered under each sector is as follows:

Sl no	Sectors	No. of organizations profiled in details
1	Biotechnology	18
2	Energy	18
3	Environment	15
4	Health	16
5	ICT	16
6	Nano Technology	15
7	Social Sciences and Humanities	15
8	Transport	12
	<b>Total</b>	<b>125</b>

Apart from detailed profiling, a database has been created that gives the name, website, publication and contact information of 50 organizations each under the selected 8 sectors which total upto 400 numbers. A matrix of 145 organizations has also been developed which maps the 8 sectoral departments and centres present in an institute. This is aimed at showcasing the varied sectoral expertise found in large institutions and universities.

## Limitations of the study

Mapping Indian Science and Technology Research Players was a vast and laborious task as it involved screening several hundreds of organizations' details to shortlist the important ones that can be showcased in this report. It became challenging as the government does not have a standard ranking system for research institutions and universities based on their overall performances.

The University Grants Commission (UGC), set up by the Central Government does provide accreditation and recognition to universities including regular inspections and grades to the universities to determine and maintain standards of teaching, examination and research in universities. However, the UGC grading of universities involves not just the S&T departments,

but other departments like arts (History, geography), and commerce (accounts, statistics). Moreover, technical institutions like the engineering colleges, NITs, IITs, IISc, are recognized by AICTE (All India Council for Technical Education). This study could not consider AICTE or UGC ranking as it had to identify and map the best from both the categories - technical institutions and the S&T departments of the universities.

There are a few web sources that ranked the S&T research institutions, but they could not be considered as reliable sources as they did not clearly state the criteria for ranking. However, there was one web source that ranked the entities based on papers published ([www.career360.com](http://www.career360.com)). This was used to arrive at the list of top entities that are profiled in detail in the report.

The size of the country in terms of population and the geographic area, and the thousands of educational institutions set up to cater to this huge population, made it a daunting task to map all the research players across the country, especially because it was a web based study, and most of the research organizations' websites did not furnish the information for all the criteria selected for the study. For many entities, information related to infrastructural facilities, R&D funds, faculties, international collaboration, were not available.

Another challenge this study faced was to map the entities under the broad area of 'Science and Technology' which embodies several sectors like environment, energy, ICT, Nano technology, biotechnology, etc. This brought about a limitation in terms of deeper and more detailed analysis of entities under individual sectors.

According to the Ministry of Science and Technology Directory, there are 4288 S&T research institutions spread across the country. Due to limitations stated above, specifically because most of the institutions details are not available online, and considering the purpose of the study, it was decided to limit the mapping activity to the highly potential ones that can be suitable for partnerships with the European entities.

Thus this report was evolved, which provides a detailed profiling of 125 best in class entities across 8 thematic sectors, 400 entities in the database with an objective to make information available about the Indian research organizations at one place, and a matrix of 145 entities which maps the institutions for the 8 different sectoral departments they have.

## Future scope of the study

The enormity of the topic of this study – mapping S&T research players, opens up a plethora of possibilities for future studies. And this study has laid a foundation for developing more refined competency matrix for future studies.

Instead of a combined S&T sectors, mapping individual S&T sector players will allow in depth analysis of the organizations and will also enable deeper understanding and examining of more number of entities under each sector. Some of the sectors that could be considered for further mapping and analysis would be biotechnology, energy and health. A questionnaire based, or an interview based study can be conducted in order to capture the expertise and strengths of the faculties, R&D funds and their research works that are not available in the websites. A questionnaire based survey for individual sectors could also help in a thorough analysis and assessment of research institutions based on different criteria and this could help develop a ranking system for research players.

Interviews can be conducted with the deans or heads of departments of institutions to exclusively understand their interest level and openness to doing collaborative research and technology transfers with European organizations. And a catalogue of such interested entities, specifying their topics of research interest can serve as a very useful tool for the international research bodies.

This study enabled in understanding the strong presence of plenty of highly capable research players in university departments and engineering colleges, whose potential has not been tapped by international players. While renowned research bodies like the CSIR labs, IITs and IISc have always been highly active in the international space for research collaborations and they are the ones that are most of the time, approached for collaboration, there are several other central and state government run universities, engineering colleges and private universities which boasts of high infrastructural facilities and experienced faculties engaged in highly innovative, advanced technological research. A future possibility of study would be to exclusively map these kinds of institutions and promote their capabilities, provide platforms to showcase their research work and encourage them to venture into collaborations with European entities. Most of the 400 entities covered in the database possess high potential of collaboration which is untapped; a study of their research capabilities could be conducted in the future to explore collaboration opportunities.

Private industries, especially in biotechnology and ICT sectors are investing highly in R&D and technological innovation. Such private entities could be mapped.

Another study that could be very interesting will be to understand what business collaborations are spinning off from the research and technology innovations happenings in the research organizations and the universities. This way successful 'lab to market' models and case studies could be catalogued and showcased to interested entities from both India and Europe.

## ANNEX – MATRIX OF R&D PLAYERS IN INDIA

SI No	Institutions	Biotechnology	Health	ICT	Energy	Environment	Transport	Nano Sciences	Social Sciences
1	Indian Institute of Science (IISc)								
2	Indian Institute of Technology – Bombay								
3	Indian Institute of Technology – Kharagpur								
4	Indian Institute of Technology – Delhi								
5	Indian Institute of Technology – Madras								
6	Indian Institute of Technology – Kanpur								
7	Indian Institute of Technology – Guwahati								
8	Indian Institute of Technology – Roorkee								
9	Indian Institute of Technology – Jodhpur								
10	Indian Institute of Technology – Hyderabad								
11	Indian Institute of Technology – Gandhinagar								
12	Indian Institute of Technology – Bhubaneswar								
13	Indian Institute of Technology – Patna								
14	Indian Institute of Technology – Mandi								
15	Indian Institute of Technology – Ropar								
16	Indian Institute of Technology (BHU) – Varanasi								
17	Indian Institute of Technology – Indore								
18	University of Delhi								
19	Jawaharlal Nehru University (JNU)								
20	All India Institute of Medical Sciences								
21	Panjab University								
22	Jawaharlal Nehru Centre for Advanced Scientific Research								
23	Tata Institute of Fundamental Research								
24	Banaras Hindu University (BHU)								
25	National Institute of Pharmaceutical Education & Research								
26	University of Hyderabad								

SI No	Institutions	Biotechnology	Health	ICT	Energy	Environment	Transport	Nano Sciences	Social Sciences
27	Sree Chitra Tirunal Institute for Medical Sciences & Technology								
28	Anna University								
29	Jadavpur University								
30	Indian Agricultural Research Institute								
31	Jamia Hamdard								
32	University of Calcutta								
33	Tamil Nadu Agricultural University								
34	Sanjay Gandhi Post Graduate Institute of Medical Sciences								
35	North Maharashtra University								
36	Aligarh Muslim University (AMU)								
37	Postgraduate Institute of Medical Education & Research								
38	University of Madras								
39	University of Pune								
40	Osmania University								
41	Annamalai University								
42	Forest Research Institute								
43	Punjab Agricultural University								
44	Indian School of Mines (ISM)								
45	University of Allahabad								
46	Indian Institute of Engineering Science and Technology								
47	National Brain Research Centre								
48	National Dairy Research Institute								
49	Indian Statistical Institute								
50	Pondicherry University								
51	Ch. Charan Singh Haryana Agricultural University								
52	Guru Nanak Dev University								
53	Indian Institute of Science Education and Research								



SI No	Institutions	Biotechnology	Health	ICT	Energy	Environment	Transport	Nano Sciences	Social Sciences
54	Cochin University of Science & Technology								
55	Guru Jambheshwar University of Science & Technology								
56	Kurukshetra University								
57	Indian Veterinary Research Institute								
58	University of Kerala								
59	University of Mysore								
60	Bangalore University								
61	University of Mumbai								
62	National Institute of Mental Health & Neuro Sciences								
63	GB Pant University of Agriculture and Technology								
64	Centre for Cellular & Molecular Biology (CCMB)								
65	Institute of Chemical Technology (ICT), Mumbai								
66	Rajiv Gandhi Centre for Biotechnology (RGCB)								
67	National Centre for Biological Sciences (NCBS)								
68	National Research Centre on Plant Biotechnology (NRCPB)								
69	Indian Institute of Chemical Biology (IICB), Kolkata								
70	SRM University								
71	Saurashtra University								
72	The Energy and Resources Institute (TERI)								
73	Variable Energy Cyclotron Centre (VECC)								
74	Sardar Patel Renewable Energy Research Institute (SPRERI)								
75	University of Petroleum and Energy Studies (UPES)								
76	National Environmental Engineering Research Institute (NEERI)								
77	Centre for Science and Environment (CSE)								
78	Translational Health Science & Technology Institute (THSTI)								

SI No	Institutions	Biotechnology	Health	ICT	Energy	Environment	Transport	Nano Sciences	Social Sciences
79	Indian Institute of Environment Management (IEM)								
80	Nansen Environmental Research Centre India (NERCI)								
81	Indian Council of Forestry Research and Education (ICFRE)								
82	G.B. Pant Institute of Himalayan Environment and Development (GBPIHED)								
83	The Indian Institute of Forest Management (IIFM)								
84	Christian Medical College Vellore (CMC, Vellore)								
85	Jawaharlal Institute of Postgraduate Medical Education and Research (JIPMER)								
86	Armed Forces Medical College (AFMC)								
87	Jawaharlal Nehru Technological University (JNTU)								
88	All India Institute of Hygiene & Public Health (AIHH&PH)								
89	Mahatma Gandhi Institute of Medical Sciences (MGIMS)								
90	Institute of Health Management Research (IHMR)								
91	National Institute of Occupational Health (NIOH)								
92	Centre for Development of Advanced Computing (C-DAC)								
93	Amity Institute/ University								
94	Institute for Social and Economic Change (ISEC)								
95	National Institute of Advanced Studies (NIAS)								
96	Center for Economic and Social Studies (CESS)								
97	Centre for the Study of Developing Societies (CSDS)								
98	Tata Institute of Social Sciences (TISS)								
99	Sri Sathya Sai Institute of Higher Learning (SSSIHL)								

SI No	Institutions	Biotechnology	Health	ICT	Energy	Environment	Transport	Nano Sciences	Social Sciences
100	Research Design and Standards Organization (RDSO)								
101	CSIR-Central Road Research Institute (CRRI)								
102	Hindustan Aeronautics Limited (HAL)								
103	National Aerospace Laboratories (NAL) - CSIR								
104	National Institute of Technology, Agartala								
105	Motilal Nehru National Institute of Technology, Allahabad								
106	Maulana Azad National Institute of Technology, Bhopal								
107	National Institute of Technology, Calicut								
108	National Institute of Technology, Durgapur								
109	National Institute of Technology, Hamirpur								
110	Malaviya National Institute of Technology, Jaipur								
111	Dr. B.R. Ambedkar National Institute of Technology, Jalandhar								
112	National Institute of Technology, Jamshedpur								
113	National Institute of Technology, Kurukshetra								
114	Visvesvaraya National Institute of Technology, Nagpur								
115	National Institute of Technology, Patna								
116	National Institute of Technology, Raipur								
117	National Institute of Technology, Rourkela								
118	National Institute of Technology, Silchar								
119	National Institute of Technology, Srinagar								
120	Sardar Vallabhbhai National Institute of Technology, Surat								
121	National Institute of Technology, Surathkal								
122	National Institute of Technology, Tiruchirapalli								
123	National Institute of Technology, Warangal								
124	National Institute of Technology, Sikkim								
125	National Institute of Technology, Goa								

SI No	Institutions	Biotechnology	Health	ICT	Energy	Environment	Transport	Nano Sciences	Social Sciences
126	National Institute of Technology, Arunachal Pradesh								
127	National Institute of Technology, Meghalaya								
128	National Institute of Technology, Nagaland								
129	National Institute of Technology, Manipur								
130	National Institute of Technology, Mizoram								
131	National Institute of Technology, Uttarakhand								
132	National Institute of Technology, Delhi								
133	National Institute of Technology, Puducherry								
134	G.B. Pant Institute of Himalayan Environment and Development (GBPIHED)								
135	Indian Statistical Institute (ISI)								
136	Indian Institute of Information Technology, Allahabad								
137	Indian Institute of Information Technology, Guwahati								
138	Indian Institute of Information Technology and Management, Kerala								
139	International Institute of Information Technology, Hyderabad								
140	International Institute of Information Technology, Bangalore								
141	International Institute of Information Technology, Bhubaneswar								
142	International Institute of Information Technology, Pune								
143	Indraprastha Institute of Information Technology, Delhi								
144	Indian Institute of Information Technology, Design and Manufacturing, Jabalpur								
145	Indian Institute of Information Technology and Management, Gwalior								

## ACRONYMS

<b>AAS</b>	<i>Atomic Absorption Spectrometers</i>
<b>ACTREC</b>	<i>Advanced Centre for Treatment, Research and Education in Cancer</i>
<b>ACTS</b>	<i>Advanced Computing Training School</i>
<b>ADB</b>	<i>Asian Development Bank</i>
<b>ADE</b>	<i>Aeronautical Development Establishment</i>
<b>AERB</b>	<i>Atomic Energy Regulatory Board</i>
<b>AFRI</b>	<i>Arid Forest Research Institute</i>
<b>AFM</b>	<i>Atomic Force Microscope</i>
<b>AFMC</b>	<i>Armed Forces Medical College</i>
<b>AFMRC</b>	<i>Armed Forces Medical Research Committee</i>
<b>AIARS</b>	<i>Amity Institute of Advance Research and Studies</i>
<b>AIB</b>	<i>Amity Institute of Biotechnology</i>
<b>AICTE</b>	<i>All Indian Council for Technical Education</i>
<b>AIIH&amp;PH</b>	<i>All India Institute of Hygiene &amp; Public Health</i>
<b>AIIMS</b>	<i>All India Institute of Medical Sciences</i>
<b>AIMA</b>	<i>All India Management Association</i>
<b>AINT</b>	<i>Amity Institute of Nanotechnology</i>
<b>AIRAE</b>	<i>Amity Institute of Renewable and Alternative Energy</i>
<b>AIRF</b>	<i>Advanced Instrumentation Research Facility</i>
<b>ALGI</b>	<i>Association of Local Governance of India</i>
<b>ALS</b>	<i>Amyotrophic Lateral Sclerosis</i>
<b>AMD</b>	<i>Advanced Micro Devices</i>
<b>AMF</b>	<i>Arbuscular Mycorrhizal Fungi</i>
<b>AMO</b>	<i>Atlantic Multi-decadal Oscillation</i>
<b>AMPL</b>	<i>Advanced Materials and Processing Lab</i>
<b>AMPRI</b>	<i>CSIR-Advanced Materials and Processes Research Institute</i>
<b>AMS</b>	<i>Attendance Monitoring System</i>
<b>ANET</b>	<i>Andaman and Nicobar Island's Environmental Team</i>
<b>ANG</b>	<i>Angiogenin</i>
<b>ANR- DST</b>	<i>Agence Nationale de la Recherche-Department of Science and Technology</i>
<b>AOA</b>	<i>Angle-Of-Attack</i>
<b>APARD</b>	<i>Andhra Pradesh Academy of Rural Development</i>
<b>APFC</b>	<i>Automatic Power Factor Correction</i>
<b>ARCBR</b>	<i>Advanced Research Centre for Bamboo and Rattans</i>

<b>ArcGIS</b>	<i>Arc Global Information System</i>
<b>ARCI</b>	<i>International Advanced Research Centre for Powder Metallurgy and New Materials</i>
<b>ARF</b>	<i>Animal Research Facility</i>
<b>ARISE</b>	<i>Applied Research in Intelligent Systems Engineering</i>
<b>ARRS</b>	<i>Agumbe Rainforest Research Station</i>
<b>ARWU</b>	<i>Academic Ranking of World Universities</i>
<b>ASDC</b>	<i>Aviation Software Development Consultancy India</i>
<b>ASTEC</b>	<i>Assam Science Technology and Environment Council</i>
<b>ASTRU</b>	<i>Association of State Road Transport Undertakings</i>
<b>AWS</b>	<i>Amazon Web Services</i>
<b>BARC</b>	<i>Bhabha Atomic Research Centre</i>
<b>BASE</b>	<i>Business Aligned Service Engineering</i>
<b>BASIC</b>	<i>Building &amp; Strengthening Institutional Capacity on Climate Change</i>
<b>BBSRC</b>	<i>Biotechnology and Biological Sciences Research Council</i>
<b>BCC</b>	<i>Biodiversity and Climate Change</i>
<b>BCM</b>	<i>Biodiversity Conservation and Management</i>
<b>BEE</b>	<i>Bureau of Energy Efficiency</i>
<b>BHEL</b>	<i>Bharat Heavy Electricals Limited</i>
<b>BHU</b>	<i>Banaras Hindu University</i>
<b>BIC</b>	<i>Biomedical Informatics Centre</i>
<b>BIPP</b>	<i>Biotechnology Industry Partnership Program</i>
<b>BITS</b>	<i>Birla Institute of Technology &amp; Science</i>
<b>BMJ</b>	<i>British Medical Journal</i>
<b>BPO</b>	<i>Business Process Outsourcing</i>
<b>BRICS</b>	<i>Brazil, Russia, India, China and South Africa</i>
<b>BRNS</b>	<i>Board of Research in Nuclear Sciences</i>
<b>BRO</b>	<i>Border Roads Organization</i>
<b>BRTS</b>	<i>Bus Rapid Transit Systems</i>
<b>BSBE</b>	<i>Department of Biosciences &amp; Bioengineering</i>
<b>BSBT</b>	<i>Department of Biosciences and Biotechnology</i>
<b>BSC</b>	<i>Biotech Science Cluster</i>
<b>BSI</b>	<i>British Standards Institution</i>
<b>BSNL</b>	<i>Bharat Sanchar Nigam Limited</i>
<b>BTA</b>	<i>Biotechnology Applications</i>
<b>CAEM</b>	<i>Centre for Automotive Energy Materials</i>

<b>CAF</b>	<i>Chinese Academy of Forestry</i>
<b>CAGR</b>	<i>Compound Annual Growth Rate</i>
<b>CARE</b>	<i>Credit Analysis and Research</i>
<b>CATV</b>	<i>Community Access Television</i>
<b>CBD</b>	<i>Centre for Biodesign and Diagnostics</i>
<b>CBT</b>	<i>Center of Biotechnology</i>
<b>CCMB</b>	<i>Centre for Cellular &amp; Molecular Biology</i>
<b>C-CAMP</b>	<i>Centre for Cellular and Molecular Platforms</i>
<b>CCEUS</b>	<i>Centre for Comparative EU Studies</i>
<b>CCHPCP</b>	<i>C-DAC Certified HPC Professional Certification Programme</i>
<b>CCR</b>	<i>Collaborative Class Room</i>
<b>C-DAC</b>	<i>Center for Development of Advanced Computing</i>
<b>C-DEST</b>	<i>Centre for Development of Education, Science and Technology</i>
<b>CDM</b>	<i>Clean Development Mechanism</i>
<b>CDDP</b>	<i>Comprehensive District Development Plan</i>
<b>CDSA</b>	<i>Clinical Development Services Agency</i>
<b>CEA</b>	<i>Central Environment Authority</i>
<b>CEEMS</b>	<i>Centre for Electronics and Embedded Systems</i>
<b>CEN</b>	<i>Centre of Excellence in Nanoelectronics</i>
<b>CEERI</b>	<i>CSIR-Central Electronics Engineering Research Institute</i>
<b>CEL</b>	<i>Central Electronics Limited</i>
<b>CeNSE</b>	<i>Centre for Nano Science and Engineering</i>
<b>CEPT-CoE</b>	<i>Center of Excellence in Urban Transport, CEPT University</i>
<b>CES</b>	<i>Centre for Ecological Sciences</i>
<b>CESA</b>	<i>Department of Computer Science and Engineering Association</i>
<b>CESE</b>	<i>Centre for Environmental Science and Engineering</i>
<b>CESS</b>	<i>Center for Economic and Social Studies</i>
<b>CETPs</b>	<i>Common Effluent Treatment Plants</i>
<b>CFCT</b>	<i>Centre for Fuel Cell Technology</i>
<b>CFMU</b>	<i>Clinical Forensic Medicine Unit</i>
<b>CFRHRD</b>	<i>Centre for Forestry Research and Human Resource Development</i>
<b>CFST</b>	<i>Centre of Food Science &amp; Technology</i>
<b>CGIAR</b>	<i>Consultative Group On International Agricultural Research</i>
<b>CIAR</b>	<i>Centre for Indoor Air Research</i>
<b>CICR</b>	<i>Central Institute for Cotton Research</i>

<b>CIDA-SICI</b>	<i>Canadian International Development Agency- The Shastri Indo-Canadian Institute</i>
<b>CIDC</b>	<i>Children in Difficult Circumstances</i>
<b>CIFF</b>	<i>Central Imaging and Flow cytometry Facility</i>
<b>CIMAP</b>	<i>Central Institute of Medicinal and Aromatic Plants ()</i>
<b>CIMMYT</b>	<i>International Maize and Wheat Improvement Center</i>
<b>CIPS</b>	<i>Centre for Innovations in Public Services</i>
<b>CIRT</b>	<i>Central Institute of Road Transport</i>
<b>CiSTUP</b>	<i>Center for infrastructure, Sustainable Transportation and Urban Planning</i>
<b>CITE</b>	<i>Centre of Innovation for Tomorrow's Enterprise</i>
<b>CIUD</b>	<i>Centre for Integrated Urban Development</i>
<b>CKMNT</b>	<i>Centre for Knowledge Management of Nanoscience and Technology</i>
<b>CNG</b>	<i>Compressed Natural gas, Propane,</i>
<b>CNRS</b>	<i>Centre Nationale de la Recherche Scientifique</i>
<b>CMAL</b>	<i>Coal Mines Authority Limited</i>
<b>CMC</b>	<i>Christian Medical College Vellore</i>
<b>CMPDI</b>	<i>Central Mine Planning and Design Institute</i>
<b>CMI</b>	<i>Chennai Mathematical Institute</i>
<b>CMMACS</b>	<i>Centre for Mathematical Modelling and Computer Simulation,</i>
<b>CMOS</b>	<i>Complementary Metal–Oxide–Semiconductor</i>
<b>CMS</b>	<i>Crew Management System</i>
<b>CMU</b>	<i>Carnegie Mellon University</i>
<b>CNSNT</b>	<i>Centre for Nanoscience and Nanotechnology</i>
<b>CNST</b>	<i>Centre for Nano Science and Technology</i>
<b>CO2</b>	<i>Carbon Di Oxide</i>
<b>COA</b>	<i>Control Office Application</i>
<b>COAST</b>	<i>Centre for Environment and Sustainability Carl von Ossietzky University</i>
<b>COD</b>	<i>Chemical Oxygen Demand</i>
<b>CONCERT</b>	<i>Countrywide Network of Computerized Enhancement Reservation and Ticketing</i>
<b>CoNe</b>	<i>Computational Nanoengineering</i>
<b>CPCB</b>	<i>Central Pollution Control Board</i>
<b>CPHERI</b>	<i>Central Public Health Engineering Research Institute</i>
<b>CPR</b>	<i>Centre for Policy Research</i>
<b>CPRI</b>	<i>Central Power Research Institute</i>
<b>CPWD</b>	<i>Central Public Works Department</i>



<b>CRDO</b>	<i>Clinical Research Development Office</i>
<b>CRIS</b>	<i>Centre for Railway information systems</i>
<b>CRISPR</b>	<i>clustered regularly interspaced short palindromic repeats</i>
<b>CRNTS</b>	<i>Centre for Research in Nanotechnology &amp; Science</i>
<b>CRR</b>	<i>Centre for Railway Research</i>
<b>CRRI</b>	<i>CSIR-Central Road Research Institute</i>
<b>CRTL</b>	<i>Central Research and Testing Laboratory</i>
<b>CSA</b>	<i>Department of Computer Science and Automation</i>
<b>CSAUAT</b>	<i>Chandra Shekhar Azad University of Agriculture &amp; Technology</i>
<b>CSB</b>	<i>Central Silk Board</i>
<b>CSD</b>	<i>Commission on Sustainable Development</i>
<b>CSDS</b>	<i>Centre for the Study of Developing Societies</i>
<b>CSE</b>	<i>Centre for Energy Studies</i>
<b>CSE</b>	<i>Centre for Science and Environment</i>
<b>CSE</b>	<i>Computer Science &amp; Engineering</i>
<b>CSFER</b>	<i>Centre for Social Forestry and Eco-Rehabilitation</i>
<b>CSIL</b>	<i>Cranes Software International Limited</i>
<b>CSIR</b>	<i>Council of Scientific and Industrial Research</i>
<b>CSIRO</b>	<i>Commonwealth Scientific and Industrial Research Organization</i>
<b>CSL</b>	<i>Computational Sciences Lab</i>
<b>CSMCRI</b>	<i>Central Salt and Marine Chemicals Research Institute</i>
<b>CSO</b>	<i>Central Standards Office</i>
<b>CSP</b>	<i>Concentrated Solar Power</i>
<b>CSU</b>	<i>Colorado State University</i>
<b>C-STAR</b>	<i>Security, Theory and Algorithms</i>
<b>CTATIC</b>	<i>Centre for Technology Acquisition Transfer and International Cooperation</i>
<b>CTRANS</b>	<i>Centre for Transportation Systems</i>
<b>CUSAT</b>	<i>Cochin University of Science &amp; Technology</i>
<b>CVD</b>	<i>Chemical Vapor Deposition</i>
<b>CVIT</b>	<i>Centre for Visual Information Technology</i>
<b>CWF</b>	<i>Climate Works Foundation</i>
<b>CZTS</b>	<i>Copper Zinc Tin Sulphide</i>
<b>DAAD</b>	<i>German Academic Exchange Service</i>
<b>DAC</b>	<i>Department of Agriculture and Cooperation</i>
<b>DAE</b>	<i>Department of Atomic Energy</i>

<b>DAIICT</b>	<i>Dhirubhai Ambani Institute of Information and Communication Technology</i>
<b>DANIDA</b>	<i>Danish International Development Agency</i>
<b>DBT</b>	<i>Department of Biotechnology</i>
<b>DC</b>	<i>Doctral Committe</i>
<b>DeiTY</b>	<i>Department of Electronics &amp; Information Technology (erstwhile DIT)</i>
<b>DFID</b>	<i>Department for International Development</i>
<b>DGFASLI</b>	<i>Directore General, Factory Advice Service &amp; Labour Institutes</i>
<b>DGHS</b>	<i>Directorate General of Health Services</i>
<b>DGMS</b>	<i>Directorate General of Mines Safety</i>
<b>DGPS</b>	<i>Differential Global Positioning System</i>
<b>DHR</b>	<i>Department of Health Research</i>
<b>DHSS</b>	<i>Department of Humanities and Social Sciences</i>
<b>DIC</b>	<i>Distributed Information Centre</i>
<b>DIRF</b>	<i>Digital Information Resource Facility</i>
<b>DISAFRI</b>	<i>Department of Forest Science and Resources</i>
<b>DIT</b>	<i>Department of Information Technology</i>
<b>DLTS</b>	<i>Deep-Level Transient Spectroscopy</i>
<b>DMD</b>	<i>Duchenne muscular dystrophy</i>
<b>DME</b>	<i>Dimethyl Ether</i>
<b>DMER</b>	<i>Department of Molecular Endocrinology and Reproduction</i>
<b>DMIS</b>	<i>Document Management Information System</i>
<b>DMM</b>	<i>Department of Molecular Microbiology</i>
<b>DMMC</b>	<i>Department of Molecular Medicine and Cancer Biology</i>
<b>DN</b>	<i>Department of Neurobiology</i>
<b>DNA</b>	<i>Deoxyribonucleic acid</i>
<b>DNV</b>	<i>Det Norske Veritas</i>
<b>DOE</b>	<i>Designated Operational Entity</i>
<b>DoHSS</b>	<i>Department of Humanities and Social Sciences</i>
<b>DPMB</b>	<i>Department of Plant Molecular Biology</i>
<b>DRC</b>	<i>Dynamic Reaction Cell</i>
<b>DRDO</b>	<i>Defence Research &amp; Development Organization</i>
<b>DSG</b>	<i>Document Solutions Group</i>
<b>DSIR</b>	<i>Department of Scientific &amp; Industrial Research</i>
<b>DSSC</b>	<i>Dye Sensitized Solar Cells</i>
<b>DST</b>	<i>Department of Science &amp; Technology</i>

<b>DSTAI</b>	<i>Directory of S&amp;T Awards in India</i>
<b>DTAF</b>	<i>Device Test Automation Framework</i>
<b>DTU</b>	<i>Delhi Technological University</i>
<b>DVC</b>	<i>Damodar Valley Corporation</i>
<b>EAM</b>	<i>Environmental Assessment &amp; Management</i>
<b>EBTC</b>	<i>European Business Technology Center</i>
<b>ECU</b>	<i>Edith Cowan University</i>
<b>EDCiL</b>	<i>Educational Consultants India Limited</i>
<b>EDX</b>	<i>Energy Dispersive X-Ray Spectroscopy</i>
<b>EEM</b>	<i>Environmental Engineering and Management</i>
<b>EFI</b>	<i>Electronic Fuel Injection</i>
<b>EIA</b>	<i>Environmental Impact Assessment</i>
<b>ELISA</b>	<i>Enzyme-linked immunosorbent assay</i>
<b>EM</b>	<i>Environment Management</i>
<b>ENVIS</b>	<i>Environmental Information System</i>
<b>EPG</b>	<i>Engineered nanoProducts Germany</i>
<b>ER&amp;DCI</b>	<i>Electronic Research and Development Centre of India</i>
<b>ERC</b>	<i>Energy Research Centre</i>
<b>ERDA</b>	<i>Electrical Research and Development Association</i>
<b>ERDAS</b>	<i>Earth Resources Data Analysis System</i>
<b>ERI</b>	<i>Environment Research Institute</i>
<b>ERS</b>	<i>Engineering and Research Service</i>
<b>ESRC</b>	<i>Economic and Social Research Council</i>
<b>EPMA</b>	<i>Electron Probe Micro Analyzer</i>
<b>EPS</b>	<i>E-Procurement System</i>
<b>EPTRI</b>	<i>Environment Protection Training and Research Institute</i>
<b>EQM</b>	<i>Environment Quality Mapping</i>
<b>ERRC</b>	<i>Environmental Resources Research Centre</i>
<b>ESCAP</b>	<i>Economic and Social Council for Asia and Pacific</i>
<b>ESD</b>	<i>Environment and Sustainable Development</i>
<b>ETPs</b>	<i>Effluent Treatment Plants</i>
<b>EWRE</b>	<i>Environmental and Water Resources Engineering</i>
<b>FACS</b>	<i>Fluorescence-activated cell sorting</i>
<b>FAO</b>	<i>Food and Agriculture Organization of the United Nations</i>
<b>FCL</b>	<i>Fault Current Limiter</i>
<b>FDI</b>	<i>Foreign Direct Investment</i>

<b>FES</b>	<i>Functional electrical Stimulation</i>
<b>FESEM</b>	<i>Field Emission Scanning Electron Microscope</i>
<b>FHI</b>	<i>Family Health International</i>
<b>FICCI</b>	<i>Federation of Indian Chambers of Commerce&amp; Industry</i>
<b>FINER</b>	<i>Federation of Industries &amp; commerce of North Eastern Region</i>
<b>FIST</b>	<i>Fund for Infrastructure in Science and Technology</i>
<b>FKCCI</b>	<i>Federation of Karnataka Chambers of Commerce and Industry</i>
<b>FNSR</b>	<i>Foundation for National Security Research</i>
<b>FOIS</b>	<i>Freight Operations Information System</i>
<b>FPLC</b>	<i>Fast Protein Liquid Chromatography</i>
<b>FP7</b>	<i>Seventh Framework Programme</i>
<b>FRI</b>	<i>Forest Research Institute</i>
<b>FSWs</b>	<i>Female Sex Workers</i>
<b>FTIR</b>	<i>Fourier Transform Infrared Spectroscopy</i>
<b>G2C</b>	<i>Government-to-citizen</i>
<b>GBIF</b>	<i>Global Biodiversity Information Facility</i>
<b>GBPIHED</b>	<i>G.B. Pant Institute of Himalayan Environment and Development</i>
<b>GBPUAT</b>	<i>GB Pant University of Agriculture &amp; Technology</i>
<b>GCRI</b>	<i>Gujarat Cancer &amp; Research Institute</i>
<b>GCS</b>	<i>Gujarat Cancer Society</i>
<b>GC/MS</b>	<i>Gas Chromatography-Mass Spectrometry</i>
<b>GDPI</b>	<i>Group Discussion and Personal Interview</i>
<b>GEC</b>	<i>Global Environment Centre</i>
<b>GEF</b>	<i>Global Environment Facility</i>
<b>GERC</b>	<i>Gujarat Electricity Regulatory Commission</i>
<b>GERD</b>	<i>Gross Expenditure in R&amp;D</i>
<b>GERD</b>	<i>Gastro-esophageal reflux disease</i>
<b>GERMI</b>	<i>Gujarat Energy Research &amp; Management Institute</i>
<b>GIS</b>	<i>Geographic information system</i>
<b>GIST</b>	<i>Graphics and Intelligence based Script Technology</i>
<b>GITA</b>	<i>Global Innovation Technology Alliance</i>
<b>GKVK</b>	<i>Gandhi Krishi Vignana Kendra</i>
<b>GLP</b>	<i>Good Laboratory Practice</i>
<b>GNLG</b>	<i>Global Network on Local Governance</i>
<b>GoI</b>	<i>Government of India</i>
<b>GPCRs</b>	<i>G Protein-Coupled Receptors</i>

<b>GPR</b>	<i>Ground penetration radar</i>
<b>GRIIC</b>	<i>GERMI Research, Innovation &amp; Incubation Centre</i>
<b>GSPC</b>	<i>Gujarat State Petroleum Corporation Ltd</i>
<b>GTC</b>	<i>General Test Committee</i>
<b>GTZ</b>	<i>Gesellschaft für Technische Zusammenarbeit</i>
<b>GUJCOST</b>	<i>Gujarat Council of Science and Technology</i>
<b>HAL</b>	<i>Hindustan Aeronautics Limited</i>
<b>HCI</b>	<i>Human-Computer Interface</i>
<b>HEMT</b>	<i>High-Electron-Mobility Transistor</i>
<b>HFRI</b>	<i>Himalayan Forest Research Institute</i>
<b>HLL</b>	<i>Hindustan Latex Limited</i>
<b>HLA</b>	<i>Human Leukocyte Antigen</i>
<b>HPLC</b>	<i>High pressure Liquid Chromatography</i>
<b>HPMC</b>	<i>Himachal Pradesh Horticultural Produce Marketing and Processing Corporation Limited</i>
<b>HRGs</b>	<i>High Risk Groups</i>
<b>HSFP</b>	<i>Human Frontier Science Program</i>
<b>HTRA</b>	<i>Half Time Research Assistantship</i>
<b>HTTA</b>	<i>Half Time Teaching Assistantship</i>
<b>HUDCO</b>	<i>Housing and Urban Development Corporation</i>
<b>HuEMan</b>	<i>Human Aspects of Software Engineering and Management</i>
<b>HUL</b>	<i>Hindustan Unilever</i>
<b>HW-CVD</b>	<i>Hot Wire - Chemical Vapour Deposition</i>
<b>IAER</b>	<i>Institute of Alternate Energy Research</i>
<b>IAIA</b>	<i>International Association of Impact Assessment</i>
<b>IAM</b>	<i>Inter-Axle Misalignment</i>
<b>IARC</b>	<i>International Agency for Research on Cancer</i>
<b>IARI</b>	<i>Indian Agricultural Research Institute</i>
<b>IBAB</b>	<i>Institute of Bioinformatics and Applied Biotechnology</i>
<b>IBBA</b>	<i>Integrated Behavioral and Biological Assessment</i>
<b>IBBM</b>	<i>Instituto de Bioquímica y Biología Molecular</i>
<b>IBEF</b>	<i>Indian Brand Equity Foundation</i>
<b>iBIO</b>	<i>Inter-Disciplinary Biology programme</i>
<b>IBM</b>	<i>International Business Machines</i>
<b>IBSA</b>	<i>India, Brazil, South Africa Local Governance Forum</i>
<b>ICAR</b>	<i>Indian Council for Agricultural Research</i>

<b>ICCG</b>	<i>International Collaboration for Clinical Genomics</i>
<b>ICCL</b>	<i>International Competence Center Logistics</i>
<b>ICDDR, B</b>	<i>International Centre for Diarrhoeal Disease Research, Bangladesh</i>
<b>ICFRE</b>	<i>Indian Council of Forestry Research and Education</i>
<b>ICFRD</b>	<i>Indian Council of Forestry Research &amp; Development</i>
<b>ICIMOD</b>	<i>International Centre for Integrated Mountain Development</i>
<b>ICMR</b>	<i>Indian Council for Medical Research</i>
<b>ICMS</b>	<i>Integrated Coach Management System</i>
<b>ICP-MS</b>	<i>Inductively Coupled Plasma-Mass Spectrometer</i>
<b>ICRISAT</b>	<i>International Crops Research Institute for the Semi-Arid-Tropics</i>
<b>ICSS</b>	<i>International College for Security Studies</i>
<b>ICSSR</b>	<i>Indian Council of Social Science Research</i>
<b>ICS-UNIDO</b>	<i>International Centre for Science and High Technology- United Nations Industrial</i>
<b>ICT</b>	<i>Information and Communications Technology</i>
<b>ICTE</b>	<i>Information and Communication Technology and Electronics</i>
<b>IERP</b>	<i>Integrated Eco-development Research Programme</i>
<b>IDRC</b>	<i>International Development Research Centre</i>
<b>IDSA</b>	<i>Institute for Defence Studies and Analyses</i>
<b>IDTS</b>	<i>Innovative Driving Test System</i>
<b>IDU</b>	<i>Injection Drug Use</i>
<b>IFDRC</b>	<i>Indo-Finnish Diagnostic Research Centre</i>
<b>IFF</b>	<i>Fraunhofer Institute for Factory Operation and Automation</i>
<b>IFGTB</b>	<i>Institute of Forest Genetics and Tree Breeding</i>
<b>IFN gamma</b>	<i>Interferon gamma</i>
<b>IFP</b>	<i>Institute of Forest Productivity</i>
<b>IGCAR</b>	<i>Indira Gandhi Centre for Atomic Research</i>
<b>IGES</b>	<i>Institute for Global Environmental Strategies</i>
<b>IGIB</b>	<i>Institute of Genomics and Integrative Biology</i>
<b>IGIDR</b>	<i>Indira Gandhi Institute of Development &amp; Research</i>
<b>IGNOU</b>	<i>Indira Gandhi National Open University</i>
<b>IHMR</b>	<i>Institute of Health Management Research</i>
<b>IHR</b>	<i>Indian Himalayan Region</i>
<b>IIA</b>	<i>Indian Institute of Astrophysics</i>
<b>IIAR</b>	<i>Indian Institute of Agriculture Research</i>
<b>IIASA</b>	<i>Institute for Applied System Analysis</i>

<b>IICB</b>	<i>Indian Institute of Chemical Biology</i>
<b>IICT</b>	<i>Indian Institute of Chemical Technology</i>
<b>IIEEM</b>	<i>Indian Institute of Environment Management</i>
<b>IIFM</b>	<i>The Indian Institute of Forest Management</i>
<b>IIIEE</b>	<i>International Institute for Industrial Environmental Economics</i>
<b>IIIT</b>	<i>International Institute of Information Technology</i>
<b>IIP</b>	<i>Indian Institute of Petroleum</i>
<b>IIT</b>	<i>Indian Institute of Technology</i>
<b>IISc</b>	<i>Indian Institute of Science</i>
<b>IISER</b>	<i>Indian Institutes of Science Education and Research</i>
<b>ILP</b>	<i>Indian Languages Programme</i>
<b>IRCA</b>	<i>Indian Railway Conference Association</i>
<b>IRISH</b>	<i>Institute for Research in Social Sciences and Humanities</i>
<b>IRL</b>	<i>IBM India Research Lab</i>
<b>IIRS</b>	<i>Indian Institute of Remote Sensing</i>
<b>IMCL</b>	<i>IndusInd Media &amp; Communications Ltd.</i>
<b>IMS</b>	<i>Institute of Medical Sciences</i>
<b>IMR</b>	<i>Indian Monsoon Rainfall</i>
<b>InGaN</b>	<i>Indium-Gallium Nitride</i>
<b>INRIA</b>	<i>Institut National De Recherche En Informatique Et En Automatique</i>
<b>INSA</b>	<i>Indian National Science Academy</i>
<b>INSDOC</b>	<i>Indian National Scientific Documentation Centre</i>
<b>INSPIRE</b>	<i>Innovation in Science Pursuit for Inspired Researcher</i>
<b>INST</b>	<i>Institute of Nano Science &amp; Technology</i>
<b>INUP</b>	<i>Indian Nanoelectronics User's Programme</i>
<b>IOC</b>	<i>Indian Oil Corporation Ltd</i>
<b>IOCL</b>	<i>Indian Oil Corporation Limited</i>
<b>IPC</b>	<i>Inorganic and Physical Chemistry</i>
<b>IPCS</b>	<i>Institute of Peace and Conflict Studies</i>
<b>IPMS</b>	<i>Institute for Problems of Materials Science</i>
<b>IPNI</b>	<i>International Plant Names Index</i>
<b>IPO</b>	<i>Initial Public Offering</i>
<b>IPR</b>	<i>Intellectual property rights</i>
<b>IRS</b>	<i>Institute of Remote Sensing</i>
<b>IRT</b>	<i>Institute of Road Transport</i>
<b>IRTT</b>	<i>Institute Of Road and Transport Technology</i>

<b>ISEC</b>	<i>Institute for Social and Economic Change</i>
<b>ISI</b>	<i>Indian Statistical Institute</i>
<b>ISIRD</b>	<i>International Society of Invertebrate Reproduction and Development</i>
<b>ISM</b>	<i>International School of Management</i>
<b>ISM</b>	<i>Indian School of Mines</i>
<b>ISM</b>	<i>Indian Summer Monsoon</i>
<b>ISO</b>	<i>International Organization for Standardization</i>
<b>ISRO</b>	<i>Indian Space Research Organization</i>
<b>ISS</b>	<i>Institute of Social Sciences</i>
<b>ISTC</b>	<i>Illinois Sustainable Technology Centre</i>
<b>ISTP</b>	<i>International Science and Technology Partnerships</i>
<b>ITS</b>	<i>Intelligent Transport System</i>
<b>ITSMA</b>	<i>Interactive Technology, Software and Media Association</i>
<b>ITTO</b>	<i>International Tropical Timber Organisation</i>
<b>IUATLD</b>	<i>International Union against Tuberculosis and Lung Diseases</i>
<b>IUSSTF</b>	<i>Indo - US Science &amp; Technology Forum</i>
<b>IUT</b>	<i>Institute of Urban Transport India</i>
<b>IWA</b>	<i>International Water Association</i>
<b>IWSA</b>	<i>Indian Women Scientists' Association</i>
<b>IWST</b>	<i>Institute of Wood Science and Technology</i>
<b>JCTSL</b>	<i>Jaipur City Transport Services Limited</i>
<b>JIPMER</b>	<i>Jawaharlal Institute of Postgraduate Medical Education and Research</i>
<b>JMDC</b>	<i>Jute Manufactures Development Council</i>
<b>JMRC</b>	<i>Jaipur Metro Rail Corporation</i>
<b>JNCASR</b>	<i>Jawaharlal Nehru Centre for Advanced Scientific Research</i>
<b>JNTUH</b>	<i>Jawaharlal Nehru Technological University Hyderabad</i>
<b>JNTUK</b>	<i>Jawaharlal Nehru Technological University Kakinada</i>
<b>JNU</b>	<i>Jawaharlal Nehru University</i>
<b>JTA</b>	<i>Jaipur Transport Authority</i>
<b>KACST</b>	<i>King Abdulaziz City for Science &amp; Technology</i>
<b>KCB</b>	<i>Knowledge Product &amp; Capacity Building</i>
<b>KCSTC</b>	<i>Kalpana Chawla Space Technology Cell</i>
<b>KDMTU</b>	<i>Kalyan Dombivli Municipal Transport Undertaking</i>
<b>KFW</b>	<i>Kreditanstalt für Wiederaufbau</i>
<b>KMC</b>	<i>Kasturba Medical College</i>
<b>KMC</b>	<i>Knowledge Management Centre</i>



<b>KPO</b>	<i>Knowledge Processing Outsourcing</i>
<b>KSEB</b>	<i>Kerala State Electricity Board</i>
<b>KSRCT</b>	<i>K. S. Rangasamy College of Technology</i>
<b>KUFOS</b>	<i>Kerala University of Fisheries and Ocean Studies</i>
<b>LaBL</b>	<i>Lighting a Billion Lives</i>
<b>LAM-ICPMS</b>	<i>Laser Ablated inductively coupled plasma mass spectrometer</i>
<b>LAN</b>	<i>Local Area Network</i>
<b>LCA</b>	<i>Life Cycle Assessment</i>
<b>LCD</b>	<i>Liquid-Crystal Display</i>
<b>LC-MS</b>	<i>Liquid chromatography–mass spectrometry</i>
<b>LHMC</b>	<i>Lady Hardinge Medical College</i>
<b>LMMD</b>	<i>Laboratory Medicine &amp; Molecular Diagnostics</i>
<b>LoS</b>	<i>Level of Service</i>
<b>LPG</b>	<i>Liquid Petroleum Gas,</i>
<b>LSE</b>	<i>London School of Economics</i>
<b>LTRC</b>	<i>Language Technologies Research Centre</i>
<b>LTT</b>	<i>Lehrstuhl für Technische Thermodynamik</i>
<b>LVAD</b>	<i>Left Ventricular Assist Device</i>
<b>MACs</b>	<i>Medicinal and aromatic crops</i>
<b>MALDI</b>	<i>Matrix-assisted laser desorption/ionization</i>
<b>MAMC</b>	<i>Maulana Azad Medical College</i>
<b>MAP</b>	<i>Mobile Agent Platform</i>
<b>MAPs</b>	<i>Medicinal and aromatic plants</i>
<b>MBA</b>	<i>Master of Business Administration</i>
<b>MBS</b>	<i>Microsoft Business Solutions</i>
<b>MBU</b>	<i>Molecular Biophysics Unit</i>
<b>MCA</b>	<i>Master of Computer Applications</i>
<b>MCBN</b>	<i>Global Network for Molecular and Cell Biology</i>
<b>MCD</b>	<i>Municipal Corporation of Delhi</i>
<b>MCHR</b>	<i>Missouri Commission on Human Rights</i>
<b>MCIT</b>	<i>Ministry of Communications &amp; Information Technology</i>
<b>MDRA</b>	<i>Marketing and Development Research Associates</i>
<b>MEA</b>	<i>Ministry of External Affairs</i>
<b>MEMS</b>	<i>Microelectromechanical systems</i>
<b>MESHAR</b>	<i>Malabar Education Society for Human Resource Development and Research</i>

<b>MFPI</b>	<i>Ministry of Food Processing Industries</i>
<b>MGIMS</b>	<i>Mahatma Gandhi Institute of Medical Sciences</i>
<b>MGICCC</b>	<i>Mahatma Gandhi Institute of Combating Climate Change</i>
<b>MHRD</b>	<i>Ministry of Human Resource Development</i>
<b>MIT</b>	<i>Massachusetts Institute of Technology</i>
<b>MJAFI</b>	<i>Medical Journal Armed Forces of India</i>
<b>M2M</b>	<i>Machine to Machine</i>
<b>MMST</b>	<i>Masters Program in Medical Science and Technology</i>
<b>MNC</b>	<i>Multinational Corporation</i>
<b>MNES</b>	<i>Ministry of Non-Conventional Energy Sources</i>
<b>MNIT</b>	<i>Malaviya National Institute of Technology</i>
<b>MNRE</b>	<i>Ministry of New and Renewable Energy</i>
<b>MOEF</b>	<i>Ministry of Environment &amp; Forests</i>
<b>MOFs</b>	<i>Metal-Organic Frameworks</i>
<b>MoC</b>	<i>Memorandum of Cooperation</i>
<b>MORTH</b>	<i>Ministry of Road Transport &amp; Highways</i>
<b>MOUD</b>	<i>Ministry of Urban Development</i>
<b>MoUs</b>	<i>Memorandum of understanding</i>
<b>MPA</b>	<i>Mineral Products Association</i>
<b>MPH</b>	<i>Masters in Public Health</i>
<b>MSc</b>	<i>Master of Science</i>
<b>MSIDC</b>	<i>Microsoft India Development Centre</i>
<b>MSME</b>	<i>Micro Small and Medium Enterprises</i>
<b>MSR</b>	<i>Microsoft Research</i>
<b>MST</b>	<i>School of Medical Science and Technology</i>
<b>M.Tech</b>	<i>Master of Technology</i>
<b>NAAC</b>	<i>National Assessment and Accreditation Council</i>
<b>NAC</b>	<i>National Advisory Committee</i>
<b>NAIP</b>	<i>National Agricultural Innovation Project</i>
<b>NAL</b>	<i>National Aerospace Laboratories</i>
<b>NABARD</b>	<i>National Bank for Agriculture and Rural Development</i>
<b>NABL</b>	<i>National Accreditation Board for Testing and Calibration Laboratories</i>
<b>NAPLs</b>	<i>Non-Aqueous Liquid Pollutants</i>
<b>NASSCOM</b>	<i>National Association of Software and Services Companies</i>
<b>NATP</b>	<i>National Agricultural Technology Project</i>
<b>NBAGR</b>	<i>National Bureau of Animal Genetic Resources</i>

<b>NCBS</b>	<i>National Centre for Biological Sciences</i>
<b>NCCC</b>	<i>National Cyber Coordination Centre</i>
<b>NCCS</b>	<i>National Centre for Cell Science</i>
<b>NCI</b>	<i>Nippon Chemical Industrial Co. Ltd</i>
<b>NCIIPC</b>	<i>National Critical Information Infrastructure Protection Centre</i>
<b>NCL</b>	<i>National Chemical Laboratory</i>
<b>NCMRWF</b>	<i>National Centre for Medium Range Weather Forecasting</i>
<b>NCNST</b>	<i>National Center for Nanoscience and Technology</i>
<b>NCPA</b>	<i>National Centre for the Performing Arts</i>
<b>NCST</b>	<i>National Centre for Software Technology</i>
<b>NCR</b>	<i>National Capital Region</i>
<b>NDC</b>	<i>National Development Council</i>
<b>NEC</b>	<i>North Eastern Council</i>
<b>NEERI</b>	<i>National Environmental Engineering Research Institute</i>
<b>NEIST</b>	<i>North East Institute of Science &amp; Technology</i>
<b>NEMS</b>	<i>Nanoelectromechanical Systems</i>
<b>NERCI</b>	<i>Nansen Environmental Research Centre India</i>
<b>NFBSFARA</b>	<i>National Funds for Basic Strategic and Frontier Application Research in Agriculture</i>
<b>NGO</b>	<i>Non Government Organization</i>
<b>NGRI</b>	<i>CSIR- National Geophysical Research Institute</i>
<b>NHAI</b>	<i>National Highways Authority of India</i>
<b>NHLBI</b>	<i>National Heart Lung Blood Institute</i>
<b>NHRC</b>	<i>National Human Rights Commission</i>
<b>NIAS</b>	<i>National Institute of Advanced Studies</i>
<b>NIB</b>	<i>Nordic Investment Bank</i>
<b>NIC</b>	<i>National Innovation Council</i>
<b>NICTA</b>	<i>National ICT Australia</i>
<b>NIH</b>	<i>National Institutes of Health</i>
<b>NIJ</b>	<i>National Institute of Immunology</i>
<b>NIIST</b>	<i>National Institute for Interdisciplinary Science and Technology</i>
<b>NIN</b>	<i>National Institute of Nutrition</i>
<b>NIMH</b>	<i>National Institute of Miners' Health</i>
<b>NIMS</b>	<i>National Institute for Materials Science</i>
<b>NIO</b>	<i>National Institute of Oceanography</i>
<b>NIOH</b>	<i>National Institute of Occupational Health</i>

<b>NIPER</b>	<i>National Institute of Pharmaceutical Education and Research</i>
<b>NIRD</b>	<i>National Institute of Rural Development</i>
<b>NIRM</b>	<i>National Institute of Rural Development</i>
<b>NISCAIR</b>	<i>National Institute of Science Communication and Information Resources</i>
<b>NISCOM</b>	<i>National Institute of Science Communication</i>
<b>NISER</b>	<i>National Institute of Science Education and Research</i>
<b>NISG</b>	<i>National Institute for Smart Government</i>
<b>NIST</b>	<i>Center for Nano-Science and Technology-NIST</i>
<b>NITT</b>	<i>National Institute of Technology, Tiruchirappalli</i>
<b>NIV</b>	<i>National Institute of Virology</i>
<b>NJIT</b>	<i>New Jersey Institute of Technology</i>
<b>NKRC</b>	<i>National Knowledge Resource Consortium</i>
<b>NMAET</b>	<i>National Mission on Agricultural Extension and Technology</i>
<b>NMITLI</b>	<i>New Millennium Indian Technology leadership Initiative</i>
<b>NMP</b>	<i>N-Methylpyrrolidone</i>
<b>NMPB</b>	<i>National Medicinal Plant Board</i>
<b>NMR</b>	<i>Nuclear Magnetic Resonance</i>
<b>MNRE</b>	<i>Ministry of New and Renewable Energy</i>
<b>NMRL</b>	<i>Naval Materials Research Laboratory</i>
<b>NMT</b>	<i>Non-Motorized Transport</i>
<b>NOPR</b>	<i>NISCAIR ONLINE PERIODICALS REPOSITORY</i>
<b>NORAD</b>	<i>North American Aerospace Defense Command</i>
<b>NOVOD</b>	<i>National Oilseeds and Vegetable Oils Development</i>
<b>NPL</b>	<i>National Physical Laboratory</i>
<b>N-PPP</b>	<i>Not-For-Profit, Public Private Partnership</i>
<b>NRC-IMI</b>	<i>Industrial Materials Institute of National Research Council of Canada</i>
<b>NRCPB</b>	<i>National Research Centre on Plant Biotechnology</i>
<b>NRDC</b>	<i>National Research Development Corporation</i>
<b>NREGA</b>	<i>National Rural Employment Guarantee Act</i>
<b>NREGS</b>	<i>National Rural Employment Guarantee Scheme</i>
<b>NRSA</b>	<i>National Remote Sensing Agency</i>
<b>NSF</b>	<i>National Science Foundation</i>
<b>NSHM</b>	<i>National Sustainable Habitat Mission</i>
<b>NSNT</b>	<i>Institute of Nanoscience and Nanotechnology</i>
<b>NSTMIS</b>	<i>National Science and Technology Management Information System</i>
<b>NTDPC</b>	<i>National Transport Development Policy Committee</i>

<b>NTES</b>	<i>National Train Enquiry System</i>
<b>NTHU</b>	<i>National Tsing Hua University</i>
<b>NTPC</b>	<i>National Thermal Power Corporation</i>
<b>NTRO</b>	<i>National Technical Research Organisation</i>
<b>NTUT</b>	<i>National Taipei University of Technology</i>
<b>NUI</b>	<i>Natural User Interface</i>
<b>NUTP</b>	<i>National Urban Transport Policy</i>
<b>ODA</b>	<i>Official Development Association</i>
<b>OEMs</b>	<i>Original Equipment Manufacturers</i>
<b>OHE</b>	<i>Overhead Equipment</i>
<b>OHRI</b>	<i>Occupational Health Research Institute</i>
<b>OHSU</b>	<i>Oregon Health &amp; Science University</i>
<b>OIDB</b>	<i>Oil Industry Development Board</i>
<b>OLEDs</b>	<i>Organic Light-Emitting Diodes</i>
<b>OMRF</b>	<i>Oklahoma Medical Research Foundation</i>
<b>OMS</b>	<i>Oscillation Monitoring systems</i>
<b>ONGC</b>	<i>Oil and Natural Gas Commission</i>
<b>OPAC</b>	<i>Online Public Access Catalogue</i>
<b>OPM</b>	<i>Oxford Policy Management</i>
<b>OREDA</b>	<i>Orissa Renewable Energy Development Agency</i>
<b>OSDD</b>	<i>Open Source Drug Discovery</i>
<b>OSL</b>	<i>Optically Stimulated Luminescence</i>
<b>PACE</b>	<i>Programming, Architecture and Compilers Engineering</i>
<b>PAN</b>	<i>Permanent Account Number</i>
<b>PBC</b>	<i>Pediatric Biology Centre</i>
<b>PCBR</b>	<i>Policy Center for Biomedical Research</i>
<b>PCR</b>	<i>Polymerase Chain Reaction</i>
<b>P-CVD</b>	<i>Plasma Chemical Vapor Deposition</i>
<b>PDPU</b>	<i>Pandit Deendayal Petroleum University</i>
<b>PEM</b>	<i>Proton Exchange Membrane</i>
<b>PGDEM</b>	<i>Post Graduate Diploma in Environment Management</i>
<b>PGDSEM</b>	<i>Post Graduate Diploma in Sustainable Environment Management</i>
<b>PGIMER</b>	<i>Postgraduate Institute of Medical Education &amp; Research</i>
<b>PGPR</b>	<i>Polyglycerol polyricinoleate</i>
<b>Ph.D</b>	<i>Doctor of Philosophy</i>
<b>PHFI</b>	<i>Public Health Foundation of India</i>

<b>PLD</b>	<i>Pulsed Laser Deposition</i>
<b>PML</b>	<i>Plymouth Marine Laboratory</i>
<b>PMPML</b>	<i>Pune Mahanagar Parivahan Mahamandal Limited</i>
<b>PPD</b>	<i>UN Partners in Population and Development</i>
<b>PPIC</b>	<i>Potash and Phosphate Institute of Canada</i>
<b>PPP</b>	<i>Public Private Partnership</i>
<b>PRDSF</b>	<i>Pharmaceuticals R&amp;D and Support Fund</i>
<b>PRS</b>	<i>Passenger Reservation Services</i>
<b>PSUs</b>	<i>Indian public sector units</i>
<b>PUC</b>	<i>Pollution under Control Certificate</i>
<b>PWRD</b>	<i>Assam Public Works Roads Department</i>
<b>QUT</b>	<i>Queensland University of Technology</i>
<b>RBI</b>	<i>Reserve Bank of India</i>
<b>RCH</b>	<i>Reproductive Child Health</i>
<b>RDCIS</b>	<i>Research and Development Centre for Iron and Steel</i>
<b>RD&amp;DP</b>	<i>Rural Development and Decentralized Planning</i>
<b>RDSO</b>	<i>Research Design and Standards Organization</i>
<b>RFIC</b>	<i>RF Integrated Circuits</i>
<b>RFID</b>	<i>Radio-frequency identification</i>
<b>RFRI</b>	<i>Rain Forest Research Institute</i>
<b>RGCB</b>	<i>Rajiv Gandhi Centre for Biotechnology</i>
<b>RGC-DEST</b>	<i>Rajiv Gandhi Centre for Development of Education, Science and Technology</i>
<b>RGRHC</b>	<i>Rajiv Gandhi Rural Housing Corporation</i>
<b>RIKEN BSI</b>	<i>RIKEN Brain Science Institute</i>
<b>rMD</b>	<i>Restrained Molecular Dynamics</i>
<b>RNA</b>	<i>Ribo Nucleic Acid</i>
<b>ROAD</b>	<i>Centre for Research on Architectural Design</i>
<b>ROHC</b>	<i>Regional Occupational Health Centres</i>
<b>ROMDAS</b>	<i>Road measuring data acquisition system</i>
<b>ROMS</b>	<i>Regional Ocean Modeling System</i>
<b>RRCAT</b>	<i>Raja Ramanna Centre for Advanced Technology</i>
<b>RRL</b>	<i>Regional Research Laboratory</i>
<b>RTBM</b>	<i>Research in Transportation Business and Management</i>
<b>RTL</b>	<i>Research and Testing Laboratory</i>
<b>RTRC</b>	<i>Railway Testing and Research Centre</i>

<b>RTS</b>	<i>Real Time Search</i>
<b>RS</b>	<i>Remote Sensing</i>
<b>SAARC</b>	<i>South Asian Association for Regional Cooperation</i>
<b>SAC</b>	<i>Space Application Centre</i>
<b>SACCO</b>	<i>Savings and 'Credit Cooperative Society</i>
<b>SACEP</b>	<i>South Asia Co-operative Environment Programme</i>
<b>SADED</b>	<i>South Asia Dialogues on Ecological Democracy</i>
<b>SAIL</b>	<i>Steel Authority of India</i>
<b>SAM</b>	<i>Self Assembled Monolayers</i>
<b>SAS</b>	<i>Statistical Analysis System</i>
<b>SAOT</b>	<i>School in Advanced Optical Technologies</i>
<b>SAP</b>	<i>Special Assistance Programme</i>
<b>SBT</b>	<i>School of Biotechnology</i>
<b>SDC</b>	<i>Swiss Agency for Development and Cooperation</i>
<b>SEAPHEIN</b>	<i>South East Asia Public Health Education Institution Network</i>
<b>SEBF</b>	<i>Sub Endometrial Blood Flow</i>
<b>SED</b>	<i>Socio Economic Development</i>
<b>SEI</b>	<i>Stockholm Environment Institute</i>
<b>SEM</b>	<i>Scanning Electron Microscope</i>
<b>SEM-EDS</b>	<i>Scanning Electron Microscope-Energy Dispersive Spectrometer</i>
<b>SERB</b>	<i>Science and Engineering Research Board</i>
<b>SERC</b>	<i>Supercomputer Education and Research Centre</i>
<b>SES</b>	<i>School of Energy Studies</i>
<b>SETLabs</b>	<i>Software Engineering and Technology Labs</i>
<b>SEZ</b>	<i>Suzlon Energy Centre</i>
<b>SGPGIMS</b>	<i>Sanjay Gandhi Post Graduate Institute of Medical Sciences</i>
<b>SHAR</b>	<i>Satish Dhawan Space Centre</i>
<b>SHSS</b>	<i>School of Humanities and Social Sciences</i>
<b>SI</b>	<i>Smithsonian Institution</i>
<b>SIAM</b>	<i>Society of Indian Automobile Manufacturers</i>
<b>SIBRI</b>	<i>Small Business Innovation Research Initiative</i>
<b>SIDA</b>	<i>Swedish International Development Authority</i>
<b>SIES</b>	<i>South Indian Education Society</i>
<b>SIEMAT</b>	<i>State Institute of Educational Management and Training</i>
<b>SIR</b>	<i>SCImago Institutions Ranking</i>
<b>SIRO</b>	<i>Scientific and Industrial Research Organization</i>

<b>SISL</b>	<i>Siemens Information System Ltd</i>
<b>SITAR</b>	<i>Swedish Indian IT Resources AB</i>
<b>SJSC</b>	<i>Schottky junction solar cell</i>
<b>SLB</b>	<i>Service Level Benchmarks</i>
<b>SMEs</b>	<i>Small and medium size enterprises</i>
<b>SPCRC</b>	<i>Signal Processing and Communications Research Center</i>
<b>SPIN</b>	<i>Socio-Physical Interaction Network</i>
<b>SPRERI</b>	<i>Sardar Patel Renewable Energy Research Institute</i>
<b>SPSS</b>	<i>Statistical Package for the Social Sciences</i>
<b>SPV</b>	<i>Solar Photovoltaic</i>
<b>SRIRU</b>	<i>Sponsored Research and Industrial Relations Unit</i>
<b>S2ST</b>	<i>Speech-To-Speech Translation</i>
<b>SSCSSN</b>	<i>Shah-Schulman Center For Surface Science And Nanotechnology</i>
<b>SSH</b>	<i>Socioeconomic Sciences and Humanities</i>
<b>SSNC</b>	<i>Swedish Society for Nature Conservation</i>
<b>SSPL</b>	<i>Solid State Physics Laboratory</i>
<b>SSS-NIRE</b>	<i>Sardar Swaran Singh National Institute of Renewable Energy</i>
<b>STDS</b>	<i>Switchgear Testing and Development Station</i>
<b>STEC</b>	<i>Kerala State Council for Science, Technology and Environment</i>
<b>STI</b>	<i>Science, Technology and Innovation</i>
<b>STP</b>	<i>Short Term Training Program</i>
<b>STPs</b>	<i>Sewage Treatment Plants</i>
<b>STUs</b>	<i>State Transport Undertakings</i>
<b>SUNY</b>	<i>State University of New York</i>
<b>SUTP</b>	<i>Sustainable Urban Transport Project</i>
<b>TAFE</b>	<i>Tractors and Farm Equipment Limited</i>
<b>TAIL-PCR</b>	<i>Thermal asymmetric interlaced polymerase chain reaction</i>
<b>TB</b>	<i>Tuberculosis</i>
<b>TCS</b>	<i>Tata Consultancy Services</i>
<b>T-DNA</b>	<i>Transfer Deoxyribonucleic acid</i>
<b>TDDP</b>	<i>Technology Development and Demonstration Programme</i>
<b>TE</b>	<i>Tracking Error</i>
<b>TERI</b>	<i>The Energy Research Institute</i>
<b>TEM</b>	<i>Transmission Electron Microscope</i>
<b>TePP</b>	<i>Techno-entrepreneurs Promotion Programme</i>
<b>TEQIP</b>	<i>Technical Education Quality Improvement Programme</i>



<b>TFRI</b>	<i>Tropical Forest Research Institute</i>
<b>TFT</b>	<i>Thin-Film Transistor</i>
<b>THSTI</b>	<i>Translational Health Science and Technology Institute</i>
<b>TIET</b>	<i>Thapar Institute of Engineering and Technology</i>
<b>TIFR</b>	<i>Tata Institute of Fundamental Research</i>
<b>TIFAC</b>	<i>Technology Information, Forecasting and Assessment Council</i>
<b>TISS</b>	<i>Tata Institute of Social Sciences</i>
<b>TLTF</b>	<i>T-lymphocyte triggering factor</i>
<b>TMRS</b>	<i>Technology Mission for Railway Safety</i>
<b>TMS</b>	<i>Terminal Management System</i>
<b>TMS</b>	<i>Track Management System</i>
<b>TNEB</b>	<i>Tamil Nadu Electricity Board</i>
<b>ToF</b>	<i>Trees Outside Forests</i>
<b>TP</b>	<i>Tracking Position</i>
<b>TR</b>	<i>Thermo luminescence</i>
<b>TRAC</b>	<i>Training, Research Advisory Committee</i>
<b>TRC</b>	<i>Thermal Research Centre</i>
<b>TRDDC</b>	<i>Tata Research Development and Design Centre</i>
<b>TRIPS</b>	<i>Trade Related Intellectual Property Rights</i>
<b>TSBF</b>	<i>Tropical Soil Biology Fertility</i>
<b>TTS</b>	<i>Text-To-Speech</i>
<b>TUM</b>	<i>Technische Universität München</i>
<b>TWAS</b>	<i>Third World Academy of Sciences</i>
<b>UAS</b>	<i>University of Agricultural Sciences</i>
<b>UBR</b>	<i>Universal Birth registration</i>
<b>UCB</b>	<i>University of California, Berkeley</i>
<b>UCD</b>	<i>University College Dublin</i>
<b>UCOST</b>	<i>Uttarakhand State Council for Science and Technology</i>
<b>UCSC</b>	<i>University of California, Santa Cruz</i>
<b>UDCT</b>	<i>University Department of Chemical Technology</i>
<b>UFO</b>	<i>UltraFastOptics</i>
<b>UGC</b>	<i>University Grant Commission</i>
<b>UHVRL</b>	<i>Ultra High Voltage Research Laboratory</i>
<b>UIUC</b>	<i>University of Illinois Centre</i>
<b>UK</b>	<i>United Kingdom</i>
<b>UKIERI</b>	<i>UK-India Education and Research Initiative</i>

<b>UNCED</b>	<i>United Nations Conference in Environment and Development</i>
<b>UNCTAD</b>	<i>United Nations Conference on Trade and Development</i>
<b>UNDP</b>	<i>United Nations Development Programme</i>
<b>UNEP</b>	<i>United Nations Environment Programme</i>
<b>UNEP RRC. AP</b>	<i>United Nations Environment Program Regional Research Centre for Asia and the Pacific</i>
<b>UNESCO</b>	<i>United Nations Educational, Scientific and Cultural Organization</i>
<b>UNFCCC</b>	<i>United Nations Framework Convention on Climate Change</i>
<b>UNFPA</b>	<i>United Nations Population Fund</i>
<b>UNICEF</b>	<i>United Nations International Children's Emergency Fund</i>
<b>UNIDO</b>	<i>United Nations Industrial Development Organisation</i>
<b>UNIFEM</b>	<i>United Nations Development Fund for Women</i>
<b>UNIK</b>	<i>Unit Inovasi Khas, Malaysia</i>
<b>UNITAR</b>	<i>United Nations Institute for Training and Research</i>
<b>UNU</b>	<i>United Nations University</i>
<b>UPES</b>	<i>University of Petroleum and Energy Studies</i>
<b>UPLC</b>	<i>Ultra Performance Liquid Chromatography</i>
<b>UPSRTC</b>	<i>Uttar Pradesh State Road Transport Corporation</i>
<b>URDIP</b>	<i>Unit for Research &amp; development of Information Products</i>
<b>USA</b>	<i>United States of America</i>
<b>USAID</b>	<i>United States Agency for International Development</i>
<b>US EPA</b>	<i>United States Environmental Protection Agency</i>
<b>USFS</b>	<i>US Forest Service</i>
<b>USFWS</b>	<i>US Fish &amp; Wildlife Service</i>
<b>USNPS</b>	<i>US National Park Service</i>
<b>U-STAR</b>	<i>Universal Speech Translation Advanced Research Consortium</i>
<b>USTM</b>	<i>University of Science and Technology-Meghalaya</i>
<b>UTS</b>	<i>Unreserved Ticketing Services</i>
<b>UV-VIS</b>	<i>Ultraviolet-Visible Spectroscopy</i>
<b>VDBP</b>	<i>Viral Disease Biology Program</i>
<b>VECC</b>	<i>Variable Energy Cyclotron Centre</i>
<b>VIDRC</b>	<i>Vaccine and Infectious Disease Research Centre</i>
<b>VIT</b>	<i>Vellore Institute of Technology</i>
<b>VJTI</b>	<i>Veermata Jijabai Technological Institute</i>
<b>VLSI</b>	<i>Very-Large-Scale Integration</i>
<b>VNA</b>	<i>Vector Network Analyzer</i>

<b>VOC</b>	<i>Volatile Organic Compounds</i>
<b>VSSC</b>	<i>Vikram Sarabhai Space Centre</i>
<b>VTT</b>	<i>VTT Technical Research Centre of Finland</i>
<b>WB</b>	<i>World Bank</i>
<b>WBUHS</b>	<i>West Bengal University of Health Sciences</i>
<b>WHO</b>	<i>World Health Organisation</i>
<b>WII</b>	<i>Wildlife Institute of India</i>
<b>WiSTA</b>	<i>Wipro Software Technology Academy</i>
<b>WNL</b>	<i>Wireless Network Lab</i>
<b>WPM</b>	<i>Watershed Process and Management</i>
<b>WRCBB</b>	<i>Research Centre in Biosciences and Bioengineering</i>
<b>WRF</b>	<i>Weather Research and Forecast</i>
<b>WTO</b>	<i>World Trade Organization</i>
<b>WWF-India</b>	<i>World Wide Fund for Nature-India</i>
<b>XRD</b>	<i>X-ray Diffraction</i>
<b>XRF</b>	<i>X-ray fluorescence spectrometer</i>
<b>YC-NISDA</b>	<i>Yashwantrao Chavan National Centre of International Security and Defense Analysis</i>
<b>ZIL</b>	<i>Zuari Industries Ltd.</i>

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1	Dept of Biotech, IIT Guwahati	Public	www.iitg.ac.in/biotech/index.htm	V. Venkata Dasu	Department Head; Associate Professor	veeranki@iitg.ernet.in	450
2	Dept of Biotech, Karunya Univ	Private	www.karunya.edu/biotech/index.html	Dr. P. Patrick Gomez	Head & Professor	patrick@karunya.edu	90
3	Dept of BSBE, IIT Kanpur	Public	www.iitk.ac.in/bsbe/	Amitabha Bandyopadhyay	Assistant Professor	abandopa@iitk.ac.in	146
4	Dept of Biotechnology, IIT Chennai	Public	www.biotech.iitm.ac.in/	Prof. Doble Mukesh	Head/Professor	mukeshd@iitm.ac.in	700
5	Amity Institute of Microbial Technology	Private	www.amity.edu/aims/default.asp	Dr. Amit C Kharkwal	Director & Head		190
6	Dept of Biotech, Thapar Univ	Public	www.thapar.edu/page-dual.asp?mainId=5&masterId=2&subId=1	Dr. Dinesh Goyal	Head & Professor	dgoyal@thapar.edu	144
7	Amity Institute of Biotechnology	Private	www.amity.edu/aib/	Prof. A.K. Srivastava	Director General	adg@abs.amity.edu	125
8	Dept of Biotechnology, Univ of Madras	Public	www.unom.ac.in/index.php?route=department/department/deptpage&deptid=11	Dr. K. Umamaheswari	Assistant Professor & Head	rk.uma@unom.ac.in	90
9	Department of Biosciences, Sri Sathya Sai Institute of Higher Learning	Private	www.ssihi.edu.in/ssuniversity/Academics/DepartmentofBiosciences/VisionOverview.aspx	Prof. T N Lakhnupal	Professor		30
10	Centre for Biotechnology, Anna Univ	Public	www.annauniv.edu/BiotechCentre/	Dr.P.Gautam	HOD/Professor	gautamprojects@gmail.com	170
11	Dept of Biotech, IIT Hyderabad	Public	www.biotech.iitih.ac.in/	Basant Kumar Patel	Head/Professor	basantkpatel@iitih.ac.in	75
12	School of Biotechnology, Shoolini Univ	Public	School of Biotechnology, Shoolini Univ	Dr. D.R. Sharma	HOD/Professor	drssib@yahoo.co.in	55
13	Dept of Biotech, IIT Punjab	Public	www.iitrpr.ac.in/bme	Dr. Jitendra Prasad	Assistant Professor & Head	jprasad@iitrpr.ac.in	45
14	Centre for Biologically Inspired System Science, IIT Rajasthan	Public	www.iitj.ac.in/biss/index.php	Amit Mishra	Assistant Professor	amit@iitj.ac.in	55
15	Dept of Biosci. and Biomedical Engg, IIT Indore	Public	www.bsbe.iiti.ac.in/	Dr. Amit Kumar	Assistant Professor	amitk@iti.ac.in	15
16	Dept of Biotechnology, Univ of Pune	Public	www.unipune.ac.in/dept/science/biotechnology/	Prof. J. K. Pal	Professor & HOD	jkpal@unipune.ernet.in	100
17	Dept of Biotechnology, SRM Univ	Private	www.srmuniv.ac.in/engineering/department-of-biotechnology/about-the-department	Dr. S. Thyagarajan	Professor & HOD	thyagarajan.s@ktr.srmuniv.ac.in	50
18	School of Biotech, Banaras Hindu Univ	Public	www.bhu.ac.in/science/biotechnology/	Dr.Brahma Deo Singh	Professor	brahmadsingh@gmail.com	515



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Sl no	Organisation Name/ Dept Name	Organi- sation Type	Website	Contact Name	Designation	Email	No. of Publica- tions
19	Dept of Biotech, MNMIT Allahabad	Public	<a href="http://www.mnmit.ac.in/index.php/departments/engineering/biotechnology.html">www.mnmit.ac.in/index.php/departments/engineering/biotechnology.html</a>	Dr. Shivesh Sharma	Head & Associate Professor	shiveshs@mnmit.ac.in	86
20	Dept of Biotech, NIT Durgapur	Public	<a href="http://www.nitdgp.ac.in/bt/">www.nitdgp.ac.in/bt/</a>	Dr. Kaustav Aikat	Assistant Professor	kaustav.aikat@bt.nitdgp.ac.in	175
21	Dept of Biotech, Panjab University	Public	<a href="http://www.biotechnology.puchd.ac.in/">www.biotechnology.puchd.ac.in/</a>	Dr. Neena Capalash	Associate Professor	caplash@pu.ac.in	80
22	Guha Centre for Genetic Engineering and Biotechnology (GGEB), Univ of Calcutta	Public	<a href="http://www.gcgeb.caluniv.in/">www.gcgeb.caluniv.in/</a>	Prof. Indu Bhushan Chatterjee	Professor	ibc123@rediffmail.com	110
23	Dept of Biotech, NIT Raipur	Public	<a href="http://www.nitr.ac.in/dept-bio_tech.php">www.nitr.ac.in/dept-bio_tech.php</a>	Anil Kumar Poonia	Associate Professor	akpoonia.che@nitr.ac.in	100
24	Dept of Biotech, NIT Rourkela	Public	<a href="http://www.nitrkl.ac.in/Academic/IDepartment/Home.aspx?hsfg32njik=MQ%3d%3d-ia2VMbHa44Y%3d">www.nitrkl.ac.in/Academic/IDepartment/Home.aspx?hsfg32njik=MQ%3d%3d-ia2VMbHa44Y%3d</a>	Prof.Ms.Krishna Parmanik	HOD/Professor	kpr@nitrkl.ac.in	105
25	School of Biotech, NIT Calicut	Public	<a href="http://www.nitc.ac.in/index.php?url=department/index/18">www.nitc.ac.in/index.php?url=department/index/18</a>	Dr.Rajanikant G. K	HOD/Professor	rajanikant@nitc.ac.in	100
26	Dept of Biotech, NIT Jalandhar	Public	<a href="http://www.bt.nitj.ac.in/">www.bt.nitj.ac.in/</a>	Dr A K Jana	HOD/Professor	janaak@nitj.ac.in	60
27	National Dairy Research Institute (NDRI)	Public	<a href="http://www.ndri.res.in/">www.ndri.res.in/</a>	Girdhari Ramdas Patil	Joint Director	grpndri@yahoo.co.in, jda@ndri.res.in	726
28	School of Biotech, Madurai Kamraj Univ	Public	<a href="http://www.mkuniversity.org/main/#">www.mkuniversity.org/main/#</a>	Dr. R. Usha	HOD/Professor	mkuregistrar@rediffmail.com	12
29	School of Biotech, NIT Warangal	Public	<a href="http://www.nitw.ac.in/nitw/index.php/departments/biotechnology">www.nitw.ac.in/nitw/index.php/departments/biotechnology</a>	Prof P.Nageswara Rao	HOD/Professor	pnr@nitw.ac.in	50
30	Department of Biotech, Univ of Hyderabad	Public	<a href="http://www.uohyd.ac.in/index.php/academics/2011-10-27-18-38-04/school-of-life-sciences/dept-biotechnology">www.uohyd.ac.in/index.php/academics/2011-10-27-18-38-04/school-of-life-sciences/dept-biotechnology</a>	Prof. P. Prakash Babu	HOD/Professor	ppbsl@uohyd.ernet.in	45
31	Dept of Biotech, Jadavpur Univ	Public	<a href="http://www.jaduniv.edu.in/view_department.php?deptid=78">www.jaduniv.edu.in/view_department.php?deptid=78</a>	Dr. Biswadip Das	HOD/Professor	hod@lifescience.jdvvu.ac.in	60
32	National Institute of Pharmaceutical Education and Research (NIPER)	Public	<a href="http://www.niper.nic.in/welcome.html">www.niper.nic.in/welcome.html</a>	Prof. U. C. Banerjee	Professor and Head	ubanerjee@nipr.ac.in	275
33	Dept of Biotech, Cochin University of Science & Technology	Public	<a href="http://www.plantbiotech.cusat.ac.in/">www.plantbiotech.cusat.ac.in/</a>	Dr Padma Nambisan	Assoc Professor	padmanambisan@cusat.ac.in	45
34	Kerala Agricultural University (KAU)	Private	<a href="http://www.kau.edu/">www.kau.edu/</a>	Dr. Sverup John	Dean of Agriculture	deanagri@kau.in; vc@kau.in	75

<b>BIOTECHNOLOGY</b>							
SI no	Organisation Name/ Dept Name	Organi- sation Type	Website	Contact Name	Designation	Email	No. of Publica- tions
35	Dept of Biotech, The Oxford Univ	Private	<a href="http://www.theoxford.edu/college_of_science/biotechnology.htm">www.theoxford.edu/college_of_science/biotechnology.htm</a>	Chetana S	Assoc Professor	<a href="mailto:info@theoxford.edu">info@theoxford.edu</a>	66
36	CSIR- Institute of Genomics & Integrative Biology (IGIB)	Public	<a href="http://www.igib.res.in/">www.igib.res.in/</a>	Hemant K. Gautam	Scientist	<a href="mailto:hemant@igib.res.in">hemant@igib.res.in</a>	510
37	Dept of Biotech, R V College of Engg	Private	<a href="http://www.rvce.edu.in/biotechnology.php">www.rvce.edu.in/biotechnology.php</a>	Dr. Pushpa Agrawal	Professor and Dean	<a href="mailto:pushpa_agrawal@rvce.edu.in">pushpa_agrawal@rvce.edu.in</a>	300
38	Dept of Microbiology and Cell Biology, IISc	Public	<a href="http://www.mcbli.iisc.ernet.in/">www.mcbli.iisc.ernet.in/</a>	P. Ajitkumar	Professor	<a href="mailto:ajit@mcbli.iisc.ernet.in">ajit@mcbli.iisc.ernet.in</a>	450
39	Dept of Biochemistry, IISc	Public	<a href="http://www.biochem.iisc.ernet.in/">www.biochem.iisc.ernet.in/</a>	C. Jayabaskaran	Professor	<a href="mailto:cjb@biochem.iisc.ernet.in">cjb@biochem.iisc.ernet.in</a>	1105
40	Biology & Bioinformatics, IICT CSIR	Public	<a href="http://www.iictindia.org/(S(urpt4552h0ttjma4iqvop45))/DivList.aspx?DIVID=5">www.iictindia.org/(S(urpt4552h0ttjma4iqvop45))/DivList.aspx?DIVID=5</a>	U.Suryanarayana Murty	Professor & Head	<a href="mailto:usnmurty@iict.res.in">usnmurty@iict.res.in</a>	225
41	Dept of Biotech, Univ of Mysore	Private	<a href="http://www.uni-mysore.ac.in/biotechnology/">www.uni-mysore.ac.in/biotechnology/</a>	Dr. Bharathi P. Salimath	Professor & Chairman	<a href="mailto:salimathuom@rediffmail.com">salimathuom@rediffmail.com</a>	46
42	Dept of Biotech, Jamia Millia Islamia	Private	<a href="http://www.jmi.ac.in/biotechnology">www.jmi.ac.in/biotechnology</a>	Dr Syed Akhtar Husain	Head	<a href="mailto:shusain@jmi.ac.in">shusain@jmi.ac.in</a> , <a href="mailto:akhtarhusain2000@yahoo.com">akhtarhusain2000@yahoo.com</a>	25
43	Institute of Bioresources and Sustainable Development	Private	<a href="http://www.ibsd.gov.in/">www.ibsd.gov.in/</a>	Shri. Sumil S. Thorat	Coordinator	<a href="mailto:sunilthorat@yahoo.com">sunilthorat@yahoo.com</a>	80
44	International Centre for Genetic Engineering and Biotechnology	Public	<a href="http://www.icgeb.org/">www.icgeb.org/</a>				2500
45	Dept of Biotech, Gulbarga Univ	Public	<a href="http://www.gulbargauniversity.kar.nic.in/FacSciTech/DeptBioTechnology.html">www.gulbargauniversity.kar.nic.in/FacSciTech/DeptBioTechnology.html</a>	Dr. G.R. Naik	Professor	<a href="mailto:gmaik@hotmail.com">gmaik@hotmail.com</a>	275
46	Dept of Biotech, PSG College of Technology	Private	<a href="http://www.psgtech.edu/department/biotechnology/index.html">www.psgtech.edu/department/biotechnology/index.html</a>	Dr V Ramamurthy	Professor & Head	<a href="mailto:ram@bio.psgtech.ac.in">ram@bio.psgtech.ac.in</a>	125
47	Institute of Microbial Technology	Public	<a href="http://www.imtech.res.in/">www.imtech.res.in/</a>	Dr. Girish Sahnii	Director	<a href="mailto:director@imtech.res.in">director@imtech.res.in</a>	500
48	School of Biotech, JNU	Public	<a href="http://www.jnu.ac.in/sbt/">www.jnu.ac.in/sbt/</a>	Prof. Rakesh Bhatnagar	Dean	<a href="mailto:rakeshbhatnagar@mail.jnu.ac.in">rakeshbhatnagar@mail.jnu.ac.in</a>	800
49	Food Microbiology dept, CFTRI	Public	<a href="http://www.cftri.com/fm.html">www.cftri.com/fm.html</a>	Dr. Venkateswaran G	Head	<a href="mailto:venkatg@cftri.res.in">venkatg@cftri.res.in</a>	210
50	National Bureau of Plant Genetic Resources	Public	<a href="http://www.nbpg.ernet.in/">www.nbpg.ernet.in/</a>	Dr. K.C. Bansal	Director	<a href="mailto:director@nbpg.ernet.in">director@nbpg.ernet.in</a>	45

ENERGY							
SI no	Organisation Name/Dept Name	Organisation Type	Website	Contact Name	Designation	Email	No. of Publications
1	Industrial Energy Efficiency dept - TERI	Public	www.teriin.org/	Mr G R Narasimha Rao	Associate Director, Industrial Energy Efficiency, Bangalore	gmr Rao@teri.res.in	75
2	Energy Systems Engineering (ESE), IIT Bombay	Public	www.es.eitb.ac.in/	Santanu Bandyopadhyay	Head & Professor	santanub@iitb.ac.in	195
3	Centre for High Energy Physics - IISc	Public	www.cts.iisc.ernet.in/	B Ananthanarayan	Chairman and Professor	anant@cts.iisc.ernet.in	425
4	Centre for Energy, IIT Jodhpur	Public	www.iitj.ac.in/energy/	B. Ravindra	Head & Professor	ravib@iitj.ac.in	325
5	Institute for Energy Studies (IES), Anna Univ	Public	www.annauniv.edu/EnergyStudies/ddesk.html	Dr. R. Velraj	Director	velraj@annauniv.edu	1000
6	National Centre for Photovoltaic Research and Education (NCPRE), IIT Bombay	Public	www.ncpre.iitb.ac.in/	Anand Patwardhan	Professor	anand@som.iitb.ac.in	110
7	Sardar Swaran Singh National Institute of Renewable Energy	Public	www.nire.res.in/	Dr.Yogender Kumar Yadav	Director	director@nire.res.in	120
8	Indian Wind Power Association - IWPA	Public	www.windpro.org/	Prof. K.Kasthoorirangaian	Vice President	iwpacno@windpro.org, iwpahq@gmail.com	70
9	World Institute of Sustainable Energy (WISE)	Public	www.wisein.org/	G. M. Pillai	Director General	gmpillai@wisein.org	35
10	Centre for Wind Energy Technology (C-WET)	Public	www.cwet.tn.nic.in/	Dr. S. Gomathinayagam	Executive Director	ec@cwet.res.in	160
11	Indian Wind Turbine Manufactures Association - IWTMA	Public	www.indianwindpower.com/	Mr. Madhusudan Khemka	Chairman	secretarygeneral@indianwindpower.com	30
12	Alternate Hydro Energy Centre (AHEC), IIT Roorkee	Public	www.iitr.ac.in/departments/AH/pages/index.html	R.P.Saini	Head & Professor	rajsafah@iitr.ac.in	210
13	National Hydro Power Corporation (NHPC)	Public	www.nhpcindia.com/	Shri G. Sai Prasad	Chairman & Managing Director	webmaster@nhpc.nic.in	30
14	Solar Energy Society of India (SESI)	Private	www.sesi.in/	Mr. Rabindra Satpathy	President	president@sesi.in, rabisatpathy90@gmail.com	40

ENERGY							
SI no	Organisation Name/Dept Name	Organi-sation Type	Website	Contact Name	Designation	Email	No. of Publi-cations
15	School of Mechanical, Materials & Energy Engineering (SMMEE) - IIT Ropar	Public	www.iitrpr.ac.in/smme	Dr. Anshu Dhar Jayal	Professor	jayal@iitrpr.ac.in	170
16	Mahatma Gandhi Institute of Rural Energy and Development (MGIRED)	Public	www.mgired.kar.nic.in/			mgired@hotmail.com	25
17	Combustion, Gasification and Propulsion Laboratory (CGPL) at the Indian Institute of Science (IISc)	Public	www.cgpl.iisc.ernet.in/site/Home/tabid/36/Default.aspx	Dr. N. K. S. Rajana	Principal research scientist	nksr@cgpl.iisc.ernet.in	131
18	Natural Energy Processing Co. (NEPC)	Private	www.nepcindia.com/	Mr. Santosh Balasubramaniam	International Business manager	santosh@nepcindia.co.in	65
19	Radhe Renewable Energy Pvt. Ltd. .	Private	www.radhegroup.com/	Dr. Shailesh Makadia	Founder	info@radhegroup.com	80
20	School of Energy Tech, Rajiv Gandhi Pradyogiki Vishwavidyalaya	Private	www.rgv.ac.in/Departments/EnergyTechDept.aspx?Dept=14				
21	CSIR-Structural Engineering Research Centre/Renewable Energy	Public	www.serc.res.in/re/areaofresearch.html	Dr. Bala Pesala		balapesala@acsir.res.in	NA
22	Indian Renewable Energy Development Agency (IREDA)	Public	www.iredaltd.com	Mr. Debashish Majumdar	Chairman & Managing Director	cmd@ireda.in	2000
23	Asia Energy Institute (AEI)	Private	www.aeinetwork.org/	Ms Swati Ganeshan	Secretary	swati.ganeshan@teri.res.in	46
24	Non-conventional Energy Development Corporation of Andhra Pradesh Limited [NEDCAP]	Public	www.nedcap.gov.in/	Sri Mrutyunjay Sahoo	Chairman		NA
25	Pandit Deendayal Petroleum University (PDDPU)	Public	www.pdpu.ac.in/	Prof. Paritosh K. Banik	Director General		60
26	Energy Research Centre, Punjab Univ	Public	www.erc.puchd.ac.in/	S. K. Sharma	Professor	sks_erc@pu.ac.in	110
27	Reliance Storage Energy & Systems Pvt Ltd	Private	www.ricotechnology.com/	Mr. M. Khaskel	Director	m_khaskel@ricotechnology.com	NA
28	Chandradeep Solar Research Institute (CDSRI)	Public	www.csrinstitute.co.in/	Mrs. Madhuchandrika Chattopadhyay	President		55
29	Devaki Energy Consultancy Pvt Ltd	Private				devkienergy@gmail.com	NA

ENERGY							
SI no	Organisation Name/Dept Name	Organisation Type	Website	Contact Name	Designation	Email	No. of Publications
30	Centre for Energy & Envi, MNIT Jaipur	Public	www.mnit.ac.in/new/dept_cree/index.php	Dr. Jyotirmay Mathur	Head/ Professor	jyotirmay.mathur@gmail.com	295
31	Dept of Energy, Tezpur Univ	Public	www.tezu.ernet.in/dener/	Prof. S K Samdarshi	Head/ Professor	sanjoy@tezu.ernet.in	150
32	Department of Petroleum Engineering & Earth Sciences, University of Petroleum and Energy Studies (UPES)	Public	www.upes.ac.in/	Ajit Kumar Hazarika	Distinguished Professor		100
33	School of Mechanical Materials and Energy Engineering, IIT Ropar	Public	www.iitrpr.ac.in/smee	Dr. Himanshu Tyagi	Assistant Professor	himanshu.tyagi@iitrpr.ac.in	180
34	Department of Energy Engineering, North Eastern Hill University	Public	www.nehu.ac.in/Schools/Technology/Energy%20Engineering/index.php	Dr. Samrat Paul	Assistant Professor	samrat@nehu.ac.in	95
35	Centre for Green Energy Technology, Podicherry Univ	Public	www.pondiuni.edu.in/departement/centre-green-energy-technology	Dr. P. Thilagan	Centre Head	thilaganp.get@pondiuni.edu.in	152
36	Centre for Energy (CEN), Jawaharlal Nehru Institute of Advanced Studies (JNIAS), Hyderabad	Public	www.jnias.in/php/schSETce.php#	Prof. K. Ramamurthy Naidu	Director General	krnaidu06@yahoo.com	90
37	Centre for Energy Studies & Policy Analysis	Public	www.cespa.in/	Mr G Krishnakumar		info@cespa.in	50
38	Centre for Energy Management, Management Development Institute	Public	www.mdi.ac.in/research-and-consultancy/centers-of-excellence/center-for-energy-management.html	Dr. Atmanand	Professor	atmanand@mdi.ac.in	106
39	Centre for renewable energy studies, Bharath Univ	Public	www.bharathuniv.com/research-renewableenergy.htm	Dr. J. Sundeeep Aanand	President / Chancellor	vc@bharathuniv.ac.in	85
40	Agency for Non-Conventional Energy and Rural Technology (ANERT)	Public	www.anert.gov.in/		Director	director@anert.in	NA
41	School of Energy and Environmental Studies (SEES), Devi Ahilya Vishwavidyalaya	Public	www.sees.dauniv.ac.in/	Prof. S P Singh	Head	spsanjali@gmail.com	70
42	Energy Management Centre, Kerala	Public	www.keralaenergy.gov.in/	K. M. Dharsan Unnithan	Director	kmd@keralaenergy.gov.in	12
43	Center for Study of Science, Technology and Policy (CSTEP)	Public	www.cstep.in/	Dr Arunachalam	Chairman & Founder	arunachalam@cstep.in	82

ENERGY							
SI no	Organisation Name/Dept Name	Organisation Type	Website	Contact Name	Designation	Email	No. of Publications
44	Centre of Excellence on Renewal Energy System, NIT Rourkela	Public	<a href="http://www.nitrkl.ac.in/Academic/Academic_Centers/CenterOfExcellence.aspx">www.nitrkl.ac.in/Academic/Academic_Centers/CenterOfExcellence.aspx</a>	Prof. Bidyadhar Subudhi	Professor	bidyadhar@nitrkl.ac.in	400
45	School of Energy Studies, NIT Agartala	Public	<a href="http://www.nita.ac.in/NITMain/schools/schoolshome.html">www.nita.ac.in/NITMain/schools/schoolshome.html</a>	Dr. Subhadeep Bhattacharjee	Professor	subhadeep_bhattacharjee@yahoo.co.in	80
46	Dept of Energy, MANIT Bhopal	Public	<a href="http://www.manit.ac.in/manitbhopal/index.php?option=com_content&amp;view=article&amp;id=61&amp;Itemid=135">www.manit.ac.in/manitbhopal/index.php?option=com_content&amp;view=article&amp;id=61&amp;Itemid=135</a>	Dr. Saroj Rangnekar	Head & Professor	saroj@yahoo.com; hodenergy@manit.ac.in	170
47	CSIR-Indian Institute of Petroleum	Public	<a href="http://www.iip.res.in/">www.iip.res.in/</a>	B M Shukla	Chief Scientist	headrpb@iip.res.in	550
48	Atomic Energy Regulatory Board (AERB)	Public	<a href="http://www.aerb.gov.in/">www.aerb.gov.in/</a>	Shri S.S. Bajaj	Chairman	webmaster@aerb.gov.in	135
49	Indira Gandhi Centre for Atomic Research (IGCAR)	Public	<a href="http://www.igcar.ernet.in/">www.igcar.ernet.in/</a>	Dr. P.R. Vasudeva Rao	Director	dir@igcar.gov.in	1000
50	Indian School of Petroleum & Energy (ISP)	Private	<a href="http://www.isp.co.in/">www.isp.co.in/</a>	Sanjay Kaul	Director		25

**ENVIRONMENT**

SI no	Organisation Name/Dept Name	Organisation Type	Website	Contact Name	Designation	Email	No. of Publications
1	<b>Kerala Forest Research Institute (KFRI)</b>	Public	<a href="http://www.kfri.res.in/">http://www.kfri.res.in/</a>	Prof. J.S. Singh	Chairman	singh.js1@gmail.com	75 books , 500 research reports, 1400 scientific papers.
2	<b>Forest Research Institute(FRI)</b>	Public	<a href="http://fri.icfre.gov.in/">http://fri.icfre.gov.in/</a>	Dr. Ramesh K. Aima	Dean (Academic)	aimark@icfre.org	not available
3	<b>Arid Forest Research Institute</b>	Public	<a href="http://afri.icfre.org/">http://afri.icfre.org/</a>	Dr.T.S.Rathore	Director	dir_afri@icfre.org	299 Research Publications in Scientific Journals, 91 conference proceedings, 41 books
4	<b>Indira Gandhi National Forest Academy (IGNFA)</b>	Public	<a href="http://ignfa.gov.in/">http://ignfa.gov.in/</a>	Dr. Mohit Gera	Professor	mohitgera@ignfa.gov.in	106 research papers
5	<b>Institute of Wood Science &amp; Technology</b>	Public	<a href="http://iwst.icfre.gov.in/">http://iwst.icfre.gov.in/</a>	Dr. S.R. Shukla	Scientist & HOD	srsukla@icfre.org	more than 500 research papers, 109 research reports, 3 books and 5 proceedings, 16 technical bulletins
6	<b>Tropical Forest Research Institute</b>	Public	<a href="http://tfri.icfre.gov.in/">http://tfri.icfre.gov.in/</a>	Dr. U. Prakasham, IFS	Director	dir_tfri@icfre.org	43 publications and more than 200 research papers
7	<b>Rain Forest Research Institute (RFRI)</b>	Public	<a href="http://rfri.icfre.gov.in/">http://rfri.icfre.gov.in/</a>	Dr. N. S. Bisht	Director	dir_rfri@icfre.org	not available
8	<b>Himalayan Forest Research Institute (HFRI)</b>	Public	<a href="http://hfri.icfre.gov.in/">http://hfri.icfre.gov.in/</a>	Dr. Kulraj Singh Kapoor	Director	kapoork@icfre.org	12 publications
9	<b>Institute of Forest Genetics and Tree Breeding</b>	Public	<a href="http://ifgtb.icfre.gov.in/">http://ifgtb.icfre.gov.in/</a>	Dr. N. Krishna Kumar	Director	dir_ifgtb@icfre.org	more than 100 research papers, 82 conference proceedings, 28 priced publications
10	<b>Institute Of Forest Productivity</b>	Public	<a href="http://ifpranchi.co.in/">http://ifpranchi.co.in/</a>	Dr. S. A. Ansari	Director	ansarisa@icfre.org	62 research papers, 4 books
11	<b>Birsa Agricultural University</b>	Private	<a href="http://www.baujharhand.org/">http://www.baujharhand.org/</a>	Prof. (Dr.) Mata Prasad Pandey	Director research	dr_bau@rediffmail.com	93 research papers, 8 books for 2012-2013

## ENVIRONMENT

SI no	Organisation Name/Dept Name	Organisation Type	Website	Contact Name	Designation	Email	No. of Publications
12	Center for Environmental Studies-TERI	Public	<a href="http://www.teriin.org/index.php?option=com_division&amp;task=view_area&amp;id=7">http://www.teriin.org/index.php?option=com_division&amp;task=view_area&amp;id=7</a>	Mr Sumit Sharma	Area Convenor	sumits@teri.res.in	more than 100 research papers
13	Applied Environmental Research Foundation (AERF)	NGO	<a href="http://aerfindia.org/">http://aerfindia.org/</a>	Dr. Archana Godbole	Managing Director	aerfindia@gmail.com	8 books and Monographs
14	Ashoka Trust for Research in Ecology and the Environment (ATREE)	NGO	<a href="http://www.atree.org/">http://www.atree.org/</a>	Sharachchandra Lela	Programme leader	slele@atree.org	40 Journal articles, 18 books & 51 book chapters, 40 reports
15	Environmental Information System Center	Public	<a href="http://envvis.mse.ac.in/">http://envvis.mse.ac.in/</a>	Dr. K.S. Kavi Kuma	ENVIS Incharge	kavi@mse.ac.in	More than 100 Scientific publications
16	Centre for Policy Research	Public	<a href="http://www.cprindia.org/">http://www.cprindia.org/</a>	Yamini Aiyar	Senior Fellow	yaiyar@gmail.com	200 scientific papers, 21 working papers, 119 books
17	Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR)	Public	<a href="http://www.jncasr.ac.in/">http://www.jncasr.ac.in/</a>	Amitabh Joshi	Scientist	ajoshi@jncasr.ac.in	3146 publications
18	National Centre for Biological Sciences (NCBS)	Public	<a href="http://www.ncbs.res.in/">http://www.ncbs.res.in/</a>	Jayant Budgaonkar	Scientist	jayant@ncb.res.in	502 publications(2006-2013)
19	National Institute of Ocean Technology (NIOT)	Public	<a href="http://www.niot.res.in/">http://www.niot.res.in/</a>	Dr.S.V.S.Phani Kumar	Scientist-E	phani@niot.res.in	120 paper publications, 20 priced journals, 2 books
20	WTERT-India	Public	<a href="http://wtert.in/">http://wtert.in/</a>	Dr. Sunil Kumar	Senior Scientist	s_kumar@neeri.res.in	17 abstracts, 10 reports
21	Chintan	Private	<a href="http://www.chintan-india.org/">http://www.chintan-india.org/</a>	Bharati Chaturvedi	Director	bharati@chintan-india.org	16 Research Reports
22	North East Centre for Environmental Education and Research (NECEER)	Public-NGO	<a href="http://www.neceer.org.in/">http://www.neceer.org.in/</a>	Ms. Mehnaz Nasreen	research fellow	neceer.imp@gmail.com	not available
23	Institute for Spatial Planning and Environment Research (ISPER)	NPO	<a href="http://isperonline.com/">http://isperonline.com/</a>	K. Surjit Singh	Director	isper.isper@rediffmail.com	5 journals
24	National Institute for Research in Environmental Health (NIREH)	Public	<a href="http://nireh.org/">http://nireh.org/</a>	Manoj Pandey	Director	nireh@yahoo.in	not available



ENVIRONMENT							
SI no	Organisation Name/Dept Name	Organisation Type	Website	Contact Name	Designation	Email	No. of Publications
25	Council on Energy, Environment and Water	NPO	<a href="http://ceew.in/">http://ceew.in/</a>	Arunabha Ghosh	Chief Executive Officer	arunabha.ghosh@ceew.in	99 research papers, 10 reports, 23 papers/ Book chapters; 5 policy briefings
26	CEPRD (Centre for Environment Protection Research & Development)	NGO	<a href="http://www.ceprd.org">www.ceprd.org</a>	Smt. Kunti Mathur Parisar	Director	ceprd1996@gmail.com	not available
27	Grass Roots Research & Creation India (P) Ltd	Private	<a href="http://www.grc-india.com/">http://www.grc-india.com/</a>	Mr. Ankur Sharma	Managing	ankur.sharma@grc-india.com	not available
28	Institute of Bioresources and Sustainable Development	Public	<a href="http://ibsd.gov.in/">http://ibsd.gov.in/</a>	Dr. N. C. Talukdar	Director	ibsd_imp@sancharnet.in	51 paper publications (2007-2010)
29	CSIR-Indian Institute of Toxicology Research	Public	<a href="http://www.iitrindia.org/">http://www.iitrindia.org/</a>	Dr. K.C. Gupta	Director	director@iitrindia.org	999 research papers,
30	Indian Institutes of Science Education and Research (IISERs), Kolkata	Public	<a href="http://www.iiserkol.ac.in/">http://www.iiserkol.ac.in/</a>	Prof. R. N. Mukherjee	Director	director@iiserkol.ac.in	150 research articles
31	C.P.R. Environmental Education Centre	Public	<a href="http://www.cpreecenvs.nic.in/">http://www.cpreecenvs.nic.in/</a>	Mr. M. Amirthalingam	Research Officer	cpreec@envs.nic.in	not available
32	Centre for Environment Education	Public	<a href="http://www.ceeindia.org/cee/index.html">http://www.ceeindia.org/cee/index.html</a>	Ms. Vanitha Kommu	Programme Coordinator	vanitha.kommu@ceeindia.org	12 publication books
33	Consumer Education and Research Centre	Public	<a href="http://www.cercenvs.nic.in">www.cercenvs.nic.in</a> , <a href="http://www.cercindia.org">www.cercindia.org</a>	Not available	Not available	cerc@cercindia.org	30 quarterly publication reports
34	Centre of Excellence (CoE) in Environmental Economics, Madras School of Economics	Public	<a href="http://coenvs.mse.ac.in/">http://coenvs.mse.ac.in/</a>	Dr. K.S. Kavi Kumar	ENVIS Incharge	kavi@mse.ac.in	150 publications
35	Water Falls Institute of Technology Transfer	Private	<a href="http://www.witts.org/">http://www.witts.org/</a>	Not available	Not available	witt@nde.vsnl.net.in	9 books
36	Center for Environmental Management of Degraded Ecosystem	Public	<a href="http://www.moef.nic.in/about-ministry/center-environmental-management-degraded-ecosystem">http://www.moef.nic.in/about-ministry/center-environmental-management-degraded-ecosystem</a>	Prof. C. R. Babu	Professor	crb26@hotmail.com	not available
37	Center for Mining Environment	Public	<a href="http://www.ismdhanbad.ac.in/depart/cme/index.htm">http://www.ismdhanbad.ac.in/depart/cme/index.htm</a>	Dr. A.K. Pal	Director	cme@ismdhanbad.ac.in	not available

ENVIRONMENT							
SI no	Organisation Name/Dept Name	Organisation Type	Website	Contact Name	Designation	Email	No. of Publications
38	Tropical Botanic Garden and Research Institute	Public	<a href="http://www.bgci.org/garden.php?id=787">http://www.bgci.org/garden.php?id=787</a>	Dr. A. Subramaniam	Director	director_tbgri@rediffmail.com	not available
39	National Institute of Ecology (NIE)	NPO	<a href="http://www.nieindia.org/">http://www.nieindia.org/</a>	Dr. Ashesh Kumar Das	President	asheshdas@sancharnet.in	not available
40	School of Environmental Sciences - JNU	Public	<a href="http://www.jnu.ac.in/SES/">http://www.jnu.ac.in/SES/</a>	V.K Jain	Professor	vkj0400@mail.jnu.ac.in	not available
41	BVU Institute of Environment Education & Research	Public	<a href="http://jeer.bharativedyapeeth.edu/">http://jeer.bharativedyapeeth.edu/</a>	Not available	Not available	ieer@bharativedyapeeth.edu	32 research reports
42	Department Of Ecology & Environmental Science-Assam University	Public	<a href="http://www.aus.ac.in/ecology&amp;environmentalscience.html">http://www.aus.ac.in/ecology&amp;environmentalscience.html</a>	B.K. Dutta, Ph.D	Professor	bimankdutta@rediffmail.com	12 priced publications
43	Andhra Pradesh Agricultural University (APAU)		<a href="http://www.angrau.ac.in/">http://www.angrau.ac.in/</a>	Dr. T. Girdhara Krishna	Associate Director of Research	adrrarstirupati@yahoo.co.in	30 priced publications
44	Department of Environmental Science, Bangalore University	Public	<a href="http://www.bangaloreuniversity.ac.in/faculties/dept_environmental_science.aspx">http://www.bangaloreuniversity.ac.in/faculties/dept_environmental_science.aspx</a>	R.K. Somashekar	Chairperson	Not available	not available
45	Indira Gandhi Academy of Environmental Education, Research and Ecoplanning		<a href="http://www.jiwaji.edu/environmental-education-research-and-ecoplanning.asp">http://www.jiwaji.edu/environmental-education-research-and-ecoplanning.asp</a>	Prof. R. J. Rao	Director	Not available	not available
46	Jawaharlal Nehru Aluminium research development and Design Centre	Public	<a href="http://www.jnarddc.gov.in/">http://www.jnarddc.gov.in/</a>	R. Srinivasan	administration	ao@jnarddc.gov.in	14 research publications
47	National Institute of Miners' Health (NIMH)	Public	<a href="http://www.nimh.gov.in/">http://www.nimh.gov.in/</a>	Dr. P. K Sishodiya	Director	directormimh@gmail.com	22 research publications
48	National Institute of Rock Mechanics	Public	<a href="http://www.nirm.in/Main.htm">http://www.nirm.in/Main.htm</a>	Dr. V. Venkateswarlu	Director	dto@nirm.in	not available
49	Nonferrous Materials Technology Development Centre	Public	<a href="http://www.nfcdc.res.in/">http://www.nfcdc.res.in/</a>	Dr K Balasubramanian	Director	Not available	not available
50	National Institute of Hydrology	Public	<a href="http://www.nih.ernet.in/">http://www.nih.ernet.in/</a>	Er. R.D. Singh	Director	rdsingh@nih.ernet.in	20 technical reports, 176 research papers

HEALTH							No. of Publications
SI no	Organisation Name/Dept Name	Organisation Type	Website	Contact Name	Designation	Email	No. of Publications
1	University College Of Medical Sciences (UCMS)	Public	www.ucms.ac.in/	Prof. O. P. Kalra	Principal	principal@ucms.ac.in	1580
2	Rajendra Institute of Medical Science (RIMS)	Private	www.rimsranchi.org/	Prof. Dr. Tulusi Mahto	Head & Professor	directorrimsranchi@gmail.com	700
3	Govt Medical College, Chandigarh	Public	www.gmch.gov.in/	Mr. Atul Sachdev	Director-Principal		200
4	Mahatma Gandhi Institute of Medical Sciences	Public	www.mgims.ac.in/	Dr BS Garg	Dean	dean@mgims.ac.in	415
5	Aligarh Muslim University	Public	www.amu.ac.in/	Prof. Seema Hakim	Coordinator	drseemahakim@rediffmail.com	1050
6	Bangalore Medical College	Public	www.bmcrl.org	Dr. Shivaprasad Reddy	Director	director_bmcrl@yahoo.co.in/ director_dean@bmcrl.org	200
7	School of Health Science - Univ of Pune	Public	www.unipune.ac.in/snc/school_of_health_sciences/default.htm	Dr. Bhushan Patwardhan	Director	bhushan@unipune.ac.in	200
8	Department of Health Information Management, Manipal Univ	Private	www.manipal.edu/institutions/alliedhealth/soahsmanipal/pages/welcome.aspx	Dr. Roopalekha Jathanna P N	Head & Professor	roopajathanna@manipal.edu	250
9	King George Medical College	Public	www.kgmu.org/	Prof. D. K. Gupta	Vice Chancellor	vc@kgmcindia.edu	350
10	Dept of Cardiology, Kasturba Medical College, Manipal Univ	Private	www.manipal.edu/institutions/medicine/kmcmanipal/departments/cardiology/pages/faculty.aspx	Dr. Padma Kumar	Head & Professor		150
11	Sri Ramachandra University	Public	www.sriramachandra.edu.in/	Shri. V.R. Venkataachalam	Chancellor	chancellor@sriramachandra.edu.in	665
12	Lady Hardinge Medical College	Public	www.hardinge.org/	Dr. Shashi Raheja	Director	shashiraheja@yahoo.co.in	1300
13	National Institute of Mental Health and Neuro Sciences (NIMHANS)	Public	www.nimhans.kar.nic.in/	Dr. P. Satish Chandra	Vice Chancellor	vc@nimhans.kar.nic.in	100
14	Nizam's Institute of Medical Sciences Hyderabad	Public	www.nims.ap.nic.in/	Dr. R. Gopinath	Professor	gopinath@nims.ap.nic.in	500
15	Sardar Patel Medical college Private	Public	www.medicaleducation.rajasthan.gov.in/bikaner/index.asp	Dr. Ram Awatar Bumb	Principal	principal_spmc@live.com	100
16	Central Drug Research Institute (CDRI)	Public	www.cdriindia.org/	Dr S.K. Puri	Director	director@cdri.res.in; sk_puri@cdri.res.in	3680

HEALTH							
SI no	Organisation Name/Dept Name	Organisation Type	Website	Contact Name	Designation	Email	
						No. of Publications	
17	Jawaharlal Nehru medical College, Belgaum	Public	www.jnmc.edu/	Dr. Chandrakant Kokate	Vice Chancellor	chandrakantkokate@gmail.com	590
18	Special Centre for Molecular Medicine, JNU	Public	www.jnu.ac.in/SCMM/index.asp	Vibha Tandon	Professor	vtandon@mail.jnu.ac.in	75
19	School of Medical Sciences, Univ of Hyderabad	Public	www.uohyd.ac.in/index.php/academics/2011-10-27-18-38-04/school-of-medical-sciences/about	Dr. Geeta K. Vemuganti	Dean	deanmd@uohyd.ernet.in, gymd@uohyd.ernet.in	216
20	M.G.M. Medical College	Public	www.mgmmedicalcollege.org.in/	Dr. A.N. Mishra	Dean, Principal	mgmmedicalcollege. janshedpur@gmail.com	131
21	Amrita Institute of Medical Science (AIMS)	Public	www.aimshospital.org/	Dr. Prem Nair	MD, Medical Director	prem@aims.amrita.edu	360
22	Indira Gandhi Institute of Medical Sciences	Public	www.igims.org/	Prof. N. R. Biswas	Director	director@igims.org	180
23	National Institute of Epidemiology (NIE)	Public	www.nie.gov.in/	Dr Sanjay Mehendale	Director	sanjaymehendale@icmr.org.in	1600
24	National Institute of Immunology (NII)	Public	www.www1.nii.res.in/	Dr. Chandrima Shaha	Director	cshaha@nii.ac.in	145
25	National Institute of Malaria Research (NIMR)	Public	www.nimrcindia.org/	Neena Valecha	Director	director@nimrcindia.org; neenavalecha@gmail.com	195
26	National Brain Research Centre	Public	www.nbrc.ac.in/	Prof. Subrata Sinha	Director	subrata.sinha@nbrc.ac.in, director@nbrc.ac.in	214
27	Indian Institute of Toxicology Research	Public	www.iitrindia.org/	Dr. K.C. Gupta	Director	kcgupta@iitr.res.in	795
28	Madras Medical College	Public	www.mmc.tn.gov.in/	Dr.R.Vimala.M.D	Dean	deanmmc@tn.gov.in	350
29	St.John's Medical College	Private	www.stjohns.in/medicalcollege/		Dean	deansjmc@sjri.res.in / dean. sjmc@stjohns.in	252
30	Sarojini Naidu Medical College & Hospital	Public	www.snmcagra.in/	Dr. (Prof.) Ajay Agarwal	Principal	dean@snmcagra.in	355
31	Dept of General Surgery, JSS Medical College	Public	www.jssmedicalcollege.in/jssmc-department-general-surgery	Dr. Siddesh G	Head & Professor	drgsiddesh@yahoo.co.in	
32	Bharati Vidyapeeth Deemed University Medical College	Private	www.mcpune.bharatividyapeeth.edu/	Prof. Dr. Dr. Vivek Arvind Saoji	Principal & Professor		10
33	Vydehi Institute of Medical Sciences and Research centre	Public	www.vims.ac.in/	Dr. Prabhakar G	Principal	principalmedical@vimsmail.com	268

HEALTH							
SI no	Organisation Name/Dept Name	Organisation Type	Website	Contact Name	Designation	Email	No. of Publications
34	Topiwala National Medical College	Public	www.tnmcnair.com/	Dr. Brinda Venkatraman	Head & Professor of Physiology	brinda.venkatraman@yahoo.in	80 (2011-2012)
35	Sri Venkateshwaraa Medical College Hospital and Research Centre (SVMCH&RC)	Private	www.svmcpondy.com/	B. Ramachandhiran	Chairman	br_ret@yahoo.co.in	85
36	Shri Guru Ram Rai Institute of Medical & Health Sciences	Public	www.sgrmmc.com/	Dr. N.K Singh	Principal	smi.hospital@gmail.com	340
37	Indira Gandhi Medical College and Research Institute	Public	www.igmcshimla.org/	Dr. S.S. Kaushal	Principal	info@igmcshimla.org	80
38	Public Health Foundation of India (PHFI)	Public	www.phfi.org/	Prof. K. Srinath Reddy	President	contact@phfi.org	1200
39	Lokmanya Tilak Municipal Medical College	Public	www.ltmgh.com/	Dr. Avinash Supe	Dean	avisupe@gmail.com	325
40	A.J. Institute of Medical Sciences and Research Centre	Private	www.ajmedicals.in/	Dr. Avinash Supe	Dean	deanajms@gmail.com	22
41	School of Public Health, SRM Univ	Private	www.srmuniv.ac.in/medicine/health-sciences/school-public-health/about-the-department	Prof. Ch. Satish Kumar	Dean		45
42	College of Nursing, SRM Univ	Private	www.srmuniv.ac.in/medicine/health-sciences/college-of-nursing	Prof. Selvakani Pandian	Prof. cum Vice Principal	vp.nursing@ktr.srmuniv.ac.in	100
43	Institute of Clinical Research India	Private	www.icriindia.com/	Dr. S. K. Gupta	Director & Dean		50
44	Tagore Medical College and Hospital	Private	www.tagoremcdcollegeandhospital.com/	Dr. S. Shantha	Dean	tagoremcd@gmail.com	182
45	Amity Institute of Behavioural Health & Allied Sciences	Private	www.amity.edu/aibhas/	Dr. Ashok K. Chauhan	President		766
46	Amity Institute of Hospital Administration & Public Health	Private	www.amity.edu/aiaha/	Dr. (Ms) Chandira Roshia	Director		50
47	MES Medical College	Private	www.mesams.com/medical-college.html	Dr. C. Sadasivan Pillai	Dean	sadasivan.c@gmail.com	130
48	Calcutta National Medical College	Public	www.cnmckolkata.webs.com/			msvp_cnmck@wbhealth.gov.in	60
49	Travancore Medical College	Private	www.tmc.ac.in/			travancoremcdcollege@gmail.com	15
50	Narayan Medical College	Private	www.narayanamedicalcollege.com/college.html	Dr. G. Subramanyam	Director		38

### INFORMATION AND COMMUNICATION TECHNOLOGY

SI no	Organisation Name/Dept Name	Organi-sation Type	Website	Contact Name	Designation	Email	No. of Publi-cations
1	Dept of EE, IISc	Public	www.minchu.ee.iisc.ernet.in/index.php	Sastry P S	Chairman	chairman@ee.iisc.ernet.in	450
2	School of Information Technology, IIT Kharagpur	Public	www.iitkgp.ac.in/academics/?page=acadunits&&dept=IT	Rajib Mall	Professor & Head	rajib @ cse.iitkgp.ernet.in	188
3	Dept of EE, IIT Bombay	Public	www.ee.iitb.ac.in/web/people	Vivek Agarwal	Professor & Head	agarwal@ee.iitb.ac.in	200
4	Dept of CSE, IIT Gandhinagar	Public	www.iitgn.ac.in/faculty/comp/	Arup Lal Chakraborty	Professor	arup@iitgn.ac.in	972
5	Dept of CSE, IIT Himachal Pradesh	Public	www.iitmandi.ac.in/institute/faculty_c&ee.html	Dr. Anil K. Sao	Professor & Head	anil@iitmandi.ac.in	400
6	Amity Institute of Information Technology	Private	www.amity.edu/aiit/	Ms. Alpana Kakkar	Dy. Director		220
7	Dept of CSE, BITS - Pilani	Private	www.bits-pilani.ac.in/pilani/computerscience/ComputerScience	Dr. Navneet Goyal	Head & Professor	goe@bits-pilani.ac.in	150
8	Centre of Information and Technology Management (CITM), Thapar Univ	Public	www.thapar.edu/page-dual.asp?mainId=7&masterId=2&subId=18	Dr. R.K. Sharma	Head & Professor	hcritm@thapar.edu,rksharma@thapar.edu	110
9	School of Electrical Sciences, IIT Bhubaneswar	Public	www.iitbbs.ac.in/electrical-science.php	Dr. Arun Ghosh	Professor	ghosha@iitbbs.ac.in	985
10	Dept of CSE, IIT Hyderabad	Public	www.cse.iith.ac.in/	C. Krishna Mohan	Professor & Head	ckm@iith.ac.in	500
11	National Remote Sensing Centre (NRSC)	Public	www.nrsc.gov.in/	V.K.Dadhwal	Director		225
12	Dept of EE, IIT Gandhinagar	Public	www.iitgn.ac.in/	Arup Lal Chakraborty	Professor	arup@iitgn.ac.in	215
13	Dept of CSE, IIT Patna	Public	www.iitp.ac.in/index.php/schools-and-centers/engineering/computer-science-a-engineering.html#	Dr. Arijit Mondal	Assistant Professor	arijit@iitp.ac.in	400
14	Dept of CSE, IIT Punjab/Ropar	Public	www.iitrpr.ac.in/cse	Dr. Apurva Mudgal	Assistant Professor	apurva@iitrpr.ac.in	560
15	Centre of IT, IIT Rajasthan	Public	www.iitj.ac.in/ict/index.php	Dr. Abdul Gafoor Shaik	Assistant Professor	saadgafoor@iitj.ac.in	726
16	Dept of CSE, IIT Indore	Public	www.cse.iiti.ac.in/	Dr. Narendra S. Chaudhari	Dean & Professor	narendra@iti.ac.in	390
17	Dept of Comp Engg, IIT BHU	Public	www.iitbhu.ac.in/cse/index.php	Prof. A. K. Agrawal	Head & Professor	akagrawal.cse@iitbhu.ac.in	810
18	IIIT-Hyderabad	Public	www.iit.ac.in/	Abhijit Mitra	Professor	abi_chem@iiit.ac.in	2000
19	IIIT-Bangalore	Public	www.iitb.ac.in/	Prof. Balakrishnan Ashok	Faculty	bashok@iitb.ac.in	585
20	IIIT-Allahabad	Public	www.iiita.ac.in/	Prof G C Nandi	Director	nandi@iiita.ac.in	380

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SI no	Organisation Name/Dept Name	Organisation Type	Website	Contact Name	Designation	Email	No. of Publications
21	IIIT-Jabalpur	Public	<a href="http://www.iiitdmj.ac.in/">www.iiitdmj.ac.in/</a>	Prof. Aparajita Ojha	Director	<a href="mailto:ojha@iiitdmj.ac.in">ojha@iiitdmj.ac.in</a>	590
22	IIIT-Gwalior	Public	<a href="http://www.iiitm.ac.in/">www.iiitm.ac.in/</a>	Prof. G. K. Sharma	Professor	<a href="mailto:gksharma@iiitm.ac.in">gksharma@iiitm.ac.in</a>	395
23	IIIT-Kerala	Public	<a href="http://www.iiitm.ac.in/academics/school-of-cs-a-it/">www.iiitm.ac.in/academics/school-of-cs-a-it/</a>	Prof. Dr. Elizabeth Shery	Professor	<a href="mailto:elizabeth@iiitm.ac.in">elizabeth@iiitm.ac.in</a>	815
24	IIIT Pune	Public	<a href="http://www.isquareit.edu.in/">www.isquareit.edu.in/</a>	Dr. Bharat Chaudhari	Principal	<a href="mailto:principal@isquareit.edu.in">principal@isquareit.edu.in</a>	325
25	CSE, NIT Karnataka	Public	<a href="http://www.nitk.ac.in/show/computer-science-engineering">www.nitk.ac.in/show/computer-science-engineering</a>	Dr. Annappa	Head & Professor	<a href="mailto:hodcse@nitk.ac.in">hodcse@nitk.ac.in</a>	305
26	CSE, NIT Jamshedpur	Public	<a href="http://www.nitjsr.ac.in/new/department/index.php?dept=cse&amp;page=home">www.nitjsr.ac.in/new/department/index.php?dept=cse&amp;page=home</a>	Mr. Rajiv Ranjan Suman	Associate Professor & Head	<a href="mailto:rrsuman.cse@nitjsr.ac.in">rrsuman.cse@nitjsr.ac.in</a>	250
27	CSE, NIT Agartala	Public	<a href="http://www.nita.ac.in/NITmain/departments/cseDept/cseFaculties.html">www.nita.ac.in/NITmain/departments/cseDept/cseFaculties.html</a>	Dr. Paritosh Bhattacharya	Head & Professor	<a href="mailto:p_bhattacharya2001@yahoo.co.in">p_bhattacharya2001@yahoo.co.in</a> ; <a href="mailto:pari76@rediffmail.com">pari76@rediffmail.com</a>	260
28	CSE, MNIT Allahabad	Public	<a href="http://www.mnit.ac.in/index.php/departments/engineering/computer-science-and-engineering.html">www.mnit.ac.in/index.php/departments/engineering/computer-science-and-engineering.html</a>	Prof. Suneeta Agarwal	Head & Professor	<a href="mailto:suneeta@mnit.ac.in">suneeta@mnit.ac.in</a>	620
29	Dept of IT, MNIT Bhopal	Public	<a href="http://www.manit.ac.in/manitbhopal/index.php?option=com_content&amp;view=article&amp;id=488&amp;Itemid=58">www.manit.ac.in/manitbhopal/index.php?option=com_content&amp;view=article&amp;id=488&amp;Itemid=58</a>	Dr. Nilay Khare	Professor	<a href="mailto:nilay.khare@rediffmail.com">nilay.khare@rediffmail.com</a>	225
30	CSE, NIT Calicut	Public	<a href="http://www.cse.nitc.ac.in/">www.cse.nitc.ac.in/</a>	Madhu Kumar S D	Head & Professor	<a href="mailto:madhu@nitc.ac.in">madhu@nitc.ac.in</a>	250
31	Computer Sci, Univ of Delhi	Public	<a href="http://www.cs.du.ac.in">www.cs.du.ac.in</a>	Dr. Sunil Kr. Mutttoo	Head & Professor	<a href="mailto:office@cs.du.ac.in">office@cs.du.ac.in</a> , <a href="mailto:head@cs.du.ac.in">head@cs.du.ac.in</a>	520
32	School of Computer and Information Sciences (SCIS), Univ of Hyderabad	Public	<a href="http://www.dcis.uohyd.ernet.in/index.php">www.dcis.uohyd.ernet.in/index.php</a>	Arun K Pujari	Professor	<a href="mailto:akpcs@uohyd.ernet.in">akpcs@uohyd.ernet.in</a>	400
33	Dept of IT, NIT Durgapur	Public	<a href="http://www.nitdgp.ac.in/it/index.php">www.nitdgp.ac.in/it/index.php</a>	Mr. Subhbrata Choudhury	Head & Professor	<a href="mailto:subhbrata.choudhury@it.nitdgp.ac.in">subhbrata.choudhury@it.nitdgp.ac.in</a>	285
34	CSE, MNIT- Jaipur	Public	<a href="http://www.mnit.ac.in/new/dept_cs/index.php">www.mnit.ac.in/new/dept_cs/index.php</a>	Dr. M.C. Govil	Professor	<a href="mailto:govilmc@yahoo.com">govilmc@yahoo.com</a>	200
35	Dept of Computer Sci & App, Punjab Univ	Public	<a href="http://www.dcsa.puchd.ac.in/">www.dcsa.puchd.ac.in/</a>	Sonal Chawla	Professor	<a href="mailto:chairpersondcsa@pu.ac.in">chairpersondcsa@pu.ac.in</a>	385
36	CSE, NIT Jalandar	Public	<a href="http://www.cs.nitj.ac.in/">www.cs.nitj.ac.in/</a>	Dr Renu Dhir	Head & Professor	<a href="mailto:dhirr@nitj.ac.in">dhirr@nitj.ac.in</a>	296
37	Dept of Comp Engg, NIT Kurukshetra	Public	<a href="http://www.nitkkr.ac.in/pagesU/homePage.jsf?pageEvent=19&amp;page=content&amp;language=2">www.nitkkr.ac.in/pagesU/homePage.jsf?pageEvent=19&amp;page=content&amp;language=2</a>	Dr. Sanjay Kumar Jain	Head & Professor	<a href="mailto:skj_nith@yahoo.com">skj_nith@yahoo.com</a>	312

### INFORMATION AND COMMUNICATION TECHNOLOGY

SI no	Organisation Name/Dept Name	Organisation Type	Website	Contact Name	Designation	Email	No. of Publications
38	CSE, VNIT Nagpur	Public	<a href="http://www.cse.vnit.ac.in/">www.cse.vnit.ac.in/</a>	Dr. P.S.Deshpande	Head & Professor	psdeshpande@cse.vnit.ac.in	242
39	Dept of CSE, NIT Raipur	Public	<a href="http://www.nitr.ac.in/dept-cs.php">www.nitr.ac.in/dept-cs.php</a>	Dr. Naresh Kumar Nagwani	Head & Professor	nknagwani.cs@nitrr.ac.in, hod.cse@nitrr.ac.in	225
40	CSE, NIT Rourkela	Public	<a href="http://www.nitrkl.ac.in/Academic/1Department/Home.aspx?hrtuery765hd=NQ==yGJEyoLsZMY=">www.nitrkl.ac.in/Academic/1Department/Home.aspx?hrtuery765hd=NQ==yGJEyoLsZMY=</a>	Prof. Santanu Kumar Rath	Head & Professor	skrath@nitrr.ac.in	512
41	NIT Silchar	Public	<a href="http://www.nits.ac.in/dept_cse.php">www.nits.ac.in/dept_cse.php</a>	Samir Kr. Borgohain	Professor	samir@nits.ac.in	375
42	NIT Tiruchirappalli	Public	<a href="http://www.nit.edu/home/academics/departments/cse/">www.nit.edu/home/academics/departments/cse/</a>	Dr. S. Selvakumar	Head & Professor	ssk@nit.edu	215
43	CSE, NIT Warangal	Public	<a href="http://www.nitw.ac.in/departments/cse/">www.nitw.ac.in/departments/cse/</a>	Dr. K Ramesh	Head & Professor	kramesh@nitw.ac.in	180
44	Dept of Comp Sci, Univ of Madras	Public	<a href="http://www.unom.ac.in/index.php?route=department/department/deptpage&amp;deptid=21">www.unom.ac.in/index.php?route=department/department/deptpage&amp;deptid=21</a>	Prof. Dr. P. Thangavel	Head & Professor	pthang@unom.ac.in	328
45	Dept of IT, Jadavpur Univ	Public	<a href="http://www.jaduniv.edu.in/view_department.php?deptid=90">www.jaduniv.edu.in/view_department.php?deptid=90</a>	Prof Samiran Chattopadhyay	Head & Professor	hod@it.jusl.ac.in	150
46	Dept of Comp Sci, Univ of Mysore	Public	<a href="http://www.uni-mysore.ac.in/computer-science/#A">www.uni-mysore.ac.in/computer-science/#A</a>	Dr.G.Hemanth Kumar	Head & Professor	ghk.2007@yahoo.com	200
47	School of IT & Engg (SITE), Vellore Institute of Technology University	Private	<a href="http://www.vit.ac.in/site/abt_site.asp">www.vit.ac.in/site/abt_site.asp</a>	Prof. Sankaran V	Head & Professor	dean.site@vit.ac.in	192
48	Dept of IT, SRM Univ	Private	<a href="http://www.srmuniv.ac.in/engineering/department-of-information-technology/about-the-department">www.srmuniv.ac.in/engineering/department-of-information-technology/about-the-department</a>	Dr. G.Vadivu	Head & Professor	hod.it@ktr.srmuniv.ac.in	220
49	CSE -NIT, Meghalaya	Public	<a href="http://www.nitm.ac.in/cse_dept.html">www.nitm.ac.in/cse_dept.html</a>	Prof. Dilip Kumar Saikia	Director	director.nitmeghalaya@gmail.com	290
50	Dept of CSE, Univ of Delhi	Public	<a href="http://www.cs.du.ac.in/index.html#_U0JodqSz5M">www.cs.du.ac.in/index.html#_U0JodqSz5M</a>	Dr. Sunil Kumar Muttoo	Assoc. Professor	skmuttoo@cs.du.ac.in	300



**NANO TECHNOLOGY**

SI no	Organisation Name/Dept Name	Organi- sation Type	Website	Contact Name	Designation	Email	No. of Publications
1	School of Nano Science and Technology- National Institute of Technology Calicut	PUBLIC	www.nitc.ac.in/index. php?url=department/index/27	Dr.M. N. Bandyopadhyay	Director	director@nitc.ac.in	70 research publications
2	Centre for Research in Nanotechnology & Science (CRNTS) - IITBombay	PUBLIC	www.iitb.ac.in/~crnts/	Prof. Indradev S. Samajdar	HEAD	office.crnts@iitb.ac.in	400 research publications
3	Department of Materials Science and Metallurgical Engineering-IIT Hyderabad	PUBLIC	www.mse.iith.ac.in/	Pinaki Prasad Bhattacharjee	HOD	pinakib@iith.ac.in	37 research publications
4	Dept. of Material Sciences-IIT Karaghpur	PUBLIC	www.iitkgp.ac.in/academics/?pag e=acadunits&&dept=MS	Prof. Shanker Ram	HOD	sram@matcs.iitkgp.ernet.in	451 research publications
5	Centre for Strategic Materials-IIT Patna	PUBLIC	www.iitp.ac.in/index.php/schools- and-centers/csm.html	Dr. Dinesh K. Kotnees	Coordinator	dinesh@iitp.ac.in	Not available
6	Dept. of Metallurgical and Materials Engineering-IIT ROORKEE	PUBLIC	www.iitr.ac.in/departments/MT/ pages/index.html	Nath, Sumeer K.	HOD	indiafmt@iitr.ac.in	56 publications, 10 conference proceedings, 1 patent
7	Metallurgical Engineering Department- IIT Varanasi	PUBLIC	www.iitbhu.ac.in/met/	G.V.S.Sastry	Professor	head.met@itbhu.ac.in	Not available
8	Centre of Nanotechnology (CNT)	PUBLIC	www.iitr.ac.in/centers/NT/pages/ Centre_of_Nanotechnology.html	Prof. Vijaya Agarwala	HOD	vijayfm@iitr.ac.in	Not available
9	Department of Metallurgical and Materials Engineering, NIT karnataka	PUBLIC	www.nitk.ac.in/show/ metallurgical-and-materials- engineering	A.O.Surendranathan	Professor	nathan@nitk.ac.in	Not available
10	Department of Metallurgical and Materials Engineering-NIT Durgapur	PUBLIC	www.nitdgp.ac.in/mme/	Not available	Not available	met@nitdgp.ac.in	Not available
11	Department of Metallurgical Engineering-		www.mme.vnit.ac.in/	Dr. R.K. PARETKAR	HOD	rkparetkar@mme.vnit.ac.in	150 publications
12	Centre for Nanoscience & Nanotechnology (U.I.E.A.S.T.)	PUBLIC	www.physics.puchd.ac.in/nsnt/	Prof. Manjit Kaur	Coordinator	manjit@pu.ac.in	Not available
13	Agharkar Research Institute	PUBLIC	www.aripune.org/index.php/dr-k- m-paknikar/	Dr. K.M. Paknikar	Director	kmpaknikar@aripune.org	18 reseach publications
14	Centre for Nanoscience and Nanotechnology-Jamia Millia Islamia	PRIVATE	www.jmi.ac.in/cnn	Dr Mushahid Husain	Professor	mhusain1@jmi.ac.in	Not available

## NANO TECHNOLOGY

SI no	Organisation Name/Dept Name	Organi- sation Type	Website	Contact Name	Designation	Email	No. of Publications
15	<b>CEN - Centre of Excellence in Nanoelectronics-IIT Bombay</b>	PUBLIC	www.cen.iitb.ac.in/cen/index.php	V. Ramgopal Rao	principal Investigator	r Rao@ee.iitb.ac.in	10 patents, 150 International Conferences publications, 86 International Journals
16	<b>Department of Physics and Nanotechnology -SRM University</b>	PRIVATE	www.srmuniv.ac.in/engineering/school-of-basic-sciences/department-physics-and-nanotechnology/about-the-department	Dr. D. John Thiruvadigal	HOD	john.d@ktr.srmuniv.ac.in	120 publications
17	<b>Department of Center for Nanosciences and Nanotechnology-IIT Bombay</b>	PUBLIC	www.mu.ac.in/science/cnum/Deptofscicnum.htm	Not available	Not available	webmaster@ucc.mu.ac.in	Not available
18	<b>Centre for Nanotechnology &amp; Advanced Biomaterials (CeNTAB)-SASTRA University</b>	PRIVATE	www.sastra.edu/centab/	Dr. S. Swaminathan	HOD	swami@sastra.edu	Not available
19	<b>Centre for Nanotechnology Research (CNR)-VIT university</b>	PRIVATE	www.vit.ac.in/cnr/cnr.asp	Prof. (Dr.) J.P.Raina	Director	director.cnr@vit.ac.in	31 journals, 42 international conference proceedings
20	<b>Centre for Nanoscience and Nanotechnology-IGCAR</b>	PUBLIC	www.centrefornanotechnology.com/	Dr. Vinita Vishwakarma	Scientist	centrefornanoscience@gmail.com	34 journals, 3 patents
21	<b>Centre for Nanoscience and Nanotechnology-Bharathidasan University</b>	PRIVATE	www.bdu.ac.in/centers/nanoscience_nanotechnology/	Dr. K. Jeganathan	Associate Professor and Coordinator	jegan@physics.bdu.ac.in	69 research publications
22	<b>Centre for Bioscience and Nanoscience Research</b>	PRIVATE	www.cbncindia.com	Mr. V. Subramanian	Director	cbncindia@gmail.com	2 research papers
23	<b>Special Center for Nanosciences (SCNS)-JNU</b>		www.jnu.ac.in/SCNS	H.B. Bohidar	Professor and Chairperson	bohi0700@mail.jnu.ac.in	23 publications, 1 patent
24	<b>NanoSniff Technologies Pvt. Ltd</b>	PUBLIC-R&D	www.nanosniff.com/	Prof. V. Ramgopal Rao	Chairman	contact@nanosniff.com	Not available
25	<b>Centre for Advanced Materials-IACS</b>	PRIVATE	www.iacs.res.in/cam/	Partha Chaudhuri	Senior Professor and Head	erpc@iacs.res.in	148 publications

NANO TECHNOLOGY							
SI no	Organisation Name/Dept Name	Organi- sation Type	Website	Contact Name	Designation	Email	No. of Publications
26	Nano Science & Technology Consortium (NSTC)	PRIVATE	www.nstc.in/	Mr. Puneet mehrotra	Director	info@nstc.in	22 books
27	Centre for Nano and Material Sciences- Jain university	PRIVATE	www.cnms.jainuniversity.ac.in/	DR. R GEETHA BALAKRISHNA	Professor	br.geetha@jainuniversity.ac.in	16 paper publications
28	Centre for Knowledge Management of Nanoscience & Technology (CKMNT)	PUBLIC	www.ckmnt.com/	Dr. G. Sundararajan	Director	gsundar@arci.res.in	3 market research reports and 2 techno commercial reports, 350 technical papers in peer reviewed journals and conference proceedings
29	Thematic Unit of Excellence on Nanodevice Technology	PUBLIC	www.newweb.bose.res.in/departments/TUENDT/	Prof. A. K. Raychaudhuri	Director & Senior professor	arup@bose.res.in	11 publications
30	Materials Research Society of India (MRSI)	PRIVATE	www.mrsi.org.in/	Prof. S.B. Krupanidhi	Vice president	nanda@mrc.iisc.ernet.in	2 books
31	Advanced Material Research Unit-S. N. Bose National Centre for Basic Sciences	PUBLIC	www.bose.res.in/~amru/	Dr. Abhijit Mookerjee	Professor	amru@bose.res.in	45 publications
32	PSG Institute of Advanced Studies	PRIVATE	www.psgias.ac.in/	Dr. P. RADHAKRISHNAN	Director	director@ias.psgtech.ac.in	39 publications(2010-2014)
33	CSIR National Physical Laboratory	PUBLIC	www.nplindia.org/	Dr. Virendra Shanker	Chief Scientist	root@nplindia.org	not available
34	Department of Center for Nanosciences and Nanotechnology- University of Mumbai (CNNUM)	PUBLIC	www.mu.ac.in/science/cnnum/profile.html	Not available	Not available	webmaster@ucc.mu.ac.in	Not available
35	Department of Nanoscience and Technology- Bharathiar University	PRIVATE	www.buc.edu.in/departments/nanotech/index.html	Prof. Dr D. Mangalaraj	HOD	dmraj800@yahoo.com	Not available
36	Center for Nano Science & Technology- JNU Hyderabad	PUBLIC	www.jntuh.ac.in/new/academic/nano-science.html	Ms. CH. Shilpa Chakra	HOD	shilpachakra.nano@jntuh.ac.in	Not available
37	Thematic Unit of Excellence- Nanoscience and Nanotechnology in Nanofabrication-IIT Kanpur	PUBLIC	www.iitk.ac.in/nanoscience/	Ashutosh Sharma	Coordinator & PI	ashutos@itk.ac.in	277 research publications(2010-2012)
38	Department of Nanoscience and Technology-Alagappa University	PRIVATE	www.alagappauniversity.ac.in/academic/science/nano_about.php	Dr.K.Gurunathan	HOD	Nano_au@rediffmail.com	Not available

## NANO TECHNOLOGY

SI no	Organisation Name/Dept Name	Organi- sation Type	Website	Contact Name	Designation	Email	No. of Publications
39	Center for Research in Nanoscience and Nanotechnology- University of Calcutta	PUBLIC	<a href="https://www.caluniv.ac.in/academic/CRNN/htmlfiles/crmfac.html">https://www.caluniv.ac.in/academic/CRNN/htmlfiles/crmfac.html</a>	Dr. Prasun Mukherjee	Assistant professor	pmukherjee12@gmail.com	109 research publications
40	Materials Research Centre-(IISc)	PUBLIC	<a href="http://www.mrc.iisc.ernet.in/Faculty/Regular/SBK/SBK_Profile.htm">www.mrc.iisc.ernet.in/Faculty/Regular/SBK/SBK_Profile.htm</a>	S. B. Krupanidhi	Professor	sbk@mrc.iiscernet.in	40 research publications
41	Department of Materials Science-sardar Patel University	PUBLIC	<a href="http://www.spuvvn.edu/academics/departments/materials_science">www.spuvvn.edu/academics/departments/materials_science</a>	Prof. (Mrs.) S. Manocha	HOD	hdmsspu@rediffmail.com	18 research papers
42	School of Mechanical, Materials & Energy Engineering (SMMEE)-IIT Ropar	PUBLIC	<a href="http://www.iitpr.ac.in/smme">www.iitpr.ac.in/smme</a>	Prof. M. K. Surappa	Director	director@iitpr.ac.in	167 research papers, 17 research reports
43	Advanced Centre for Materials Science-IIT Kanpur	PUBLIC	<a href="http://www.iitk.ac.in/acms/about.htm#">www.iitk.ac.in/acms/about.htm#</a>	Dr. Sandeep Sangal	Professor	sangals@iitk.ac.in	5 (professor)
44	Centre of Material Science-University of Allahbad	PRIVATE	<a href="http://www.alluniv.ac.in/index.php?option=com_k2&amp;view=item&amp;id=86&amp;Itemid=363">www.alluniv.ac.in/index.php?option=com_k2&amp;view=item&amp;id=86&amp;Itemid=363</a>	Brajendra Singh	Assistant Professor	brajendr@allduniv.ac.in	Not available
45	Department of Metallurgical and Materials Engineering-IIT Madras	PUBLIC	<a href="http://www.mme.iitm.ac.in/">www.mme.iitm.ac.in/</a>	Prof. M. Kamaraj	HOD	mmhead@iitm.ac.in	85 research publications
46	CSIR – National Institute for Interdisciplinary Science and Technology (NIIST)	PUBLIC	<a href="http://www.niist.res.in/english/research-areas/materials-and-minerals/highlights.html">www.niist.res.in/english/research-areas/materials-and-minerals/highlights.html</a>	Dr. Sebastian M.T	Chief Scientist and Head	mtsebastian@niist.res.in	1200 publications, 115 patents
47	Department of Materials Engineering -IISc	PUBLIC	<a href="http://www.materials.iisc.ernet.in/web/">www.materials.iisc.ernet.in/web/</a>	Prof. Vikram Jayaram	Chairman	chairman_@_materials.iisc.ernet.in	160 journal publications, 5 patents(2013)
48	International Center for Material sciences(ICMS)	PUBLIC	<a href="http://www.jncasr.ac.in/icms">www.jncasr.ac.in/icms</a>	Professor C.N.R. Rao	Director	cnrao@jncasr.ac.in	46 books, 1604 research papers(professor)
49	Department of Metallurgical Engineering and Materials Science-IIT Bombay	PUBLIC	<a href="http://www.met.iitb.ac.in/index.html">www.met.iitb.ac.in/index.html</a>	Prof. N. Prabhu	HOD	nprabhu@iitb.ac.in	90 research publications, 10 patents, 3 patents filed
50	School of Materials Science and Technology - Institute of Technology, Banaras Hindu University, Varanasi	PUBLIC	<a href="http://www.iitbhu.ac.in/mst/index.html">www.iitbhu.ac.in/mst/index.html</a>	Prof. D. Pandey	professor	dpandey_bhu@yahoo.co.in	17o publications, 4 patents filed

**SOCIAL SCIENCES**

SI no	Organisation Name/Dept Name	Organi- sation Type	Website	Contact Name	Designation	Email	No. of Publi- cations
1	Dept of HSS, IIT Gandhinagar	Public	<a href="http://hss.iitgn.ac.in/">http://hss.iitgn.ac.in/</a>	Achal Mehra	Professor	<a href="mailto:achal@iitgn.ac.in">achal@iitgn.ac.in</a>	199
2	Dept of HSS, IIT Patna	Public	<a href="http://www.iitp.ac.in/index.php/schools-and-centers/humanities-and-social-sciences/about-the-department.html">http://www.iitp.ac.in/index.php/schools-and-centers/humanities-and-social-sciences/about-the-department.html</a>	Dr. Aditya Raj	Professor	<a href="mailto:aditya.raj@iitp.ac.in">aditya.raj@iitp.ac.in</a>	110
3	Dept of HSS, IIT Punjab/Ropar	Public	<a href="http://www.iitrpr.ac.in/hu">http://www.iitrpr.ac.in/hu</a>	Dr. Rajyashree Khushu-Lahiri	Head & Professor	<a href="mailto:rajyashree@iitrpr.ac.in">rajyashree@iitrpr.ac.in</a>	50
4	Dept of HSS, IIT Indore	Public	<a href="http://hss.iiti.ac.in/index.html">http://hss.iiti.ac.in/index.html</a>	Dr. Amarjeet Nayak	Professor	<a href="mailto:amarjeet@iiti.ac.in">amarjeet@iiti.ac.in</a>	50
5	HSS, NIT Agartala	Public	<a href="http://www.nita.ac.in/NITMain/departments/humanitiesDept/humanitiesProgrammes.html">http://www.nita.ac.in/NITMain/departments/humanitiesDept/humanitiesProgrammes.html</a>	Dr. Debasis Neogi	Head & Professor	<a href="mailto:dnecon@gmail.com">dnecon@gmail.com</a>	65
6	HSS, JNTU	Public	<a href="http://jntuhceh.ac.in/viewdept/12">http://jntuhceh.ac.in/viewdept/12</a>	Dr. V Parvathi	Professor	<a href="mailto:parvathivudumula@jntuh.ac.in">parvathivudumula@jntuh.ac.in</a>	100
7	School of HSS, IIT Bhubaneswar	Public	<a href="http://www.iitbbs.ac.in/social-science.php">http://www.iitbbs.ac.in/social-science.php</a>	Dr. Amrita Satapty	Professor	<a href="mailto:asatapathy@iitbbs.ac.in">asatapathy@iitbbs.ac.in</a>	185
8	School of Science and Humanities, Karunya Univ	Private	<a href="http://www.karunya.edu/sh/index.html">http://www.karunya.edu/sh/index.html</a>	Dr. J. Daphy Louis Lovenia	Director	<a href="mailto:daphy@karunya.edu">daphy@karunya.edu</a>	50
9	Dept of HSS, BITS Pilani	Private	<a href="http://www.bits-pilani.ac.in/pilani/pilaniDepartmentofHumanitiesandSocialSciences/DepartmentofHumanitiesandSocialSciences">http://www.bits-pilani.ac.in/pilani/pilaniDepartmentofHumanitiesandSocialSciences/DepartmentofHumanitiesandSocialSciences</a>	Dr Geetha B	Head & Professor	<a href="mailto:geetha@pilani.bits-pilani.ac.in">geetha@pilani.bits-pilani.ac.in</a>	165
10	Dept of HSS, Shiv Nadar Univ	Private	<a href="http://www.snu.edu.in/humanitiessocialsciences/humanities_social_sciences_overview.aspx">http://www.snu.edu.in/humanitiessocialsciences/humanities_social_sciences_overview.aspx</a>	Shubhashis Gangopadhyay	Director		35
11	Dept of HSS, NIT Karnataka	Public	<a href="http://www.nitk.ac.in/show/humanities-social-sciences-and-management">http://www.nitk.ac.in/show/humanities-social-sciences-and-management</a>			<a href="mailto:aloysiushs@gmail.com">aloysiushs@gmail.com</a>	108
12	Madras Institute of Development Studies (MIDS)	Public	<a href="http://www.mids.ac.in/">http://www.mids.ac.in/</a>	Prof. K. L. Krishna	Chairman	<a href="mailto:krishna@econidse.org">krishna@econidse.org</a>	280
13	Dept of IT, MNIT Bhopal	Public	<a href="http://www.manit.ac.in/manitbhopal/index.php?option=com_content&amp;view=article&amp;id=50&amp;Itemid=61">http://www.manit.ac.in/manitbhopal/index.php?option=com_content&amp;view=article&amp;id=50&amp;Itemid=61</a>	Dr. (Mrs.) Shuchi Srivastava	Head & Professor	<a href="mailto:shuchi_rajendra@yahoo.co.in">shuchi_rajendra@yahoo.co.in</a>	60
14	Dept of HSS, MNIT Allahabad	Public	<a href="http://www.mnmit.ac.in/index.php/departments/others/humanities-and-social-science.html">http://www.mnmit.ac.in/index.php/departments/others/humanities-and-social-science.html</a>	Dr. Niroj Banerji	Head & Professor	<a href="mailto:rcvaishya@mnmit.ac.in">rcvaishya@mnmit.ac.in</a>	85
15	Dept of HSS, NIT Durgapur	Public	<a href="http://www.nitdgp.ac.in/hu/">http://www.nitdgp.ac.in/hu/</a>	Sengupta Partha Pratim	Head & Professor	<a href="mailto:parthapratim.sengupta@hu.nitdgp.ac.in">parthapratim.sengupta@hu.nitdgp.ac.in</a>	70

## SOCIAL SCIENCES

SI no	Organisation Name/Dept Name	Organi-sation Type	Website	Contact Name	Designation	Email	No. of Publi-cations
16	Dept of HSS, MNIT Jaipur	Public	<a href="http://www.mnit.ac.in/new/dept_hmt/index.php">http://www.mnit.ac.in/new/dept_hmt/index.php</a>	Dr. Vibhuti Singh Shekhawat	Head & Professor	vibhutisingh@yahoo.com	65
17	Dept of HSS, NIT Jalandar	Public	<a href="http://hm.nitj.ac.in/">http://hm.nitj.ac.in/</a>	Sh S J S Bedi	Head & Professor	bediss@nitj.ac.in	50
18	HSS, VNIT Nagpur	Public	<a href="http://hum.vnit.ac.in/index.php/">http://hum.vnit.ac.in/index.php/</a>	Dr.Y.M.Deshpande	Head & Professor	ydeshpande@hum.vnit.ac.in	100
19	HSS, NIT Silchar	Public	<a href="http://www.nits.ac.in/dept_humanities.php">http://www.nits.ac.in/dept_humanities.php</a>	Prof. Gurudas Das	Professor	gurudas_das@yahoo.co.in	146
20	HSS, NIT Rourkela	Public	<a href="http://www.nitrkl.ac.in/Academic/1/Department/Home.aspx?hsgf32hjk=MTA%3d-5a3%2bNygtr8%3d">http://www.nitrkl.ac.in/Academic/1/Department/Home.aspx?hsgf32hjk=MTA%3d-5a3%2bNygtr8%3d</a>	Prof.(Ms.) Seemita Mohanty	Professor	seemita@nitrkl.ac.in	200
21	Dept of HSS, NIT Tiruchirappalli	Public	<a href="http://www.nitt.edu/home/academics/departments/humanities">http://www.nitt.edu/home/academics/departments/humanities</a>	Dr. C. Meenakshisundaram	Professor	cm@nitt.edu	120
22	Dept of HSS, NIT Kurukshetra	Public	<a href="http://www.nitkr.ac.in/pagesll/homePage.js?pag eEvent=25&amp;page=content&amp;language=2">http://www.nitkr.ac.in/pagesll/homePage.js?pag eEvent=25&amp;page=content&amp;language=2</a>	Dr. Vikas Chaudhary	Head & Professor	vikas9291@yahoo.com; vikas9291@yahoo.com	48
23	Dept of HSS, NIT Raipur	Public	<a href="http://www.nitr.ac.in/dept-english.php">http://www.nitr.ac.in/dept-english.php</a>	Dr. S. P. S. Matharu	Professor	spmtharu123@rediffmail; spsm.mech@nitrr.co.in	50
24	Dept of HSS, NIT Warangal	Public	<a href="http://www.nitw.ac.in/nitw/index.php/departmen-t-of-humanities-people">http://www.nitw.ac.in/nitw/index.php/departmen-t-of-humanities-people</a>	Dr. Kesava Rao D S	head & professor	kesavads@gmail.com	71
25	Dept of HSS, NIT Patna	Public	<a href="http://www.nitp.ac.in/ssh_dept.php">http://www.nitp.ac.in/ssh_dept.php</a>	Dr. Kalpana Sinha	Head & Professor	ssh@nitp.ac.in	35
26	Dept of HSS, NIT Meghalaya	Public	<a href="http://www.nitm.ac.in/humanities_dept.html">http://www.nitm.ac.in/humanities_dept.html</a>	Dr. Amal Dev Sharma	Professor	amaldevsarma@gmail.com	30
27	Dept of HSS, NIT Uttarkhand	Public	<a href="http://www.nituk.com/NIT_Departments.html">http://www.nituk.com/NIT_Departments.html</a>	Dr. Manvendra Singh Khatri	Head & Professor	mshkhatr@gmail.com	42
28	Dept of Sociology, Jadavpur Univ	Public	<a href="http://www.jaduniv.edu.in/view_department.php?deptid=75">http://www.jaduniv.edu.in/view_department.php?deptid=75</a>	Dr. Rauby Das Sain	Head & Professor	hod@socialjdvu.ac.in	60
29	Dept of Sci and Humanities, NIT Goa	Public	<a href="http://www.new.nitgoa.ac.in/web/Deptindex.aspx? page=a&amp;ItemID=18&amp;nDeptID=11">http://www.new.nitgoa.ac.in/web/Deptindex.aspx? page=a&amp;ItemID=18&amp;nDeptID=11</a>	Dr. P. S Reddy	Head & Professor	psreddy@nitgoa.ac.in	100
30	Dept of HSS, NIT Mizoram	Public	<a href="http://www.nitmz.ac.in/humanities_and_social_science.html">http://www.nitmz.ac.in/humanities_and_social_science.html</a>	Dr. K. Gyanendra Singh	Professor	gyanendra_eco@yahoo.com	50
31	Dept of Sociology, Univ of Delhi	Public	<a href="http://www.du.ac.in/index.php?d=440&amp;L=0">http://www.du.ac.in/index.php?d=440&amp;L=0</a>	Dr. Satish Deshpande	Head & Professor	head@sociology.du.ac.in	170

**SOCIAL SCIENCES**

SI no	Organisation Name/Dept Name	Organi- sation Type	Website	Contact Name	Designation	Email	No. of Publi- cations
32	<b>Indira Gandhi Institute of Development Research (IGDR)</b>	Public	<a href="http://www.igdr.ac.in/">http://www.igdr.ac.in/</a>	S. Mahendra Dev	Vice Chancellor	profmahendra@igdr.ac.in	123
33	<b>School of Soc Sci, Univ of Hyderabad</b>	Public	<a href="http://www.uohyd.ac.in/index.php/academics/2011-10-27-18-38-04/school-of-social-sciences">http://www.uohyd.ac.in/index.php/academics/2011-10-27-18-38-04/school-of-social-sciences</a>	Prof. Aloka Parasher Sen	Professor		88
34	<b>Centre for SSH, Univ of Calcutta</b>	Public	<a href="http://www.caluniv.ac.in/academic/Centre%20for%20Social%20Sciences%20and%20Humanities.htm">http://www.caluniv.ac.in/academic/Centre%20for%20Social%20Sciences%20and%20Humanities.htm</a>	B Chakra	Professor	bchakra@gmail.com	100
35	<b>Dept of Sociology, Univ of Madras</b>	Public	<a href="http://www.unom.ac.in/index.php?route=department/departments/deptpage&amp;deptid=65">http://www.unom.ac.in/index.php?route=department/departments/deptpage&amp;deptid=65</a>	Dr. A. Karupiah	Head & Professor	akarupiah2002@yahoo.co.in	30
36	<b>Centre for Studies in Science Policy, JNU</b>	Public	<a href="http://www.jnu.ac.in/SSS/CSSP/default.htm">http://www.jnu.ac.in/SSS/CSSP/default.htm</a>	Pranav N. Desai	Professor	pndesai@mail.jnu.ac.in; dpranav@hotmail.com	290
39	<b>Dept of HSS, Symbiosis International University</b>	Private	<a href="http://www.siu.edu.in">www.siu.edu.in</a>	Dr. Jyoti Chandiramani	Director SSE		168
40	<b>Faculty of Social Sci, BHU</b>	Public	<a href="http://www.bhu.ac.in/social_sciences/index.php">http://www.bhu.ac.in/social_sciences/index.php</a>	Prof. R.R. Jha	Professor	jha@ss.bhu.ac.in	76
41	<b>Centre for SSH, Univ of Pune</b>	Public	<a href="http://www.unipune.ac.in/cssh">www.unipune.ac.in/cssh</a>	Dr. S. M. alias Raja Dixit	Professor	smrajadixit@unipune.ac.in	134
42	<b>Dept of Sociology, Osmania Univ</b>	Public	<a href="http://www.osmania.ac.in/ArtsCollege/sociology.htm">http://www.osmania.ac.in/ArtsCollege/sociology.htm</a>	Dr. S. Deva Prakasham	Professor		100
43	<b>School of Social Sciences, JNU</b>	Public	<a href="http://www.jnu.ac.in/SSS/">http://www.jnu.ac.in/SSS/</a>	Anjan Mukherji	Professor	anjan@mail.jnu.ac.in	415
44	<b>Indian Statistical Institute (ISI)</b>	Public	<a href="http://www.isical.ac.in/">http://www.isical.ac.in/</a>	Manipushpak Mitra	Professor	mmitra@isical.ac.in	600
45	<b>North Maharashtra University</b>	Public	<a href="http://nmu.ac.in/soos/en-us/home.aspx">http://nmu.ac.in/soos/en-us/home.aspx</a>	Prof. R.H. Gupta	Head & Professor	rhgupta@nmu.ac.in	130
46	<b>Dept of Sociology, Univ of Kerala</b>	Public	<a href="http://www.keralauniversity.ac.in/departments/socio">http://www.keralauniversity.ac.in/departments/socio</a>	Dr Manu Bhaskar	Professor		100
47	<b>Dept of Sociology, Univ of Mysore</b>	Public	<a href="http://uni-mysore.ac.in/sociology">http://uni-mysore.ac.in/sociology</a>	Prof. R Indira	Chairman	indiraramao@rediffmail.com, ramaraoindira@gmail.com	150
48	<b>School of Social Sciences &amp; Languages, VIT</b>	Private	<a href="http://www.vit.ac.in/sss/sss.asp">http://www.vit.ac.in/sss/sss.asp</a>	Dr. M. John Sundar David	Dean and Professor	dean.ss@vit.ac.in	125
49	<b>Amity Institute of Social Sciences (AISS)</b>	Private	<a href="http://amity.edu/aioss/">http://amity.edu/aioss/</a>	Dr. Nirupama Prakash	Director		50
50	<b>Dept of Soci, Univ of Allahabad</b>	Public	<a href="http://www.allduniv.ac.in/index.php?option=com_k2&amp;view=item&amp;layout=item&amp;id=113&amp;Itemid=504">http://www.allduniv.ac.in/index.php?option=com_k2&amp;view=item&amp;layout=item&amp;id=113&amp;Itemid=504</a>	Ashish Saxena	Professor	ashish.ju@gmail.com	65

## TRANSPORT

SI no	Organisation Name/Dept Name	Organi-sation Type	Website	Contact Name	Designation	Email	No. of Publications
1	Centre for Transportation Research (CTR)-IIT Calicut	PUBLIC	<a href="http://www.nitc.ac.in/index.php?url=department/index/47">www.nitc.ac.in/index.php?url=department/index/47</a>	Not available	Not Available	ctr@nitc.ac.in	not available
2	CTTRANS- Centre of Excellence of IIT Roorkee	PUBLIC	<a href="http://www.iitr.ac.in/centers/CTTRANS/index.html">www.iitr.ac.in/centers/CTTRANS/index.html</a>	Prof. M. Parida	Head	ctrans.iitr@gmail.com	28 research publications
3	Transportation Research and Injury Prevention Programme (TRIPP)	PUBLIC	<a href="http://www.tripp.iitd.ernet.in/">www.tripp.iitd.ernet.in/</a>	Not available	Not Available	ird10165@cbme.iitd.ernet.in	210 publication
4	Naval Science & Technological Laboratory (NSTL)	PUBLIC	<a href="http://www.drdo.gov.in/drdo/labs/NSTL/English/Index.jsp?pg=HistoricalBG.jsp">www.drdo.gov.in/drdo/labs/NSTL/English/Index.jsp?pg=HistoricalBG.jsp</a>	Shri CD Malleswar Sc G	Director	director@nstl.drdo.in	not available
5	Institute of Urban Transport India (IUT)	PUBLIC	<a href="http://www.iutindia.org/">www.iutindia.org/</a>	Shri. B. I. Singal	Director General	info@iutindia.org	47 research publications
6	Central Institute of Road Transport (CIRT)	PUBLIC	<a href="http://www.cirtindia.com/">www.cirtindia.com/</a>	Shri Abhay Damle	DIRECTOR	director@cirtindia.com	50
7	Center for infrastructure, Sustainable Transportation and Urban Planning (CISTUP)	PUBLIC	<a href="http://www.cistup.iisc.ernet.in/">www.cistup.iisc.ernet.in/</a>	Prof. J.M.Chandra Kishen	Chairman	chairman@cistup.iisc.ernet.in	42
8	Central Road Research Institute(CSIR)	PUBLIC	<a href="http://www.crridom.gov.in/">www.crridom.gov.in/</a>	Dr. S. Gangopadhyay	Director	director.crrri@nic.in	113
9	Automotive Research Association of India (ARAI )	PUBLIC	<a href="https://www.araiindia.com">https://www.araiindia.com</a>	Not available	Not Available	info@araiindia.com	not available
10	Transportation Research Group of India	PRIVATE	<a href="http://www.trgindia.org/">www.trgindia.org/</a>	Dr Ashish Verma	President	ashishv@civil.iisc.ernet.in	59 International Journal, 9 national journals
11	Association of Transportation Professionals of Indian Origin (ATPIO)	PRIVATE	<a href="http://www.atpio.org/">www.atpio.org/</a>	Dr. Shashi Nambisan	Director	shashi@iastate.edu	not available
12	Ashoka Highway Research & Centre (AHRC)	PRIVATE	<a href="http://www.ahrc.in/ashokabuildcon.html">www.ahrc.in/ashokabuildcon.html</a>	Not available	Not Available	Not Available	not available
13	Indian Roads Congress (IRC)	PUBLIC	<a href="http://www.irc.org.in/ENU/Pages/IRC.aspx">www.irc.org.in/ENU/Pages/IRC.aspx</a>	Shri Sumil Bhowmick	President	cetripura@yahoo.com	35 Publications
14	Transportation Engineering Group, IISc	PUBLIC	<a href="http://www.civil.iisc.ernet.in/trp/main.html">www.civil.iisc.ernet.in/trp/main.html</a>	Dr. Ashish Verma	Assistant Professor	ashishv@civil.iisc.ernet.in	not available



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SI no	Organisation Name/Dept Name	Organi- sation Type	Website	Contact Name	Designation	Email	No. of Publications
15	Volvo Research and Educational Foundations	PRIVATE	<a href="http://www.vref.se/thefutprogramme/centresofexcellence4-3b8af0c112ec0f3879380002757.html">www.vref.se/thefutprogramme/centresofexcellence4-3b8af0c112ec0f3879380002757.html</a>	V.Agarwal	Researcher	secretariat@vref.se	2 (professor)
16	Centre for Transportation Research (CTR)- Centre of Excellence-NIT Calicut	PUBLIC	<a href="http://www.nitc.ac.in/index.php?url=department/index/47">www.nitc.ac.in/index.php?url=department/index/47</a>	Dr.M.V.L.R Anjaneyulu	Professor	ctr@nitc.ac.in	not available
17	Transportation Engineering-Dept of civil engineering, IIT Madras	PUBLIC	<a href="http://www.civil.iitm.ac.in/new/?q=te">www.civil.iitm.ac.in/new/?q=te</a>	Dr. A. Veeraragavan, FIE, FISEAM	Professor	av@iitm.ac.in	11 publications (professor)
18	Department of Civil Engineering at IIT Kanpur	PUBLIC	<a href="http://www.iitk.ac.in/ce/">www.iitk.ac.in/ce/</a>	Dr. Partha Chakroborty	Professor	partha@iitk.ac.in	85 research papers
19	Shipping Corporation of India.Ltd	PUBLIC	<a href="http://www.shipindia.com/profile/about-sci.aspx">www.shipindia.com/profile/about-sci.aspx</a>	Mr A. K. Gupta	Director	arun.gupta@sci.co.in	not available
20	Centre for Aerospace Systems Design and Engineering (CASDE)-IIT Bombay	PUBLIC	<a href="http://www.casde.iitb.ac.in/aboutus/">www.casde.iitb.ac.in/aboutus/</a>	Prof. K Sudhakar	Professor	sudhakar@aero.iitb.ac.in	36 publications
21	Department of Civil Engineering, IIT Bombay	PUBLIC	<a href="http://www.civil.iitb.ac.in/">www.civil.iitb.ac.in/</a>	Prof. Tarun Kant	Professor	hod@civil.iitb.ac.in	137 research journals
22	Dept. Of civil engineering, IIT Delhi	PUBLIC	<a href="http://www.civil.iitd.ac.in/index.php?menuid=sections">www.civil.iitd.ac.in/index.php?menuid=sections</a>	Dr. A.K. Swamy	Assistant Professor	akswamy@civil.iitd.ac.in	9 journals, 7 conference proceedings, 2 research reports (professor)
23	Dept. Of civil engineering, IIT Gawahati	PUBLIC	<a href="http://www.iitg.ac.in/civil/fac.htm">www.iitg.ac.in/civil/fac.htm</a>	Dr C. Mallikarjuna	Faculty-In-Charge	c.mallikarjuna@iitg.ernet.in	not available
24	CAPA India- CAPA - Centre for Aviation	PRIVATE	<a href="http://www.capaindia.com/">www.capaindia.com/</a>	Kapil Kaul	Person-In Charge	kk@centreforaviation.com	20 research reports
25	CSIR - National Aerospace Laboratories	PUBLIC	<a href="http://www.nal.res.in/">www.nal.res.in/</a>	SHYAM CHETTY	Director	purchasek@nal.res.in	11 publications
26	T.S. CHANAKYA- Indian maritime university	PUBLIC	<a href="http://www.imumbai.com/">www.imumbai.com/</a>	SHRI J. K. DHAR	Director	director.mum@imu.co.in	not available
27	Lal Bahadur Shastri College of Advanced Maritime Studies & Research	PUBLIC	<a href="http://www.imumbai.com/">www.imumbai.com/</a>	Capt. S.C.Panigrahy	Institute Incharge	headlbs.mum@imu.co.in	not available
28	AMET University (Academy of Maritime Education and Training)	PRIVATE	<a href="http://www.ametuniv.ac.in/">www.ametuniv.ac.in/</a>	Dr.N.Manoharan	Director	directorresearch@ametuniv.ac.in	9 research journals

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SI no	Organisation Name/Dept Name	Organi-sation Type	Website	Contact Name	Designation	Email	No. of Publications
29	Marine Engineering and Research Institute (MERI)	PUBLIC	www.merimumbai.net/	Shri Rajeeva Pakash	Deputy Director	director.mum@imu.co.in	not available
30	The Institute of Marine Engineers(IMEI)	PRIVATE	www.imare.in/	Mr. C V Subba Rao	President	administration@imare.in	not available
31	International Maritime Institute	PRIVATE	www.imi.edu.in	Not available	Not Available	support@imi.edu.in	not available
32	Research and Development-Directorate Technical Centre	PUBLIC	www.dgca.nic.in	Dr. PRABHAT KUMAR	Director	rnd@dgca.nic.in	not available
33	School of Maritime Studies-Vels University	PRIVATE	www.velsuniv.ac.in/marine-science-engineering.asp	Dr. K. Sekhar	Vice - Chancellor	vistas@velsuniv.org	not available
34	Indian Maritime University	PUBLIC	www.imu.edu.in/	Mr. K Ashok Vardhan Shetty	Vice Chancellor	itadmin@nsdrc.com	not available
35	Department of Civil Engineering-IIT (Banaras Hindu University)	PUBLIC	www.iitbhu.ac.in/civ/index.php/head-ce.html	Dr. Devendra Mohan	Professor & Head	devendra.civ@itbhu.ac.in	not available
36	Department of Civil Engineering-IIT Roorkee	PUBLIC	www.iitr.ac.in/departments/CE/pages/index.html	Rajat Rastogi	Associate Professor	rajatfce@iitr.ac.in	7 research papers (Professor)
37	Department of Aerospace Engineering at IIT Bombay	PUBLIC	www.aero.iitb.ac.in/home/index.php	Prof. S. D. Sharma	HOD	sds@aero.iitb.ac.in	60 research publications
38	Department of Aerospace Engineering-IIT Kharagpur	PUBLIC	www.iitkgp.ac.in/academics/?page=acadunits&&dept=AE	Prof. B N Singh	HOD	bnsingh@aero.iitkgp.ernet.in	38 research papers (2013-2014)
39	Department of Civil Engineering-IIT Kharagpur	PUBLIC	www.iitkgp.ac.in/academics/?page=acadunits&&dept=CE	Prof. Subhasish Dey	HOD	sdey@civil.iitkgp.ernet.in	102 research papers (2013-2014)
40	Department of Ocean Engineering & Naval Architecture	PUBLIC	www.iitkgp.ac.in/academics/?page=acadunits&&dept=NA	Prof. T. Sahoo	HOD	tsahoo@naval.iitkgp.ernet.in	26 Research papers (2013-2014)
41	Department of Civil Engineering- Malaviya National Institute of Technology, Jaipur	PUBLIC	www.mnit.ac.in/new/dept_civil/index.php	Prof. Sudhir Kumar	HOD	hodcivilmit@gmail.com	47 journals
42	Transportation Engineering Laboratory- NIT Trichy	PUBLIC	www.nitt.edu/home/academics/departments/civil/facilitieservices/labs/tran/	Mrs. V. Sunitha	Lab-in-charge	sunitha@nitt.edu	not available

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SI no	Organisation Name/Dept Name	Organi-sation Type	Website	Contact Name	Designation	Email	No. of Publications
43	Dept Of Civil engineering-Motilal Nehru National Institute of Technology Allahabad	PUBLIC	<a href="http://www.mnmit.ac.in/index.php/departments/engineering/civil-engineering.html">www.mnmit.ac.in/index.php/departments/engineering/civil-engineering.html</a>	Er. Anupam Rawat	Assistant Professor	anupam@mnmit.ac.in	not available
44	Dept of Civil engineering-IISc	PUBLIC	<a href="http://www.civil.iisc.ernet.in/research.php">www.civil.iisc.ernet.in/research.php</a>	Dr Ashish Verma	Assistant Professor	ashishv@civil.iisc.ernet.in	26 journals
45	Don Bosco Maritime Academy	PRIVATE	<a href="http://www.dbma.in/">www.dbma.in/</a>	Fr. Adolph Furtado.sdb	Director	donboscomarine@vsnl.net	not available
46	Tolani Maritime Institute	PRIVATE	<a href="http://www.tolani.edu/tmi/">www.tolani.edu/tmi/</a>	Dr.Brijendra Kumar Saxena	Principal	info@tmi.tolani.edu	not available
47	Department of Civil Engineering- NIT Kurukshetra	PUBLIC	<a href="http://www.nitkr.ac.in/pagesUI/homePage.jsf?pageEvent=59&amp;page=content&amp;language=2">www.nitkr.ac.in/pagesUI/homePage.jsf?pageEvent=59&amp;page=content&amp;language=2</a>	Dr. Dharmender Kumar Soni	HOD	dksoni@nitkr.ac.in	not available
48	Department of Civil Engineering-NIT-Jamshedpur	PUBLIC	<a href="http://www.nitjsr.ac.in/new/department/index.php?dept=civil&amp;page=home">www.nitjsr.ac.in/new/department/index.php?dept=civil&amp;page=home</a>	Dr. Anil Kumar Choudhary	HOD	hod.civil@nitjsr.ac.in	not available
49	Department of Civil Engineering-NIT Raipur	PUBLIC	<a href="http://www.nitrr.ac.in/dept-civil.php?dept=Faculty">www.nitrr.ac.in/dept-civil.php?dept=Faculty</a>	Dr. R.K. Tripathi	HOD	rktripathi.ce@nitrr.ac.in	not available
50	Civil Engineering Department-SVNIT Surat	PUBLIC	<a href="http://www.svnit.ac.in/dept/ced/index.php">www.svnit.ac.in/dept/ced/index.php</a>	Dr. G. J. Joshi	Assistant Professor	gj@ced.svnit.ac.in	6 national journals, 2 international journals (Professor)



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EBTC's efforts focus on 4 key sectors – Biotech, Energy, Environment and Transport – all of which offer enormous scope for closer EU-India collaboration, be it in business, science or technology. As the connecting platform between business, research, and government, EBTC ensures that EU players are well networked with a solid base from which to develop their venture.

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