Minutes of the 4th meeting of the Project Approval Board constituted under the Scheme National Initiative for setting up of Design Innovation Centres, Open Design School & National Design Innovation Network, held on 3rd September, 2015.

A meeting of the Project Approval Board (PAB) constituted under the Scheme “National Initiative for setting up of Design Innovation Centres, Open Design School & National Design Innovation Network”, was held under the Chairmanship of Secretary (HE) on 3rd September, 2015 at 5 p.m. in Room No.112-C, Conference Hall, Shastri Bhavan. List of participants is enclosed at Annexure I.

2. It was informed to the PAB that Project proposals from 11 institutes for setting up of DICs have been scrutinized by the Review Committee, constituted as per the recommendations of the PAB, in its meeting held on 13th August, 2015. Review Committee has recommended proposals of 5 institutes viz. (i) Panjab University, (ii) IIT Kanpur, (iii) School of Planning & Architecture (Delhi) (iv) Jawaharlal Nehru Technological University (Kakinada) and (v) Maharaja Sayajirao University of Baroda. Apart from these, proposal of Central University of Kerala which was earlier considered by PAB in its meeting held on 23rd March, 2014 but could not be approved and proposals for establishing National Design Innovation Network and Open Design School have also been placed before PAB for consideration.

3. Initiating the discussions, Chairman requested institutions with proposals for setting up of new DICs to make a presentation before PAB. Observations and decisions of PAB are detailed below:-

(i) **Panjab University (PU)** - Representative of the University informed that the proposal has been slightly modified based on the observations made by the Review Committee in its meeting held on 13th August, 2015. Instead of a large no. of spokes as indicated in earlier proposal, PU has now proposed to establish DIC with three spokes – Dr. Harvansh Singh Judge Institute of Dental Sciences, PEC University of Technology and CSIR-CSIO as spokes. The proposal focuses on four sub-themes – (i) Medical Devices & Restorative Technology, (ii) Transparent Ceramic Materials & Technology, (iii) Instrument Development & Research and (iv) Energy Harvesting and Management.
It is proposed to offer nine elective courses in designing under Choice Based Credit System in two modes – (i) as Open Electives to UG & PG students and (ii) in Modules to UG students for specialization in Designing. Deliverables in respect of each sub-themes have been indicated along with a sustainability plan. Prof. Roy, IIT, Kanpur viewed that DICs should necessarily inculcate sense of creativity in students. Every DIC should try to create case studies indicating how the problem was being resolved conventionally and how the innovative technique developed at DIC has contributed in getting a better solution.

Based on the recommendations made by the Review Committee and the presentation made, PAB approved the proposal for establishment of DIC at Panjab University. The proposal is at Annexure-II.

(ii) IIT, Kanpur (IITK) - Representative of the IITK informed that the proposal has been slightly modified based on the observations made by the Review Committee in its meeting held on 13th August, 2015. IITK now proposes to establish DIC with three spokes : (i) Harcourt Butler Technological Institute, (ii) Indian Agricultural Research Institute and (iii) Sanjay Gandhi Postgraduate Institute of Medical Sciences. It was informed that DIC would focus on health care, livelihood generation, education, water & energy and waste management. The innovations would be centered around developmental goals and explore solution in frugal and as well as cutting edge technology. DIC would aim at innovation i.e. people driven, environment friendly and economical viable. It was also highlighted that IITK has major infrastructure of its own and therefore maximum percentage of funds would be available for people involved. AS(T) desired that research framework may focus on social relevant fields. Prof. Anil Gupta observed that there is a need of repository for case studies. It was informed by representative of DIC that there would be at least 15 case studies in respect of 15 designs proposed to be developed at hub.

Based on the recommendations made by the Review Committee and the presentation made, PAB approved the proposal for establishment of DIC at IIT, Kanpur. The proposal is at Annexure-III.

(iii) School of Planning and Architecture (SPA), Delhi - SPA, Delhi has proposed to establish DIC with three spokes : (i) School of Planning and Architecture, Bhopal, (ii)
School of Planning and Architecture, Vijaywada and (iii) Dr. B.R. Ambedkar University of Delhi. DIC would focus on architecture and planning with sub-themes on shelter, universal access and social design. The innovations would have relevance to Government Missions of Smart City, Housing for All, 2020 and Swacch Bharat Abhiyan. Though details of courses are not available, DIC envisages to introduce multi-disciplinary elective courses both at UG & PG level and also online courses. JS(P) advised that there should be at least one Massive Open Online Course. Prof. Anil Gupta suggested that a design on post disaster shelter also needs to be developed. He further added that there is a need to tackle the problem caused in disintegrating the material and design audit tools. He also emphasized on the requirement of designs or standards for toilets with less water requirements.

It was also disclosed that SPA, Delhi and SPA, Vijaywada are spokes for other DICs. Policy Division mentioned that there are no specific guidelines in this regard. The issue was discussed and PAB members were of the view that spokes may also be given an opportunity for establishment of DIC or to associate with other hubs but in different areas of design innovations and delivery of different products.

Based on the recommendations made by the Review Committee and the presentation made, PAB approved the proposal for establishment of DIC SPA, Delhi subject to the condition that no duplication is involved in the proposed innovations/courses/products at SPA, Delhi and SPA, Vijaywada. The proposal is at Annexure-IV.

(iv) Jawaharlal Nehru Technological University Kakinada (JNTUK) – JNTUK proposed to establish a DIC with Maharaj Vijayaram Gajapati Raj College of Engineering, Gudlavalleru Engineering College, Lakireddy Baliraddy College of Engineering as spokes. It was informed that the proposed DIC would offer multidisciplinary courses and which cater to the societal needs. Three courses on Renewable Energy Sources, Refrigeration & Air-conditioning systems and Design with Advanced Materials are proposed to be offered. Besides, training programmes on Design & Development of Solar-powered products/fire wood gas stoves for rural applications/ Eco-friendly Refrigeration & Air-conditioning systems are to be conducted along with a Centre for Design & Development of Advanced Cutting Tools. JS(P) observed that only three general courses are being offered and training programmes
need to be in-built in the courses. Chairman, AICTE observed that low cost and more efficient products in the suggested fields are already available. Secretary (HE) & Chairman (PAB) was of the view that the proposal lacks innovation.

After detailed deliberations, PAB did not approve the proposal of JNTUK to establish a DIC. The proposal is at Annexure V.

(v) Maharaja Sayajirao University of Baroda (MSU) – MSU proposed to establish a DIC at Maharaja Ranjitsingh Institute of Design (MRID) as hub and Upendra Shilp Anusandhan Sansthan (Patna), School of Biotechnology (Kollam) & Netaji Subhash Institute of Technology (New Delhi) as spokes. The courses proposed to be offered are – Craft & Design Innovation, Craft & Marketing, History of Indian Crafts, Contemporary Design Theories, Documentary Film Making, Vegetable Dying Process, Material Exploration, Entrepreneurship and Craft & Digital Technology. Representative of MSU informed that the products under the proposed project would be – craft directory, craft directory website, mobile app for craftsmen, encyclopedia of Indian crafts, release of journals & documentary films, development of bio materials, production of natural pigments/strengthening of bamboo through genetic engineering. Secretary (HE) & Chairman (PAB) enquired about the usage of genetic engineering in strengthening of bamboo which could not be answered due to absence of concerned representative of MSU. It was further pointed out by him that NID has already done a considerable work on craft directory. Prof. Roy, IITK appreciated the subject matter i.e history of craft chosen for the proposed DIC but pointed out that it is more research oriented. PAB members were of the view that the project lacks innovation component.

After detailed deliberations, PAB did not approve the proposal of MSU to establish a DIC. The proposal is at Annexure VI.

(vi) Members of the PAB were informed that consequent upon a decision taken by PAB in its earlier meeting held on 13.1.2015, a Committee consisting of representatives of IIT Bombay, IIT Delhi, IISc Bangalore, IIT Guwahati and NIC was constituted to work out the modalities for setting up of National Design Innovation Network (NDIN). The Committee in its meeting held on 15.4.2015 decided that representatives of IIT Bombay, IIT Delhi and IISc Bangalore and IIT Guwahati would prepare a draft DPR for
establishing NDIN. Prof. Gurumurthy, IISc Bangalore made a presentation on the draft proposal in this regard. Prof. Arindam Das, Director, NIFT desired to extend the portal for inclusion of design innovation in school system also. Prof. Gupta observed that NDIN should target to bring more & more people at one forum, not only from the design institutes but other institutes desirous of contributing in the design innovation field. There is lack of clarity on the responsibilities of each institute. The Portal needs to be anchored by some institute. Others are responsible only for uploading their portion. Chairman PAB & Secretary (HE) mentioned that more challenges are ahead in the field of design education & design innovation and deliverables, indicated in the draft proposal, need to be pushed up. He opined that it is necessary to keep in view the interest of end users while setting up NDIN and gave an idea of mobile network. Prof. Gupta advised that NDIN should have a good in-built feedback/monitoring system. It was also observed that objectives of NDIN, inter alia, include access/gateway to online courses/ lectures and enable mentoring & incubating design projects by providing online access and as such, should not overlap with the objectives of Open Design School.

After detailed deliberations, PAB was of the view that the proposal needs to be reworked in view of the suggestions given above.

(vii) JS(P) informed the members that consequent upon a decision taken by PAB in its meeting held on 13.1.2015, IIT Bombay was assigned the task of preparing the contours of Open Design School (ODS) under the Scheme and its first draft has been placed before PAB for consideration. Prof. Chakravarthy, IIT Bombay stated that the mandate of ODS is to provide excellent, sustainable, inclusive and flexible design education to all segments of society. He highlighted that the concept of blending learning i.e. learning through E-content as well as hands on training in the relevant field, would be used in providing courses under ODS. The concept at ODS would, therefore, be much better than that is available in case of MOOCs i.e. online learning combined with mentoring. Chairman, PAB mentioned that there should be no duplicacy in respect of courses being offered at MOOCs platform with those proposed to be available at ODS. He desired that JS(P) may look into the processes for avoiding any duplication. He also mentioned that provisions at SWAYAM portal need to be taken into consideration while finalizing the concept of ODS.
After detailed deliberations, PAB advised IIT Bombay to submit a detailed proposal for establishment of ODS along with financial implications so that there is no duplication with the MOOCs project.

(viii) The proposal of Central University of Kerala could not be considered as nobody could attend the meeting.

4. Joint Secretary (Policy) informed the Chair that the scheme envisages to establish 20 DICs, for which 22 Institutes were tentatively identified in the EFC Memo based on their geographical distribution. Further, PAB in its meeting held on 23rd March, 2015 had approved consideration of proposals of IIT, Kanpur and School of Planning & Architecture, Delhi in place of non-responding Institutes. Out of these 24 institutes, proposals of 6 institutes could not be recommended by the Review Committee so far and one institute i.e. Jadavpur University of Kolkata has not submitted its proposal despite repeated persuasion. However, IIT, Hyderabad has submitted a proposal for setting up of a DIC. It was decided to consider the proposal of IIT Hyderabad in place of non-responding institutes. It was also decided that JS(P) may take necessary steps to facilitate institutes in submitting their project proposals.

The meeting ended with the Vote of Thanks to the Chair.
List of Participants attended 4th Meeting of Project Approval Board (PAB) under Scheme of national Initiative for Design Innovation on 3rd September, 2015 at Shastri Bhawan

1. Sh. V.S. Oberoi, Secretary (HE), MHRD
2. Sh. R. Subrahmanyan, Additional Secretary (TE), MHRD
3. Sh. Rakesh Ranjan, Joint Secretary (P), MHRD
4. Sh. Rajiv Aggarwal, Joint Secretary, DIPP
5. Sh. Anil Sahasrabudhe, Chairman, AICTE
6. Sh. Jagdish Singh, Senior Research Officer, NITI Aayog
7. Prof. Satyaki Roy, IIT Kanpur
8. Sh. Anindam Das, NIFT, Gandhinagar
9. Prof. Anil K. Gupta, IIM Ahmedabad
10. Sh. Chetan Vaidya, SPA, New Delhi
11. Sh. R.K. Tondar, Deptt. of Telecommunication Head Qtr., New Delhi
12. Sh. D.S. Srinivasan, US, Deptt. of Industrial Policy & Promotion
13. Dr. Sunita Siwach, University Grants Commission
14. Sh. B. Gurumoorthy, IISc Bangalore
15. Sh. P.V.M. Rao, IIT Delhi
18. Sh. Prasad Bokil, IIT Guwahati
19. Sh. Avinash Shende, IIT Guwahati
20. Smt. Pramila Saxena, Deputy Secretary, MHRD
21. Dr. A. Gopala Krishna, Prof., Jawaharlal Nehru Technological University, Kakinada
22. Sh. S.R.K. Reddy, Jawaharlal Nehru Technological University, Kakinada
23. Sh. Manoj Arora, Director, PEC, Chandigarh
24. Smt. Renu Vig, Professor, UIET, Panjab University, Chandigarh
25. Dr. Rakesh Tuli, UIET, Panjab University, Chandigarh
26. Dr. U.P. Verma, Asstt. Professor, UIET, Panjab University, Chandigarh
27. Dr. J.D. Sharma PEC University of Technology Chandigarh
28. Dr. Prashar Jindal, UIET, Panjab University, Chandigarh
29. Sh. Manoj Kumar Sharma, Associate Professor, UIET, Panjab University, Chandigarh
30. Dr. Naveen Aggarwal, UIET, Panjab University, Chandigarh
31. Sh. Mandeep Singh, Professor, Dean SPA Delhi
32. Sh. N. Sridharan, SPA Delhi
33. Ms. Sheuli Mitra, SPA Bhopal
34. Dr. Jayaram Poduval, Deptt. of Art History, Maharaja Sayajirao University, Baroda
35. Sh. Koumudi Patil, Design Programmer, IIT Kanpur
36. Sh. N. Tiwari, IIT Kanpur
37. Dr. Shantanu Bhattacharya, IIT Kanpur
Proposal for setting up
Design Innovation Centre
at Panjab University, Chandigarh

Submitted to Ministry of Human Resource Development (MHRD)

Under the Scheme of National Initiative for setting up Design Innovation Centre (DIC)

Updated Version for Project Approval Board, HRDG, Sep 3, 2015
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Panjab University sees the initiative of MHRD to establish DICs, as a nationally visionary strategy that would go a long way in transforming the way engineering education is imparted in India. On receiving the invitation from MHRD, the Vice Chancellor, PU got the proposal circulated to several departments within the university and also to several institutes in neighbourhood, who could team up with PU in evolving a multidisciplinary design culture in Chandigarh region. Several ideas emerged during the early meetings. These included designing technologies for smart cities, biomedical devices, architectural designing of building structures and speciality apparels, advanced materials, navigational and tourism aids, green environment devices, energy & traffic management, green chemical processes etc. After multiple rounds of meetings, four technology areas were shortlisted. These included, Traffic Sensing & Information Technologies, Medical Devices & Restorative Technologies, Energy Harvesting and Management Technologies and Transparent Ceramic Materials & Technologies. Finally, the present proposal emerged. This presents collective thoughts of at least six institutes who hope to design a joint teaching curriculum for UG, PG and Certificate courses, enriched with designing training in identified areas of technology-driven applications. During the initial period of three years, the DIC in Chandigarh region hopes to evolve a culture that would attract some of the brightest students and industries for working at the DIC. Soon, the industry should begin to look forward to the Chandigarh DIC to add value to their products and solve their technical problems. The DIC hopes to become a major centre for interdisciplinary innovations, where a number of institutes in engineering, biological and chemical sciences will converge together to function like a meta university and form a functional cluster that would innovatively handle bigger problems in S&T. As given in the details that follow, Panjab University has been promoting the idea of bringing functional convergence among several institutes in Chandigarh region, by developing Chandigarh Region Innovation and Knowledge Cluster (CRIKC). Establishment of the DIC at PU is in line to accelerate the process and an excellent opportunity to transform the translational ability and learning experience of students in the region.

Design Innovation Centre at Panjab University

Design Innovation Centre at Panjab University, Chandigarh is proposed to be set up with a strong focus on knowledge, information and training for developing technologies and for
designing tools, devices and systems for the development of smart cities, navigational systems, small energy scavengers and assistive technologies for health care. An ecosystem will be developed to promote entrepreneurial skills and competencies based on the specialised areas for designing prototypes. This would enhance knowledge driven employability of youth and tap their skills for application of knowledge and skills in local, national and international environments. The DIC will provide an enabling ecosystem and facilities through collaborative platforms for the convergence of innovativeness and diverse skills available at the cluster of institutes in this region, to develop new processes, technologies, product designs and applications. The students will be trained on high impact, career defining translational projects of interest to technology-driven industry.

Design Innovation Centre at Chandigarh will follow the hub and spoke model, with Panjab University, being the hub. The following complementing institutes are proposed to collaborate as the spokes and share their expertise, facilities and experience in meeting the objectives of the DIC. Facilities at the spokes will be enhanced wherever necessary to give complete design training and evolve innovative culture in the specified areas. Additional experts will be invited from other specialised institutes as may be required for adding higher level of value to the teaching, designing and training programmes. Joint designing projects will be taken up, aimed at meeting the technical needs of the industry and innovation driven start up entrepreneurs. The DIC will enhance the level of innovation and design culture in Chandigarh region. In due course, the DIC will become self sustainable, and forge advanced partnerships with industry. The following members will participate as the spokes:

- PEC University of Technology, Chandigarh
- Central Scientific Instruments Organisation, Chandigarh
- Dr Harvansh Singh Judge Institute of Dental Sciences, Chandigarh

**Theme area and sub-themes at the Panjab University Design Innovation Centre:**

The DIC will develop facilities, capture innovative ideas and expertise for evolving designing facilities around the theme area of "Smart Technologies". Specific courses, designing
facilities and interdisciplinary teams will be created around the following sub themes during the first three years at the DIC.

1. Traffic Sensing & Information Technologies
4. Transparent Ceramic Materials & Technologies

Common Objectives of all sub-theme areas:

- To enhance knowledge and training of students in innovative applied skills.
- To provide liberal laboratory facilities in specified areas of technical expertise and guidance to students to develop targeted prototypes.
- To develop facilities for testing and optimisation of prototypes.
- To evolve team work and ecosystem that would be driven by synergies required for incubating start-ups and thus, promote entrepreneurship.
- To enhance Business Incubation facilities in defined areas of technical expertise.
- To take up collaborative research to give solutions to industry.

The proposed Design Innovation Centre aims to carry out specialised class room courses and core laboratory training that would lead to Certificate Degrees and Diplomas, or offer Choice Based Elective Courses to students in the defined technical areas of designing. During the first three years, laboratory facilities will be developed to provide infrastructure for designing and development of new products for traffic management, energy scavenging, ceramic applications for night vision and thermographic imaging and additive manufacturing for dental applications. The ultimate objective is to build workshops housing state of the art machines and tools for training and designing of technologies and processes related to smart applications in traffic, energy, surveillance and health.
Partners at the DIC:
The Hub: Panjab University

Since its inception 133 years ago in 1882 (at Lahore, now in Pakistan), Panjab University, Chandigarh, fourth oldest university in the country, has been in the forefront in imparting quality education and undertaking intellectually challenging as well as socially relevant research. By virtue of its achievements, philosophy and experience, it has become a university of national recognition and global stature. The well-regarded Times Higher Education (THE) World University Rankings powered by Thomson Reuters adjudged Panjab University along with IISC Bangalore at the highest rank amongst Indian academic institutions. On world-wide basis University was put in the bracket of 276-300 in September 2014. Our ranking translated to 32nd place in Asia and amongst Universities in BRICS and twelve other emerging economies. Panjab University got adjudged at the 13th place. The Associated Chamber of Commerce and Industry (ASSOCHAM) declared Panjab University to be the best Government University in India for the year 2014. Department of Science and Technology placed Panjab University in the top four institutions for the 2nd cycle of PURSE grant. University has 78 teaching and research departments and 15 Centers/Chairs for teaching and research at the main campus located at Chandigarh. 188 affiliated colleges spread over Punjab and having one rural Regional Centre at Kauni, and 3 Regional Centres at Muktsar, Ludhiana and Hoshiarpur and 4 Constituent Colleges located at Sikhwala (Sri Muktsar Sahib), Balachaur (SBS Nagar), Nihalsingh Wala (Moga) and Guru Har Sahai (Ferozepur) having a student base of more than 3.5 lacs.

P.U. Vision 2020:

a) promoting quality education at affordable prices;
b) attracting and retaining highly talented and innovative minds: strengthening basic and applied research;
c) promoting quality research relevant to the society, economy, polity and administration;
d) engaging actively in patenting its research for value addition to creativity;
e) shaping students relevant not only to the market (local, national and international) but also sensitive to Indian culture, human values and patriotism.

f) widening and enhancing the achievements in the basic sciences where Panjab University has already received national and international recognition such as in Mathematics, Geology,
Chemistry and Chemical Engineering and Technology, Physics (specially Accelerator based Nuclear and Particle Physics), Botany, Zoology, Pharmaceutical and Bio-medical sciences.

Development of Functional Cluster of Institutes in Chandigarh Region (CRIKC)

Panjab University is the Nodal Centre for promoting cluster approach towards teaching and research as envisaged by Narayan Murthy Report 2012 submitted to Planning Commission. Our University is working with institutions of repute in and around Chandigarh region i.e. Post Graduate Institution of Medical Education and Research (PGIMER), PEC University of Technology, Central Scientific Instruments Organisation (CSIO), Institute of Microbial Technology (IMTECH), National Institute of Pharmaceutical Education & Research (NIPER), Mohali; Indian Institute of Science Education and Research (IISER), Mohali; National Agri-Food Biotechnology Institute (NABI), Mohali, Centre for Applied and Innovative Bioprocessing (CIAB), Mohali, Institute of Nano Science & Technology (INST), Mohali, Indian School of Business (ISB), Mohali; I.I.T. Ropar, Terminal Ballistics Research Laboratory (TBRL), Chandigarh as well as the pharmaceutical industry cluster at Baddi (HP), Rajiv Gandhi Chandigarh Technology Park, Software Technology Park India (STPI), Mohali etc. PU houses the Office of Chandigarh Region Innovation and Knowledge Cluster (CRIKC), with Vice Chancellor as its Chairman. Through the last three years, CRIKS has been providing an effective platform to enhance the level of excellence in research & teaching through synergy among these institutes. Members of the CRIKC family have been carrying out joint collaborative research projects and teaching programmes. CRIKC has gradually been working towards its formal establishment as a distinct entity and bringing into function a meta university. The Design Innovation Centre (DIC) at PU will complement and accelerate the objectives of CRIKC. It will enhance the process of achieving synergy in the distinct direction of evolving an ecosystem for the development of a culture for designing new products, technologies and their innovative applications.
Partners as the Spokes

PEC University of Technology

The PEC University of Technology, Chandigarh was originally established as Mugalpura Engineering College at Lahore (now in Pakistan) on November 9, 1921. In 1994 this institution was adjudged the best technical college in India by the National Foundation of Engineers. The college progressed through a rich history of change in location and administrative set ups, till it was renamed as PEC University of Technology in 2009. PEC gives excellent teaching and training in Civil, Electrical, Mechanical Aeronautical, Electronics & Electrical Communication, Metallurgy, Production and Computer Science Engineering. There are eleven post-graduate courses leading to Masters of Engineering degree in Highways, Structures, Hydraulics and Irrigation, Rotodynamic Machines, Electrical Power Systems, Environmental Engineering (Interdisciplinary), Electronics Metallurgical Engineering and C.I.M. Facilities for post-graduate studies for regular as well as part time students. The institute has developed innovative competencies towards research, especially in ergonomics and materials at its Centre of excellence.

Central Scientific Instrumentation Organization

Central Scientific Instruments Organisation (CSIR-CSIO), Chandigarh is a constituent unit of Council of Scientific & Industrial Research (CSIR). This premier national laboratory is dedicated to Science and Technology Development, Technology Dissemination, Human Resource Development and catering to research and technology needs relevant to society and defence sector. It contributes to the national planning for instrumentation activities in order to sustain instrumentation and allied sectors. It is a multi-disciplinary institute with unique strengths in the country.

The laboratory is well equipped with high-end sophisticated analytical instruments and has highly qualified and well trained staff in the areas of Biomedical Instrumentation, Optical Devices and Systems, Precision Mechanical Systems, Ubiquitous Analytical Techniques, Computational Instrumentation, medical instrumentation, prosthetic devices, advanced
materials based transducers, agrionics etc.. A large number of instruments have been
designed and developed by CSIO and know-hows have been passed on to the industry for
commercial exploitation. In its XIIth five year plan, the CSIR-CSIO has program on Opto-
Mechatronics Technologies for Next Generation Sensors and Applications (OMEGA) and
Advanced Instrumentation Solutions for Health Care and Agro-based Applications(ASHA).
The scientists have more than 80 patents granted, about 170 patents filed, more than 500
publications since 2000 and many prestigious awards have been received by the scientists of
CSIR-CSIO.

CSIO is part of the CSIR’ Academy of Scientific & Innovative Research (AcSIR), and has an
Indo-Swiss Training Centre (ISTC). AcSIR provides quality HR in science and technology.
At ISTC, all students get an opportunity to obtain hands on training on advanced mechanical
machines and are trained to execute industrial jobs and face real life work environment. Thus,
CSIO is an excellent resource centre for PU to establish a DIC with future applications in
mind.

Dr Harvansh Singh Judge Institute of Dental Sciences, Chandigarh

In view of the imminent need for providing a public funded quality health care set up to
impart dental education and open avenues for research in the field of oral health, Dr Harvansh
Singh Judge Institute of Dental Sciences was established in April’2006 under the aegis of
Panjab University. The institute aims at providing oral health care facilities to the general
public and training to the students at both undergraduate and postgraduate levels. It has the
ability to generate ample research avenues in dental/medical sciences which can impact not
only oral but general health with special thrust on community healthcare and outreach
programs for the children and underserved population.

Within this span the institute has been attending to large number of patients everyday in the
various speciality clinics. A fully equipped diagnostic lab is functional at the institute which
is carrying out innumerable bio-chemical, histopathological and microbiological tests at the
institute itself. The institute is running BDS course with 100 intake and MDS course in five
specialities namely Prosthodontics, Orthodontics, Periodontics, Conservative Dentistry and
Oral Surgery.
Our faculty members are involved in various clinical and basic sciences research projects. The major focus area of the institution is to provide good and affordable dental treatment in various specialties to the general public, carry out clinical and bench research including surveys, diagnostic and randomized controlled clinical trials, conduct outreach program to enhance oral health awareness to the population for the benefit of the masses and to provide clinical and didactic training as part of teaching curriculum.

The institute is already working in collaboration with many institutes like PGIMER, GMCH-32 etc. The dental institute has been ranked Number One institute in the region consecutively for three years (2012-2014) by a leading newspaper 'The Tribune'.

The dental Institute has been granted research funding by government agencies like DST, UGC, IUSSTF and by industry as well like Waterpik. The publication profile of the dental institute is amongst the best in the country amongst the dental institutes with publications in high impact factor journals like Journal of Immunology, Cytokine, Circulation etc.

Additional Networking

The Design Innovation Centre at Panjab University will evolve a vibrant and dynamic academic culture where innovative ideas for prototype development and the application of technologies will be taken up. It will provide an environment in which all stakeholders shall be brought together to ensure better understanding and dynamic nature of the designing problems. Wherever required, advanced expertise and participation from other organisation in the neighbourhood will be invited to give specialised lectures, workshops, contractual consultancy and outsourcing to meet specific needs and objectives. Such institutes may particularly include the following:

i. Chandigarh College of Engineering & Technology, Chandigarh
ii. Punjab University SSG Regional Centre, Hoshiarpur
iii. IIT, Ropar
iv. IIT, Delhi
v. CDAC, Mohali
vi. Terminal Ballistics Research Laboratory (TBRL), Chandigarh
Prototypes & Deliverables from the DIC in the First Three Years in each Sub-theme:

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| 1. Traffic Sensing & Informational Technologies | - Real-time Mobility Map of City Roads, based on sensor data (GPS, GSM, Accelerometer, Barometer, Acoustics etc.  
- An Automatic Low Cost City Road Conditions detection tool  
- Traffic Congestion Detector for City roads  
- Dynamic Decision Making System for Road Traffic Management & Policing  
- Event Recognition using Acoustic Signal Analysis |
| 2. Medical Devices & Restorative Technologies  | - Location Awareness & Navigational Tools for Visually Impaired  
- Acoustic Awareness Tools for the Deaf.  
- Technology for the Development of 3D digital Images for additive Manufacturing of Dental Prosthesis  
- Additive Manufacturing of High Precision Accessories for Dental Applications.  
- Transparent Braces and Aligners for Dental Care  
- Dental Bridges, Crowns, Guides for Implant, lip guard etc.  
- Technologies for optimal oral health care |
| 3. Energy Harvesting Technologies              | - Design circuits for scavenging energy from exercising equipments  
- Mobile Applications for Monitoring Power Utilisation |
4. **Transparent Ceramic Materials & Technologies**

- Design, development and processing of Nd3+, Yb-doped Y2O3.
- Attainment of above 60% transparency in polycrystalline sintered.
- Application of developed ceramics to Lasing, especially for night vision and thermographic imaging.

### Teaching Courses to be offered at the DIC:

I. The programme envisages to offer designing experience to students in the following theme areas

   a) Traffic Sensing & Information Technologies
   b) Medical Devices & Restorative Technologies.
   c) Energy Harvesting and Management Technologies.
   d) Transparent Laser Materials Technologies

Matching with the above theme areas, the following 8 elective courses will be offered to students at the university, under the Choice Based Credit System.

   a) Principles of Designing and Engineering Processes
   b) Data Acquisition and Hardware Interfacing
   c) Data Mining and Analytics
   d) Smart System Technologies
   e) Sensors based Application Systems
   f) Designing restorative & regenerative materials for Advanced Health care
   g) Design & Applications of New Tools & Materials
   h) Imaging and Additive Manufacturing
   i) Alternate Energy Sources and Conservation

The first course listed above relates principles in designing engineering based processes, products and technologies. This will be a compulsory course for all UG and
PG students who like to specialise in designing. Other courses will be offered as Modules of teaching courses with Major Designing Project under guidance of faculty in charge of the sub theme areas. Work Hence these courses will be available as optional credited courses to the students at different levels, depending upon their choice to learn designing aspects in any of the above theme areas. They would receive their regular degrees with an additional certificate from the DIC, stating specialisation in Designing. This will enhance their skills and employability. This would also give them an opportunity to work extra and participate in development of specific prototypes, taken up preferably with a user group in public or private sector. The experience in these cases will be enriching and translational, because all courses will be run by faculty teams across multiple institutional partners in the DIC-PU and in networking with user stakeholders.

**Proposed Budget for the Design Innovation Centre at PU:**

<p>| (Rs in Lac) |
|------------------|------------------|
| <strong>1.</strong> Innovation Programmes, Students Fellowships and internships at Hub | 80.00 |
| <strong>2.</strong> Development of Design Laboratories at Hub | 172.00 |
| Fablab Equipments for Innovation Studios: | |
| • Sensors &amp; Electronics Bench Lab (Physical-, Bio-, Optical- &amp; Chemical Sensors, E. Benches etc.) | |
| • Energy Harvesting &amp; Storage Lab | |
| • Big Data Analytics Labs | |
| • Instrumentation Lab. (MATLAB, CAD CAM, Hardware for Data acquisition) | |
| • Product Design &amp; Manufacturing Equipment | |
| (3D Printers, Imaging &amp; Digitisation, Materials Laboratory etc.) | |
| • Transparent Materials Processing Lab facility at Spoke (PEC Chandigarh) | |
| <strong>3.</strong> Concept Development, Mock-up models and prototyping Expenses (Designing tools, Kits for prototype development, Scale up tools, facilities &amp; hardware &amp; | 112.00 |</p>
<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.</td>
<td>Staff salary and honorarium for visiting faculty at Hub (Technical, Non Technical, Consultants etc.)</td>
<td></td>
<td></td>
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<td>117.00</td>
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<tr>
<td>5.</td>
<td>Tooling cost for user trials, Design Tools at Hub (Softwares, Operating costs, Consumables, CAD/CAM Design, Printer, Laptop, Electronic Designing at user location, outsourcing etc)</td>
<td></td>
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<td>78.00</td>
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<td>6.</td>
<td>Travel &amp; Field Trial related Expenses at Hub (Contingency, small tools, equipments, software for networking with trial sites)</td>
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<tr>
<td>7.</td>
<td>Workshops, Training &amp; Outreach by Hub (Workshop tools, Training Kits, protocols etc.)</td>
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<td></td>
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<td>88.50</td>
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<tr>
<td>8.</td>
<td>Networking, Scale up, Outsourcing IPR etc</td>
<td></td>
<td></td>
<td></td>
<td>10.00</td>
</tr>
<tr>
<td>9.</td>
<td>Creation of Innovation Nodes at partner institutes (Budget for the Spokes)</td>
<td></td>
<td></td>
<td></td>
<td>305.00</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>1000.00</strong></td>
</tr>
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</table>

**Year-wise summary of Budget**

(Rs in Lakh)

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<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Total</th>
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<td>1.</td>
<td>Innovation Programmes, Students Fellowships and internships at Hub</td>
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<td>2.</td>
<td>Fablab Equipments for Innovation Studios</td>
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<td>3.</td>
<td>Concept Development, Mock-up models and prototyping Expenses</td>
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<td>Staff salary and honorarium for visiting faculty at Hub</td>
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<tr>
<td></td>
<td>Workshops, Training &amp; Outreach by Hub</td>
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<tr>
<td>---</td>
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<tr>
<td>9</td>
<td>Creation of Innovation Nodes at partner institutes</td>
<td>174</td>
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<tr>
<td>Total</td>
<td>507.8</td>
<td>317.1</td>
<td>175.1</td>
<td>1000.00</td>
<td></td>
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</table>
Review Committee of DIC-Panjab University
Task Force at MHRD

Project Advisory Committee DIC
Chair: To be appointed by VC
Members: Faculty in charge of 4 sub theme areas at UIET + Project in charge from 5 Spokes (PEC, CSIO, MIIIDC, CCET, HSS Hoshiarpur) + Two Representatives from Industry in related area
Convenor: Distinguished Scientist/Project Coordinator

Implementation Committee (Prototype Development):
Chairman: Theme area in Charge from Hub.
Members: four sub-theme in charge + PI from participating Spokes + one outside expert / from industry

Implementation Committee (Academic Affairs):
Chairman: Course Coordinator from Hub.
Members: Faculty in charge + HODs

Implementation Committee (Industry liaison & IPR)
Chairman: Project Coordinator + four sub-theme in charge + Placement Officer UIET

Implementation Committee (Industry liaison & IPR)
Chairman: Project Coordinator + four sub-theme in charge + Placement Officer UIET

- Traffic Sensing & Information Technologies
- Medical Devices & Restorative Technologies
- Energy Harvesting and Management Technologies
- Transparent Ceramic Materials & Technologies
- Data Acquisition and Hardware Interfacing
- Data Mining and Analytics
- Smart System Technologies
- Sensors based Application Systems
- Renewable Energy Sources and Conservation
- Design & Applications of New Materials
- Imaging and Additive Manufacturing
- Field Trials & Tech Transfer
- Industry Projects
- Incubation of Start-Ups
- Industry Placements
- Experts
Annexure 1
Details of Sub-theme areas and Deliverables

Sub Theme Area 1:
Traffic Sensing & Information Technologies

GoI hopes to setup 100 smart cities across India. Each city needs to have technologies to develop its own dynamic Mobility map of commuters which defines the way commuters move in the city at different times on different days. Such mobility maps are essential for making decisions for effective and efficient traffic management. Mobility map contains data of each group of commuters in a typical city, so amount of data is very huge. Querying such a large data and performing analytics using normal database is not possible. Hence, Big Data technologies need to be used for storage and real time analytics. Following are the main challenges in the collection and analysis of such data and for the management of city traffic.

1. Data collection is a huge task: We may have to use both infrastructure based and infrastructure less solutions. Infrastructure based solutions include the installation of sensors such as GPS on vehicles & infrared sensors on the roads. Infrastructure-less solution includes the development of mobile applications for volunteers and collecting data in real time.

2. Data Storage: We need to use Big data Distributed technologies such as Hadoop distributed file systems for effective real time storage for such a large data.
   a) Real time data Analytics: Analysing such a large data in real time is very challenging. Different frameworks such as “Mapreduce” and “PIG” can be used. We can detect different events. Smart cities are expected to help commuters and detect different traffic events happening in the city. Detection of events will eventually help in making decisions to help commuters.
   b) Flow of vehicular Traffic (Heavy, Low, Traffic Jams): A static mobility map of city traffic can be prepared by collecting data of traffic movement over a period of time. In real time, GPS installed on vehicles and GPS of commuter smart phones can help to define traffic density. Further, acoustic sensors can also help to detect the traffic on a particular road stretch. For example, Ambulance movement can be
detected using the acoustics. This information can help to dynamically manage the traffic lights.

c) Burst Movements (Riots detection): During Riots, people start moving in bursts. Due to use of smart phones by large community, their GSM signal strength can help us to know the people density in a particular area at a given time. These sudden movements can be tracked in real time for pre-riot management.

- Spokes and their roles

<table>
<thead>
<tr>
<th>Name of the spoke institution</th>
<th>Roles and Responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEC University of Technology, Chandigarh</td>
<td>1) Preparing Mobility maps for city, using various sensors.</td>
</tr>
<tr>
<td></td>
<td>2) Depiction, understanding and reasoning of mobility maps for various decisions.</td>
</tr>
<tr>
<td></td>
<td>3) Assisting in designing various prototypes</td>
</tr>
<tr>
<td>Chandigarh Police (Traffic) &amp; Centre for Police Administration, PU</td>
<td>1) Providing historical data</td>
</tr>
<tr>
<td></td>
<td>2) Help in implementation of prototypes</td>
</tr>
</tbody>
</table>

Sub Theme Area II: Medical Devices & Restorative Technologies

A. Location Awareness Stick for visually Impaired: These sticks will be designed with low cost processing kits such as Raspberry Pi. These sticks will use following technologies

a. Ultrasonic Sensors for Obstacle Detection.

b. GPS sensor for area sensing.

c. Wi-Fi Bluetooth sensors fingerprinting for precise location accuracy

These sticks will guide users to move around the pre-notified places.
B. **Acoustic Awareness for Deaf persons:** A Smartphone based app will be designed to detect acoustic events in closed environment and user will be notified using visual cue and vibrations.

These events can be of following types

a. Detection of approaching Ambulance / vehicle for deaf by giving vibration and visual clues.

b. Detection of noise or large sounds in environments

**Spokes and their roles**

<table>
<thead>
<tr>
<th>Name of the spoke institution</th>
<th>Roles and Responsibilities</th>
</tr>
</thead>
</table>
| PEC University of Technology, Chandigarh | 1) Analysis of Sensor based Location awareness techniques.  
2) Assisting in implementation of prototypes of location and Acoustic awareness |
| CSIO, Chandigarh | 1) Development of prototype for visually impaired, deaf and elderly people.  
2) Help in validating the prototypes in different situations |
| Department of Public Health, Chandigarh | 1) Help with volunteers for testing the prototypes |

C. **Development of Devices and Materials for Restorations in Dentistry**

Development Dental braces, lip guard attachments and bridges by using known and now polymers. Polymer based nano-composite materials will be developed which have transparent appearance and favourable adhesion, tensile and elastic properties. These materials will be developed as per the biological safety and compatibility parameters, while imparting sufficient strength so that the desired results are met. Newer prototypes for effective oral health care using sensor based technologies shall be developed.
Main challenges

1. Development of indigenous technologies for 3D imaging and digitisation for additive manufacturing.

2. Fabrication of a bio-compatible and transparent polymer/nano-composite.

3. Achieving desired mechanical and visual characterization of the composite materials.

New product lines superior to the existing products & technologies will be targeted.
 Courses for teaching and training will be designed accordingly.

- Spokes and their roles

<table>
<thead>
<tr>
<th>Name of the spoke institution</th>
<th>Roles and Responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEC University of Technology, Chandigarh</td>
<td>1) Transparent ceramic fabrication methods</td>
</tr>
<tr>
<td></td>
<td>2) Material Characterization techniques</td>
</tr>
<tr>
<td>Central Scientific Instruments Organization, CSIO, Chandigarh</td>
<td>1) Facilities for 3D image capturing and processing.</td>
</tr>
<tr>
<td></td>
<td>2) Establishment of 3D imaging facility for dental applications</td>
</tr>
</tbody>
</table>
Sub- Theme Area III :
Energy Harvesting and Management Technologies

A. Design & development of human power based Energy Harvesting Systems

There are numerous ways by which energy can be tapped from nature and our surroundings, even if the scale of energy generated is small. One of the needs is to scavenge the energy released by human activity, as in case of the exercising in a gym. Many people regularly use gymnasium for exercise on the different equipments and this human effort can be converted in to useful energy by making modification in the system equipment without affecting the efforts and benefits to human being in a gym. Thus, trapping such energy can conserve substantial amount of energy, which will otherwise be wastefully dissipated. Such energy can be stored and used to meet good part of the load in the gym itself, on demand. The actuators and sensors will be used to convert mechanical movements to electrical energy which can be stored in batteries and used for further applications.

Deliverables:

1st year:

• Designing the energy scavenging system based on human power spent during exercising and estimates of energy generation from a given area.
• Selection of appropriate machines, sensors and actuators for different exercising equipments and design evaluation of the energy generation system.

2nd year:

• Designing of wiring circuit system with a provision of energy storage and its utilization schemes/pattern.
• Implementation of the circuitry and installation of the equipments with sensors based control.

3rd year:

• Designing and testing of the prototype developed.
• Analysis of results obtained

B. Development of Energy Storage and Management Systems

The biggest limitation with the electric power is that it cannot be stored. Thus, management of energy along with development of small storage systems become very important to efficiently utilize the available power. There have been various efforts in efficiently using
the power and some of them have worked well. In present era when there so much use of information technology more efficient systems can be design at a very low cost which not only are cost effective but also reliable. One of the ways is to develop Mobile apps based, timer based and light sensors based systems processes for the controlling the operation of electrical system in a single area building etc. It is equally important to have system for online monitoring, data collection and for that SCADA system will be implemented in institution building for data collection, online monitoring. Besides this, PMU placements, WAMS systems and control for effective energy utilization will also be introduced.

**Deliverables:**

1\textsuperscript{st} year:
- Study of electrical distribution system of the building or University and identification of key areas for installation of sensors and communication systems.
- Designing of appropriate circuit schemes for the installation and development of mobile apps based and other control based system for power control.

2\textsuperscript{nd} year:
- Implementation of the energy management application based on control prototype developed.
- Setting up of SCADA system for monitoring and control of power.
- Design process to select the appropriate sensors, transducers and storage devices.

3\textsuperscript{rd} year:
- Development of online monitoring system for energy in a building through PMU SCADA systems containing PMU, sensors etc.
- Energy consumption and data collection through SCADA and analysis and recommendation.

C. **Development of low energy generation and harvesting systems**

Solar energy is widely and freely available in this region for most of the year. It can be used for production of energy for small applications such as laptop charging, mobile charging, etc. The biggest challenge is to store the energy generated, hence it is important to design and test new storage systems for efficient use of power generated through solar. In addition, small
energy can also be tapped from various other mechanisms such as using piezoelectric material at suitable locations, energy from human body heat and converting noise energy into electrical energy. Small modules for energy generation can be developed along with low energy harvesting circuitry to efficiently use this energy. This can be used for small applications in our day to day life such as for lighting display boards, charging mobiles, lighting small area using power frequently. The energy generated will have to be stored and an efficient topology and device have to be developed for the same.

**Deliverables:**

1st year:
- Identification and designing of energy generation modules through piezoelectric material under various operating conditions such as variable frequency, size, force, and temp.
- Developing appropriate process for selection and categorization of various sensors, actuators and storage devices for the development of the low energy harvesting system prototype.

2nd year:
- Design and development energy generation system through noise and body heat.
- Designing of appropriate circuitry and storage for implementation.
- Development of different Prototypes.

3rd year:
- Design of prototype for storage system through low power energy generation for electric charge vehicle.
- Analysis and testing of the prototypes developed.

**Spokes and their Role:**

**PEC University of Technology, Chandigarh:**

- a) To develop & Test energy storage systems and configurations for low energy modules
- b) To develop electric charging vehicle system module with provision for storage.
Central Scientific Instruments Organisation, CSIO, Chandigarh:

a) To design develop and select suitable sensors and transducers for low energy harvesting systems.

Sub-Theme Area IV:

Transparent Laser Materials development

Transparent ceramics are produced through synthesis and sintering of Nano-powder (Nd:YAG&Nd:Y₂O₃). The DIC will carry out specialised teaching on transparent ceramics and render hands on training and innovative designing of their applications for the development of smart technologies. Some of the immediate objectives are given in brief.

Night Vision Imaging devices

Night vision infrared devices image in the near-infrared, just beyond the visual spectrum, and can see emitted or reflected near-infrared in complete visual darkness. All objects above the absolute zero temperature (0 K) emit infrared radiation. Hence, an excellent way to measure thermal variations is to use an infrared vision device, usually a focal plane array (FPA) infrared camera capable of detecting radiation in the mid (3 to 5 μm) and long (7 to 14 μm) wave infrared bands, corresponding to two of the high transmittance infrared windows. Abnormal temperature profiles at the surface of an object are an indication of a potential problem. Infrared thermography, thermal imaging, and thermal video, are examples of infrared imaging science. These technologies will be developed at the DIC.

Thermography Imaging:

In thermography imaging, infrared radiation with wavelengths between 8–13 micrometers strikes the detector material, heating it, and thus changing its electrical resistance. This resistance change is measured and processed into temperatures which can be used to create an image. Thermographic imaging has several applications in medical imaging, surveillance cameras, insulation and fault detection etc. Some of these will be studied at the DIC.

Deliverables and milestones:
First Year: Transparent materials processing laboratory will be developed at PIC. A high temperature low pressure sintering furnace will be procured and the synthesis of nano Nd Y2O3 by wet process will be achieved.

Second Year: Optimization of sintering parameters and production of lasing ceramics.

Third Year: Development of Lasing ceramics for smart applications.

**Role of Partner Institutes:**

<table>
<thead>
<tr>
<th>Institute</th>
<th>Responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>UIET, Chandigarh</td>
<td>1) Optimization of grinding process</td>
</tr>
<tr>
<td></td>
<td>2) Assisting in modelling of sizing parameters</td>
</tr>
<tr>
<td>CSIO, Chandigarh</td>
<td>1) Microstructural analysis of samples through SEM, TEM</td>
</tr>
<tr>
<td></td>
<td>2) Transparency analysis of sinter</td>
</tr>
</tbody>
</table>
Annexure 2
Structure of Teaching Courses

1. Data Acquisition and Hardware Interfacing

Objective: This course will introduce various data acquisition systems and techniques and their application using different hardware interfacing mechanisms.

Part-A
Signal conditioning and data acquisition: Analog-to-digital and digital-to-analog converters; sampling rate, multiplexing, resolution, range, and code width; grounding, isolation and noise; single-ended and differential measurements; attenuation, amplification, and filtering; excitation and linearization; impedance mismatch and loading; digital signal conditioning; signal transmission (voltage vs. current loop); and hardware architecture of a modern multi-function data acquisition card. Various DAS Configurations, Single Channel DAS, Multi-Channel DAS, IC Based DAS, Data Acquisition, Data Acquisition in PLC

Fundamentals of programming logic: Lab View; Virtual instruments: indicators and controls; front panel and block diagram; data types and data flow programming; case and sequence structures: arrays, loops, and clusters; graphs and charts: sub VIs; and file I/O.

Part-B
Instrument control: Components of an instrument control system (GPIB and RS-232); detecting and configuring instruments; and instrument drivers.
Instrumentation system design: Design specifications: functional block representation; design, debugging, and testing; interpretation and presentation of data; user interface; temperature control system design; motor speed control system design; and instrumentation project incorporating multiple sensors, signal interfacing electronics, data-acquisition hardware, instrument control

Project Work: Using Labview: Generation of signal (different function generators) on PC and acquiring the signal from sensor at PC again with different sampling rate and quantization level. Representations of different characteristics of acquired signals and their analysis and reporting.

Course Outcomes: Students will be able
1. To understand the principles of operation and limitations of the data acquisition system (single and Multiple channels).
2. To use Labview for analysing and generating reports of various acquired signals.
3. To use different interface mechanism of devices for communication.

Recommended Books:
6. Data acquisition technique using personal computers by Howard Austurlitz.
Project Work: Using Labview: Generation of signal (different function generators) on PC and acquiring the signal from sensor at PC again with different sampling rate and quantization level. Representations of different characteristics of acquired signals and their analysis and reporting.

Course Outcomes: Students will be able
1. To understand the principles of operation and limitations of the data acquisition system (single and Multiple channels).
2. To use Labview for analysing and generating reports of various acquired signals.
3. To use different interface mechanism of devices for communication.

Recommended Books:
6. Data acquisition technique using personal computers by Howard Austurlitz.
2. Data Mining and Analytics

Objectives: This course should provide the students with good understanding of various techniques of Data analysis & Data Mining. At the end of this course students will be having good knowledge of Data Mining concepts and analytical techniques.

Part-A

Elements of Data Analysis: Averaging, Filtering and Smoothing, Descriptive and summary statistics, Discrete random variables, distributions, cumulative distribution, expectation, Variance, Conditional probability, independence, Bayes. Continuous random variables, density function, linear functions, Multiple Linear Regression

Data Mining Architecture: Data Mining primitives, Task relevant data, interestingness measures, presentation and visualization of patterns, Data Mining Architecture, Concept Description, Data Generalization and Summarization, Attributed oriented induction, Analytical characterization, Mining class comparisons

Part-B

Association Rules: Association rules mining, Mining Association rules from single level, multilevel transaction databases, multi dimensional relational databases and data warehouses, Correlation analysis, Constraint based association mining

Classification and Clustering: Classification and prediction, Decision tree induction, Bayesian classification, k-nearest neighbour classification, Cluster analysis, Types of data in clustering, categorization of clustering methods

Introduction of Mining Complex Data: Complex data objects, Mining spatial databases, Multimedia databases, Time Series and sequence databases, Text databases and World Wide Web.

Project Work (Using SAS Analytica, R tool): Comprehensive descriptive statistical analysis of data in different formats. Data pre-processing, Normalising, cleaning, integration and transformation tasks using SAS toolboxes. Application of different data mining functionalities such as frequent pattern analysis, linear (uni variable and multi variable) and logistic regression, classification, clustering on different categories of data.
Course Outcomes:

1. Students will be able to apply fundamental data analysis techniques on different categories of data.
2. Students will demonstrate an understanding of data mining framework and its implementation using open source tools.
3. Students will be able to use different data mining representation techniques used in different domains using SAS analytic and R tool.

Recommended Books:

2. Data Mining Introductory and Advance Topics By Dunham, Pearson Education, Latest Edition
3. Smart System Technologies

Objectives
This course shall introduce various MEMS, NEMS based smart system technologies. This would help them to process the acquired data from real world so as to make the system smart.

Part-A
Introduction: Main definitions for smart sensors and its properties, quasi-digital sensors, MTS. MEMS and system-on-chip (SoC): Sensors classifications from output point of view and quasi-digital sensors classification: Sensors architectures for integrated and smart sensors: Informative parameters (unified and frequency-time domain parameters of signal); Advantages of frequency as informative parameter including high noise immunity, high power of signal, wide dynamic range, high reference accuracy, simple interfacing, simple integration and coding.

Smart and Quasi-Digital Sensors State-of-the-Art: Temperature sensors, pressure sensors and transducers, accelerometers, rotation speed sensors, intelligent opto (light and color) sensors, humidity sensors, mass variation chemical, gas and biosensors, magnetic sensors and others (tilt, torque, level, flow, conductivity, etc.) as well as multiparameters sensors. This lets to formulate main requirements for modern sensors systems.

Classical Frequency-to-Digital Conversion Methods: standard counting method, indirect counting method, combined method and interpolation method. Metrological performances (quantization error and other components of conversion error, conversion time, frequency range) and measures how to reduce the quantization error. It is shown that the use of weight functions can improve metrological characteristics. Phase shift-to-digital conversion.

Part-B

Smart Sensor Systems: One-channel, multi-channel and software level sensor interfacing. Multilayer sensor based network architecture. A case study of smart sensor system - Anti-Lock Braking System (ABS) including rotation speed sensor, conversion method and sensor interfacing.

Virtual Instruments: Definition of virtual instrument. Differentiate virtual instruments from measuring systems based on PC interfacing, standalone measuring instruments, measuring systems with GUI and microcontroller-based measuring systems with virtual measuring channel, Industrial DAQ boards. Virtual instruments examples: virtual thermometer, data logger for pressure sensors, virtual tachometer and video-graphic paperless recorder.


Digital Sensors and Smart Sensors System Design: Practical realizations of different smart sensors systems and digital sensors: optical sensors systems with color-to-digital and light-to-digital converters; a DAQ system for temperature sensors; accelerometers based systems; rotation speed digital sensors and systems; digital humidity sensors and data loggers; temperature and humidity multisensors system; pressure sensors systems and digital gauges; digital magnetic sensors and systems; multiparameters sensors systems.

IEEE 1451 Standard and Frequency Sensors: Brief introduction to IEEE 1451 standard and its extension for any sensors and transducers from frequency-time signal domain. Direct Sensor-to-Microcontroller Interface for resistive, capacitance, inductance, resistive bridges sensing elements. Future Trends: The future development of main systems’ components as the Universal Frequency-to-Digital Converter (UFDC-2) and Universal Sensors and Transducers Interface (USTI). Integration of all components of sensor system into a single system-on-chip (SoC) with advanced processing and conversion methods.
Project Work:
Students will work on different problems from industries and come up with some practical solutions.

Course Outcomes: students will be able to
1. Analyze real life problems requiring smart systems.
2. Identify components to implement solutions.

Recommended Books:
2. Understanding the Smart Sensors by Frank, R. Artech House; Second edition; 2000
4. Introduction to Instrumentation, Sensors and Process Control by Dunn, C. W; Artech House; 2006
5. Smart Sensor Systems by Meijer, C.G. John Willey & Sons Ltd; 2008.
4. Sensor Based Application Systems

Course objectives:
The students will learn to:

- Develop judgment of what sensors and modalities are appropriate for different applications
- Know how to electronically condition the sensor, hook it up to a microcomputer, and process the signal (at least basically)
- Have some idea of how/where these sensors were used before
- Have a reasonable idea of how different sensors work

Part-A
Basics: Sensors: examples and definitions, Introduction to Sensor Electronics and terminology (Fraden Ch. 2)
Strain Gauges: Basics and Examples (Fraden Ch 3.5, 5.1, 5.2, 5.7, 9)
Thermometers: Measurement Techniques and Examples, Flow Sensors (Fraden Ch. 16)
Radiation Sensors: Overview of Types, Examples of Applications (Fraden Ch. 14)
IR Sensors and Demo: IR Motion
Capacitive sensors: Fundamentals, Applications and Examples (Fraden Ch. 3.2, 6.3, 7.3, 10.6)

Part-B

Accelerometers (Fraden Ch. 8)
Piezoelectric Sensors (Fraden Ch. 3.6, 5.2.4, 8.4)
Pressure sensors: Principles and Examples (Fraden Ch. 10)
Inductive and Magnetic Sensors (Fraden Ch. 3.3, 3.4, 7.4)
Active sounding: Methods for measurement, Examples (?)
Chemical Sensors
Biosensors
RF sensors
Applications of sensors in Process Control, Biomedical Field, Automation, Transportation, Agriculture, Post harvest supply chain and processing, Environment etc.

Project work.
Students will work on different problems from industries and come up with some practical solutions.

Course Outcome:
1. An ability to apply knowledge of mathematics, science, and engineering.
2. An ability to design and conduct experiments, as well as to analyze and interpret data.
3. Students are assigned both individual and group projects, which require ability to conduct simulation, analyze and interpret results.
4. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
5. An ability to function on multi-disciplinary teams.
6. An ability to identify, formulate, and solve engineering problems. Students are presented with engineering problems, like designing sensors for biomedical, automotive applications.
7. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Recommended Books:
5. Alternate Energy Sources and Energy Conservation

Course objectives:
The students will learn to:

1. Recognize the place and importance of renewable energy and alternative fuels in the energy landscape.
2. Understand the technological basics of primary renewable electricity sources.

Part-A

I. Basics: Energy Demand and Supply, Environmental effects of energy use – necessity for alternative energy sources.

II. Solar Energy:
I-V. P-V curves, electrical load matching, sun tracking, PV system component and peak power point operation. Processing and manufacturing of photovoltaic Design, sizing and sub-systems of PV system.

Energy Storage: Battery, performance characteristics, battery charging, charge regulators and battery management.

Electrical Performance: Harmonic, distortion, voltage sags, and national standards.

Hybrid Systems: Design of hybrid photovoltaic-wind-battery systems, Modelling of Hybrid photovoltaic/thermal systems. Smart grid and PV systems. Urban and rural applications of solar energy.

Part-B

III. Biomass/Bio-fuels:

IV. Fuel cells
Transportation - fuel cells, Modelling and design.
V. Energy Conservation and Auditing
Energy auditing procedures and energy conservation retrofitting.

VI. Economics of Energy Projects:
Evaluation of project cost, payback analysis, optimization.

VII. Project Work:
Students will work on different problems from industries and come up with some practical solutions.

Course Outcomes: Students will be able to:
1. Calculate solar energy design parameters.
2. Select appropriate energy storage device.
3. Perform an economic analysis on energy projects.
4. Perform energy auditing and provide recommendations for energy savings.

Recommended Books:
6. Design & applications of new materials

Course Objective:
To realize the important of materials used for developing different engineering applications related to medical, structural, defence needs etc.

1  Nano Materials:
Definition, historical perspective, effects of nano science and nanotechnology on various fields: Application and synthesis of CNTs. Materials selection and related factors such as design, processing and economics; case histories related to CNT selection. Classification of nano-structured materials.
Bio-Nano materials, top down and bottom up approaches of generation, Mechanical properties of nano-materials; other important properties of nano-structured materials. Study of micromechanics, additional strength, theory, perforated and notched composites, experimental techniques, fracture, manufacturing and processing, structural mechanics/vibration, nanomaterials, smart structures/systems/materials.

2  Engineering polymers and ceramics:
Thermoplastic, thermosetting polymers and elastomers; High strength engineering ceramics. Advanced analysis of composite materials; anisotropic elasticity; behaviour of composite plates and beams under bending, buckling, and vibration; advanced elasticity solution techniques; thermal behaviour of polymer composites; strength prediction theories and failure mechanisms in composites.
Introduction, synthesis and application of Transparent Ceramics.

3  Fabrication methods:
Fundamentals of rheology and visco-elasticity of polymer solution and metal; Master curve and its use for design of polymer parts: polymer fabrication by techniques such as compression, moulding, extrusion, calendaring, thermoforming, injection moulding, reaction injection moulding (RIM), blow moulding etc. Compounding of plastics and role of additives in processing.
4 Introduction to Finite Element Method:
Basic concept, Historical background, engineering applications, general Description, Comparison with other methods.

5 Finite Element Techniques:
Model boundary value problem, finite element discrete element shapes, sizes, nodal locations, interpolation functions, derivation of element equations, connectivity, boundary conditions, FEM solution, post-processing. Compatibility and completeness requirements, convergence criteria. higher order and isoparametric elements, natural coordinates, Lagrange and Hermite Polynomials.

Recommended Books:
7. Imaging and Additive Manufacturing

Course Objectives:
To understand the complete process of image capturing and developing complex high precision structures through additive manufacturing

1. Introduction And Digital Image Fundamentals: The origins of Digital Image Processing
   Examples of Fields that Use Digital Image Processing Fundamentals
   Steps in Image Processing
   Elements of digital image processing, Image model, Sampling and quantization, Relationships between pixels

2. Converting Between data classes and Image Types
   Introduction to M Function Programming using MATLAB
   • Image Enhancement in the Spatial Domain: Some basic
     Gray Level Transformations
     Histogram Processing,
     Discrete Fourier Transform, Discrete Cosine Transform, Haar Transform, Hadamard Transform,
     Enhancement by point processing, Spatial filtering, Enhancement in the frequency domain.
   Color Image Processing

3. Image Segmentation, Discontinuity detection, Edge linking and boundary detection.
   Thresholding, Region oriented segmentation, Use of motion for segmentation

4. Multispectral Image Analysis - Color Image Processing
   Three Dimensional Image Processing
   Computerized Axial Tomography-Stereometry-Stereoscopic Image Display
   Shaded Surface Display
   Image Restoration: A model of The Image Degradation / Restoration
   Only Spatial Filtering Processing Application Some basic morphological algorithms.
   Extensions to gray level images

5. 2D & 3D Transformations of geometry: Translations, Scaling, Reflection, Rotation,
    Homogeneous representation of transformation, Concatenation of transformations,
    Perspective, Axonometric projections, Orthographic and Oblique projections.
    Polymer and Photopolymerization, (SLS), LCVD, DMD,

Design of Solids: Solid entities, Boolean operations, B-rep of Solid Modelling, CSG approach of solid modelling. Advanced modelling methods. Data Exchange Formats and CAD Applications: Data exchange formats. Finite element analysis, reverse engineering, modelling with point cloud data, Rapid prototyping. 3D Scanning and Digitizing Devices CAD Model Construction from Point Clouds, Data handling & Reduction Methods, AM Software (Magics, Mimics, 3Matic, Rhino) Tessellated Models, STL File Problems, STL File Manipulation and Repair Algorithms, Role of Rapid Solidification

Recommended Books:
8. Advanced Health Care Deliveries

Objective: this course shall deal with the advances in technologies applicable to health care both during the treatment phase and later during maintenance phase.

Course Modules:
1) Orthodontic Functional Appliance
2) Additive restoration/Prosthesis Fabrication
3) Energy Optimised Oral Health Care Devices
4) Prototyping of abutment preparation and impression making.
5) Systemic application of intraoral devices.

Project Work:
Using 3-D printing technologies: generation of signal based on impressions obtained of the prepared abutment and interfacing this with printer for precision fit, customized prosthesis.

Course Outcomes:
Students will be able to
1) To design and fabricate customised functional appliances using CAD-CAM and sensor based scanning technologies
2) To fabricate precision prosthesis using 3D printing technologies
3) To design prototypes of customizable oral health maintenance device.

Recommended Books:

- McCabe, JP & Walls TWG: Applied Dental Materials
- Lindhe, Frans PGM, Van Der: Aproblems and Procedures in Dentofacial Orthopedics.
- Orton, Harry S: Functional Appliances in Orthodontic Treatment.
- Wiskott, HW Anselm: Fixed Prosthodontics-Principles and Clinics
- Hammerle, Christoph: Dental Ceramics: Essential Aspects for Clinical Practice.
9. Principles of Designing and Engineering Processes:

1. **Introduction to design**
   Impact/function of Design. Indigenous Design Practices, types of design, the design process, relevance of product lifecycle issues in design, societal considerations in general as well as engineering design. generic product development process

2. **Creative thinking**
   Creativity and problem solving, creative thinking methods, generating design concepts, systematic methods for designing

3. **Role and responsibility of Designers**

4. **The Product Design and Development Process**

5. **Design Modeling**
   Three main methods of modeling: (1) mathematical modeling, (2) simulation using computers, and (3) creation of 2D and 3D scale models

6. **Design Principles**
   Aesthetic-Usability Effect, Attractiveness, Alignment, Color, Highlighting, Iconic Representation, Proximity, Similarity

7. **Environment Impact**

8. **Local resource utilisation and socio economic aspects of designing**

9. **Designs for Scale Up and Manufacturing**

10. **Innovativeness in Designing and protection of Intellectual Property**

11. Specialised aspects of designing in target specific areas: Engineering Designs, Biomedical Device Designing, Chemical Process Designing etc.
Specific Responsibilities of individual Partners and their Strengths

Spoke 1: PEC University of Technology

Budgetary allocation: Rs 125 lac

Role in different subtheme areas:

Sub Theme Area I: Traffic Sensing & Information Technologies
1. Preparation of mobility maps for Chandigarh city, using various sensors.
2. Depiction, understanding and reasoning of mobility maps for decision making.
3. Partnership for designing various prototypes
4. Lectures & design projects in Smart Systems Technologies

Sub Theme Area II: Medical Devices & Restorative Technologies
1. Analysis of Sensor based location awareness techniques.
2. Partnership in implementation of prototypes for location and Acoustic awareness.
3. Lectures & design projects on smart sensors

Sub Theme Area III: Energy Harvesting and Management Technologies
1. To develop & Test energy storage systems and configurations for low energy modules
2. To develop electric charging vehicle system module with provision for storage.

Sub Theme Area IV: Transparent Ceramics Technologies
1. Transparent ceramics fabrication.
2. Prototypes for night vision devices
3. Prototypes for thermographic imaging.
4. Lectures & design projects on applications of new materials
Spoke 2: CSIO, Chandigarh

Role in different sub theme areas

Budgetary Allocation: Rs 60 lakh

Sub Theme Area II: Medical Devices & Restorative Technologies

1) Partnership in the development of prototypes for visually impaired, deaf and elderly.
2) Partnership in validating the prototypes in different situations.
3) Partnership in establishing technologies for capturing and processing of 3D images for AM in dental applications.
4) Lectures and design projects on 3D image construction & analysis.

Sub- Theme Area III: Energy Harvesting and Management Technologies

1) Partnership in designing, development and selection of suitable sensors and transducers for low energy harvesting systems.
2) Lectures and design projects on sensors and applications in energy storage.

Sub-Theme Area IV: Transparent Ceramics & Technologies

1) Micro structural analysis of samples by SEM, TEM
2) Transparency analysis of sinter

Spoke 3: Dr Harvansh Singh Judge Institute of Dental Sciences, Chandigarh

Budgetary Allocation: Rs 120 lac

Role in the sub themes areas:

Sub Theme area 2: Medical Devices and Restorative Technologies

1. Guidance and partnership in designing accessories and substitutes for dental applications.
2. Guidance & partnerships in developing 3D imaging technology
3. Partnership in developing High Precision Accessories and testing in Dental Applications.
4. Partnership in designing and testing of transparent braces and aligners for dental care.
5. Partnership in designing and testing of dental bridges, crowns, guides for implant etc.
6. Lectures and design projects on advanced health care devices in dental applications

Other Partners:

Funds set aside for other partners to carry out specific field, laboratory or outsourcing works:
Partners envisaged: IIT Ropar, CDAC, DIHAR, Department of Public Health, Chandigarh, Chandigarh Traffic Police etc.
Funds set aside: Rs 10 lakh
Annexure 4

Table 1. List of Equipments and Facilities already available at partner institutes

<table>
<thead>
<tr>
<th>Name of Partner Institute</th>
<th>Available facilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>UIET, Panjab University</td>
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<tr>
<td></td>
<td>Rack Servers -06</td>
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<td></td>
<td>Rack Mounted Nas Storage with 42U Rack</td>
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<td></td>
<td>HDMI Capture Card and Accessories</td>
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<td></td>
<td>Antivirus softwares</td>
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<td></td>
<td>Netbook &amp; Ultrabooks</td>
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<td></td>
<td>22U Networking Rack</td>
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<tr>
<td></td>
<td>Biomedical Sensor Kits</td>
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<td></td>
<td>MSDN Alliancse Software</td>
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<td></td>
<td>IBM Academic Alliance Software</td>
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<td></td>
<td>Cloud Servers</td>
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<td></td>
<td>Measurement of Magnetoresistance of semiconductor</td>
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<td></td>
<td>Melting Point Apparatus</td>
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<td></td>
<td>Pallet Maker</td>
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<tr>
<td></td>
<td>Video Conferencing Setup</td>
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<td></td>
<td>Smart Class room Setup</td>
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<td></td>
<td>EEG Monitoring System for 10 Channel-New</td>
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<td></td>
<td>Networking Camera</td>
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<td></td>
<td>UTM-CSE</td>
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<td></td>
<td>DTH and Installation-CSE</td>
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<td></td>
<td>Chiral Columns-Biotech</td>
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<td></td>
<td>Reversed Phase Columns</td>
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<td></td>
<td>Portable Wireless Neuro feedback – Biofeedback System</td>
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<td>UPS</td>
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<td>Refractive index</td>
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<td></td>
<td>Rotary Evaporator</td>
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<td></td>
<td>Spin Coating Unit</td>
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<td></td>
<td>MEMS Multiphysics tool</td>
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<td></td>
<td>Mechatronics</td>
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<td></td>
<td>TLC</td>
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<td></td>
<td>Ultra Sonicator</td>
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<td></td>
<td>Ultrasonic Interferometer</td>
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<td>UV-VIS Spectrophotometer</td>
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<td></td>
<td>Vacuum pump</td>
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<td></td>
<td>Water Bath</td>
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<td></td>
<td>LCR Meter</td>
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<tr>
<td>Equipment</td>
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<tr>
<td>Refrigerator &amp; Oven</td>
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<tr>
<td>Fermenter</td>
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<tr>
<td>Digital pH Meter</td>
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<tr>
<td>Deep Freezer (-80 degree C)</td>
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<tr>
<td>Sonicator</td>
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<tr>
<td>Diffusion cell apparatus (side by side)</td>
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<tr>
<td>High-Precision Polarimeter</td>
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<tr>
<td>Conductivity meter</td>
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<tr>
<td>UPS-Polarimeter</td>
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<tr>
<td>Robotic Sensors &amp; Robot items</td>
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<tr>
<td>Robotic - Arms &amp; Accessories</td>
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<tr>
<td>Robotic - Batteries</td>
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<tr>
<td>Robotic-Modules</td>
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<tr>
<td>Klystron power Supply</td>
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<tr>
<td>FEA simulation software Mechanical</td>
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<tr>
<td>Mechanics of Material Lab Mechanical</td>
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<tr>
<td>DAQ Lab Mechanical</td>
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<tr>
<td>Automatic Control Lab</td>
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<tr>
<td>Fabrication Machine</td>
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<tr>
<td>Design Expert Software</td>
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<tr>
<td>2D Electrophoresis</td>
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<tr>
<td>Virtual Instrument Lab-ECE</td>
<td></td>
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<tr>
<td>OptElectronics Lab</td>
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<tr>
<td>HyperLynx 3D EM-SSD ECE</td>
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<tr>
<td>Communication lab ECE</td>
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<tr>
<td>Embedded Development Lab</td>
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<tr>
<td>TCAD Software ECE</td>
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<tr>
<td>Biquartz polarimeter</td>
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<tr>
<td>Centrifuges</td>
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<tr>
<td>Electron Gun</td>
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<tr>
<td>Electron Spin resonance spectrometer</td>
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<td>Accupipettes</td>
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<tr>
<td>Analytical Balance</td>
<td></td>
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<tr>
<td>Oil Bath</td>
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<td>Curie Temperature</td>
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<tr>
<td>Spectrophotometer</td>
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<tr>
<td>FTIR-Spectrophotometer</td>
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<tr>
<td>Heating Mantle</td>
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<td>Hot Plate</td>
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<td>Hysteresis loop</td>
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<tr>
<td>Laser Kit</td>
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<tr>
<td>Networking facility of more than 500 systems</td>
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<tr>
<td>Campus Wide wi-fi facility</td>
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<tr>
<td>Dental Institute</td>
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<tr>
<td>Ceramic Furnance</td>
<td></td>
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<tr>
<td><strong>Casting Machine</strong></td>
<td><strong>Digital OPG &amp; Ceph which can be upgraded to CBCT</strong></td>
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<td>---------------------</td>
<td>---------------------------------------------------</td>
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<tr>
<td><strong>PEC</strong></td>
<td><strong>Constant temperature Water bath</strong></td>
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<tr>
<td></td>
<td><strong>Biological Incubator (70°C)</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Programmable high temperature furnace (1500°C)</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Precision analytical balance</strong></td>
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<tr>
<td></td>
<td><strong>Memmert type Oven (350°C)</strong></td>
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<tr>
<td></td>
<td><strong>Ultrasonic bath</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Double stage distillation unit</strong></td>
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<tr>
<td></td>
<td><strong>Magnetic stirrer with hot plate</strong></td>
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<td><strong>Rota mental</strong></td>
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<td></td>
<td><strong>High speed stirrer</strong></td>
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<tr>
<td></td>
<td><strong>Digital pH meter</strong></td>
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<td></td>
<td><strong>Image analysis software</strong></td>
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<tr>
<td></td>
<td><strong>CDIC compatible trinocular Optical Microscope</strong></td>
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<td></td>
<td><strong>03 - Optical Microscopes</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Zetasizer Nano range Analyzer</strong></td>
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<tr>
<td></td>
<td><strong>Dip coating Unit</strong></td>
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<tr>
<td></td>
<td><strong>06 - Programmable furnaces for temperature upto 1400°C</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Controlled Atmosphere programmable tube type sintering furnace for temp. upto 1400°C</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Surface Roughness Tester</strong></td>
</tr>
<tr>
<td><strong>CSIO</strong></td>
<td><strong>Field emission scanning electron microscope</strong></td>
</tr>
<tr>
<td><strong>CCET</strong></td>
<td><strong>Computer &amp; Electronics Labs</strong></td>
</tr>
<tr>
<td><strong>Campus Hoshiarpur</strong></td>
<td><strong>Electronics Labs with microwave workbench, storage oscilloscope etc</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Computer Labs with 25 networked systems and rack mounted servers</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Networking facility of more than 200 systems</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Smart Class rooms</strong></td>
</tr>
</tbody>
</table>
### Annexure 5

#### Table 2. List of equipments and facilities proposed at different partner institutes under the DIC-PU

<table>
<thead>
<tr>
<th>S No</th>
<th>Name of Equipment/facility to procure</th>
<th>Estimated cost (Rs in Lakh)</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Year 1</td>
<td>Year 2</td>
</tr>
<tr>
<td>A</td>
<td>UIET, Panjab University</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Computer Vision Lab (Arduino boards, Beagleboards, UPS, Power Supply etc.)</td>
<td>5</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>Range server Camera, IR Camera, Vision based Camera</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>Software License for Visual processing libraries</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>Sensor Lab Processing Kits</td>
<td>10</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>Smart Phone Sensors, Portable Sensor boards</td>
<td>5</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>Different Sensors for experiments (acoustic, temperature, GPS, GLONASS, Barometer, GSM, Accelerometer, Magnetometer, Piezoelectric, proximity, light sensors)</td>
<td>10 5 5</td>
<td>20</td>
</tr>
<tr>
<td>7</td>
<td>Software Libraries Licenses for Data Acquisition, Processing</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>Acoustic Lab (Infrastructure for Noise proof Environment)</td>
<td>10</td>
<td>-</td>
</tr>
<tr>
<td>9</td>
<td>sound generator, multiway recorder</td>
<td>5</td>
<td>-</td>
</tr>
<tr>
<td>10</td>
<td>Storage devices for Acoustics and, Processing Servers</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>11</td>
<td>Software Libraries Licenses for Audio Acquisition, Processing</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>12</td>
<td>BIG Data Analytics Lab: Apache Hadoop Server, Rack Servers, Rack Installation, Power Supply etc.</td>
<td>10 3</td>
<td>-</td>
</tr>
<tr>
<td>13</td>
<td>Software License (IBM BIGInsights, VMWare Professional License)</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>14</td>
<td>Reporting and Visualization Tools (JasperSoft)</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>15</td>
<td>ICT Equipments Networking infrastructure, Computers for workshops, printers etc.</td>
<td>20 10 5</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>16</td>
<td>Nano indentor,</td>
<td>49</td>
<td>10</td>
</tr>
<tr>
<td>17</td>
<td>Composite Fabrication machine</td>
<td>40</td>
<td>10</td>
</tr>
<tr>
<td>18</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Tracking photovoltaic array, Wind turbine Piezo Materials and poling unit Solar Energy Harvesting Development Tool PEM Fuel Cells Generators fitted cycling system with gear mechanisms thermo couples set up RF and inductive energy harvesting system</td>
<td>25</td>
<td>5</td>
</tr>
<tr>
<td>20</td>
<td>Batteries • 400 Ah SLA Hybrid Electric Vehicle EPCOS Classic Aluminium Electrolytic Capacitors Super capacitors Flexible batteries Electric Loads Energy storage device research setup</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>21</td>
<td>Inverter DC-DC BUCK Converters MPPT solar charge controller Adjustable Load model Variable temperature Chamber</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>22</td>
<td>IV curve tracer Solar radiometers Normal incidence Pyroheliometer Precision Spectral Pyranometer Data logger Power Analyzer Phasor measuring units Communication systems Frequency drives Impedance Analyzer Thermal analyzer</td>
<td>17</td>
<td>6</td>
</tr>
<tr>
<td>23</td>
<td>SCADA System Lab VIEW software</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>24</td>
<td>Various Sensors, actuators PCB fabrication and testing kits D33 meter for Piezo martial testing Vibration generation system Data acquisition cards/systems Thermal analyzer AVR module</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>S No</td>
<td>Name of Equipment/facility to procure</td>
<td>Estimated cost (Rs in Lakh)</td>
<td>Application</td>
</tr>
<tr>
<td>------</td>
<td>---------------------------------------</td>
<td>----------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Year 1</td>
<td>Year 2</td>
</tr>
<tr>
<td>1</td>
<td>Dental Institute, Chandigarh</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CBCT Upgradation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Scanner with exocad</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Sintering Furnace</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Suction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>3D Additive Printing Systems</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>55</td>
<td>30</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>S No</th>
<th>Name of Equipment/facility to procure</th>
<th>Estimated cost (Rs in Lakh)</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Year 1</td>
<td>Year 2</td>
</tr>
<tr>
<td>1</td>
<td>Lab scale Electrically heated sintering furnace (1800-2200°C maintaining vacuum of the order of 10⁻³ mBar)</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Hot Cold Isostatic Pressing machine</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sintering of the powder is the most critical component of the production of transparent ceramics. The powders selected for the project work have the melting temperature in the range 2500°C, but the process is designed to sinter them in fused state, hence 1800°C. The order of the purity required in the process make the use of vacuum conditions necessary. Specific need of the furnace is to optimize the sintering parameters by optimizing sintering additives to achieve theoretical density.
the methodology of production of the transparent ceramics. It immensely affects the voidage fraction of the sinter hence the transparency of the ceramic.

<table>
<thead>
<tr>
<th>S No</th>
<th>Name of Equipment/facility to procure</th>
<th>Estimated cost (Rs in Lakh)</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Year 1  Year 2  Year 3  Total</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Film thickness measurement unit</td>
<td>15</td>
<td>Sensor Characterization</td>
</tr>
<tr>
<td>2</td>
<td>3D Scanner and imaging system</td>
<td>15</td>
<td>Capturing and processing of 3D images</td>
</tr>
<tr>
<td>3</td>
<td>Measurement and test equipment</td>
<td>8</td>
<td>Prototype design</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>38  38</td>
<td></td>
</tr>
</tbody>
</table>

| Total | 65  50  115 |

CSIO, Chandigarh
### Annexure 6

**Table 3. Recurring Budgetary Requirements for partners in DIC-PU**

<table>
<thead>
<tr>
<th>S No</th>
<th>Partner Institute</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>UIET</td>
<td>90.8</td>
<td>112.6</td>
<td>103.6</td>
<td>307</td>
</tr>
<tr>
<td>2</td>
<td>Dental Institute</td>
<td>5</td>
<td>15</td>
<td>15</td>
<td>35</td>
</tr>
<tr>
<td>3</td>
<td>PEC</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>CSIO</td>
<td>9</td>
<td>6.5</td>
<td>6.5</td>
<td>22</td>
</tr>
<tr>
<td>7</td>
<td>Outsourcing, Consultants, IPR etc.</td>
<td>0</td>
<td>5</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td>106.8</td>
<td>143.1</td>
<td>134.1</td>
<td>384.0</td>
</tr>
</tbody>
</table>
Annexure 7

Table 4. Final Budget under Non Recurring & Recurring B/H for all Partners in for DIC-PU

<table>
<thead>
<tr>
<th>S No</th>
<th>Partner Institute</th>
<th>Recurring</th>
<th>Non Recurring</th>
<th>Grand Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Year 1</td>
<td>Year 2</td>
<td>Year 3</td>
<td>Total</td>
</tr>
<tr>
<td>1</td>
<td>UIET</td>
<td>90.8</td>
<td>112.6</td>
<td>103.6</td>
</tr>
<tr>
<td>2</td>
<td>Dental Institute</td>
<td>5</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>3</td>
<td>PEC</td>
<td>2</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>CSIO</td>
<td>9</td>
<td>6.5</td>
<td>6.5</td>
</tr>
<tr>
<td>7</td>
<td>Outsourcing, consultants, IPR etc</td>
<td>0</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>106.8</td>
<td>143.1</td>
<td>134.1</td>
</tr>
</tbody>
</table>
Design Programme

D³ innovation

Developmental Design for Disruptive Innovation
Indian Institute of Technology Kanpur

Submitted to
Ministry of Human Resources and Development
under the National Initiative for Setting up of Design Innovation Centres

1 of 74
ENDORSEMENT FROM THE HEAD OF INSTITUTION

Subject: The Project Proposal entitled "Def. Developmental Design for Disruptive Innovation, DIS-IT-IT Kanpur" as enclosed herewith.

Certified that the Institute/University/Organization welcomes participation of Dr. Ravi Pratap Rathi as the Principal Investigator for the project for stated duration and that in the unforeseen event of discontinuance by the Principal Investigator, the Co-investigator, Dr. Syed Ali, otherwise eligible will assume the responsibility of the final completion of the project with the approval of MOUs.

Certified that the Institute/University/Organization shall abide the terms and conditions of monitoring the project.

Certified that the equipment and other basic facilities and such other administrative facilities as per terms and conditions of the grant will be extended to the investigator(s) in entire duration of the project.

Certified that the Institute/University/Organization assures to undertake the financial and other management responsibilities of the project.

[Signature]

Name and Signature of Head of the Institution

Seal/Stamp of the Institution

Date: May 15, 2019
Place: IIT Kanpur
Contents

Introduction to Design Programme
- About us
- Pedagogy
- Lab Facilities at Design Programme
- Achievements
- Rational for a DIC at IIT Kanpur

S3: Developmental Design for Disruptive Innovation
- PPP model: People-Planet-Profit model for Innovation
- Curriculum for Design Innovation: Course development

Hub-Spoke Interaction
- Relation between Hub-Spoke
- Spoke 1
- Spoke 2
- Spoke 3

Operational Structure
Deliverables
Outreach Activity
Budget
Plan for Sustainability of the Centre

Annexure
- Consent letters of spokes
- Patents, Awards and Recognitions- Faculty
- Awards and Recognition- Students
- Student Placements
- Work done in last two years in Design Programme
Introduction to Design Programme

Design Programme, Indian Institute of Technology Kanpur, is an interdisciplinary initiative to inculcate and spread a culture of creativity within and outside the Institute boundaries. The Programme has been conceived as a platform for synthesising knowledge of multiple domains to encourage lateral problem solving. Not only does the Programme encourage new and radical concepts, but it also facilitates the development of market-ready prototypes. Hands on work blends uniquely with designerly thinking to create a complete learning cycle.

Working in dedicated state-of-the-art studio spaces throughout the two years of their education, students acquire visualisation skills and learn design process and theories that help them craft objects, communicate concepts, and develop complex systems that facilitate meaningful interactions. Unlike traditional design education, the pedagogy of the Design programme focuses on designerly thinking, instead of discipline based thinking. Discipline based thinking often lacks lateral thinking process required to solve complex real life problems. It is the synthesis of multiple disciplines in design problem solving which makes it a unique holistic approach towards tackling wicked problems.

With this in view, the Programme brings in the synthesis of more than more than a dozen Disciplines, to pronounce itself truly interdisciplinary. We draw our faculty from Mechanical Engineering, Electrical Engineering, Biological Sciences and Bio-engineering, Aerospace Engineering, Computer Science and Engineering, Psychology, Sociology, Fine Arts, Economics and Industrial Management and Engineering. Therefore, under a single roof we are able to engage with all aspects of the Design cycle: Cognition (Psychology, Sociology, Economics, Fine Arts), Engineering (ME, CS, EE, AE, CE, BSBE) and Entrepreneurship (IME). Such a synthesis of Discipline is not just uncommon, but also unique by itself.

Candidates with a bachelor’s degree in Engineering, Design or Architecture with a valid CEED/GATE score are eligible to apply for the two-year Master of Design Programme. CEED and/or GATE scores are used for short listing the applicants, followed by an interview which may be preceded by a brief written assignment.

Lab Facilities at Design Programme: Our Lab facilities include access to the Tinkering laboratory for learning while doing following the constructivist view of education. The 4L lab is an advanced facility for High Fidelity Prototyping and precision designing that includes Rapid Prototyping Machines, CNCs, Water jet cutting machine and the Laser cutting machines amongst others. Several other advanced laboratories and studios of the Institute are also available to the students to study form and aesthetics, ergonomics, material selection, computer-aided manufacturing, opto-electronics, microprocessor and micro-controller, artificial intelligence, smart polymers and the media technology lab. A sample of the same is mentioned in the forthcoming pages.
4i Lab
3-Axis CNC Milling Centre
DMC 63V Deckel MAHO
Speed Range: 10000 rpm
Working Bed Size: 630mm x 500mm x 500 mm
CNC milling is controlled by a central computer that has been integrated with the modeling environment. Machining needs are met with a complete selection of cutting patterns that include highly automated roughing and finishing approaches as well as curve and edge based machining. Delcam, Mastercam softwares are used to generate the CNC code for complex profiles and then transferred to the machine controller.

Rapid Prototyping
FDM TITAN
Fused Deposition Modeling System
Layer Thickness: 0.125mm Build Size: 406mm x 355mm x 406mm Materials: ABS Plastic and Polycarbonate
Prototyping is the crucial stage between transformation of a design process into a product. It exposes and facilitates the elimination of design errors early in the product development stage. This system uses additive manufacturing process, which do not require any tools and setups as compared to the subtractive techniques used in the traditional machining operations and thus reduces the prototype development time.
CNC Lathe
CTX GILDMEISTER TURNING CENTER
Spindle Speed: 4500 rpm
Turning Length: 600mm, Dia 305mm
CNC turning is controlled by a central computer that has been integrated with the modeling environment. Machining needs are met with a complete selection of cutting patterns that include highly automated roughing and finishing approaches as well as curve and edge based machining. Delcam, Mastercam softwares are used to generate the CNC code for complicated profiles and then transferred to the machine controller.

Water Jet
OMAX 2652
Table size: 5' 9" x 2' 6" (1753 mm x 762 mm) X-Y Travel: 4' 4" x 2' 2" (1321 mm x 660 mm)
Materials: Exotic Alloys like Inconel & Titanium, Glass, Rubber, Stone and Wood
Abrasive Water Jets are used to create precision parts for hard to cut materials. The OMAX 2652 is a mid-sized cantilever-style machine, it boasts a cutting tolerance of ±0.003" (±0.08 mm). With a completely sealed and protected Ball Screw Drive System, this robust and reliable workhorse is perfect for shops cutting projects with smaller dimensions but needing high precision.

Tinkering Lab
At present basic lathe machines, basic milling machine, bench drilling machine, vacuum plastic forming machine, sheet metal cutting and bending machine, shearing machine, small grinders, buffing tools, hand grinders and drill machines, air-compressors, welding machine, bench vices for metal fitting and wood work activities, spray painting, all fitting and carpentry tools, marking and measurement tools, are available.
SIDBI Incubation Center

SIIC is a one point contact for all matters related to innovation, incubation, entrepreneurship, technology transfer and commercialization at IIT Kanpur. It is supported by SIDBI, DIT, DST, MSME, BIRAC and DSIR to boost the entrepreneurial ecosystem in the country.

It offers a whole gamut of incubation facilities and services to prospective entrepreneurs and intrapreneurs to convert their innovative ideas into commercially viable products. SIIC incubates ventures in technology, engineering and other interdisciplinary areas. Regular events like entrepreneurial talk series, workshops and seminars have offered SIIC a good interface and visibility in the region. SIIC can incubate on an average 33 companies. Since its inception, it has incubated and mentored 53 companies of which 26 have already graduated. In 2011, SIIC was awarded the National Award for Technology Business Incubators.
Achievements
Despite the relatively young age of our Programme, we have made significant contributions to the design field in general and to India in particular. The faculty as well as students have together filed more than 25 patents, won national and international awards and represented the country in international events like the 'Design for the other 90%' workshop held by MIT, PD6 workshop at Aalto University, Finland, World Congress of ITRA, and the India-Stanford Biodesign internship amongst many others. (refer to the details of the awards and patents in the Annexure)

The Design Programme has a strong international presence, evident in our collaborations with various eminent universities over the years. We have been regularly collaborating with the following universities on projects as well as academics.

- Aalto University, Finland
- KTH University, Sweden
- Stanford University, USA
- University of Melbourne, Australia
- University of St. Galien, Switzerland
- Waseda University, Shinjuku, Japan
- University of Gavle, Gavle, Sweden
- Sheffield University, United Kingdom
- Pontificia Universidad Javeriana (PUJ), Columbia

Our students have been placed in well established companies like Microsoft, Nokia, Yahoo, Escher, Honda, ITC amongst others. Please refer to the Annexure for the detailed list. Besides full time jobs, many of our alumni have become entrepreneurs to develop their own design vision. We believe that these design entrepreneurship will carve a new standard of life in India. Some of the start ups include

- Haxo Labs (Vinay Paheljani)
- Red Studio (Ruchin Sharma)
- D Cube (Shah Mohammad)
- Indus D'Sign Solutions (Sushil Narsian)
- Arnium Technologies Pvt. Ltd (Mayukh Chakraborty)
- Thinking Threads (Butool Abbaas)
- H2I (Riddhi Jaydeo Chokhawala)

Rational for a DIC at IIT Kanpur
There are two main reasons why we think that IIT Kanpur has the capability and the infrastructure to host a DIC

1- We have the ability to take a product from Board to the Market!
The synthesis of multiple disciplines available under a single roof enables us to approach Design Innovation Cycle holistically: Cognition (Psychology, Sociology, Economics, Fine Arts), Engineering (ME, CS, EE, AE, CE, BSBE) and Entrepreneurship (IME).

2- Developmental Innovation is our forte; therefore our products reflect responsible design which is also profitable.
PPP model: People-Planet-Profit model for Innovation

We, at IIT Kanpur, are wary of the excessive thrust on newness in an ‘innovation driven economy’ that may often side step the reason of appropriateness, feasibility of technology, need for affordability or the planning for sustainability, in the race to produce the ‘new’, ‘different’ or the ‘exclusive’. We think it is important to evaluate innovation on not just its economic cost, but also on its social and environmental cost to ensure our engagement with responsible design for a developing economy like India. Therefore, we propose to apply the Triple bottom line model-People, Planet, Profit, to not just evaluate our work but also to build it. People is the social capital whose needs and aspirations we design to satisfy. Planet is our Environmental capital from which we borrow the resources for our living as well as designing; while Profit is the monetary capital requirement for producing an object to make its production viable. D³ therefore aims at innovation that is people driven, environmentally friendly and economically viable. The Centre will strive to achieve the following objectives:

- To develop a research hub for facilitating D-B Innovation (Design to Business) at IIT Kanpur and its spokes with the above mentioned aim
- To develop a design pedagogy to fuel a culture of innovation
- To not only feed the academia and industry but also shape entrepreneurs to drive an innovation based economy

The salient features of D³ Innovation will be:

a- Innovations will be centred around Developmental goals.
b- The Centre will not be limited to, but instead will explore solutions in Frugal as well as cutting edge technology as long as the resulting solution is appropriate.
c- The cycle of innovation will not be complete at proof of concept but at proof of marketing.
d- The objectives of the centre are not limited to product innovation alone, but also to create a culture of innovation within and outside the Institute.

Details of the model are discussed from here on.
Education:
The skewed student-teacher ratio in many Indian schools is a strong barrier to the implementation of the Right to Education act, as well as for establishing equality of access and opportunity to our little citizens. This lopsided ratio affects the teaching as well as learning capabilities of the class, besides churning out wards who lack both cognitive and motor skills.

Assuming that some motivated teachers are present in school, the low number affects their ability to customise content according to varying learning abilities, pay extra attention to the problems of the weaker students and also queries of the bright and the curious ones. Besides tiring and demoralising the teacher, such a system fails to utilise the potential of the learners. Therefore, several members of the Design Programme are willing to collaborate between disciplines (Social sciences, Fine Arts, Computer Science and Engineering) to develop appropriate educational aids for enhancing learning potential. Two major approaches towards this end are discussed below.

a- Innovative content development for knowledge dissemination in disadvantaged schools and communities: A significant contribution to the Indian educational system could be an effort to redesign standard Indian curriculum content for peer to peer learning both as a supplement to and in absence of schooling. The platform could be Multi-media Rich Lessons (MMRL) or physical instructional aids depending on the access to infrastructure at the Field site or even a Child-Robot interaction for supplementary education.

b- Skill Development: Hand motor skills is an often neglected area of focus in learning, despite the significantly large number of skilled workforce dependent on the hand in the Informal economy like craft and cottage industry. Given the dearth of trainers in the field of skill development and lack of access to remote communities, Massive Open Online Courses can partially solve the problem of decentralized education. Online courses on skill development are literally unavailable even on the best online websites like Coursera. Developing the same will not only be novel, but also revolutionize skill development in the country. As skill development cannot be completely taught through ‘seeing/hearing’ course material alone, a hybrid system of online and offline platforms can make a good alliance between technology and traditional classroom teaching.

Here, we would like to emphasise that many educational initiatives have been taken ahead by the Faculty of Design Programme. Shilpakoshta, funded by the Ministry of Textiles is one of its kind virtual platform for engaging low-literate designers like craftsmen with online materials and graphic softwares.1 Adu-Huli, an aid designed for visually challenged children was displayed at International Toy Research Association in 2014, Portugal.2 NPTEL, IIT Kanpur has developed 213 courses as well as several number of web courses for making quality engineering education accessible to all students.3 Not just the Programme, but even faculty in other departments as well as students of IIT Kanpur are well known in the surrounding areas for their educational interventions. Rural schools like the one at Lodhar, the NGO- Shiksha Sopan and Prayas are all initiatives led by institute members. In fact, Prayas is led independently by volunteering students of IIT Kanpur.

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1 Prof. Koumudi Patil
2 Ms. Ekta S
3 Prof. Satyaki Roy
LOW COST NEONATAL PHOTOTHERAPY UNIT FOR JAUNDICE
Healthcare: World Health Organization's 2000 World Health Report, ranked India's healthcare system at 112 out of 190 countries. India still spends only around 4.2% of its national GDP towards healthcare goods and services (compared to 18% by the US). One of the key drivers of India's healthcare landscape, besides that of the urban-rural divide, is the high out-of-pocket expenditure on mostly private hospitals in the absence or lack of efficiency in the Public health system. Hospitals alone are not to be blamed as the infrastructure cost of most efficient systems itself is exceedingly high. Most high-end equipment is imported and the cheaper ones are not context specific to the Indian environment. This urgency calls for innovation in the health sector as a prime developmental objective, while also opening up a lucrative untapped market opportunity.

Faculty in the Design Programme realised this dire need as well as opportunity several years ago, and have developed many innovative products for this sector. They have also been closely collaborating with SGPGI (Sanjay Gandhi Post Graduate Institute of Medical Sciences) and KGMC (King George's Medical University), Lucknow on needs emerging from on ground use and experience of medical equipment. Two areas in which the DIC at IIT Kanpur will focus on specifically in the next three years are elaborated below.

a- Assistive Technology: Expertise on development of prosthetic devices in particular and assistive technology in general has been a strong research area in the Design Programme. Sociable robots for monitoring the health of children or the elderly, development of smart prostheses that can mimic and exceed the capabilities of biological limbs, navigational aids for the visually impaired and better tree designs for inclusive architecture are some of the areas for innovation that the D3 will concentrate on. Efforts may also be made to design inclusive classrooms with assistive devices, such as automatic page-turners, book holders, and adapted pencil grips, for supporting learners with disabilities to participate in regular educational activities.

It should be noted that many innovative efforts in the past in these areas have been highly appreciated by the industry and academia alike. Vardaan, a stair climbing wheelchair won the Gandhi Young Technology Award and a patent in 2012. It has been displayed on various national and international forums. A recently developed prosthetic foot with enhanced flexibility for higher mobility has achieved a manufacturing cost lower than that of even the Jaipur foot. The innovation is in the patent process. (For more details please refer to Annexure)

b- Indigenous development and manufacturing of appropriate Medical equipment: The medical devices sector is the smallest piece of India's healthcare pie. However, the medical devices sector is also seen as the most promising area for future development by foreign and regional investors. More importantly, it is an important developmental goal to pursue, if the impact of innovation is significant to us. It is an indispensable need which despite advancement in medical sciences is bound to remain strong for many more years to come in a developing country like India. Therefore, designing low-cost medical equipment for country-specific needs or substituting exorbitantly priced imported equipment with ingenious mechanisms or manufacturing techniques is one of the primary aims of the DIC. For instance, one of the recent designs of an Invertible Body Fusion device for neurosurgery applications at IIT Kanpur reduced the cost of its development by 1/10th from its imported counterpart. The device is essentially a connector surgically introduced within the patient's while neurosurgery. Similarly, an inexpensive phototherapy unit for neonatal jaundice was designed for primary health centres in disadvantaged areas. In another project as a part of an ongoing course, a low cost dental chair is being designed and developed in collaboration with a team of dentists from the Sardar Patel School on Dental and Medical sciences at Lucknow.

---

4 Shanu Sharma and Dr. J. Ramakumar
5 Prof. Neeraj Sinha
6 Prof. Shantanu Bhattacharya
Planet Driven innovation
The next wars might well be about survival in an increasingly unsustainable ecosystem. Therefore, any innovation in this area will make the innovator as its first beneficiary. It is a matter of survival for the innovator as well as for whom he is innovating.

Water and Energy
The next wars might well be about survival in an increasingly unsustainable ecosystem with serious energy deficit. Civilizations which will have surplus energy will survive whereas the others will perish. So it is high time that, the burgeoning economies like India and South East Asia, start to explore the possibility of sustainable energy harvesting and storage systems. Here it is worth mentioning that biggest inspiration can be drawn from biological systems to develop bio-analogue energy systems. A cheap, sustainable, pollution free approach conforming with Gandhi model of growth and development. Therefore, any innovation in this area will make the innovator as its first beneficiary. It is a matter of survival for the innovator as well as for whom he is innovating.

Water contamination has been an area of concern in general, but also in particular to Kanpur. Time and again, Kanpur has been in the news for the high level of Chromium in the Ganga, its infiltration in the fields and consequently into food. Potable water and its accessibility to all is a primary need that is still unfulfilled in the country. Therefore water treatment, water harvesting, water distribution as well as monitoring environmental health through sensors are opportunities for innovation. We plan to have strong design research thrusts in the area of technology driven multiple utility platforms to sense and remediaste contaminated water to make it fit for human consumption.

Waste
Despite the broad publicity of the cradle to cradle approach, the unsuccessful management of product waste has continued to be a bane of the design field. Plastic, e-waste and general remnant of consumed products have littered the landscape and destroyed visibility of what were once our cities, for instance Shimla. Many approaches towards waste minimisation and management have been followed lately. This includes segregation, disposal, recycling as well as a zero waster policy. Several projects for waste management have been undertaken by the Institute in the past. These include projects on substitution of plastic with environment friendly material. In a recent project with Hindustan Unilever, the Institute also worked on zero packaging models for eliminating packaging waste altogether. Treasure and Beauty of the reassigned urban trash has become a part of the pedagogy as well as practice of some faculty initiatives.
Profit Driven Innovation

Viability of any innovation is a pertinent concern of the innovator as well as the investor. Shelved innovations have a potential but not a use. Therefore, it is important to build a business model around, and for every innovation. D-B or Design to Business strategies would attempt to embody the business requirement within the design process itself. D-B lab at DIC would foster connections between academia and industry, by pushing for collaborations by itself, rather than wait for industry demand to emerge. Innovative ideas often linger in the research phase because the product development and investment connection with the industry is missing in the development cycle. Business value proposition can be inbuilt in the innovation cycle early on, if the stakes of industry collaborators as well as venture capitalists are accepted early in the design process. The D-B lab would act as a link between the research and market production cycle of innovation, by actively initiating a dialogue between the academia and the industry. Similar to the Fraunhofer model, D-B Lab will draw industry into the academia, but unlike the former it will not assist in scale-up. It will act only as a nodal agency for making business value propositions of innovations in the pipeline to the industry, and academic value propositions of emerging industry demands to the academia.
Besides, fostering Industry-Academia connections, D-B lab will also facilitate and encourage entrepreneurship amongst the various stakeholders of the DIC. The industry often takes calculated risks with innovations, but entrepreneurs are more aggressive in the market; therefore, willing to take a longer leap. The seed money and the infrastructure required during the gestation period of any venture will be given on the basis of merit by the SIDBI Incubation Centre hosted by IIT Kanpur. The D-B lab would assist the entrepreneur in writing the business plan, drawing a competition matrix, risk analysis and financial modelling of the business. Towards this end, the Lab would be mentored by experienced faculty from Industrial Management and Engineering Department, besides hiring expert consultants from outside.

As stated earlier, these three areas of Innovation-People, Planet and Profit will feed into each other and therefore should not be considered as exclusive of one another.
For instance, livelihood generation does not imply an efficient high end manufacturing innovation that is polluting and unaffordable.

Innovators for Innovation:
For the success of any such model, human capital is the key which draws together technological, social, cultural and economical capital. Innovators not only have ideas to leverage an opportunity but also the ability to execute them, either by themselves or in a team.
To build a culture of innovation, D3 must gather together tinkering agile minds. Therefore, D3 will scout for young innovators to be either mentored or experienced innovators for collaboration and consultation on its own projects to build a culture of innovation.

Design Innovators in Residence: There is immense untapped knowledge and experience in the design industry that hardly resonates in design education, largely because practitioners refuse to theorise their experience. But nevertheless many senior designers in the industry and master craftsmen are a wealth of knowledge. To take advantage of this resource as well as build a connection with the Industry, three designers from the industry will be invited for six months each to reside on campus. During their residency they will collaborate with faculty on on-going projects, mentor student projects, present seminars and take modules on innovation for the campus residents.
Design Student Fellows: Students often design ingenious solutions that are lost in the humdrum of academic schedules. Such innovations require mentoring for further development. If innovative mindset and practices are acknowledged, there are higher chances that peer to peer interaction will enthuse more students to engage with problems which enlarge the scope of academic explorations. With this in mind, D3 will announce 30 student fellows from the Hub as well as its 3 spokes for working on projects of their choice. These projects will be mentored by faculty members of the Institute and will have to be completed in a time bound manner.

Design Senior Fellows: A lot of experienced alumni of many Design Institutes do not want to sever their ties with the industry but yet want to pursue small design projects within a timeframe. This pool of passionate young designers could be helpful in setting up the tone of innovation in D3. Design Incubation Fellows will be taken for a stipulated time period of 6 months on the basis of a competitive project appraisal. Such self-initiated projects will bring in a constant flow of new ideas and processes.

Self Configurable Modular Robot


INVENTORS: Dr. Sishakti Bhattacharya, (Mechanical Engg.), Mr. Ankur Agarwal, Student, (Mechanical Engg.)

BRIEF DESCRIPTION: The invention relates to the concept of reconfigurable modular robots, i.e., machines with variable morphology and which comprise of several identical modules.
Curriculum for Design Innovation: Course Development

We believe that Design needs to step up to the increasingly complex global, social, and business innovation challenges, which requires a combination of domain knowledges and skills. This requires a paradigm shift in design pedagogy from the traditional system of domain specific specialisation to the pertinent contemporary need of specialisation in the synthesis of domains. Convergence of multiple domains is leading to the emergence of new methodologies to effectively target "wicked problems" which lie outside the purview of any one field.

With this in view, we are working to develop new inter-disciplinary methodologies that synthesise design thinking with the behavioral and social sciences, economics, technological development, and business strategies to create design solutions of a systemic nature rather than furnish small, often temporal component-specific response to a need. In line with this philosophy, we would like to offer 10 courses through DIC to design a curriculum for Innovation.

Level 1: Domain-specific skills for Innovation (Design-Technical-Social-Management)
Level 2: Creative Visualisation techniques for Innovation
Level 3: Design Integration of Multiple Domains (technical - social- management) for Problem Solving: Integrating technical and social analysis with creative synthesis
Level 4: Innovation Management: Life Cycle Assessment, Knowledge protection,

Objectives of the Curriculum
1. To inculcate a mindset and required skills to innovate amongst students: The innovation pedagogy will strive to produce students who can synthesize engineering, social science, and design approaches in the creation of innovative solutions for design challenges.
2. To foster an innovation culture in the Industry: It is of importance to the Academia, that Innovation skill set developed through this curriculum is effectively absorbed in the Industry to complete the education cycle. Therefore, the content of the courses will not only shape but also be shaped by Industry requirements.

Details of the Courses

The courses mentioned below are representative of the ten courses that IIT Kanpur will develop for DIC. With further consultation, they will be refined and evolved into a successful framework for an Innovation pedagogy.
Course Name: Ethnography of Innovation

Course Learning Objectives:
1. To be able to apply ethnographic techniques for identification of wicked problems.
2. To imbibe the ability to transform artefacts, language and interactions as learning objects for gaining design insights.
3. To analyse and evaluate new real time data gathering techniques.
4. To understand cultures of innovation as a pluralistic practice.

Course Level: Level 2: Creative Visualisation techniques for Innovation.

Targeted students: Industry participants and students of Spokes.

Course Format:

<table>
<thead>
<tr>
<th>Kind of Course</th>
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Course Duration: 4 months
2 weeks (20 hours)
2 weeks (20 hours)

Course Content:
Ethnography is the method of gathering and recording data about human culture and societies in naturally occurring situations/environment. The 'immersion' of the ethnographer in the community or life of the user through traditionally prolonged contact results into 'thick description' of the data in the Geertzian sense. Ethnography being a holistic method of data collection often gives insights on the entire design ecosystem rather than from singular parts/individuals/instances. This

1. Design Problems
2. Ethnography of Innovation
   - Cultural Innovation: Jugaad to Innovation Industry
   - Kinds of Innovation
3. Participant observation methods
   - Specimen-Scientist model
   - Student-Teacher model
   - Apprentice- Master model
4. Visual Ethnography
5. Technologically mediated methods of data collection
   - Cyber Ethnography
   - Video Ethnography
   - Real-time data collection devices
6. Analysis of Ethnographic data
7. Case studies
8. Design Project on Ethnographic data collection

Relevance to Innovation:
Ethnographic studies assists in the generation of stakeholder (in this case industry or users) relevant problems which consider the real-time dynamics of various social-economical-technical factors. In lesser understood user segments like the bottom of the pyramid or in complex modern environments like a factory, this method can be used to identify areas of innovation. Therefore, it connects areas of innovation with the innovator.
Course Name: Design Marketing & Design Entrepreneurship

Course Learning Objective: New products and services are crucial to sustainable growth and profit in most industries. Successful design innovations are those that benefit users more than established offerings. This course will help students learn how to manage the development of new products and services that meet customer needs in consumer and B2B settings. The focus of this course is on identifying and processing information from customers, creating customer value and exploring new business models for design entrepreneurs.

Course Level: Level 4: Innovation Management

Targeted students: IIT Kanpur- B.Tech/M.Des/IME

Course Format:

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<td>4 months</td>
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Course Outline:

I. Sources of Innovation
   1. Success factors of New Business Development
   2. Social Shaping of Design Innovation
   3. Incremental & Radical innovation - Design Alternatives

II. Tools for Identifying Customer Needs
   1. People Centered Design Methods
   2. Ethnography for Design Marketers

III. Concept Generation & Selection
   1. Concept Search
   2. Concept Testing
   3. Concept Screening
   4. Prototyping & Experimentation
   5. Marketing Testing

IV. Execution Strategy
   1. Kano Model
   2. Quality Function Deployment
   3. Trade-off Analysis
   4. Target Specification
   5. Cost Models

V. Venture Planning
   1. Opportunity Taxonomy
   2. Final Market STP
   3. Allocation of Resources
   4. Pre-Launch Planning
   5. Entrepreneurial Venture Dynamics
Course Name: Design Thinking for Social Innovation

Course Learning Objective: The course aims to encourage a multidisciplinary approach to socio-technical design innovation in response to today's need of the world that faces complex social challenges. The course relies on blending learning by doing; project-based inductive learning and design thinking through experiential engagements. This course helps to translate the concept of design thinking into innovation eco-system requirements. This course elaborates that the use of Design Thinking is aligned with several practices of innovative solutions and methods. Social innovations bring a lot of behavioral changes in the social environments during the process. Design Thinking acts as an enabler for the better adaption of these behavioral changes in society.

Course Level: Level 3: Design integration of multiple domains (technical - social-management) for problem solving

Targeted students: IIT Kanpur- B.Tech/M.Des/ M.Tech/ MBA

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<td>4 months</td>
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Course Outline:

- Introduction to Design and Innovation
- Design Thinking: Design Thinking + Visual Thinking: Creativity in Teams – Generating Innovative Ideas
- People Research
- Context Research
- Design Insights
- Design Strategy
- Opportunity Sensing and Ranking
- Concept Innovation and Shaping
- Proto-cepting and Prototyping/ Design Dynamics: Explore Architectures & Platforms
- Usability Testing
- New Business Model and Market Launch Planning
- Communicating your Design

Relevance to Innovation:

Design Thinking promises Social Innovations inspired by design. An innovation comes through the iterative and continuous application of Design Thinking. This course will help students that how to adapt Design Thinking to simplify the complex issues of socio-technical challenges and conceive an innovative solution. Design Thinking enables innovation; this course aims at providing a better understanding of this concept, that how it is used in social innovation domain, and its role in building Innovation Capabilities. The interrelation between learning how to use Design Thinking, obtaining enough spaces for its use, and allowing its exploitation to contribute to growing Innovation capabilities is a delicate balance therefore this proposed structure will help to understand the interplay between innovation capabilities and use of Design Thinking, in relation to building Innovation capabilities in the socio-technical scenario.
Course Name: Frugal Innovation

Course Learning Objectives:
1. To understand the relevance of developmental design.
2. To be able to design under stringent constraints of affordability in the context of usability, desirability and viability for the grassroots communities.
3. Co-creating design solutions with communities for increased participation in problem solving, solution development as well as solution implementation.
4. Thinking for and through a design ecosystem for all stakeholders—animate as well as inanimate.

Course Level: Level 3: Design Integration of Multiple Domains (technical - social - management) for Problem Solving

Targeted students: B.Tech/M.Des/M.Tech students of spokes and the industry

Course Format: With suitable changes in content, this course can be offered in any or all of the three formats.

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Course Content:

1. Fortune at the Bottom of the Pyramid
   - Inter dependency of issues: People, Planet, Profit
   - The Indian Pyramid
     - Bottom of the Pyramid
     - Middle of the Pyramid
     - Top of the Pyramid
     - Maslow’s hierarchy
   - Developmental problems
     - Poverty
     - Education
     - Health
     - Sanitation
     - Security
     - Water, food, house
   - Inclusivity—Gender, Caste, Religion
   - Case studies: Warka water towers, Jaipur foot, Hippo, Headstart, Toys-from-trash etc.

2. Frugal Technology
3. Frugal Economics
4. Frugal Culture and Society
5. Design Ecosystem
6. Frugal Design Process
   - Context mapping: Resources, stakeholders, skills
   - Jugaad: Appropriation and Assimilation
   - Synechtics
   - Participative design
   - User testing
7. Design Projects on developmental problems

Relevance to Innovation:
Innovation for the grassroots communities has become a part of many renowned international institutes like MIT, Stanford and Copenhagen Institute of Interaction Design. This sector is opening up for innovation not only for ethical, but also economical reasons. C.K. Prahalad celebrated frugal innovation in his seminal book—Fortune at the bottom of the Pyramid. Paul Polak questioned the zeal for innovation only for the economically well-off segments. He said, 90% of the world's designers spend all their time addressing the problems of the richest 10% of the world's customers. It needs to change.
5. Course Name: Design Innovation Process

Course Learning Objectives:
1. To use the design innovation process for product design.
2. To be able to negotiate design decisions among various team members.

Course Level: Level 3: Design Integration of Multiple Domains (technical - social-management) for Problem Solving

Targeted students: B.Tech/M.Des/M.Tech students of spokes and the industry

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Course Content:

The ME310 is a course run by Stanford Design school with the involvement of design research teams across the world and starting to use a roadmap for designing in 06 steps as provided below. These steps will be introduced in the course practice-based pedagogy. Students will work on real world design challenges either posed by the industry or the user communities.

(1) User research: The first step will introduce the user research step with a problem definition and identification. The philosophy for doing this user research is empathy and mutual respect for each other. That is the only way of defining the actual problem.

(2) Field research: In this step one has to identify the stakeholders and context of the problem. It also has to cater to where the problem has to be addressed and what will be the actual needs of the stakeholders.

(3) Analysis: This step involves building of personas and identifying the scenarios in which the person a s would define the problem and finally a conceptual model of the problem and research is zeroed. The step is followed by need finding and critical need analysis steps.

(4) Brainstorming and ideation: The needs are discussed based on which the ideation is initiated with the stakeholders and realization of idea racks is created. The emphasis is solely on the problem and stakeholder based ideations. The idea rack is a special concept of the Stanford design process which gives the designer an empowerment of solution providence.

(5) Prototyping: This step includes the critical experience prototyping, the critical functional prototyping, the dark horse prototyping which focuses on the most non viable solution which can be just tried with low confidence but if it can be realized it can be the best solution. This is followed by developing of the funky prototyping and the functional prototyping finally.
(6) User testing and iteration of the design: The last step is about user testing and multiple iterations of the design.

The course will involve a networking between 7-8 student teams which will be paired up with students from other participating institutes.

**Relevance to Innovation:** Instead of component design, this course will focus on system-based innovations that not only have robust engineering solutions, but are also mindful of usability, desirability, and societal implications. This course will also be directly linked to the challenges posed by the industry through the D-B lab.
6.
Course Name: Design and Economic Analysis

Course Learning Objectives:
The aim of this course is to introduce design students to the fundamentals of Economics and market forces. This will equip them with the tools necessary to market their design products effectively.

Course Level: Level 4: Innovation Management

Targeted students: B.Tech/M.Des students of spokes and the industry

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<td>Course Duration</td>
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Course Content: Demand and Supply, Consumer Theory, Producer Theory, Different Market forms, Imperfection in the Market, the functioning of arts markets, the financial problems of performing arts companies and museums, and the key role of public policy

Relevance to Innovation: Yes
Course Name: Design, culture and society

Course Learning Objectives:
The aim of the course is to understand the nature and structure of design in the context of Indian society and its cultural framework; to explore methods of cultural anthropology as a tool for observing user experience; to examine some specific case studies in the light of cross-cultural and comparative concerns; to explore the process of trend mapping; and to develop appropriate products for the Indian society.

Course Level: Level 2. Creative Visualisation techniques for Innovation

Targeted students: B.Tech/M.Des students of spokes and the industry

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Course Content: Indian society and its cultural framework, methods of cultural anthropology as a tool for observing user experience, Examples of cross-cultural and comparative concerns, and trend mapping

Relevance to Innovation: Yes
Course Name: Method for Design research

Course Learning Objectives:
The aim of the course is to understand the nature and structure of design in the context of Indian society and its cultural framework; to explore methods of cultural anthropology as a tool for observing user experience; to examine some specific case studies in the light of cross-cultural and comparative concerns; to explore the process of trend mapping; and to develop appropriate products for the Indian society.

Course Level: Level 2: Creative Visualisation techniques for Innovation

Targeted students: B.Tech/M.Des students of spokes and the industry

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Course Duration: 4 months

Course Content: Research Process and Problems, Sampling, Data Collection Techniques, Data Analysis Techniques, Ethics in Research and Thesis Writing.

Relevance to Innovation: Yes

Preparedness of Design Programme / Spokes to execute a curriculum on Design Innovation:
The faculty of Design Programme have agreed to build the course curriculum in close collaboration with each other. As many faculty members are already involved in either teaching courses on design innovation, research on methods of innovation or sponsored project for developing innovative designs, building and executing the curriculum to enhance the culture of innovation will only be a matter of natural extension from current activities. All pedagogical facilities required for holding these courses already exist within the Design Programme.

Our spokes have agreed to hold these courses also. Wherever necessary the Hub will support the same within the spoke institutes.
Hub-Spoke Interaction

The Hub-Spoke model at IIT Kanpur envisages the spoke as its satellite campus, segregated by distance but with similar capabilities and opportunities to build a culture of innovation as the Hub itself. Therefore, all activities initiated by the Hub will be either operational for the Spokes too, or will be accessible through the Hub to them. For instance, all academic material as well as courses will be shared with the Spoke as it is leading to an environment of sharing and collaboration. In instances where activities are not shared, such as the D-B lab, the spokes will have access to the opportunities generated by the Lab. The interactions between the hub and spoke can be defined in the following activities.

**Academic interaction**: Pedagogical materials of all courses, modules, and workshops will be shared with the Spokes for free use in their own institutes. Additionally, 9 innovation modules will be conducted by the Hub for the Spokes. The spokes can choose their area of interest in these modules subject to their line of specialisation, and the Hub will conduct them accordingly. Details of these modules will be drawn with mutual consensus.

**Mentorship**: Thirty students from the spokes will be invited for internships with the faculty of the Hub. These internships can be based on the projects of D3 or areas of interest of the students, as mutually decided. The Hub faculty can also co-guide thesis of the students or mentor their projects as need be. Students from the Spokes are also eligible to submit proposals for the DIC fellowship of 50,000 Rs/-.

**Collaborative projects**: Projects from each Spoke will receive a grant not more than Rs. 88,00,000 Rs/- each in the course of three years. These projects will be selected through a competitive procedure overseen by an external committee of experts organised by the Hub. Based on the decision of the experts and the opinions of the spoke, the projects will either become independent of the Hub or executed in collaboration with the Hub faculty.

**Shared Lab facilities**: All infrastructure developed through DIC funding will be equally accessible to the spokes. Therefore, the Cogitation Lab, High Fidelity prototype lab for Communication and Product design, and D-B Lab will be a shared facility between the Hub and the Spoke. Access to all Labs except D-B lab will be on the Hub campus. The D-B lab can be accessed on the campus, but can also share its industry contacts and projects virtually.

**Promotion and branding**: All D3 international workshops, conferences as well as national exhibitions will be conducted in collaboration with the Spokes. They will be part of the organisational teams, and will also leverage the promotional and branding advantages of these outreach activities.
About Spoke 1:
Harcourt Butler Technological Institute:
Set up in 1921, it is one of the oldest Engineering colleges in Uttar Pradesh. In fact IIT Kanpur was hosted in HBTI in its initial days in 1961. The institute is spread across two campuses, the east campus (77 acres) and the west campus (271 acres) situated about 3 km apart, affiliated to Uttar Pradesh Technical University, Lucknow. The institute runs 13 undergraduate programmes leading to B. Tech degree. The undergraduate programmes in Chemical, Mechanical, Electrical, Electronics, Civil, Computer Science Engineering and Chemical Technology (Biochemical Engineering, Food, Oil and Paints and Plastic Technology) of the institute has been accredited by the National Board of Accreditation (N.B.A). Besides it has active research programmes being carried out in various disciplines. Recognizing its competence in delivering to enhance technical horizons 'Dataquest' in the edition of May 2005 has designated it as 21st best technical institute of the country and the leading institute among 8 government funded institutes of U. P Technical University, Lucknow.


Rational for selection of Spoke partners:
1- IIT Kanpur is situated in a city that has not kept pace with the development trajectory of the country. Therefore, it is important that IIT contributes to Institutions and infrastructure first and foremost in its vicinity, before moving beyond. HBTI was selected as a spoke so that IIT Kanpur would contribute to the education system of the city.
2- HBTI has 13 undergraduate disciplines in engineering, which gives ample scope to the faculty of IIT Kanpur for collaboration in its projects.
3- Also, considering that HBTI is not a CFTI, it is significant that DIC funds are utilised for promoting a culture of innovation here, than in any other institute flushed with funds. Complimenting the ongoing collaboration of IIT Kanpur faculty with HBTI is also a key factor in this decision.

About Spoke 2:
Indian Agricultural Research Institute (IARI):
The Indian Agricultural Research Institute was established in 1905 at Pusa (Bihar) with the generous grant of 30,000 pounds from an American philanthropist, Mr. Henry Phipps. It shifted to Delhi in 1936. It focuses on the development and use of a systems based approach towards crop modelling, bioindicators, nuclear tools, remote sensing and GIS to achieve greater understanding of the production systems, the resources, the environment and their sustainability and modify them to reduce the environmental and human health risks to make them more sustainable in the context of holistic ecological and socio-economic systems.

Currently, the Institute has 20 divisions 5 multi-disciplinary Centres situated in Delhi, 8 regional stations, 2 off-season nurseries, 3 All India coordinated research projects with headquarters at IARI and 10 national Centres functioning under the all India coordinated research projects. It has the sanctioned staff strength of 3540 comprising scientific, technical, administrative and supporting personnel.
The Indian Agricultural Research Institute won the Sardar Patel Outstanding ICAR Institution Award for the year 2010 (jointly with TNAU, Coimbatore) for outstanding contribution in the field of agricultural research, education and extension. It was also conferred the Environment Leadership Award of ‘Agriculture Today, 2011’ for its pioneering work on development of sustainable agriculture, protection of environment, mitigation and adaptation to climate change and environmental policy planning for the benefit of farming community.

It has been collaborating with 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), United Nations Environment Program Regional Research Centre for Asia and the Pacific (UNEP RRC.AP).

Rational for selection of Spoke partners:
1- A number of faculty in the Design Programme are working in the domain of Agricultural Technology which happens to be the key area of work at IARI. Its close physical proximity is an added advantage for facilitating this collaboration.

About Spoke 3:
Sanjay Gandhi Postgraduate Institute of Medical Sciences
Sanjay Gandhi Post Graduate Institute of Medical Sciences (SGPGIMS) is located in Lucknow, Uttar Pradesh. It was established in 1983 and is spread over 550 acres (2.2 km²) of residential campus at Raebareli Road, 15 km from the main city. The institute offers its own degrees, which are recognised by the Medical Council of India. SGPGIMS delivers tertiary medical care, super-specialty teaching, training and research. It offers DM, MCh, MD, Ph.D., postdoctoral fellowships and postdoctoral certificate courses (PDCC), and senior residency.

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.

Rational for selection of Spoke partners:
1- SGPGI offers not only medical training but also provides inexpensive medical care. This combination of theory and practice is essential for design thinking.
2- A number of faculty in the Design Programme are working in the domain of Medical Technology. Also, Health care is a selected area of innovation at DIC, IIT Kanpur. SGPGI will be a suitable fit in this area for collaboration, being a Medical institute itself.
design innovation
Operational Structure
The Hub will be hosted by the Design Programme in the Indian Institute of Technology Kanpur. As stated earlier, the Programme has the sufficient strength of faculty and students as well as infrastructure to support this Centre.

D3 will have the following administrative structure.

<table>
<thead>
<tr>
<th>Project Advisory Committee</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAC members</td>
</tr>
<tr>
<td>External experts</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>D3 Steering Committee</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spoke 1</td>
</tr>
<tr>
<td>Spoke 2</td>
</tr>
<tr>
<td>Spoke 3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Project Review Board</th>
</tr>
</thead>
<tbody>
<tr>
<td>Courses within IT</td>
</tr>
<tr>
<td>Courses for spokes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Academic Cell</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student Fellows</td>
</tr>
<tr>
<td>Senior Fellows</td>
</tr>
<tr>
<td>Innovators-In-residence</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Residency &amp; Fellowship Cell</th>
</tr>
</thead>
<tbody>
<tr>
<td>International conference</td>
</tr>
<tr>
<td>Exhibition</td>
</tr>
<tr>
<td>Academia-Industry programme</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lab-in-charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cogitation Lab</td>
</tr>
<tr>
<td>High fidelity prototyping Lab (Communication Design)</td>
</tr>
<tr>
<td>High fidelity prototyping Lab (Product Design)</td>
</tr>
<tr>
<td>D-B lab</td>
</tr>
</tbody>
</table>

**Project Review Board:** An external committee consisting of renowned experts largely from the Industry (3-4) and a few from the Academia (1-2) will review all proposals. All Project proposals of both the Hub and the Spoke, Faculty as well as Fellows will be tabled before the Review board for selection. These review meetings will also be followed by the Annual Progress Review of each project. This being an Institute level project, minutes of these reviews will be later tabled before the PAB and the BoG.

**Project Seminars:** Every Faculty and Fellow of the Hub as well as the Spoke will present a project seminar of approximately 15 minutes every six months within the DIC. In order to save time and resources Spokes may present their work through video conference or skype. These seminars will be open to the entire IIT fraternity which will encourage the exchange of ideas, gather feedback, seek further collaboration, and also encourage others to join hands in developing a culture of innovation.

**Project Website:** The project website will host the progress timelines of the innovation, their application as well as distribution through the D-B lab.
Outreach Activity

**International Conference/Workshop on Innovation:** In order to draw multifaceted skills as well as knowledge from experienced designers, two international conference/workshop with minimum ten foreign delegates will be hosted by the Hub in collaboration with the Spokes. These advanced level Conferences will be limited for people within the field, but open to innovators outside the Institute also. The proceedings of these conferences will be uploaded on an online E-journal with an ISSN number.

**National Exhibitions on Innovations:** The work completed in the projects by faculty and students of both the Hubs and the Spokes, besides the DIC Senior Fellows will be displayed in Design Innovation Exhibitions at IIT Kanpur, and if possible at New Delhi (If budget and other logistical considerations permit). Such Exhibitions will become a source for dissemination of innovation know-how to public in general. The Design Programme has experience in designing such exhibitions through its Annual Design Exposition (ADEX) as well as curatorial work for Museum displays.

**Bi-semesterly Seminars on Innovation:** Invited speakers from the Industry and the Academia will deliver a one day seminar on Design Innovation. The seminar will be a case study of developed designs, and not a theoretical approach. Two such seminars will be held every semester, open to the entire IIT community as well as the Spokes.

**Design Innovation Programme for Industry:** Industry specific workshops similar to the current OIPs or Quality Improvement Programmes will be held in the Institute or at the Industry, as mutually agreed upon. Four such courses will be held in three years. Besides, invigorating Industry-Academia contacts, this would also facilitate an exchange of Industry know-how with the academia.
TINKERING TOY
CONSTRUCTIVIST LEARNING AIDS
Deliverables

Product development
15 Designs: Developed by Hubs
10 Designs: Developed by Spokes
30 Designs: Developed by Student Fellows
12 Designs: Developed by Senior Fellows

Course Development
10 Courses: Hub Courses
12 Modules: Innovation Modules for Spokes
02 Design Innovation workshop for industry and faculty

Outreach Activities
01 International Workshop on Innovation
01 International Conference on Innovation
01 National Exhibitions on Innovations
06 Seminar: Talks by Innovators
30 Internships

Impact on Human Resources (Conservative estimate)
30 Designers, Faculty - Senior Fellows
80 Student designers
150 Students (On an average, 50 student per course)
100 Participants in seminars (On an average, 100 people per outreach activity)
30 Internships

Impact on Product Environment
16 Design Innovations in three years

It should also be noted that besides the above, the following achievements may also be accrued to some exemplary innovations

Patents
Awards
Community Development
Research Papers
### Operational Plan for Deliverables

<table>
<thead>
<tr>
<th>Deliverables</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
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</thead>
<tbody>
<tr>
<td><strong>Development of Labs</strong></td>
<td></td>
<td></td>
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<tr>
<td>Design Cognition Lab</td>
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<td></td>
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<tr>
<td>Design Prototyping Lab:</td>
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<tr>
<td>Mechanics</td>
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<tr>
<td>Electronics</td>
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<tr>
<td>Fabrication</td>
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<tr>
<td>D-B Lab</td>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>Product Development</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Developed by Hubs</td>
<td></td>
<td></td>
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<tr>
<td>15 Designs: 7/8 each in year 2 &amp; 3</td>
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<tr>
<td>Developed by Spokes</td>
<td></td>
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<tr>
<td>10 Designs: 5 each in year 2 &amp; 3</td>
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<tr>
<td>Developed by Student Fellows</td>
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<tr>
<td>30 Designs: 10 each in year 1,2 &amp; 3</td>
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<tr>
<td>Developed by Senior Fellows</td>
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<tr>
<td>12 Designs: 6 each in year 2 &amp; 3</td>
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<tr>
<td><strong>Course Development</strong></td>
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<tr>
<td>Course curriculum development</td>
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<tr>
<td>Course 1-5</td>
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<tr>
<td>Course 6-10</td>
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<tr>
<td>Courses for Spokes and Industry- 10-15</td>
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<tr>
<td><strong>Outreach Activities</strong></td>
<td></td>
<td></td>
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<tr>
<td>International Workshop/Conference</td>
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<tr>
<td>01</td>
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<tr>
<td>National Conference/Workshop 01</td>
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<td></td>
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<tr>
<td>National Exhibition 01</td>
<td></td>
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<tr>
<td>Seminars 06</td>
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<td></td>
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</tr>
<tr>
<td>Internships 30</td>
<td></td>
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</table>

39 of 74
Patents
Filing of Patents

Research papers
Submission of papers to journals
### Overview of the Hub Budget: 2015 to 2018

<table>
<thead>
<tr>
<th>Budget Head</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HUB HUMAN RESOURCE</strong></td>
<td></td>
</tr>
<tr>
<td><strong>DIC Faculty Projects (Hub)</strong></td>
<td>25,00,000 x 15 projects, 3,75,00,000</td>
</tr>
<tr>
<td><strong>DIC Students Fellows</strong></td>
<td>80,000 (upper limit) x 30 fellows, 24,00,000</td>
</tr>
<tr>
<td>DIC Students Fellows From Hub and Spokes only (Fellowship funds are available for product development only which will be released as per actual expenditure. Minimum number of fellowships are 30. The maximum will depend on the actual expense/project)</td>
<td></td>
</tr>
<tr>
<td>DIC Senior Fellows (Open call)</td>
<td>Fellowship: 30,000 x 12 months x 12 Fellows, 51,00,000</td>
</tr>
<tr>
<td>DIC Innovators in Residence (On an invitation alone)</td>
<td>1,00,000 x 6 months x 3 Innovators, 20,40,000 (18,00,000+60,000+1,80,000)</td>
</tr>
<tr>
<td><strong>HUB INFRASTRUCTURE</strong></td>
<td></td>
</tr>
<tr>
<td>Cognition Lab</td>
<td>2,50,000, 2,50,000</td>
</tr>
<tr>
<td>Resource Centre</td>
<td></td>
</tr>
<tr>
<td>User testing Lab</td>
<td></td>
</tr>
<tr>
<td>Communication Design Lab</td>
<td>2,50,000</td>
</tr>
<tr>
<td></td>
<td>3,00,000 (Consumable)</td>
</tr>
<tr>
<td>Computer, projectors and related accessories</td>
<td>8,50,000</td>
</tr>
<tr>
<td>Commum facility for all Labs to be handled by Cognition Lab</td>
<td></td>
</tr>
<tr>
<td>D-B Lab</td>
<td>2,30,000 (Travel, L&amp;B for interacting with Industry)</td>
</tr>
<tr>
<td>Design to Business Lab</td>
<td>1,00,000 (Printing of promotional material)</td>
</tr>
<tr>
<td>High Fidelity Prototyping Lab</td>
<td>18,00,000 (Electronics)</td>
</tr>
<tr>
<td>Electronics</td>
<td></td>
</tr>
<tr>
<td>Mechanics</td>
<td>23,00,000 (Mechanics)</td>
</tr>
<tr>
<td>Fabrication</td>
<td>16,00,000 (Fabrication)</td>
</tr>
<tr>
<td></td>
<td>10,00,000 (Consumables for workshop)</td>
</tr>
<tr>
<td></td>
<td>67,00,000</td>
</tr>
<tr>
<td>Budget Head</td>
<td>Amount</td>
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<tr>
<td>----------------------------------------------------------------------------</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td><strong>Manpower</strong></td>
<td></td>
</tr>
<tr>
<td>Administrative staff for D-B Lab and DIC (2)</td>
<td></td>
</tr>
<tr>
<td>Mechanics (2)</td>
<td></td>
</tr>
<tr>
<td>Electricians (2)</td>
<td></td>
</tr>
<tr>
<td>Fabricators (Wood, Composites, Plastics, Metal) (2)</td>
<td></td>
</tr>
<tr>
<td>Programmers (2)</td>
<td></td>
</tr>
<tr>
<td><strong>OUTREACH ACTIVITIES</strong></td>
<td></td>
</tr>
<tr>
<td>Running cost of IT courses (On actuals only)</td>
<td></td>
</tr>
<tr>
<td>DIC Semester Seminars</td>
<td></td>
</tr>
<tr>
<td>Travel, boarding and lodging</td>
<td></td>
</tr>
<tr>
<td>1 International Conference/ Workshop on Innovation</td>
<td></td>
</tr>
<tr>
<td>Travel, boarding and lodging and consumables (Printing etc)</td>
<td></td>
</tr>
<tr>
<td>1 National Conference/ Workshop of Innovation</td>
<td></td>
</tr>
<tr>
<td>Travel, boarding and lodging and consumables (Printing etc)</td>
<td></td>
</tr>
<tr>
<td>1 Exhibitions of Project work from Hub and Spoke</td>
<td></td>
</tr>
<tr>
<td>Design Innovation Programme for Industry and Faculty</td>
<td></td>
</tr>
<tr>
<td>(Travel, lodging and boarding on Participant)</td>
<td></td>
</tr>
<tr>
<td><strong>OPERATIONAL EXPENDITURE</strong></td>
<td></td>
</tr>
<tr>
<td>Travel</td>
<td></td>
</tr>
<tr>
<td>Hub and Spoke meetings</td>
<td></td>
</tr>
<tr>
<td>Review meetings at MHRD</td>
<td></td>
</tr>
<tr>
<td>External review panel</td>
<td></td>
</tr>
<tr>
<td>Consumables</td>
<td></td>
</tr>
<tr>
<td>Contingency</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>6,490,000</td>
</tr>
</tbody>
</table>
# Overview of the Spoke Budget: 2015 to 2018
The budget division of Spoke 1 will be applicable for Spoke 2 and 3 also.

<table>
<thead>
<tr>
<th>Budget Head</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Spoke 1</strong></td>
<td></td>
</tr>
<tr>
<td>DIC Faculty Projects (Spokes only)</td>
<td>Maximum limit of 20,00,000 for any project</td>
</tr>
<tr>
<td>(Salary, consumable, travel and contingency excluding equipment)</td>
<td>88,00,000</td>
</tr>
<tr>
<td>DIC Student Projects</td>
<td>Maximum limit of 50,000 for any project</td>
</tr>
<tr>
<td>All projects under the mentorship of faculty</td>
<td>8,00,000</td>
</tr>
<tr>
<td>Innovation Modules for Spokes (students)</td>
<td>10,000 x 2 experts x 4 workshops</td>
</tr>
<tr>
<td>(Modules to be taken by Hub for the spoke on an innovation topic of mutual benefit)</td>
<td>2,50,000</td>
</tr>
<tr>
<td></td>
<td>50,000 product development x 4 workshops</td>
</tr>
<tr>
<td>Interns for Spokes (students)</td>
<td>10,000 x 6 interns x 2 months</td>
</tr>
<tr>
<td></td>
<td>1,20,000</td>
</tr>
<tr>
<td>Total (a)</td>
<td>1,00,00,000</td>
</tr>
<tr>
<td>Total Spoke 1 (a) x 3</td>
<td>3,00,00,000</td>
</tr>
</tbody>
</table>
## Hub Budget: 2015 to 2018: Year-wise Recurring Budget

<table>
<thead>
<tr>
<th>Budget Head</th>
<th>Amount</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HUB HUMAN RESOURCE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DIC Faculty Projects (Hub)</td>
<td>25.00,000 x 15 projects (70% of 3.75,00,000)</td>
<td>2,62,50,000</td>
<td>1,22,50,000</td>
<td>1,40,00,000</td>
</tr>
<tr>
<td>DIC Students Fellows (From Hub and Spokes only)</td>
<td>80,000 x 30 fellows (Product development)</td>
<td>24,00,000</td>
<td>6,00,000</td>
<td>12,00,000</td>
</tr>
<tr>
<td>DIC Senior Fellows (Open call)</td>
<td>Fellowship: 30,000 x 12 months x 12 Fellows</td>
<td>51,00,000</td>
<td>17,00,000 (6,50,000) Fellows</td>
<td>25,50,000 (6,50,000) Fellows</td>
</tr>
<tr>
<td>DIC Innovators in Residence (On an invitation alone)</td>
<td>1,00,000 x 6 months x 3 Innovators x 3 Travel x 3 (L&amp;A)</td>
<td>20,40,000 (1,80,000+ 60,000+1,800)</td>
<td>13,50,000</td>
<td>6,50,000</td>
</tr>
</tbody>
</table>

| **HUB INFRASTRUCTURE** | | | | |
| Communication Design Lab | 3,00,000 | 3,00,000 | 1,00,000 | 1,00,000 | 1,00,000 |
| D-B Lab Design to Business Lab | 2,00,000 (Travel, L&B for interacting with Industry) | 3,00,000 | 50,000 | 1,50,000 | 1,00,000 |
| High Fidelity Prototyping Lab Electronics Mechanics Fabrication | 10,00,000 (Consumable for workshop) | 10,00,000 | 3,00,000 | 3,00,000 | 3,00,000 |
| Manpower | 30,000 x 36 x 2 | 90,00,000 | 30,00,000 | 30,00,000 | 30,00,000 |
| | 25,000 x 36 x 6 | (21,60,000) | | | |
| | 20,000 x 36 x 2 | (64,00,000) | 14,40,000 | |

<p>| <strong>OUTREACH ACTIVITIES</strong> | | | | |
| Running costs of IIT courses (on actuals only) | 1,00,000 | 1,00,000 | 25,000 | 37,500 | 37,500 |</p>
<table>
<thead>
<tr>
<th>Budget Head</th>
<th>Amount</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIC Semester Seminars</td>
<td></td>
<td></td>
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<tr>
<td>Travel, boarding and lodging</td>
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<tr>
<td>1 International Conference/Workshop on Innovation</td>
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<tr>
<td>05 foreign invitees x</td>
<td>8,00,000</td>
<td></td>
<td></td>
<td>8,00,000</td>
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<tr>
<td>1,00,000 (Travel + L&amp;B)</td>
<td>1,00,000+</td>
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<td></td>
<td></td>
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<tr>
<td>05 National invitees x</td>
<td>2,00,000</td>
<td></td>
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</tr>
<tr>
<td>20,000 (Travel + L&amp;B)</td>
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<tr>
<td>(Consumable)</td>
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<tr>
<td>1 National Conference/Workshop of Innovation</td>
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<tr>
<td>15 National invitees x</td>
<td>5,00,000</td>
<td></td>
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<td>5,00,000</td>
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<tr>
<td>20,000 (Travel + L&amp;B)</td>
<td>3,00,000+</td>
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<tr>
<td>2,00,000 (Consumable)</td>
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<tr>
<td>1 Exhibition of Project work from Hub and Spoke</td>
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<tr>
<td>2,50,000 Display</td>
<td>8,50,000</td>
<td></td>
<td></td>
<td>8,50,000</td>
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<tr>
<td>1,50,000 Travel</td>
<td></td>
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<tr>
<td>4,00,000 Printing</td>
<td></td>
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<tr>
<td>50,000 Contingency</td>
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<tr>
<td>Design Innovation Programme for Industry and Faculty</td>
<td>2,00,000</td>
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<td></td>
<td>1,00,000</td>
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<tr>
<td>(Travel, lodging and boarding on Participant)</td>
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<tr>
<td>1,00,000 x 2 courses</td>
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<tr>
<td>(consumables for prototype development)</td>
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<tr>
<td>OPERATIONAL EXPENDITURE</td>
<td></td>
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<tr>
<td>Travel</td>
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</tr>
<tr>
<td>Hub and Spoke meetings</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>20,000 x 6 spoke Pls x</td>
<td>6,60,000</td>
<td>2,20,000</td>
<td>2,20,000</td>
<td>2,20,000</td>
</tr>
<tr>
<td>x 3 meetings</td>
<td>(3,60,000 +</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,00,000 x 2 Hub Pls x</td>
<td>60,000+</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>3 meetings</td>
<td>2,40,000</td>
<td></td>
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<tr>
<td>20,000 x 4 experts x</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>3 meetings</td>
<td></td>
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<tr>
<td>Review meetings at MHRD</td>
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<tr>
<td>External review panel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3,000 x 3 years</td>
<td>9,00,000</td>
<td>3,00,000</td>
<td>3,00,000</td>
<td>3,00,000</td>
</tr>
<tr>
<td>Consumables</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3,000 x 3 years</td>
<td>9,00,000</td>
<td>3,00,000</td>
<td>3,00,000</td>
<td>3,00,000</td>
</tr>
<tr>
<td>Contingency</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>5,16,00,000</td>
<td>1,80,45,000</td>
<td>2,43,17,500</td>
<td>83,37,500</td>
</tr>
</tbody>
</table>
### Hub Budget: 2015 to 2018: Year-wise Non-Recurring Budget

<table>
<thead>
<tr>
<th>Budget Head</th>
<th>Amount</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HUB HUMAN RESOURCE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DIC Faculty Projects (Hub)</td>
<td>25,00,000 x 15</td>
<td>1,12,50,000</td>
<td>52,50,000</td>
<td>60,00,000</td>
</tr>
<tr>
<td>(30% of 3,75,00,000)</td>
<td></td>
<td>7 projects</td>
<td>8 projects</td>
<td></td>
</tr>
<tr>
<td><strong>HUB INFRASTRUCTURE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cognition Lab</td>
<td>2,50,000</td>
<td>2,50,000</td>
<td>2,00,000</td>
<td>50,000</td>
</tr>
<tr>
<td>Resource Centre</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>User testing Lab</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communication Design Lab</td>
<td>2,50,000</td>
<td>2,50,000</td>
<td>2,00,000</td>
<td>50,000</td>
</tr>
<tr>
<td>Computer, projectors and related accessories</td>
<td>8,50,000</td>
<td>8,50,000</td>
<td>5,95,000</td>
<td>2,35,000</td>
</tr>
<tr>
<td>High Fidelity Prototyping Lab</td>
<td>18,00,000</td>
<td>57,00,000</td>
<td>34,20,000</td>
<td>22,80,000</td>
</tr>
<tr>
<td>(Electronics)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electronics</td>
<td>23,00,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mechanics</td>
<td>16,00,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fabrication</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>43,50,000</td>
<td>95,05,000</td>
<td>68,35,000</td>
<td>35,05,000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12,50,000</td>
<td>52,50,000</td>
<td>60,00,000</td>
</tr>
<tr>
<td>2</td>
<td>2,50,000</td>
<td>2,00,000</td>
<td>50,000</td>
</tr>
<tr>
<td>3</td>
<td>8,50,000</td>
<td>5,95,000</td>
<td>2,35,000</td>
</tr>
<tr>
<td>4</td>
<td>18,00,000</td>
<td>34,20,000</td>
<td>22,80,000</td>
</tr>
<tr>
<td>5</td>
<td>23,00,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>16,00,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Spoke Budget: 2015 to 2018: Year-wise Recurring Budget

<table>
<thead>
<tr>
<th>Budget Head (Spokes)</th>
<th>Amount</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Spoke 1</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DIC Faculty Projects (Spokes only)</td>
<td>Maximum limit of 20,00,000 for any project</td>
<td>44,00,000</td>
<td>17,60,000</td>
<td>26,40,000</td>
</tr>
<tr>
<td>(Salary, consumable, travel and contingency including equipment)</td>
<td>All projects above 10,00,000 will be in collaboration with the Hub. (50% of 88,00,000 is recurring)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DIC Student Projects</td>
<td>Maximum limit of 50,000 for any project</td>
<td>8,00,000</td>
<td>3,20,000</td>
<td>4,80,000</td>
</tr>
<tr>
<td>All projects under the mentorship of faculty</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Innovation Modules for Spokes (students)</td>
<td>10,000 x 2 experts x 4 workshops</td>
<td>2,40,000</td>
<td>1,40,000</td>
<td>1,40,000</td>
</tr>
<tr>
<td>(Modules to be taken by Hub for the spoke on an innovation topic of mutual benefit)</td>
<td>(80,000 + 20,000)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interns for Spokes (students)</td>
<td>10,000 x 6 interns x 2 months</td>
<td>1,20,000</td>
<td>48,000</td>
<td>72,000</td>
</tr>
<tr>
<td>Total (a)</td>
<td>56,00,000</td>
<td>21,28,000</td>
<td>33,32,000</td>
<td>44,00,000</td>
</tr>
<tr>
<td>Total Spoke 1 (a) x 3</td>
<td>1,68,00,000</td>
<td>63,84,000</td>
<td>99,96,000</td>
<td>1,32,0,000</td>
</tr>
</tbody>
</table>
## Spoke Budget: 2015 to 2018: Year-wise Non-Recurring Budget

<table>
<thead>
<tr>
<th>Budget Head (Spokes)</th>
<th>Amount</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Spoke 1</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DIC Faculty Projects (Spokes only)</td>
<td>Maximum limit of 20,00,000 for any project</td>
<td>44,00,000</td>
<td>17,60,000</td>
<td>26,40,000</td>
</tr>
<tr>
<td></td>
<td>All projects above 10,00,000 will be in collaboration with the Hub. (50% of 88,00,000 is non-recurring)</td>
<td>44,00,000</td>
<td>17,60,000</td>
<td>26,40,000</td>
</tr>
<tr>
<td><strong>Total (a)</strong></td>
<td>44,00,000</td>
<td>17,60,000</td>
<td>26,40,000</td>
<td></td>
</tr>
<tr>
<td><strong>Total Spoke 1 (a) x 3</strong></td>
<td>132,00,000</td>
<td>52,80,000</td>
<td>79,20,000</td>
<td></td>
</tr>
</tbody>
</table>
Plan for Sustainability of the Centre

**Academic viability of the innovation content:** All courses developed for IIT Kanpur students-B.Tech/M.Des/MBA/M.Tech will remain a part of the Course of studies irrespective of the timeline of the MHRD funding. These courses will be a permanent addition of the innovation pedagogy in the IIT Kanpur curriculum and will be taught regularly by the faculty during the semesters.

**Industry Sponsored Projects and Consultancy Services:** The brand of DIC as well as IIT Kanpur will be leveraged to gain consultancy assignments from the industry on design innovation and its allied areas. These consultancies are short term and focused on Industry driven needs and targets. In the past, faculty of Design Programme have successfully completed many such assignments for the industry. With the D-B Lab in place, we are hopeful that such interactions will only increase further.

**Startups:** Many entrepreneurial ventures in the market are in dire need of design intervention, but are unable to access the same in a customised and affordable package. Such budding ventures typically have low funds, but if DIC positions itself for mentorship on targeted specific areas it can still make a profitable use of its time and effort. Strategically, it is an unexplored market.

**Company Strategic Consulting:** The D3 brand must be orchestrated to command large industry projects as prime funding opportunities. The D-B lab will be able to pitch the strengths of D3 to the industry and procure projects for consultation.

**Design Innovation Programmes for Industry:** DIPs for industry will be appropriately charged. These short modules as discussed before could be of theoretical or practice based, as per the requirement. The Faculty members can conduct them either on-site at the Industry or arrange for the same in the Institute premises. These programmes will not only add to the funding requirements of the D3 but also enhance its relations with the industry.

On a more adventurous level, if D3 is successful even business models like crowd sourcing for community driven projects can be explored.
Annexure

- Consent letters of Spokes
- Patents, Awards and Recognitions - Faculty
- Awards and Recognition - Students
- Student Placements
Dr. S. Srivastava
Scientist-IV

To,

Dr. Nachiketa Tirana
Associate Professor
Indian Institute of Technology (IIT)
Kanpur 208 016

Madam,

Kindly refer to your e-mail letter dated: 29th August, 2015, regarding the invitation to the Institute as a participating Institute for the setup of Design Innovation Centre (DIC) at IIT, Kanpur.

I would like to inform you that the Institute in-principle accepted for its participation in the proposed Design Innovation Centre (DIC) a project of MHRD which includes for projects as well designing courses as mentioned by you.

You are requested to kindly send us the documents of the above activities in due course of time, as soon as they are finalized by your Institution.

This is issued with the approval of the Director, SGPGI.

Yours sincerely,

(DR. S. SRIVASTAVA)
SCIENTIST-IV

PGDIR/RC/956/2015
Dated: 31.8.2015
Ref No. 40/DB Ext/2015

From,
The Director

To,
Dr. Koumudi Patil
Department of Humanities and Social Sciences
Design Programme
Indian Institute of Technology,
Kanpur (U.P.), India

Sub.: Participation as a Spoke in DIC, IIT, Kanpur

Dear Prof. Patil,

With reference to your e-mail message dated 15th of May, 2013 regarding invitation as participating Institute for the setup of Design Innovation Center (DIC). In this connection it is to inform you that this Institute has no objection to become as Spoke partner of Design Innovation Centre (DIC) opening at your Institute.

On behalf of the Institute I am glad to accept your above mentioned proposal.

Thanking you,

Yours sincerely

(A.K. Nagpal)
Director
Dear Prof. Manna,

I have pleasure in declaring our intent to agree to become a ‘Spoke Partner’ of Indian Institute of Technology, Kanpur to engage in (1) Development of tools and technologies for agriculture and (2) Courses on Design innovation for students for developing technologies under research project mode.

I would like to introduce Dr. Indra Mani Mishra, Head of Agricultural Engineering Division, ICAR-IARI for dealing with ‘Development of tools and technologies for agriculture’ and Professor of Agricultural Engineering Division, ICAR-IARI for ‘Course on Design innovation for students for developing technologies’ as the Nodal Officers to initiate the required information from our side to join under Spoke mode.

With regards,

Yours sincerely

Prof. Indranil Manna
Director
Indian Institute of Technology Kanpur
Kanpur – 208016, UP

(K.V. Prabhu)
Patents, Awards and Recognitions - Faculty

Prof. Bishakh Bhattacharya

1. Patent
   Patent number: GB2365376
   National / International: National
   Nature of Innovation: A Novel Non-contact damping technique using magnetostrictive particulate Coatings
   Images if any:

2. Patent
   Patent number: 4688439
   Nature of Innovation: Vibration damping system and a method of damping vibrations

VIBRATION DAMPING SYSTEM AND A METHOD OF DAMPING VIBRATIONS

PATAEN NUMBER: US 6,688,439 B2

INVENTORS: Bishakh Bhattacharya, Colombo (HI), James Rangoni, Stockport (GB), Geoffrey R. Tomlinson, Stockport (GB)

BRIEF DESCRIPTION: A vibration damping system (8) wherein the system (8) comprises a magnetism generating medium (12) and a magnetism energy dissipating medium (15). Whereby, in use, vibration of the magnetism generating medium (12) generates a magnetic field, the magnetism generating medium (12) and the magnetism energy dissipating medium (15) being so disposed with respect to each other that the magnetic field is then dissipated by the magnetism energy dissipating medium (15) thereby damping the vibrations of the magnetism generating medium (12).

3. Patent
   National / International: National
   Nature of Innovation: A modular robotic system
   Images if any

4. Patent
   Patent number: IN. 232707, 2012
   National / International: National
   Nature of Innovation: A green harvesting device for low power electronic equipment
   Images if any

5. Patent
   Patent number: IN-811469, 2012
   National / International: National
   Nature of Innovation: A new semi-autonomous drug infusion system using smart material
   Images if any

54 of 74
A green harvesting device for low power electronic equipment

PATENT NUMBER: 232707

INVENTORS: Dr. Sishakh Bhattacharya (ME) and Mr. Atul R. Sultana (DP).

BRIEF DESCRIPTION: This invention relates to designing of a device which can charge a broad range of low power electronic devices. This includes devices like mobile phones, iPods, cameras etc which can be powered when a person is away from conventional source of electricity while travelling on adventure outings, outdoor camping etc. The same system could also be used for defence applications, for soldiers when they are away from the source of conventional power.

Fu-Smart (A Remote Health Monitoring and Control Unit)

PATENT NUMBER

INVENTORS: RAJESH RANJAN, BASAVA KUMAR M, DR. BISHAKH BHATTACHARYA (Professor).

BRIEF DESCRIPTION: The interface of enabling technology with advanced product design has shown radical development in the field of intelligent sensor embedded system design. Numerous applications are envisaged exploiting this interconnectivity, particularly in the field of biomedical applications. A need, for example, that is of growing demand is in the field of remote health monitoring and control of critically ill patients, with the help of networked sensors. The continuous monitoring of the health of a patient in a hospital, information fusion from multiple sensors data as well as broadcasting the recorded data on a network for the ease of access to the clinician and implementing the decisions of clinicians through automated drug delivery units could save millions of precious lives in a country and linked medical experts. The availability of monitoring and control features on I-Pad, smart phones etc. will provide ease of access to the doctors and also help in immediate treatment of patients in the critical care unit. In what follows is a brief detailed description of such a system that is proposed to develop.
Awards and Recognition

Prof. Bishakh Bhattacharya (contd.)

1. Awards
   Name of the award: Academic Representative
   Nature of the achievement: Mentor Council of DGET, Industrial Automation & Instrumentation
   Year: 2014

2. Awards
   Name of the award: Empanelled Eminent Expert
   Nature of the achievement: National Manufacturing Competitiveness Program
   Year: 2013

3. Awards
   Name of the award: UKIERI award
   Nature of the achievement: UK India Research Initiative Council
   Year: 2012-2014

4. Awards
   Name of the award: DST-UKIERI award
   Nature of the achievement: DST and UK India Research Initiative Council
   Year: 2009-2011

5. Awards
   Name of the award: Young Scientist's award
   Nature of the achievement: The Systems Society of India
   Year: 2006

6. Awards
   Name of the award: Nominated Special member in the Senate
   Nature of the achievement: IIT-Kanpur
   Year: 2003-2005

7. Awards
   Name of the award: Selected Technical Committee
   Nature of the achievement: Technical Committee of IASTED, World Modeling and Simulation Forum (WMSF)
   Year: 2002-2005

8. Awards
   Name of the award: Young Scientist Award
   Nature of the achievement: Department of Science and Technology, India
   Year: 2001

9. Awards
   Name of the award: Recipient of Best Thesis Award
   Nature of the achievement: Department of Aerospace Engineering
Year: 1998

10. Awards
   Name of the award: Senate Commendation for excellent teaching
   Nature of the achievement: in the courses: Principles of Vibration Control and Design Practice

Year:

11. Student Mentor in Design Program for the following National Awards:
    Name of the award: 2nd Runners up
    Nature of the achievement: Nokia Bhasha 2011 - Rahul, Madhavan, Meenakshi, Aravind, Nishant
    Year: 2011

Name of the award: 1st Prize
Nature of the achievement: Design Challenge-08, Yahoo R&D, Bangalore for designing of a transportation system for the differently able people
Year: 2008

Name of the award: Display Selection
Nature of the achievement: Auto Expo 2008
Year: 2008

Name of the award: 1st Prize
Nature of the achievement: Design Challenge-09 IISc, Bangalore for designing a sustainable mobile phone
Year: 2009

Prof. Braj Bhushan

Awards and Recognition

1. Awards
   Name of the award: Abstract Award
   Nature of the achievement: International Association for Suicide Prevention, 3rd Asia Pacific Regional Conference of IASP, Hong Kong.
   Year: 2008

2. Awards
   Name of the award: Man of The Year Award
   Nature of the achievement: American Biographical Institute, North Carolina
   Year: 2005

3. Awards
   Name of the award: In Search of Excellence' Award
   Nature of the achievement: IAAP and NADP-I
   Year: 2004
4. Awards
   Name of the award: Young Scientist Award
   Nature of the achievement: Indian Science Congress Association
   Year: 2002

5. Awards
   Name of the award: B.H.U. Merit and Prize Award
   Nature of the achievement: Banaras Hindu University
   Year: 1991

6. Awards
   Name of the award: Best Announcer Award
   Nature of the achievement: National Youth Week, Banaras Hindu University
   Year: 1993

Prof. Koumudi Patil

1. Patent
   Patent number: 1481/DEL/2013
   National/International: National
   Nature of innovation: Meenakshi Singh and Koumudi Patil
   Images if any: Two way Volume Adjustable Load Bearing Foldable Unit in Pliable Material for making Furniture

Awards and Recognition

2. Best Research award for doctoral work at the World Congress, 2014, Braga, Portugal organized by the International Toy Research Association
3. Fellow of Arts Network Asia, Singapore for 2008-2009
4. Six month Art and Design Residency awarded by Kanoria Center of Arts, Centre for Environment Planning and Technology, Ahmedabad.

Prof. Jayanta Chatterjee
Awards and Recognition (faculty)

1. Awards
   Name of the award: Best Graduate Gold Medal
   Nature of the achievement: Jadavpur University
   Year: 2008-2009

2. Awards
   Name of the award: Best Manager of the Year
   Nature of the achievement: Delhi Management Association, AIMA

3. Awards
   Name of the award: Member, Research Advisory Board
   Nature of the achievement: NISTADS, CSIR, New Delhi

58 of 74
4. Awards
   Name of the award: Member, Academic Advisory Board

5. Awards
   Name of the award: Visiting Professor & Member, Faculty Selection Committee

   Nature of the achievement: Aalto University, Finland.

6. Awards
   Name of the award: Visiting Professor

   Nature of the achievement: Asian Institute of Technology, Bangkok, Thailand

7. Awards
   Name of the award: Member, Board of Directors

   Nature of the achievement: Larsen & Toubro, EAIC

8. Awards
   Name of the award: Many commendations from IITK senate for teaching excellence

   Prof. Mainak Das

   1. Patent
      Patent number: US 8,815,584 B1
      Nature of Innovation: Methods of co-culturing mammalian muscles cells and motoneurons

   Prof. Deepu Philip

   Awards and Recognition (faculty)

   1. Awards
      Name of the award: Most promising paper award


      Year: 2011

   2. Awards
      Name of the award: Innovation Awards

      Nature of the achievement: Embedded and Critical Systems award winners (From: Innovation Awards, 22 November 2012, London - for TrackSafe: Decision Support System to Enhance Safety of Railway Track Workers - part of Bombardier Transportation project jointly funded by ISTP Canada, Bombardier, and GITA India. (with Prof. Loutfy, R., Mr. Sood, P., Prof. Phani, B.V.)

      Year: 2012

   3. Awards
      Name of the award: Class of 1970 research fellowship

      Nature of the achievement: IIT Kanpur

      Year: For three years (from June 2013)

   4. Awards
      Name of the award: Honorary lifetime member of Alpha-Pi-Mu

      Nature of the achievement: Industrial Engineering honor society
Year:

5. Awards
   Name of the award: Commendation for teaching from Chairman Senate
   Nature of the achievement: IIT Kanpur
   Year: 2010
   Prof. Shantanu Bhattacharya

   1. Patent
      Patent number: 772/DEL/2015@8223
      National/ International: National
      Eshan, Mainak Das, Shantanu Bhattacharya.

   1. Patent
      Patent number: (missing)
      National/ International: National
      Nature of Innovation: "Design and development of a simplistic dental chair for Rural India"
      Amit Kundal, Mohit Tewari, Shiva Kumar, Himanshu Gupta, Shantanu Bhattacharya.

   3. Patent
      Patent number: (missing)
      National/ International: National
      Nature of Innovation: "Design and development of a workspace for group study"
      Ankit Belchanda, Apoorva Aggarwal, Ritu Panchal, Shantanu Bhattacharya.

   4. Patent
      Patent number: (missing)
      National/ International: National
      Nature of Innovation: A novel 3-D soft lithography technique to formulate micro-channels in polymers

   5. Patent
      Patent number: (missing)
      National/ International: National
      Nature of Innovation: Integrated dielectrophoresis based rapid concentration of pathogenic bacteria
      and their quantitation using Fluorescence techniques.

   6. Patent
      Patent number: 8066831
      National/ International: International
      Nature of Innovation: Shock wave and power generation using onchip nanoenergetic materials.

   7. Patent
      Patent number: (missing)
      Nature of Innovation: Agerose nanoplatinum composites.

   8. Patent
      Patent number: (missing)
      National/ International: International

   9. Patent
      Patent number: (missing)
      National/ International: International
      Nature of Innovation: Thin-film heater for initiating self-propagating thermite reactions with a 3 V
Awards and Recognition

1. Awards
   Name of the award: Best Mechanical engineering design award
   Nature of the achievement: NDRF (National Design Research Forum), IEI
   Year: 2014

2. Awards
   Name of the award: Young Scientist award
   Nature of the achievement: Institute of Smart Structures and Systems
   Year: 2013

3. Awards
   Name of the award: Associate Editor
   Nature of the achievement: The nanotechnology and nanoscience
   Year: 2011

4. Awards
   Name of the award: Editorial board member of the journal
   Nature of the achievement: New Trends in Mechanical Engineering
   Year: 2013

5. Awards
   Name of the award: Honorary Fellow
   Nature of the achievement: Institute of High Energetic Materials in Melbourne
   Year: 2011

6. Awards
   Name of the award: Young Engineers Award
   Nature of the achievement: IEI, in Mechanical Engineering
   Year: 2009-2010

7. Awards
   Name of the award: Boeing Outstanding Leadership certificate
   Nature of the achievement: Boeing Corp. USA
   Year: 2009-2010

8. Awards
   Name of the award: Selected in Chancellor's list
   Nature of the achievement:
   Year: 2005-2006 and 2003-2004

9. Awards
   Name of the award: Huggins Graduate Fellowship award
   Nature of the achievement: University of Missouri at Columbia
   Year: From 2004-2006
10. Awards
Name of the award: Won 3rd place in the college wide research creative activities competition
Nature of the achievement: University of Missouri at Columbia
Year: 2006

11. Awards
Name of the award: Won 2nd place in the research poster contest. Won a mini research grant of $500
Nature of the achievement: Lifesciences week 2004 at MU

12. Awards
Name of the award: Nominated for the best graduate student award
Nature of the achievement:
Year: 2005

13. Awards
Name of the award: Nominated for the best student entrepreneur award
Nature of the achievement:
Year: 2006

14. Awards
Name of the award: Won a IEEE certificate of recognition for an invited talk
Nature of the achievement: IIT (KGP)
Year: 2003

15. Awards
Name of the award: Won a certificate of recognition
Nature of the achievement: For organizing the Entrepreneurship Motivation Program, Faculty of Technology at the University of Delhi

16. Awards
Name of the award: Won a Gold medal and a certificate of merit
Nature of the achievement: National Science Aptitude test held by the national science teachers association in the year
Year: 1989

17. Awards
Name of the award: Won prizes
Nature of the achievement: National Olympiad Mathematics Contest

Ishan Sharma
Awards and Recognition (faculty)

1. Awards
Name of the award: INAE Young Engineer Award
2. Awards
   Name of the award: McMullen Fellowship, Cornell University
   Year: 1999

Prof. J. Ramkumar

1. Patent
   Patent number:
   National/International:
   Nature of Innovation: Microwave Post Sintering of WC Drills 2001

2. Patent
   Patent number:
   National/International:
   Nature of Innovation: New media for AFM machining 2005

3. Patent
   Patent number:
   National/International:
   Nature of Innovation: Joining of Dissimilar Pipes through adhesive joining 2007

4. Patent
   Patent number:
   National/International:
   Nature of Innovation: Magnetic Float Levitative Finishing 2007

5. Patent
   Patent number:
   National/International:
   Nature of Innovation: A novel viscoelastic media used for a nano-finishing of materials through abrasive flow machining process and method of manufacture thereof 2007

6. Patent
   Patent number:
   National/International:
   Nature of Innovation: Fabrication of Jute fiber sandwich composites 2008

7. Patent
   Patent number:
   National/International:
   Nature of Innovation: A device for magnetic abrasive finishing of a workpiece and magnetic abrasive finishing process 2008

8. Patent
   Patent number:
   National/International:
   Nature of Innovation: Rotatory abrasive flow finishing process for finishing and texturing of internal and external surfaces of hard and composite materials and an apparatus therefore 2009

9. Patent
   Patent number:
   National/International:
   Nature of Innovation: A Multipurpose transporter with modular configuration 2010
10. Patent
   Patent number:
   National / International:
   Nature of Innovation: Modular transporter for material handling and personalized ridding
   2010

11. Patent
   Patent number:
   National / International:
   Nature of Innovation: The Drift-Battery Operated Campus Vehicle
   2011

12. Patent
   Patent number:
   National / International:
   Nature of Innovation: A Self Propelled Stair Climbing Wheel Chair
   2011

13. Patent
   Patent number:
   National / International:
   Nature of Innovation: Stair Climbing Wheel Chair
   2011

Awards and Recognition

1. Awards
   Name of the award: Best outing B.E(Prod) student
   Nature of the achievement: R E C Trichy
   Year: 1996

2. Awards
   Name of the award: Gold medalist
   Nature of the achievement: M. Tech, IIT Madras
   Year: 2000

3. Awards
   Name of the award: Dr. S. Vaidyanathan Memorial Award
   Year: 2000

4. Awards
   Name of the award: Innovation Potential of Student Projects Awards
   Nature of the achievement: Indian National Academy of Engineering (INAE)
   Year: 2004

5. Awards
   Name of the award: Fast Track DST Young Scientist Award
   Nature of the achievement: Dpt. of Science & Technology
   Year: 2004

6. Awards
   Name of the award: Young Scientist Award
   Nature of the achievement: Engineering Science Division - Indian Science Congress Association
   Year: 2007
7. Awards
   Name of the award: Young Scientist Award
   Nature of the achievement: Dept. of Atomic Energy, India
   Year: 2007

8. Awards
   Name of the award: Rajkumar Varshney Awards
   Nature of the achievement: System Society of India
   Year: 2010

9. Awards
   Name of the award: IEL Young Engineers Award
   Nature of the achievement:
   Year: 2011

10. Awards
    Name of the award: Class of 1984 fellowship award
    Nature of the achievement: From 2012-2015
    Year: 2011

11. Awards
    Name of the award: Prestigious Japanese Fellowship Monbusho
    Year: 2001

12. Awards
    Name of the award: Short-Term Fellowship
    Nature of the achievement: JSPS
    Year: 2005

13. Awards
    Name of the award: Short-Term Fellowship
    Nature of the achievement: National University of Singapore
    Year: 2007

14. Awards
    Name of the award: Boyscast Fellowship
    Nature of the achievement: Dept. of Science & Technology, India
    Year: 2008

Prof. Vimal Kumar

Awards and Recognition

1. Awards
   Name of the award: Social Science Merit Fellowship
   Nature of the achievement: University of California, Irvine, California USA
   Year: 2003-08

2. Awards
   Name of the award: Social Science Summer Fellowship
Nature of the achievement: University of California, Irvine, California USA

3. Awards
Name of the award: Institute of Mathematical Behavioral Science
Nature of the achievement: University of California, Irvine, California USA
Year: 2004, 2007

4. Awards
Name of the award: Center for the Study of Democracy Research Grant
Nature of the achievement: University of California, Irvine, California USA
Year: 2005

5. Awards
Name of the award: CGPACS-Graduate Student Grant
Nature of the achievement: University of California, Irvine, California USA
Year: 2007-2008

6. Awards
Name of the award: 3rd Place in All India School Quiz
Nature of the achievement: Public School Association of India
Year: 1993-94

7. Awards
Name of the award: Recipient of the National Talent Search Examination (NTSE) Scholarship
Nature of the achievement: India
Year: 1995

Munmun Jha

Awards and Recognition (faculty)

1. Awards
Name of the award: Charles Wallace Fellowship in Social Anthropology, Queen
Nature of the achievement: University, Belfast, UK
Year: 2009

2. Awards
Name of the award: Visiting Professor
Nature of the achievement: Institut Orientaliste, Universite Catholique de Louvain, Belgium
Year: 2000

3. Awards
Name of the award: The Human Rights Millennium Award
Nature of the achievement: Indian Institute of Human Rights, New Delhi
Year: 2000

4. Awards
Name of the award: Commonwealth Scholarship
Nature of the achievement: University of Glasgow, UK

Year: 1992-1995

5. Awards
   Name of the award: Several commendation letters from the Senate for excellence in teaching.

Prof. Niraj Sinha

Awards and Recognition

1. Awards
   Name of the award: NSERC Postdoctoral Fellowship

Nature of the achievement: NSERC stands for Natural Sciences and Engineering Research Council of Canada

Year: 2008 - 2010

2. Awards
   Name of the award: Nominated for NSERC Doctoral Prize

Nature of the achievement: Faculty of Engineering, University of Waterloo

Year: 2008

3. Awards
   Name of the award: NSERC Alexander Graham Bell Canada Graduate Scholarship

Year: 2006-2008

4. Awards
   Name of the award: University of Waterloo President's Graduate Scholarship (Awarded 9 times during Ph.D.)

Nature of the achievement: University of Waterloo Graduate Scholarship

Year: 2006-2008

Prof. Nachiketa Tiwari

Awards and Recognition

1. Awards
   Name of the award: CCMS fellowship at Virginia Tech for three continuous years.
Awards and Recognitions (Students)

Name of the Student: Prantik Banerjee, Meera Mangrukar, Jayesh Pillai
Name of Award – RGB short film festival, NID
Nature of achievement – Winner
Year – 2007

Name of the Student: Yogesh G Maralkar, Alok Agashe, Payal Chowdhury
Name of Award – RGB, NID, Design of Waste Disposal System
Nature of achievement – Winner
Year – 2007

Name of the Student: Umang Shah
Name of Award – Autofest, NIT Surat
Nature of achievement – Winner
Year – 2007

Name of the Student: Stuti Shalini Gurna
Name of Award – UMO Boycott Bad Design Contest
Nature of achievement – Winner
Year – 2008

Name of the Student: Umang Shah
Name of award – RE-Kriti, DAIICT
Nature of achievement – Winner
Year – 2008
Name of the Student: Prantik Banerjee and Payal Chowdhury
Name of award – Design of Transit System, Pune Festival
Nature of achievement – 2nd Prize
Year – 2008
Name of the Student: Neha Kiran Singh
Name of award – WUD
Nature of achievement – 2nd Prize
Year – 2008
Name of the Student: Himanshu Agarwal
Name of award – Forum NOKIA, USID Challenge
Nature of achievement – 2nd Prize
Year – 2008
Name of the Student: NA
Name of award – Design Challenge, Yahoo R&D, Transportation system for differently abled people
Nature of achievement – 2nd, Runner’s Up
Year – 2008
Name of the Student: NA
Name of award – Design Challenge, Yahoo R&D, Transportation system for differently abled people
Nature of achievement – 1st Prize
Year – 2008
Name of the Student: Umang Shah
Name of award – Nokia USID International Design Challenge
Nature of achievement – 3rd Prize
Year – 2009
Name of the Student: Umang Shah
Name of award – National Design Challenge
Nature of achievement – 2nd Prize
Year – 2009
Name of the Student: Alap Shah
Name of award – UMO Boycott Bad Design
Nature of achievement – 1st Prize
Year – 2009
Name of the Student: Umang Shah
Name of award – USID NOKIA Challenge
Nature of achievement – 3rd Prize
Year – 2009
Name of the Student: Umang Shah
Name of award – Design Challenge, IISc Bangalore
Nature of achievement – 1st Prize
Year – 2009
Name of the Student: Prithu Paul, Ankit Kumar
69 of 74
Name of award - Electrolux Design Contest
Nature of achievement - Finalist
Year - 2009

Name of the Student: Atul Sultane, Kiran Bajpe
Name of award - Escorts Tractor of 2020 Design contest, CAD modelling
Nature of achievement - 2nd Prize
Year - 2009

Name of the Student: Satish Shekhar
Name of award - Escorts Tractor of 2020 Design contest, CAD modelling
Nature of achievement - 1st Prize
Year - 2009

Name of the Student: Siddharth Bathala
Name of award - UNICEF Worldwide Video contest
Nature of achievement - Finalist
Year - 2009

Name of the Student: NA
Name of award - Design Challenge, IISC Bangalore
Nature of achievement - 1st prize
Year - 2009

Name of the Student: Atul Sultane
Name of award - Solid works Design Competition for Power Pro
Nature of achievement - 1st Prize
Year - 2010

Name of the Student: Himesh Singh
Name of award - USID Gurukul Bad Design Contest
Nature of achievement - 1st Prize
Year - 2010

Name of the Student: Vikas
Name of award - USID Gurukul Bad Design Contest
Nature of achievement - 2nd Prize
Year - 2010

Name of the Student: Madhavan
Name of award - USID Gurukul Bad Design Contest
Nature of achievement - 2nd Prize
Year - 2010

Name of the Student: Satish Shekhar
Name of award - ICSIR Robot Design
Nature of achievement - Finalist
Year - 2010

Name of the Student: Rahul, Nishant
Name of award - SAE Design Challenge
Nature of achievement - 1st Prize
Year - 2010

Name of the Student: Rahul, Madhavan, Meenakshi, Aravind, Nishant
Name of award - Nokia Bhasha
Nature of achievement - 2nd Runners Up  
Year - 2011

Name of the Student: Vivek, Richa, Nutan, Abitosh  
Name of award – Nokia Bhasha  
Nature of achievement – Best Developer Award  
Year - 2011

Name of the Student: Prasoon Kumar and Vikas Chopra  
Name of award – Packinnova  
Nature of achievement – 2nd Prize  
Year - 2011

Name of the Student: Rahul, Saptarshi, Mayukh, Paritosh  
Name of award – Packinnova  
Nature of achievement – 1st Prize  
Year - 2011

Name of the Student: Jivtesh, Ekta, Priyanka, Himesh  
Name of award – Samsung Splash India on TV  
Nature of achievement – Runners up  
Year - 2011

Name of the Student: Jivtesh, Ekta, Priyanka, Himesh  
Name of award – Samsung Splash India on TV  
Nature of achievement – Runners up  
Year - 2011

Name of the Student: Bidisha, Paritosh, Praveen, Saptarsh  
Name of award – Samsung Splash India on TV  
Nature of achievement – 1st Prize  
Year - 2011

Name of the Student: Himesh Singh  
Name of award – TRAI All India Logo Design Competition  
Nature of achievement – Winner  
Year - 2011

Name of the Student: Shanu Sharma  
Name of the Award – Gandhian Young Technological Innovation Award  
Nature of achievement – Winner  
Year - 2012

Name of the Student: Mritunjay Kumar and Chirapriya Mondal  
Name of the Award – International Craft Film Festival  
Nature of achievement – one of the 14 Finalists  
Year - 2012

Name of the Student: Jivtesh, Ekta, Priyanka, Vivek, Charul, Paritosh, Saptarshi, Mayukh, Saptarsh  
Name of the Award – Samsung Smart App Challenge  
Nature of achievement – Best App awards  
Year - 2012
Name of the Student: Shanu Sharma
Name of the Award – GE Innovation Award
Nature of achievement – Winner
Year - 2012

Name of the Student: Priyanka, Ekta, Jivteesh, Vivek
Name of the Award – Samsung Student Design Challenge, Mobile game app
Nature of achievement – Consolation Prize
Year - 2012

Name of the Student: Paritosh, Chirapiya, Mritunjay
Name of the Award – We Care Film Festival
Nature of achievement – Shortlisted
Year - 2012

Name of the Student: Paritosh Singh
Name of the Award – Pune Design Festival, short animation
Nature of achievement – Runner Up
Year - 2012

Name of the Student: Thomas Jacob
Name of the Award – Hackathon organized by Govt. of India for mobile app ‘FYI - For Your Information
Nature of achievement – Winner
Year - 2013

Name of the Student: Hari, Midhun, Charu
Name of the Award – Abled solution competition, Goldman Sachs
Nature of achievement – Winner
Year - 2014

Name of the Student: Kriti Dairiya
Name of the Award – UX now Design Conference, Make my trip
Nature of achievement – 1st Prize
Year - 2014

Name of the Student: Ashwin Gandhi, Sachin NP
Name of the Award – 3rd Inter IIT TechMeet, Product Design competition
Nature of achievement – 1st Prize
Year - 2015

Name of the Student: Hanprasad K
Name of the Award – The Great Indian Dusbin Contest, Asian Paints
Nature of achievement – 1st Prize
Year - 2015

Name of the Student: Sooraj Ramchandran
Name of the Award – Aerospace Design Challenge, Honeywell
Nature of achievement – 1st Prize
Year - 2015

Name of the Student: Priti
Name of the Award – Sciencoon competition, Techkriti
Nature of achievement – 1st Prize
Year - 2015
Name of the Student: Sachin and Ashwin
Name of the Award – SocCon, Techkriti
Nature of achievement – 2nd Prize
Year – 2015

Name of the Student: Nikhil Jamdade, Toshib Bagde
Name of the Award – Gandhian Young Technological Innovation Award.
Nature of achievement – Winner
Year – 2015

Placements of Design Programme

UX & Interaction design
• Microsoft
• Yahoo
• Tata Motors
• Oracle
• Infosys
• LG
• Adobe
• Nvidia
• Amazon
• Google
• Philips
• InMobi
• Naukri
• Honeywell
• Ibibo Interactive
• SAP
• CLX
• Make My Trip
• Autodesk
• Capital Dynamics
• Bharti Soft Bank
• Samsung Research India
• Hewlett-Packard Company
• Cognizant Technology Solutions
• Research In Motion
• Tata Consultancy Services
- Snapdeal
- Housing.com
- Flipkart
- Myntra
- Dell
- Persistent
- Target
- Global Logic
- Elephant Design
- MoonRaft
- Qualcomm

Visual Communication
- Dentsu
- E-Mantras
- Pencil Sauce
- Tata Eksi

Automobile
- Ashok Leyland
- Bajaj
- DC Studio
- Eicher
- Forbo
- Hero Honda
- JCB
- Tata
- TVS
A Proposal

on

DESIGN INNOVATIONS CENTER WITH A FOCUS ON ARCHITECTURE AND PLANNING
(REVISED)
submitted to

Ministry of Human Resource Development

by

School of Planning and Architecture, New Delhi

in association with

SPA-Bhopal, SPA-Vijaywada,
Ambedkar University, Delhi

New Delhi 29 August 2015
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1. INTRODUCTION

1.1 Background

Design-centered innovation is a force multiplier that can help the country move up in the value chain making Indian economy globally competitive. In this context, the Ministry of Human Resource Development (MHRD) launched a program to set up a number of Design Innovations Centers throughout the country. In this context the School of Planning and Planning Delhi (SPA-D) is submitting this proposal with a focus on architecture and planning (built-environment and human settlements).

1.2 Organizations

SPA Delhi has its origins in the pre-independence era of 1940s. Initially, it was established as a Department of Architecture under the Delhi Polytechnic in the year 1942. SPA Delhi was established in the year 1955. In the year 1979, the School was conferred upon the status of a deemed University under Section 3 of the UGC. Fully funded by the MHRD, the School has today emerged as an apex premier national level institution in the fields of architecture, planning and allied areas. It offers two undergraduate courses in architecture and planning and ten postgraduate courses including urban planning, regional planning, transport planning, environmental planning, housing, urban design, conservation, landscape architecture, industrial design and building engineering. All departments offer Ph.D. programs. The proposal is submitted with SPA-Bhopal, SPA-Vijaywada and Dr. B.R. Ambedkar University of Delhi (AUD). SPA-B and SPA-V were set up seven years ago.

All three SPAs were declared as institutions of national importance through an Act of Parliament under the SPA Act 2014 supported by the MHRD. SPAs in Bhopal and Vijaywada also offer undergraduate, postgraduate and Ph.D. courses in architecture and planning, AUD is founded by Government of the National Capital Territory of Delhi with a School of Design, which offers a course on Social Design. Faculty of all the three SPAs actively participated in the preparation of Design Manifesto prepared by the MHRD in 2013-2014.

1.3 Objectives

Major objective of the proposal is to mainstream design-centered innovation in the fields of architecture and planning education, and research and practice throughout the country (Figure 1). Other objectives include support design education; knowledge sharing among all stakeholders including building industry, private and public development organizations, etc.; provide platform for product development and its marketing; initiate inter-disciplinary approach; and undertake inclusive and socially responsible design in built environment and human settlements.

All four institutions will focus on four different areas with the broad framework depending upon their capacity and themes of interest. SPA Delhi will focus on industrial design, built environment and development of human settlements. SPA-B will focus on themes of Shelter for All and Universal Access for Heritage. SPA-V will focus on craft and architecture. AUD will focus on social design.
1.4 Targets

There are over 350 colleges of architecture and about 20 colleges of planning in
India. These institutions presently have over 20,000 students. Moreover, there are
over 70,000 architects and planners. Students, faculty and professionals in the
fields of architecture and planning as well as other professionals of built
environment are potential targets and stakeholders of the proposed DIC.

1.5 Studio Teaching Pedagogy

The Design and Planning studios are central to the Architecture and Planning
curriculum. Based on learning by doing model, students are required to undertake
real life situations and apply creative and problem solving skills. Throughout the
process, the student is required to make predictions, think divergently and
converge, apply values, make decisions, argue, work with other people, present
ideas and defend them and to consider the interrelationships between components
of the environment and between components of the planning and design process.

It is where all the other subjects taught in every other stream culminate. It can be
said that, the studios are laboratory of the education process. It is in the studio that
all ideas and concepts get tested with respect to the design and planning problems
that are formulated on the basis of the syllabus as well as connecting to real life
situations. Starting from learning simple concepts the projects and situations
provided to students. Progressively-increase in scale and complexity.

The Studio methodology encourages solutions which are sensitive to the local
context and combines theory and application. Beginning with relevant case studies
done singly or in groups including physical, social and visual surveys at site as well
as online studies of similar examples worldwide. The second stage involves
analysis of the problem in the current context and identify main areas of concern.
This exercise encourages our would-be architects and planners to learn to identify,
balance and prioritize different requirements and provide solutions or approaches
for a particular socio-physical context while also training them to visualize the
future through a divergent and creative thinking process.

The final and most important stage is when students begin exercising their minds
to evolve a design and planning solutions that meets as closely as possible the brief
established previously. This stage takes up most of the time allocated to a
particular design problem. It involves many stages of design and planning
development beginning with early concept to detailed proposals that are achieved
through intense discussions, critiques and reviews. The design proposal thus
conceptualized and perfected is final submission.

Studio projects will provide initial analysis for products and process under this
proposal. Moreover, outputs from the DIC will provide inputs to improve studio
teaching in architecture and design studios.

1.6 Outline of Proposal
Given this introduction, next section describes proposal by SPA-D. Other three sections present proposals of SPA-B, SPA-V and AUD. Last section deals with summary of outputs, sustainability and budget estimate.
2. SPA-DELHI

2.1 Tasks

For SPA Delhi, the specific tasks to be undertaken are outlined below:

(i) Coordination: SPA-D will play a crucial role in coordinating various internal departments within the School as well as with other three institutions.

(ii) Workshops: As a first step, a workshop will be organized among faculty of the four institutions to review and finalize first year annual program and accounting procedures. This will be followed up with a series of workshops that will be organized as a part of the project. This will be organized in New Delhi, Vijaywada, Bhopal and other places. SPA-D will organize six workshops over the three year period.

(iii) Identification of Partners: A project of this kind cannot be carried out without active support and participation of public private, non-governmental organizations, and citizens. The SPA-D has very strong alumni networks. The alumni are placed in important positions in various organizations all over India as well as outside India. In addition, the four institutions are in touch with various academic, NGOs, public and private sectors. Based on these interactions, a set of partners will be identified for different proposed products and processes as well as courses.

(iv) Knowledge Sharing: Knowledge sharing and dissemination will be an important task under this project. A website will be developed to provide a platform for all stakeholders to share and disseminate information. In addition, an e-newsletter will be published once in four months. Social media like Twitter, Facebook, etc. will be also utilized to share information.

(v) Online-Courses: DIC will introduce two online cum contact courses on design with a focus on architecture and planning. One of this will be four to eight weeks orientation course whereas the second will be more specialized course with duration of 16 weeks or so. Students taking these courses will be given credits in their degree programs.

(vi) Elective Courses: DIC will introduce one elective course each for postgraduate and undergraduate courses in Design Innovation. In addition, modules will be prepared that could be replicated elsewhere.

(vii) Students, Competition and Quiz: Students’ competition and quiz will be organized on design innovation for students of architecture and planning in India. It will help to raise awareness on the subject among the students and faculty. DIC will approach organizations who regularly organize such students' activities.

(viii) Internship for Design Innovation: This will be given ten inter-disciplinary teams of students. Each team will have 4 to 5 students from different institutions of built environment and settlement planning. The team will work on the proposal for 2 to 3 months. and come out with a solution to the problem.
A number of products and processes will be designed as elaborated below.

2.2 Products and Processes

SPA New Delhi has selected 10 products and processes that will be then taken up for further development, dissemination, registration and marketing.

2.2.1 Industrial Design Products

Department of Industrial Design, established in 1992, has for the last two decades worked extensively in areas of design of products and systems related to the built environment. In the field of sanitation and toilet design, the Department has produced noteworthy work that has recently been commemorated by the Bill and Melinda Gates Foundation.

Each year, during the Final Semester, the students undertake projects, some funded by the industry and others self-sponsored, to demonstrate their abilities as Industrial Designers before they step out as professionals in the design industry. With comprehensive study, research, analysis and subsequent development of solutions, these projects culminate in designs that have the potential to move from prototype to the market. Intellectual Property Rights is part of the program and the products are patent driven.

The following thesis projects will be supported for further technical development, design engineering, user testing and validation before they can be made ready for mass production. For this purpose, the following projects can be incubated in the institution.

(a) Neonatal Incubator for Rural India

This project was undertaken to address the issue of huge number of deaths among babies born premature due to hypothermia and jaundice. Most of these deaths take place in rural areas, which lack continuous power supply, service infrastructure and skilled human resources. This neonatal incubator is being designed specifically for these scenarios. It uses renewable energy and works off-grid, and is designed for easy operation by semi-skilled staff to create a controlled environment for quality infant care.

(b) Soochalaya: The Thinking Toilet Project

This project has been going on in the Department since 2013. The students have worked on various domains of toilet design both in the rural and urban context. Significant among these are (i) Prefabricated, ready to install, low maintenance toilets for EWS housing; and (ii) Safe Public Toilet design for women with specially designed urinals.

2.2.2 Designing Built Environment

i. Resource Audit as a Tool for Energy Conservation
In 2013, the students of the Department of Architecture undertook an audit of SPA Delhi. It looked at complex inflow and outflow of resources and energy in the Complex. This enabled the students to learn how building science and services integrate with architecture in practice. It is planned to create a resource audit as a tool for emerging conservation in built environment. Resource audit can be an effective tool for occupancy evaluation. Through this exercise, energy choices could be made by common people as well as professionals. A web-based Application for auditing own house and neighborhood would enable SPA to house high level Energy Lab for testing, measuring, and simulating. It would be a toolkit for training, research and practice.

ii. Learning from Rural Habitat for Low Income Settlements in Urban Areas

This initiative is set within a pedagogic approach where learning from indigenous knowledge through active engagement with communities in their habitat and can be applied through a grounded research methodology.

The second year students of architecture studied a low income area primarily inhabited by immigrants in South Delhi followed by a study of their native settlements in West Bengal within the Sunderbans, as a part of an integrated studio program. This facilitated a direct interface of the students with the community resulting in mutual learning; awareness of the needs of the society; and possibilities of contribution to grassroots realities. In effect, the students also learnt to see themselves as responsible professionals, as architects who can empathize with end users, understand spatial as well as social practices, and can provide a built environment propagating collective rights and equity.

Under DIC it is proposed to carry forward this studio program to provide tools for teaching and practice at three scales: creating new developmental models for low income groups in rural and urban areas at the macro scale; innovating affordable and sustainable construction systems appropriate to the context at meso level; and innovating prototypes to arrive at contemporary solutions for communities at micro scale. These envisaged products and processes out of these activities will lead to: (i) development of a database on rural-urban settlements and local skills and practices; (ii) development of innovative affordable prototypes of built environment responding to current day social aspirations; (iii) testing of prototype in real life conditions through active participation and engagement with various stakeholders; (iv) developing knowledge products and capacity building; and (v) eventually developing tools for teaching and practice. Affordable prototypes will include models for residences, schools and community architecture based on building technology systems furthering indigenous skills and practices.

iii. System Design and Workshop for Shading Devices

Shading building fenestration appropriately presents a cost effective and efficient way of reducing energy use for lighting and space conditioning. At present shading design in building is largely governed by standardized codes and very few products are available in the market for customized application to building requirements. Today shading devices have evolved to become dynamic and sophisticated systems
that can adjust shading demands of buildings in real time. With specific solar
gometry and climactic data available for different locations, as well as software
tools to facilitate development and simulations, it is now possible to cater to more
varied situations and arrive at specific solutions for each requirement. The
initiative therefore it is to develop:

- readily deployable products for varied markets such as new projects, and
  retrofitting of existing buildings;
- solutions for other specific situations; and
- ready reckoner for shading design.

For the purposes of carrying out above tasks, we propose a workshop for
similation, experimentation, and product testing of shading devices to be designed.
The workshop will provide appropriate shading device design solutions based on
the energy audit of the new or existing project to create energy efficient and
comfortable working and living conditions inside buildings. The workshop will
require space, computers, softwares, machinery and equipment for sample
manufacturing and testing as well as manpower for doing day to day activities.

iv. Integrated Project Planning Design and Management Building
Information Modeling Applications

Building design solutions need to perform to meet functional needs in the context
of external environmental parameters. The design evolution and development
stage is the opportunity to analyze the suitability of the design solution in terms
desired execution and operational management throughout its life. Design
robustness needs to be established its performance considering the uncertainties
during execution and variability in the perceived facility use. Building Information
Modeling (BIM) provides a basic platform to create and develop design solutions to
analyze efficiency through thermal performance, lighting analysis, parametric
functional assessment, and sustainability assessment. Simultaneously, the
complexities of execution through 4 D simulation analyze construction processes
and clash analysis. Creating accurate construction documentation, it leaves
minimizes effect of uncertainties. During operational facility management,
including emergencies and disasters, BIM platform integrates facility management
responses. Interoperability of BIM further facilitates specialized design studies
using domain specific tools.

The Department has undertaken research activities to link these areas to integrate
BIM centric domain knowledge for professional application. In this respect
following process are proposed to be developed:

- Fire and Life Safety audit based design improvement process complying
  provisions of the Codes and established good practices:
    o BIM integrated with advanced 3D animated simulation would be
      used to develop performance assessments and derive processes for
      life safety planning in building designs.
- Process template for Facility Management linked through BIM:
    o Facility management processes would be adapted in line with
      international standards (such as KOBIE, UK) though interoperability
with IBM Maximo software.

These will be made available to the students, faculty and professionals as tools for education, training and practice.

v. **Urban Form and Climate Change**

It is established that every significant proportion of the negative climate change imperatives lay within the domain of built environment. Individual buildings, through green initiatives have started addressing the prevailing situation of the crisis of climate change in a limited way. However, the cumulative implication of collective built environment including groups of buildings, clusters, streets, neighborhood, plazas, etc. along with functional groupings like industrial and IT parks, townships, transit stations, commercial complex and centers, mass housing, recreation hubs, etc. has not been accounted for as of yet, nor corrective steps in this direction are initiated. There is a need for a scientific enquiry through urban form laboratory experiments on specific form characteristics and their corresponding responsiveness to climatic indices for different geographic zones in this country is evident.

The main objective of this study is to set up a scientific process of evaluating urban form visualization proposals with respect to climate responsiveness. Through the establishment of an Urban Form Laboratory, this project will generate a 'process' for evaluation of urban form against climatic characteristics across different geographic zones in the sub-continent. The research outcome will be of use to climate change experts, architects, urban designers, planners, city development agencies and academia.

This project will be led by the Department of Environment Planning. It will be completed in collaboration with the Department of Urban Design, Department of Architecture and Oxford Institute for Sustainable Development, Oxford Brookes University.

vi. **Mobile Application to Assess Landscape Design Variables Green Building**

Landscape Architecture in India is still in its nascent stages of development. Country specific and region specific design related digital tools are almost nonexistent. The Department of Landscape Architecture at SPA Delhi will develop a list of plants along with their design characteristics and selection methodology through mobile application based on landscape architecture design requirements. These design requirements will include physical, botanical and horticultural characteristics and medicinal properties. The mobile application will be used to simulate site and function specific real life conditions.

This will provide real time inputs for plant selection and design. This mobile application will enable the designer to digitally assess changes in landscape design variables in a variety of projects, and simulate changes in micro climate with different design options. This type of projects may vary from those which will have a predominance of planting design such as public parks and children's play areas
to those where plants are primarily used for functional uses such as parking lots and courtyards.

vii. Developing Conservation Techniques for Historic Building Materials and Systems

With a large part of the historic urban fabric in India today comprising of buildings constructed with traditional materials, and the need for an improved quality of life in these historic settlements, it is important to understand and develop technical expertise which will enable improved performance of these building materials and systems to include waterproofing, retrofitting, structural strengthening, sustainable adaptation and resilience specific to the demanding climatic conditions, high levels of vulnerability to natural hazards.

It is proposed to create a technical database through a series of workshops, both studio and site centric along with development of a state of the art resource centre and innovation laboratory, focusing on materials characterization, their performance standards, development and demonstration of cutting edge technical interventions, improved practices and appropriate techniques for maintenance, retrofitting, improved seismic resistance, conservation, up-gradation and adaptive reuse of built heritage. The documentation will aid professionals and institutions involved in use and conservation of traditional materials and will support the development of an online training module to be undertaken subsequently.

2.2.3 Planning Human Settlements

(a) Web Based Urban Plan Monitoring and Visualization Tool

Although plan monitoring is regarded as an important step in the planning process, it is also the weakest link in the Indian planning system. While the government is progressively constructing good 'smart' information gathering and reporting tools, there is attrition in data gathering and collation, and the consequent loss in efficiency. Huge investments are made in development projects arising out of planning decisions. However, the absence of software frameworks for monitoring and visualization leads to major gaps.

This tool would focus on real-time collection and representation of planning indicators, which will be made available to all, free of cost, in an open access environment to strengthen plan monitoring component of the planning system, from a national level to city-ward or gram-panchayat levels. The framework will function at two levels: pedagogical level for academic institutions and decision making level for the state and public sector organizations.

Commercial applications will be made available. There can be subscriptions for developers and property agents, mobile devices, custom reporting tools for social applications and city planning functions unique to one or two.

The project will involve SPA as an academic partner and architecturez as industry partner.
(b) Toolkit for Integrating Environmental Concerns in Settlement Planning Process

Department of Environmental Planning has been conducting studio exercises to address emerging environmental issues of global and national concern. In order to relate aspects of global warming, energy, etc. to spatial development plans, scientific parameters of gaseous emissions, energy quantification, footprint calculations have to be worked upon. This involves using of softwares related to emission modelling, footprint calculation methods, monitoring of pollution compatible with GIS software. This process could be streamlined by developing toolkits for these applications. As part of the innovation center, it is proposed to develop a toolkit for planning for emission control, solar zoning, and footprint modelling. This could find application in planning studies to estimate emissions, scenarios of energy consumption and footprint calculations. These estimates will help us to take scientific decisions to integrate environmental concerns with urban and regional planning. The toolkit would be supported by exposure of students, researchers, and professionals to pollution monitoring, emission measurements, meteorological measurements and its application to planning.

Equipment required for the same are CO2 meter, air, noise and water testing kits, weather monitoring equipment, etc. Software related to energy simulation, air pollution dispersion modeling, carbon footprint, etc. such as Ecotect, DOE-2, WRF-AERMOD, etc. would be required.

(c) Traffic Signal for Visually Challenged

As per latest legislation, all transport projects will have to meet guidelines for universal accessibility. There have been some innovative intersection designs for universal accessibility. However, none of the designs of traffic signal has addressed the need of visually challenged. The product will be in the form of sound based traffic signal and sound based mobile indicators that will inform visually challenged as well as other users.

Background work on the product was done by the Department of Transport Planning. As per latest act on disability, it will be mandatory for an authority to have universal traffic signal. The product can be patented as it is intellectual property that will be in the form of actual product.

(d) Designing a GIS based Model for Road Maintenance System using Intelligent Transport System (ITS) tools

In India road maintenance is very big issue and lots of money is spent simply in maintaining roads. Due to lack of time series and correlated data related to maintenance activities, it results in wastage of man hours and cost. Once the details correlated data with respect to actual longitude, latitude and terrain are modelled then it is easy to optimize costs and efforts related to road maintenance system. This model can be used by different agencies responsible for roads maintenance, construction and management to review, modify or plan their strategy for road
maintenance and management. The main feature of this model is incorporation of technological tools of Intelligent Transport System (ITS) and communication so that even senior transport officers can observe the ground reality in real time. This will greatly help in bringing transparency in this high value work.

Table 1 below shows a summary of all products and processes including details of departments responsible for carrying out these innovations and initiatives.

Table 1: Products and Processes, Departments Involved and Potential Partners (Ten)

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Product and Process</th>
<th>Main Department</th>
<th>Other Departments</th>
<th>Potential Partners</th>
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<td>Industrial Design</td>
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<td>Industrial Design</td>
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<td>Resource Audit as a Tool for Energy Conservation</td>
<td>UD and EP</td>
<td>MNRE, GRIHA, TERI</td>
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<td>Architecture</td>
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<td></td>
<td>Learning from Rural Habitats for Low Income Settlements in Urban Areas</td>
<td>Architecture</td>
<td>RRPA, Shelter Boards, HUDCO</td>
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<td>Architecture</td>
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<td>System Design and Workshop for Shading Techniques</td>
<td>Architecture</td>
<td>Housing Boards, MNRE</td>
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<td>Architecture</td>
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<td>Integrated Building Information Modeling with Facility Management</td>
<td>Architecture</td>
<td>CREDAI Autodesk</td>
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<td>Urban Form and Climate Change</td>
<td>Urban Design</td>
<td>MOEF and Development Authority</td>
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<td>Architectural Conservation</td>
<td>EP and LA</td>
<td>MOEF and Development Authority</td>
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<td>Landscape Architect</td>
<td>EP and UD</td>
<td>Forest Dept, Consultants</td>
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<td>Architectural Conservation</td>
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<td>INTACH, MOUD</td>
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<td></td>
<td>Toolkit for Integrating Environmental Concerns in Settlement Planning Process</td>
<td>Environmental Planning</td>
<td>PP and UIP</td>
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<td>Transport Planning</td>
<td>ID</td>
<td>Traffic Police</td>
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<td></td>
<td></td>
<td>Center for Analysis and Systems Studies</td>
<td>TP</td>
<td>Technical Partner, UTI</td>
</tr>
</tbody>
</table>

Departments: Architecture (Arch.), Building Engineering and Management (BEM), Environmental Planning (EP), Industrial Design (UD). Physical Planning (PP), Transport Planning (TP), Regional Planning (RP), Landscape Architecture (LA), Urban Design (UD), Urban Planning (UP), Center for Analysis and Systems Studies (CASS).

2.3 Course Outline

Design and innovation have a huge impact on society well beyond the creative industries - finding solutions to problems that affect every aspect of our lives. Offering an exciting and innovative approach to learning, this course gives students the framework for developing innovative design products in all areas of design while developing an understanding of marketing and business strategy.

(a) Objectives:
- Distinguish between incremental innovation and radical innovation when creating new solutions.
- Research and understand the complex network of stakeholders involved in product and process life cycle.
- Understand and use the psychology behind human-machine interface.
- Effectively understand if your end-users will be delighted by your product or service.

(b) Contents
- Design Process: An overview of the design process and group exercises.
- Innovation & Design Principles: Understanding the origin of innovation, evaluating design principles.
- Decision-evaluation and critique: Evaluation exercise, critique techniques
- Psychology & experiences: Understanding the social-psychological aspect of design and learning to interpret the design experiences.
- Creativity Through Analysis & Open/Closed Thinking: Understanding how to develop innovative ideas through ethnographic research
- Stakeholder Analysis: Understanding how to map the complex network of beneficiaries
- Usability Testing & Wrap-up: Formal methods for usability testing and methods for rapid notation and analysis

(c) Design Exercises
- Interactive design exercise: game design, evaluation of design
- Vision Creation: Learning to articulate design in phases, State Tables
- Mind mapping: Learning to create mind maps.
- Human Factor analysis: Exercise on understanding human dimension and factor affecting human behavior.
- Concept generation and detailing: Exercise to generate innovative concepts through design methods and detailing it further.
- Modeling: Creating models of generated concepts.
3. SPA BHOPAL

3.1 Background

SPA Bhopal proposes two thematic thrust areas in which to work based on the contextual and societal relevance of the domains and strengths and capabilities of the institute in these domains. The two identified themes are “Shelter for All” and “Universal Design Innovation for Heritage”.

3.2 Capability Profile

SPA Bhopal offers undergraduate and postgraduate programmes in the disciplines of planning and architecture. The institute also has a large number of research scholars enrolled in doctoral programmes. In the last six years of its existence the institute has undertaken research and consultancy works in various domains of planning and architecture and has developed a large talent pool of multidisciplinary professionals amongst its faculty. The students of the undergraduate and postgraduate courses from various parts of India are the institute’s biggest asset as ambassadors of the future. The institute has also developed state of the art facilities in graphics and GIS laboratories, which are extensively used in all projects, academic and professional. There are several research scholars and faculty working on different aspects of shelter and academic curriculum across disciplines address shelter concerns through planning and design studios and theoretical assignments. In the context of the second theme of Universal Design, the institute has a unique human centered laboratory (equipment and full scale simulation models) and many academic and dissemination activities have been taken up under the Center for Human Centric Research housed in the institute.

The institute through its programmes of Physical Planning, Urban and Regional Planning, and Environmental Planning, Architecture, Urban Design, Conservation and Landscape has the milieu of trained professionals and large students’ community to explore design innovations in both thrust areas effectively and disseminate the same to a wide spectrum of people. The envisaged projects would involve faculty, students and researchers from across disciplines and initiate cross disciplinary dialogues in design innovation and thinking.

A brief concept note and deliverables for both thematic areas are outlined below.

3.3 Shelter for All

Presently the mandate of the Ministry of Urban Development is to provide housing for all by 2022 by a convergence of various existing schemes and by adopting more proactive mechanisms of housing delivery by addressing both demand and supply side constraints. At the same time the findings of the Report of the Technical Group on Urban Housing Shortage, (2012-17) pegs urban housing shortage figures for 2012 as 18.78 million dwelling units. The magnitude of the figure is immense and the social impact far reaching. There is a need for research with an operational objective, which could be used by policy makers, urban planners and public at large for decision making at various stages.
(a) Objectives

The design innovations would target two areas of work.

- To design appropriate decision making tools for better rationalising the process of identifying new land parcels suitable for different housing segments, through the use of GIS based technology. It would work towards creation of multi-layered online databases accessible to multiple government agencies and to people at large which could be used to take rational decisions on suitability of land for all housing classes. Training and capacity building of government officials on the merits of an integrated data base system would be imparted along with hands on training of the tools developed.

- To design tools to quantify the contribution of vacant or obsolete or dilapidated premises in the city's developable land pool, with possible mechanisms of redevelopment and reuse in the core city areas. The 'Report of the Technical Group on Estimation of Urban Housing Shortage' also identifies 'obsolescence' and 'congestion' as two major causes contributing to urban housing shortage. The project would address the need to best utilise the potential of these premises with obsolete housing stock in a manner benefitting the local residents, retaining the character of the place and balancing the economic viability of the project. Ward committees and local residents would be trained in using the toolkit to help them prioritise the local needs and use the premises appropriately.

An introductory brainstorming session would be conducted for further refining the design innovation thrust areas required for achieving 'Shelter for All' for students, faculty and researchers to kick start the process of design innovation thinking.

(b) Workshops

- International workshop for sharing the prototypes developed and seeking peer review through a consultative process among experts from across the world and India.

- National Level workshop for sharing the tools developed and disseminating the tools to professionals, bureaucrats, general public and providing basic training for using the tools.

(c) Electives

Elective on 'Design Innovations for Achieving Shelter for All' that would be offered at undergraduate and post graduate programmes across disciplines of planning and architecture to initiate innovative design thinking and question exiting processes. The course would have modules targeted to innovate in processes related to (i) the demand side aspects of shelter on one hand, through computations of housing affordability indices, socio-cultural influences on housing preferences etc. and (ii) the supply side aspects of shelter on the other hand through innovations in land and housing database creation and management, housing condition assessment etc.
The elective would also be developed as an online e-learning module, for wider dissemination possibilities.

(d) Products

SPA, Bhopal has briefly described two products in this theme. Extensive discussions will be carried out with faculty and partners to select one product from this theme and faculty will then further work on this for development, dissemination, registration and marketing.

i. Residential Land Suitability & Prioritising Tool

The design of this toolkit is to rationalise the decision-making process of land allotment for affordable housing to government, private sector and individual owners who are the main actors in the supply of shelter for all. Land will be considered as suitable on which sustained use of housing is expected to yield benefits which justify the inputs, without unacceptable risk or damage to land resources.

The decision-making tool would include the design of a spatial information system based on three broad modules: Data, Methods and GIS technology. The modular approach would lead to development of research for innovations in each domain and may result in incubating many more new product or process innovations. It gives scope to develop back ground process innovations on both demand and supply side computation methods (housing affordability index, land use conflict measurement etc.) The suitability criteria, inter alia, jurisdiction, ownership, accessibility, infrastructure availability, land price, environmental vulnerability etc. would be developed with simultaneous design of a data inventory. Layering of data through GIS technology would finally help reflect the degrees of suitability of the land to prioritise the use of land for different categories of shelter with focus on affordable housing.

The tool would be available online and the data base would have different levels of access permission, to enable housing consumers, ward level committees, ULBs, Metropolitan Planning Committees, all to participate in the decision-making process but with different roles in the hierarchy of data creation and decision-making process.

(ii) Rapid Appraisal Tool Kit for Shelter in Core City Areas

Rapid Appraisal Tools for assessing the future scenarios of development and intervention possible in old cores of cities. The fate of any premise in an old city area is determined by the combination of attributes such as accessibility, premise size, building type and condition and socio-economic characteristics of the owners. The toolkit would be designed to capture the qualities of premises on all of the above attributes. The design would attempt to innovate and create a template for mapping the attributes of housing on individual premises and assign values to the
attributes which would provide the rationale of future development typology of the plot. The design of this holistic rapid appraisal tool would help in accomplishing the first task of identifying premises which can be intervened on and prioritising projects in core areas. Design interventions at premise level would emerge from the social and physical condition analysed through the use of the tools. Material and technology innovations appropriate for infill interventions Planners, architects, builders, city authorities and residents would take collective decisions through the use of this tool and it would be shared on interactive platforms.

This tool attempts to reach out to local communities and make them a part of the decision making process for redevelopment projects in core city areas and facilitate building of appropriate shelter types in the city core. The toolkit would possibly be tested on pilot projects within the project period for testing and subsequent refinement.

Potential partners are: Ministry of Housing & Urban Poverty Alleviation, UNHabitat, World Bank, State Housing Boards, City Municipal Corporations.

<table>
<thead>
<tr>
<th>Activities</th>
<th>Time Plan</th>
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<tbody>
<tr>
<td>Refining of Thematic Areas &amp; Brainstorming with Various Stakeholders</td>
<td>H1</td>
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<tr>
<td>Field Surveys for data collection for formulation of design criteria</td>
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<tr>
<td>Launch and conduct of internships and fellowships and electives</td>
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<tr>
<td>Initiation of Lab Research activities for Development of Tool Kit</td>
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<tr>
<td>Development of Toolkit and Web-Based Application of Prototype</td>
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<tr>
<td>National Workshop for Product Feedback on Prototype Developed</td>
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<tr>
<td>Trial run and Prototype Testing</td>
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<tr>
<td>Refinement of product</td>
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<tr>
<td>Launch of Final Web-Based Application</td>
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<td>National Dissemination and training Workshop for Final Product</td>
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<tr>
<td>Preparation of Online Course and Launch</td>
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<tr>
<td>• Running Online-course Will continue after project period</td>
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<tr>
<td>Workshops</td>
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<tr>
<td>Product and Online Course Delivery</td>
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<tr>
<td>H1...An Half Year Time periods</td>
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</tbody>
</table>
4. **SPA – VIJAYWADA**

4.1 **Background**

The field of design has acquired new dimensions over the years encompassing different disciplines, wide spectrum of ideas, identities and entities, and opened up channels of opportunities to regenerate, explore and innovate by exchanging and connecting with diverse creative talents and skills. As a part of the Design and Innovation Centre perceived by the School of Planning and Architecture, Delhi, SPA Vijaywada strives to harness the prospects of the field of design by integrating education, industry, tradition and culture within a collaborative framework, by tying up with artisans, institutions and designers. SPA-V will focus on revitalization and promotion of traditional arts and crafts in the southern and eastern coastal regions of India by including five states namely Andhra Pradesh, Kerala, Karnataka, Odisha and Tamil Nadu.

4.2 **Past Collaborations**

SPA-V intends to serve as a resource and knowledge centre, and provide incubation and training to artisans and designers, and facilitate industry interactions. SPA-V has signed an MOU with Andhra Chamber of Commerce and Industry. SPA-V has interfaced with NSME Auto cluster in Vijayawada, Kalamkari association at Pedana, Sri Kalahasti, Kondapalli and Etikoppaka toy makers association and other crafts villages in Durgi, Dharmavaram (Andhra Pradesh), and Raghurajpur (Odisha).

4.3 **Proposed Activities**

At SPA-V we started the first initiative to connect with the artisans of Andhra Pradesh and Odisha by organizing a ‘Live Demonstration Workshop’ during the celebration of World Heritage Day on 17 April 2015 by highlighting the cultural and built heritage of this historic region.

Two workshops will be organized as part of the project. SPA-V will be setting up the following laboratories:

- 3D printers for making designer printing blocks to come up with innovative product prototypes.
- Setting up of material workshop for designing innovative drudgery reduction tools and techniques.

SPA–V will also initiate the following education programs under the DIC:

- Imparting online courses in Design and product development.
- Offering Design related elective subjects in the UG or PG level of the entire existing educational program, including crafts product designing in the UG and PG final year thesis.

4.4 **Products with Focus on Crafts**

Any two products may be taken forward for further incubation and development:
(e) Time Schedule

<table>
<thead>
<tr>
<th>Activities</th>
<th>Cumulative Time</th>
<th>Time Plan</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
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<tbody>
<tr>
<td>Literature Survey, Diagnostic Field Survey and Brainstorming of Various</td>
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<td>H1</td>
<td>H2</td>
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<td>Stakeholders (Discussion with Visiting Experts)</td>
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<td>H3</td>
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<td>Preliminary Audit Toolkit Preparation</td>
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<td>H4</td>
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<td>Pilot Survey with Preliminary Toolkit (3 Heritage Sites)</td>
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<td>H5</td>
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<tr>
<td>Finalization of Toolkit and Web-Based Application Preparation (Softwares</td>
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<td>and Simulation Equipments Procurement)</td>
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<td>Prototype Development of Web-Based Application (plus Workshop for Product</td>
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<td>Feedback)</td>
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<td>Prototype Testing for 5 Heritage Sites</td>
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<td>Launch of Final Web-Based Application (and Sharing through Industry-</td>
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<td>Institute Workshop)</td>
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<td>Preparation of Online Course and Launch</td>
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<td>• Augmentation of Application with Phase Wise Collection of Audit Data</td>
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<td>• Running Online-course</td>
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<td>Will continue after project period</td>
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</table>

- Workshops
- Product and Online Course Delivery

H1...Hn Half Year Time periods

Potential Partners: Ministry of Culture, MSJE, ASI, UNESCO and NGO’s
Once the product is developed, an **industry institute workshop** on 'Universal Design and Safety Audit in Historic Sites' will be organized, for inclusive development community building in India.

- **One online multidisciplinary course** on 'Enhancing livability through Universal Design Innovation in Historic Cities' will be developed for students and practicing professionals.

(d) Product

**Web-Based Application on 'Universal Design Audit Toolkit with Information on Accessibility and Safety of Heritage Sites'**

The Access Audit Toolkit intends to document the barriers which can cause difficulties for people with disabilities and elderly at heritage sites. It would include an assessment of the complete journey to the site, following a normal journey sequence from city level to individual heritage site. The web-based product intends to develop a user-friendly application that would analyze data generated by Audit Toolkit on the extent of physical accessibility and safety of various heritage destinations of a place. The application would include data of different types "layered" on a spatial GIS platform over a physical map. Different thematic databases may include but are not limited to accessible infrastructure, accessible transportation, accommodation types, risk assessments (e.g., accessibility, social safety), universal route choices, inclusive facilities at sites, facilitation of comfort for elderly users, accessible networking (attraction magnets and linkages) of heritage sites, etc. The application may combine more than one such thematic layers on GIS platform to respond to various queries of specific nature. The application may both be accessed on a computer platform as well as run on tabs or smartphones.
3.4 Universal Design Innovation for Heritage

(a) Background

India, rich in cultural, historic desired and religious landscape, is a group of heritage cities and sites. Most of these heritage sites are vibrant and inhabited urban landscapes imbued with rich values. Besides hosting local population, these heritage destinations are the frequent visiting places by large number of national and international tourists, however, accessibility for persons with disabilities (PwDs) and elderly has always been a major concern in these sites due to lack of inclusive environments. The other vulnerable populations who face difficulties are children, women, and families with rural background, poor and unschooled. Making the heritage sites inclusive and universally accessible in an appropriate and sensitive manner can increase awareness and appreciation of its cultural, social and economic value. Moreover, India is signatory of United Nations Mandate of UNCRPD which casts responsibility on member Nations to provide equal participation of PwDs in arts and cultural life. The aim of this proposed design innovation proposal is to develop a body of knowledge to improve accessibility for PwDs in historic cities, heritage sites and monuments across disciplines of planning and architecture.

(b) Objectives

The tangible and intangible objectives of this universal design innovation proposal are to:

- Identify the environmental challenges for persons with disabilities, elderly, women, children and other vulnerable populations visiting and living in heritage sites and cities of India.

- Explore contextual research methods for universal design investigation in India.

- Disseminate achieved processes and outcomes of universal design for heritage cities in India, through publications and outreach workshops.

- Develop ONE Universal Design Innovation Product ‘Universal Design Audit Toolkit with Information on Accessibility and Safety of Heritage Sites’. This would be a web-based, innovative and contextual toolkit to provide information regarding accessibility and safety for heritage destinations and foster social inclusion.

(c) Workshops and Courses

- To complete this project, a multidisciplinary studio and workshop on ‘Universal Design Innovation in Historic Sites’ will be carried out.
5.1 Background

The School of Design has been set up at the Ambedkar University Delhi since 2012. The School of Design focuses on design not only through formal and functional aspects which go into the design of objects, services, systems and environments, but also through critical reflection on how design shapes society and environment and vice versa. The School offers a 1½ year full time Masters programme in Social Design with a predominant focus on public services, systems, governance interfaces, community networks and environments. Issues such as health, hygiene, education, resource access, mobility, sanitation, that continue to be some of the significant challenges in social domain, are major focus of the programme.

While design innovation space is predominantly seen through product manifestations with potential for patents and/or marketing of the same, we believe that design innovation is equally needed in systems and services. We articulate this space as Social Design in form of social innovation that contributes to larger social value. The nature and spirit of initiatives envisaged is therefore, in public systems and services which need to be addressed through design innovation.

5.2 Future Projects Lab

The proposed Design Innovation Centre is seen as a symbiotic development with the Future Projects Lab planned as a part of the activities of the School of Design at AUD. The Lab is visualized as a collaborative platform to engage with project initiatives pertaining to issues in public domain, which can be addressed through design and innovation with multi-disciplinary research, systemic interventions and located in real world conditions.

It is planned as a convergence of various domain expertise from within and outside university and leverage tools and methods of design and systems thinking, co-creation, innovation and scenario development that can provide new imagination to address complex issues. The Lab is visualized as a real life learning opportunity for the students through their involvement in ongoing projects. It will act as an ongoing demonstration of the contribution that design and innovation can make in developing effective, sustainable and convivial services, systems and interfaces that communities seek to ensure access, equity, convenience, quality comfort, and affordability.

The Design Innovation Centre is visualized as a precursor to the Future Projects Lab, which will sustain and perpetuate the larger objectives of DIC in future. Activities envisaged under the proposed Design Innovation Centre are:

5.3 Workshops

Two workshops to inculcate the value of innovation among university students and for mentoring the projects taken up by design students, visiting faculty, practitioners and domain expertise will be organized. Such requirements will be augmented through the Design Innovation Centre support. The pool of internal and external
(a) Clay and other art forms near Etikoppaka: Kumari panai is a form of clay art practiced near Etikoppaka (65 km from Visakhapatnam). This art form, if customized, can be utilized as good acoustical and thermal insulation materials.

(b) As an acoustic diffuser: The main role of acoustic diffuser is to distribute sound evenly throughout the room. Generally diffusers are imported to give good acoustical effects in the recording studios, conference and lecture halls, etc. Tumbler-like objects made of clay (Kumari Panai) if placed in appropriate combinations as cladding elements on the wall can work well as an acoustic diffuser. Etikoppaka toys and crafts are known for its roundness and glossy finish. Such kind of finishes and roundness are good for acoustic diffusers. Hence this property can be explored through experimental and simulation studies in detail under the DIC.

(c) As Helmholtz Resonators: Helmholtz resonator is cavity resonator, which is very effective for arresting low and mid frequency noise and vibration. Low frequency noise will create disturbance and excessive vibration in small rooms. The clay pots, if it is fabricated according to the specified dimensions and high precision, it can be utilized as cavity resonators in the recording and post-production studios interiors. SPA-V has proposed to establish a sophisticated acoustical laboratory to do extensive research on Acoustical properties of these materials and crafts. Quantification regarding Noise Reduction Criteria (NRC) and diffusion properties can be achieved through this facility.

(d) Thermal Insulation Material: Clay tumblers, if packed and arranged effectively in roofs and walls, it can act as a thermal insulation material. SPA-V has an environmental laboratory, which has instruments such as Thermo Couples, Temperature Probe (TESTO 425), Thermal imaging camera, etc. With the help of these instruments it is possible to quantify the heat transmittance (U value) for such composite structures.

(e) SPA-V will also work on Kalamkari and Etikoppaka arts and crafts for designing innovative Interior elements and office and household products. Kalamkari arts and Etikoppaka crafts concepts can be integrated to design creative interior elements and household products such as lanterns and lamp shades, wooden vase, wall panels, partitions and office stationary items such as designer folders, pen stands, degree certificate holders etc.
resources will also conduct workshops and training with audience outside the university. These can include ITIs and schools etc as outreach initiatives.

5.4 Course on Design Innovations

An elective course on Design Innovations will be introduced in the School. The students will undertake projects in areas of public services such as healthcare, mobility and mass transport support through integrating Para-transit with public transport systems. This includes development of mobile-based applications. Similarly, interventions through projects being considered will also be in areas such as public sanitation and hygiene, resettlement, access to education for marginalized, way finding services for visitors and tourists, urban farming, waste management and more.

Specific roundtables will be held in exploring the role of innovation in these areas. The workshops will also include students from other disciplines of the University to look at the potential for visualizing entrepreneurship opportunities in their respective fields using the processes of innovation.

5.5 Products

Two Projects with potential for real life impact and larger social value will be prototyped for their systemic efficacy, sustainability and refinement. Such projects will be under the guidance of faculty, domain experts and may be partnered with external agencies to ensure workability, ownership and economic criteria. These projects will be put through multiple iterations in potential contexts, users and other stakeholders to address realistic constraints and needs. Any two of the following projects will be undertaken for realization:

(a) Urban Farming

Aiming at building a unique service that assists in cultivating organic vegetables and herbs at home. This service would aim at providing service mainly to those households, which do not have gardens or lawns and thus feel that it is impossible to grow vegetables inside houses. The service would involve setting up customized gardens in a household and training the customer and their gardener to further manage the garden. This is visualized as a service system cum product support to be developed as social enterprise.

(b) Mobile Phone Application for Better Accessibility to City’s Transit System

Creating a mobile phone application that will plan trips for the users by giving them information of the recommended mode of transport for the route (both Para-transits and mass transit included), fares, timings etc. The application will also have information on DTC, DMRC, various locations and its specialties and also an option to chat to another user to solve confusions. The application will be crowd sourced and would allow the users to add information easily. The user would be able to bookmark localities of their choice and get continuous access to information or add some, about the happenings of the locality, much like a blog (written by the user).
The project will be developed as pilot in selected location and is visualized as a social enterprise.

**Schedules product development stages and timelines**

i. Development of Mobile App for facilitating first and last mile connectivity and integration with public transport. Time line of activities and final outcome

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Activity</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Field research and mapping of the Para Transit situation (feeder services provided by Para transit modes like 3 wheelers, e rickshaws, cycle rickshaws, mini buses etc) in select locations, geographies of public transport, operational structure, legal and compliance norms, operations and passenger needs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Articulation of design brief including contents, features, technologies, alignment with public transport systems, interface options, mobile platforms</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Hierarchy of needs, features, wireframe concept options, field validation with user groups, technology options</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Layout of flow, features, navigation experience, content network as a brief for app developer</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>5.</td>
<td>Optimisation of core and add on features</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Appearance and visual graphic elements development with design options</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Tie ups with Para transit providers and agreements of terms of use and terms of operations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Selection of developer, contracts and agreements of non-disclosure, legal documentation of copy rights/patent registration</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>9.</td>
<td>User trials, feedback and refinement of the App</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>Creating developer accounts registration with App selling platforms (Google, Apple etc) for sales/downloads</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>Business development and systems coordination</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>Analytics accounts for tracking downloads and sales</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>Product Launch and promotion</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>14.</td>
<td>Mapping user experience and feedback and experience analysis</td>
<td></td>
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<tr>
<td>15.</td>
<td>Improvisation and debugging of operative features and on field network optimisation and promotion</td>
<td></td>
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</tr>
<tr>
<td>16.</td>
<td>Development of added features and promotion</td>
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</tr>
</tbody>
</table>
### Design and Development of Service Network for Urban Farming

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Activity</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Field research and mapping of available techniques for farming based on compact, resource efficient and organic methods to maximise available spaces like terraces, balconies, walls, land patches in urban environment and potential user groups as customers for a system combining products and services for urban farming.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Articulation of design brief including contents, features, technologies, human resource, seasonal patterns and species, infrastructure, alignment with domestic, institutional and organisational, needs, scalability options, on and offline user group platforms.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Development of service package options based on nature of space, scale, habit patterns, convenience, affordability, ownership and know how training.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Pilot projects at the University involving its students, faculty and staff for establishing various product mixes of vegetables, composting, water usage, soil development, products, accessories, user manuals, testing.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Optimisation of various service products from the perspective of affordability, ease of care, produce mix, sizes and space variety.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Training of field workers, business developers and service support.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Development of business models, technology and service support, production of accessories, products and support infrastructure.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Development of user guides, promotional material, techniques, trouble shooting, online support, pilot runs with communities, organisations, institutions.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>Launch of the service in select geographical areas with actual customers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>Feedback and refinement of the service and trouble shooting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>Creating customer accounts registration with online platforms, user groups’ interaction for mutual sharing of experiences.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>Business development and systems coordination</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>Analytics accounts for tracking customer experience and feedback</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td>Product Launch and promotion in other geographic locations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.</td>
<td>Improvisation and debugging of service and knowhow features and on field support optimisation.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16.</td>
<td>Development of added features and promotion</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
6. OUTPUTS, SUSTAINABILITY AND BUDGET

6.1 Sustainability

Grant under the DIC will help to set up common facilities at SPA Delhi. These common facilities will be utilized by students, faculty and partners on payment basis. The project will develop at least 16 products and processes that will be patented and marketed. This would also provide financial support to the DIC. Thus the center will be financially sustainable in future.

6.2 Summary of Outputs

A number of products and processes will be developed under the DIC by all four institutions, details of which are provided below in Table 2. These will help to mainstream design-centered innovation in Architecture and Planning education, research and practice in India. These will also provide important design and implementation inputs for various Government programs like Smart City, Swachh Bharat, Housing for All, PM Gram Vikas Yojana, etc.

Table 2: Summary of outputs is given in Table below:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>SPA-D</th>
<th>SPA-B</th>
<th>SPA-V</th>
<th>AÜD</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Workshops</td>
<td>6</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>14</td>
</tr>
<tr>
<td>2. Online Course</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>3. Elective Courses</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>4. Products and Processes</td>
<td>10</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>16</td>
</tr>
<tr>
<td>5. Knowledge Sharing Platform</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>6. Students’ Competitions</td>
<td>4</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>7. Internships for Design Innovation</td>
<td>30</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>30</td>
</tr>
</tbody>
</table>

Mainstream Design-centered Innovation in Architecture and Planning Education in India

6.3 Budget Estimates for the DIC

Table 3 shows budget estimates for the DIC for all the four institutions. Total estimate is Rs. 10.0 crore. The estimate expenditure is Rs. 7.0 crore and Rs. 1.0 each for SPA-B, SPA-V and AÜD.
Table 3: Budget Estimate for DIC with focus on Architecture and Planning (Revised)

<table>
<thead>
<tr>
<th></th>
<th>NON-RECURRING</th>
<th>RECURRING</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1st Yr.</td>
<td>2nd Yr.</td>
<td>3rd Yr.</td>
</tr>
<tr>
<td>Fabrication Lab Equipments for the Innovation Studios</td>
<td>200</td>
<td>NIL</td>
<td>200</td>
</tr>
<tr>
<td>Computer hardware &amp; Software, Repository, Tooling cost for user trials</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Furnishing &amp; renovation</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total (A)</td>
<td>200</td>
<td>0</td>
<td>30</td>
</tr>
<tr>
<td>Innovation Programmes, Students Fellowships, Internships</td>
<td>25</td>
<td>20</td>
<td>15</td>
</tr>
<tr>
<td>Staff salary, honorarium for visiting faculty, IPR Consultancy</td>
<td>40</td>
<td>40</td>
<td>30</td>
</tr>
<tr>
<td>Concept Development, Mockup models, prototyping</td>
<td>50</td>
<td>50</td>
<td>40</td>
</tr>
<tr>
<td>Expenses, Consumables</td>
<td>20</td>
<td>28</td>
<td>20</td>
</tr>
<tr>
<td>Travel &amp; Field Trial related expenses</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Workshops, Training &amp; Outreach</td>
<td>30</td>
<td>28</td>
<td>20</td>
</tr>
<tr>
<td>Contingency and overheads</td>
<td>30</td>
<td>28</td>
<td>20</td>
</tr>
<tr>
<td>Total (B)</td>
<td>185</td>
<td>170</td>
<td>145</td>
</tr>
<tr>
<td>TOTAL (A+B)</td>
<td>385</td>
<td>170</td>
<td>145</td>
</tr>
</tbody>
</table>
ANNEXURES: LETTERS OF PARTICIPATION FROM SPA-B, SPA-V and AUD
Ref No.: SPA/Dean/R&D/2015/462
Dated: 7th May, 2015

To
Prof. Kartik Vaidya
Director
School of Planning and Architecture
New Delhi

Subject: Acceptance for collaborating with SPA, New Delhi, as spoke of DLC

Dear Sir,

This has reference to your e-mail dated 26th April, 2015, inviting School of Planning and Architecture, Bhopal to be one of the spokes of the Design Innovation Centre being proposed by SPA, New Delhi, in response to the request by MHRD for the same.

School of Planning and Architecture, Bhopal is pleased to accept the offer and would be happy to collaborate as a spoke centre of SPA, New Delhi.

As desired, please find enclosed a brief outline proposal for the Design Innovation Centre at School of Planning and Architecture, Bhopal where two thrust areas of "Shelter for All" and "Universal Design Innovation for Heritage" are proposed.

Thanking you,

With best regards,

Sincerely,

Shreya Mitra

Get: Director, SPA, Bhopal
Ref.No. 2/ DIC/ SPAV/ 2015

Prof. Chetan Vaidya
Director, SPA- Delhi

Dear Sir,

School of Planning and Architecture, Vijayawada is willing to act as a spike/hub for SPA- Delhi for carrying out Design and Innovation Activities in Vijayawada. You may be aware that SPA-Vijayawada has already established a Design and Innovation Center and carried out many activities under the center. We have a MoU with IIT-Mumbai Industrial Design Center for our Design and Innovation Center. However, as listed in our activities (sent separately), SPAV will concentrate on architectural design with SPA-Delhi collaboration.

Best regards,

[Signature]

Prof. Dr. N. Sridharan
11th May 2015

To,
Professor Chetan Vaidya,
Director, School of Planning & Architecture
Delhi

Dear Professor Vaidya,

This is with reference to the correspondence you had with Prof. Shyam Menon, Vice Chancellor, Ambedkar University Delhi (AUD) in connection with SPA-D setting up a Hub for an inter-disciplinary Design Innovation Centre (DIC) at the invitation of MHRD. Professor Menon has already communicated by email our willingness to collaborate in this partnership.

Under the Hub and Spoke model, we would like to confirm this proposal extended to the AUD to be one of the three Spokes along with SPA Bhopal and SPA Vijayawada. The School of Design at AUD will be primarily engaged with this initiative and will coordinate with Dr. Leen Morenas, Associate Professor SPA-D as advised by you.

The proposal for the same is being sent separately.

With best regards

[Signature]
Professor Jam Bhart
Dean School of Design, AUD

Copy to:
Vice Chancellor AUD
Registrar AUD
JAWAHRLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Kakinada -533003, Andhra Pradesh, India

Proposal for
Design Innovation Centre

Submitted to
Department of Higher Education
Ministry of Human Resource Development
New Delhi
September 2015
Dr. G. V. R. Prasada Raju  
B.E., M.E., Ph.D.
REGISTRAR

To

Shri Rakesh Ranjan  
Joint Secretary (Policy) & Member Secretary (PAB)  
Government of India  
Ministry of Human Resource Development  
Dept. of Higher Education  
New Delhi

Sir,

Sub:- Design Innovation Centre - Submission of revised proposal - reg.

I am glad to learn that JNTUK is under consideration for setting up of “Design Innovation Centre”. With reference to the above, we herewith submit the revised proposal for your kind perusal. I request you to kindly consider the proposal and do the needful.

Thanking you,

Yours faithfully,

REGISTRAR
CERTIFICATE

This is to inform that the funds received for the purpose of "Design Innovation Centre" will be utilized for the purpose given in the application form and will be open to a review by the Government of India, Ministry of Human Resource Development.

Date: 27-05-2015

Signature of the Registrar with stamp

REGISTRAR
J.N.T. University Kakinada
KAKINADA-533 003
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   - 3.1.2 Innovation
   - 3.1.3 Products proposed
   - 3.1.4 Budget Details
   - 3.1.4.1 Itemized Budget for Manpower requirement
   - 3.1.4.2 Itemized Budget for Material requirement
   - 3.1.5 Deliverables
   - 3.1.6 Sustainability

   3.2 Training program on “Design of Solar-photovoltaic equipment”
   - 3.2.1 Objectives
   - 3.2.2 Activities
   - 3.2.3 Budget Details
   - 3.2.4 Itemized Budget for Training Equipment
   - 3.2.5 Deliverables

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   - 3.3.4 Budget Details
   - 3.3.4.1 Itemized Budget for Equipment

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   Maharaj Vijayaram Gajapati Raj College of Engineering (MJGR)

   4.1 Design and Development of Bio-mass fired wood gas stoves for rural applications
4.1.1 Introduction
4.1.2 Objectives
4.1.3 Technology Innovation Scope
4.1.4 Activity Schedule
4.1.5 Budget Details
4.1.6 Itemized Budget for permanent equipment
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4.1.9 Deliverables

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5.1.4 Budget Estimation
5.1.5 Itemized Budget for Permanent Equipment
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5.1.7 Itemized details for Material requirement
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EXECUTIVE SUMMARY

For a growing country such as India, the quality technical education drives the progress of industries contributing to around 20% of GDP which act as a formidable pillar for the growing economy. On the backdrop of thrust given to technical higher education in the country, the new focus is on innovation. It is has become indispensable even for the global companies to adopt “Innovate or Perish” which indicates the importance given to innovation and critical design in the present day world.

Jawaharlal Nehru Technical University Kakinada (JNTUK), being a Design Innovation Centre, imparts quality technical education on innovation in design to its students, while promoting an eco-system to take the ideas from academic labs to the market. In addition, it facilitates interdisciplinary design-focused education, research and entrepreneurial activities in order to create commercial opportunities and build partnerships between academics and industry in the country leading to significant contributions and breakthroughs impacting quality of human life.

The following programmes are proposed as a part of the project with three different potential institutes acting as the satellite centres and JNTUK as the hub: i) Design and Development of Solar-Energy based Products, ii) Design and Development of Biomass gas stoves for rural applications, iii) Design of Eco-friendly Refrigeration and Air-conditioning systems, and IV) Centre for Design and Development of Advanced Cutting Tools. These projects are suitable for green manufacturing. The training programmes corresponding to the above specified projects are also proposed, in addition to P.G and U.G courses. The P.G and U.G courses are introduced in order to infuse design concepts into curriculum. Totally nine programs are proposed; three design projects, two training programs, one design centre, two U.G courses and one P.G course.
All the programs are designed in such a way that they are innovative, inter-disciplinary, and sustainable in character. The programs are of immediate benefit to the society and embrace enough potentiality for commercialization and sustainability.
1. INTRODUCTION TO JNTUK

Jawaharlal Nehru Technological University Kakinada (JNTUK), established in the year 2008, has a renowned history. It had its genesis in 1946 as Government College of Engineering and became a part of JNTU, Hyderabad in the year 1972. Later in the year 2008, it was transformed into a full-fledged Andhra Pradesh State Government University.

At the moment, JNTUK is the second biggest technological university in India, having 224 Engineering Colleges affiliated to it. The University has the student strength of around three lakhs, catering to the needs of Coastal Andhra Pradesh. Over the years, JNTUK campus has produced highly professional and competitive engineers and is infusing greater quality and content into the curriculum and educating the students with appropriate skills in the fields of science, technology, engineering, and management (STEM).

The University is currently offering 21 U.G and 82 P.G Programmes. It largely focuses on P.G studies and Research in Multi-disciplinary areas of science and technology and established various schools viz, food technology, bio-technology, nano-technology, pharmacy, spatial information technology and health sciences besides conventional engineering disciplines. The University has 13 MOUS, with international universities across the globe to promote international collaboration.
2. SATELLITE INSTITUTIONS & PROGRAMS OFFERED

Fig. 1 exhibits the “Hub & Spoke Model” in which JNTUK acts as the hub to the 3 satellite centres proposed under the scheme. JNTUK, being the hub, acts as a mentor for synergizing and leveraging the potential of its satellite institutes and provides an environment to transform the innovative ideas generated at the academic institutes into the physical products.

Table 1 lists the institutions and the corresponding programs they offer under the scheme. Several brainstorming sessions were held with the satellite institutes before the respective programs were finalized. The programs were finalized based on the competence of the faculty and basic infrastructure available with the satellite institutions.

Table 1

<table>
<thead>
<tr>
<th>Institution</th>
<th>Program</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEC</td>
<td></td>
</tr>
<tr>
<td>JNTUK</td>
<td></td>
</tr>
<tr>
<td>MVGR</td>
<td></td>
</tr>
<tr>
<td>LBRCE</td>
<td></td>
</tr>
</tbody>
</table>

Fig. 1. Hub & Spoke Model
<table>
<thead>
<tr>
<th>Institution</th>
<th>Program proposed</th>
</tr>
</thead>
</table>
| **1. Satellite Institution -1**  
Lakireddy Balireddy College of Engineering (LBRCE), Reddy Nagar, Mylavaram, Krishna District, PIN-521230 | i) Design and Development of Solar-Powered Products  
ii) Training programs on “Design of Solar-Photovoltaic Equipment”  
iii) U.G course on “Renewable Energy Sources” |
| **2. Satellite Institution -2**  
Maharaj Vijayaram Gajapati Raj College of Engineering (MVGR), Chintalavalasa, Vijayanagaram, Vijayanagaram District, PIN-521505 | i) Design and Development of Biomass fired wood gas stoves for Rural applications  
ii) Training Programs on “Design of Biomass fired wood gas stoves” |
| **3. Satellite Institution -3**  
Gudlavalleru Engineering College (GEC), Gudlavalluru, Krishna District, PIN-521356 | i) Design and Development of Eco-friendly Refrigeration and Air-conditioning systems  
ii) U.G course on “Refrigeration and Air-conditioning systems” |
| **4. Hub - Jawaharlal Nehru Technological University Kakinada (JNTUK)** | i) Centre for “Design & Development of Advanced Cutting Tools”  
ii) P.G Course on “Design with Advanced Materials” |
3. SATELLITE INSTITUTION-1: LAKIREDDY BALIREDDY COLLEGE OF ENGINEERING (LBRCE)

The College was established in the year 1998 with the aim of providing high quality education in engineering to create employment to the deserving personnel. The UGC vide its Letter No.22-1/2010(AC), August 2010 conferred the status of Autonomy to this college and is recognized under 2(f) and 12(B). The institution is accredited by NAAC with 'A' grade. The NBA of AICTE also accredited the institution and application is now being submitted for renewal. All academic and administrative procedures are ISO 9001:2008 certified.

3.1 DESIGN AND DEVELOPMENT OF SOLAR-POWERED PRODUCTS

The world is rapidly changing the way it produces and consumes energy. As fossil fuels are getting depleted fast and usage of such fuels is deleterious to the environment, the demand for clean and sustainable energy sources has grown exponentially.

We, as an academic organization, have focused on promoting renewable energy for agricultural and domestic applications. We make our every effort to extend the usage of solar technology to the common man through different activities proposed in the scheme.

3.1.1 Objective

To

Design and Develop low cost and efficient solar energy based products
3.1.2 Innovation

- To develop a new power point tracking algorithm for extracting maximum power from PV array in which the DC-DC boost converter and three-phase inverter will be designed to operate under soft switching scheme to reducing the switching losses and improving overall efficiency of the solar system. This proposed scheme will be suitable for both grid connected applications and standalone applications.

3.1.3. Products proposed

As the energy is generated and utilized at the same place; there are no lengthy cables running and hence are less transmission losses. We will enjoy freedom from monthly electricity bills as well as satisfaction that comes with owning and operating an environmental friendly unit. The following products will be designed and developed at the centre:

**Solar Torch** – Light weight solar torches comprising solar panels of different capacities will be developed. Batteries will also be attached to them for power storage. They will be cost-effective and easy-to-use items.

**Solar LED light** – This product will be developed to have easy installation, longer service life and low energy consumption. A variety of products in range of 5W to 10W will be developed.

**Solar tube light** - A low cost solar tube light with soft and evenly dispersed natural light will be developed that requires no operating and maintenance costs.
**Blind stick** - This product will make it quite a practical solution for blind commuters. The Eye Stick will be fitted with a sensor lens towards the bottom part, from where it picks up location bearings, like is the person nearing a staircase, or is he near the traffic lights.

**Solar mobile charger** - Mobile needs frequent charging which consume a lot of electricity but in rural area electricity is not available because of frequent cuts. A durable mobile charger with sufficient battery backup will be developed.

**Solar calculator** - This kind of products will be developed utilizing liquid crystal displays as they are power efficient and capable of operating in the low voltage range of 1.5 - 2 V. 5W capacity solar calculators will be developed.

**Solar laser pointer** - This laser pointer and LED flashlight will be designed in such a way that it hangs on a keychain and requires no batteries whatsoever since it gets all the power it needs from the sunlight or from the room light.

**Solar agricultural pump sets** - In this proposed system we utilize the solar energy from solar panels to automatically pump water from bore well directly into a ground level storage tank depending on the intensity of sunlight. While conventional methods include pumping of water from bore well into a well and from this well onto field using another pump, our system uses only a single stage energy consumption wherein the water is pumped into a ground level tank from which a simple valve mechanism controls the flow of water into the field. This saves substantial amount of energy and efficient use of renewable energy. A valve is controlled using intelligent algorithm in which it regulates the flow of water into the field depending upon the
moisture requirement of the land. In this system we use a soil moisture sensor that detects the amount of moisture present in the soil and depending upon the requirement of level of moisture content required for the crop the water flow is regulated thus, conserving the water by avoiding over flooding of crops.

**Solar water heater** - It will be designed to provide hot water at the required temperatures having its availability even on partially cloudy days.

**Portable solar refrigerator** - Highly efficient units with exceptionally low energy consumption will be designed to require a smaller photovoltaic system for refrigeration needs. The brushless dc motor compressor operates on 12 or 24 V DC.

**Solar cooker** - A solar cooker based on sunlight will be developed that does not consume any fuel and running cost.

**Solar DC Ceiling fan** - Trouble-free and long life solar fans for continues use will be developed.

**Solar Table fan** - It will be a double duty fan with LED emergency light that comes with single battery. In the event of AC power cut, the DC fan can run for 3 hours with high speed and 5 hours with low speed.

**Solar water purifier** - A high quality Solar Water Purifier which can give purified water will be developed for its ideal design to save power. The other benefits include easy installation and minimal maintenance and affordable price.
Solar inverters - These will be manufactured with proper protection against output overload & short circuit, output over voltage and battery low. The sine wave Inverter- 200 VA will have the indications for mains ON, inverter ON, battery low, overload and charging ON / LCD optional. This inverter will be also developed with changeover of electromechanical switch.

Solar desalination unit - A solar powered desalination unit will be produced from potable water from saline water through direct or indirect methods of desalination powered by sunlight.

3.1.4 Budget Details (Rs. in Lakhs)

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Head</th>
<th>1st Year</th>
<th>2nd Year</th>
<th>3rd Year</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<td>10.00</td>
<td>6.00</td>
<td>28.00</td>
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<tr>
<td></td>
<td>40kW Panels</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>2</td>
<td>Man Power</td>
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<td>9.48</td>
<td>10.2</td>
<td>29.16</td>
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<tr>
<td>3</td>
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<td>1.5</td>
<td>4.5</td>
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<td>requirement</td>
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<td></td>
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<td><strong>20.98</strong></td>
<td><strong>17.70</strong></td>
<td><strong>61.66</strong></td>
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### 3.1.4.1 Itemized Budget for Manpower Requirement

(Rs. in Lakhs)

<table>
<thead>
<tr>
<th>S.No</th>
<th>Type</th>
<th>Number required</th>
<th>1&lt;sup&gt;st&lt;/sup&gt; Year</th>
<th>2&lt;sup&gt;nd&lt;/sup&gt; Year</th>
<th>3&lt;sup&gt;rd&lt;/sup&gt; Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Junior Research Fellow (@Rs. 25,000 for first two years and Rs. 28,000 for third year)</td>
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<td>3.00</td>
<td>3.00</td>
<td>3.36</td>
</tr>
<tr>
<td>2.</td>
<td>Technicians (@Rs. 12,000 for first two years &amp; @Rs. 15,000 for third year)</td>
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<td>2.88</td>
<td>2.88</td>
<td>3.24</td>
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<tr>
<td>3.</td>
<td>Internships @Rs. 6,000 for six months in a year</td>
<td>10</td>
<td>3.6</td>
<td>3.6</td>
<td>3.6</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td></td>
<td><strong>9.48</strong></td>
<td><strong>9.48</strong></td>
<td><strong>10.2</strong></td>
</tr>
</tbody>
</table>

### 3.1.4.2 Itemized Budget for Material Requirement

(Rs. in Lakhs)

<table>
<thead>
<tr>
<th>S.No</th>
<th>Item</th>
<th>1&lt;sup&gt;st&lt;/sup&gt; Year</th>
<th>2&lt;sup&gt;nd&lt;/sup&gt; Year</th>
<th>3&lt;sup&gt;rd&lt;/sup&gt; Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Consumables</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2.</td>
<td>Overhead charges</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>1.5</strong></td>
<td><strong>1.5</strong></td>
<td><strong>1.5</strong></td>
</tr>
</tbody>
</table>
3.1.5 Deliverables

- Improvement in the efficiency of DC-DC converter operation under soft switching scheme and proposed MPPT techniques.
- Cost-effective innovative solar products useful for Rural areas and Agriculture, etc.
- The numbers of solar products that will be developed at the centre are as in Table 2 and the developments of products with respect to the timelines are provided in Section 8.

<table>
<thead>
<tr>
<th>Type</th>
<th>1st Year</th>
<th>2nd Year</th>
<th>3rd Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of different Solar products proposed to develop</td>
<td>10</td>
<td>9</td>
<td>8</td>
</tr>
</tbody>
</table>

![Solar Torch](image1)

![Solar LED light](image2)
Solar LED Tube light

Solar Inverter

Solar Calculator

Solar laser pointer

Solar Pumping

Solar Water Heater

Solar Portable Refrigerator
3.1.6 Sustainability after 3 years

- Revenue generation through commercialization of products
- The excess energy produced using solar panels might be given to the grid which can be a source of the revenue of the centre.
- Revenue generation through training programs

3.2 TRAINING PROGRAMS ON "DESIGN OF SOLAR-PHOTOVOLTAIC EQUIPMENT"

This training program aims at imparting practical knowledge on the working of Photovoltaic Systems to the participants. The application of Photovoltaic modules is eventually to use them in a system which can produce electrical output. The system components will comprise
inverters, charge controllers, batteries etc. The output derived can be either used directly by a set of loads or stored for later use or can be fed to the common power grid.

The program gives end-to-end learning and hands-on experience on Solar PV Systems. The program is intended to equip its users with all the skills required by the industry and ignite the scholars for further research.

3.2.1 Objectives

- To provide in-depth knowledge on the technical aspects of the solar PV energy.
- To provide practical and real time experience on various applications of solar energy.
- To create awareness about the various schemes with regard to renewal energy sources being offered by the government.

3.2.2 Activities

This course imparts training to the student community and the unemployed youth for the numbers of 50 for the duration of two weeks every year. It covers the following topics:

- Design of solar PV systems.
- Comprehensive coverage of the system sub-components.
- Troubleshooting measures.
- Installation and maintenance of different solar products.
- Creating awareness of Government policies and schemes.
- Providing Entrepreneurial guidance and Job assistance

Basically the program encompasses the training on the following key activities:
(i) Solar PV Stand-Alone System Concepts

(ii) Solar PV Grid - Tied Concepts

(iii) Solar PV Emulation

i) Solar PV Stand-Alone System Concepts

**PV characteristics**
- Single PV module I-V and P-V characteristics with radiation and temperature changing effect.
- I-V and P-V characteristics with series and parallel combination of modules.
- Effect of shading.
- Effect of tilt angle.
- Demonstration of bypass and blocking diode.

**Stand alone system**
- Battery charging and discharging characteristics.
- Demo of system using DC load with battery (with variable rated capacity of system).
- Demo of system using AC load with battery.
- Combined AC and DC load system with battery.

**Maximum Power Point Tracking**
- Finding MPP by varying the resistive load across the PV panel.
- Finding MPP by varying the duty cycle of DC-DC converter.
- Finding Vmax, Imx and Pmax and duty cycle at which MPP occurs.
- Performing the above experiments with battery in the circuit.

**Inverter**
- Observing the output voltage waveform of inverter in auto mode.
- Observing the output voltage with manual control.
  - 180° control
  - 120° control and
• Observing the RMS value and waveform of output voltage with both 180° and 120° control.

ii) Solar PV Grid-Tied Concepts

• Theoretical Study of Complete grid tied system with virtual grid
• Grid Synchronization and Assessment of Power Quality
• Demonstrate grid dynamics and power quality with linear and non-linear load
• Evaluate the active and reactive power flow between two inverters and load
• Demonstrate Islanding Protection of Grid Tied inverter
• Demonstration of change in load angle (angle between inverter voltage and grid voltage) at the terminals of both standalone and grid tied inverter with change in local load, change in input power from PV panels

iii) Solar PV Emulation

• MPPT algorithm testing
• Inverter control testing for different operating conditions
• Analysis and characterization of solar stand alone PV system
• Analysis and characterization of grid connected system
• Micro-grid and smart grid control testing
3.2.3 BUDGET DETAILS (Rs. in Lakhs)

<table>
<thead>
<tr>
<th>S.No</th>
<th>Head</th>
<th>1st Year</th>
<th>2nd Year</th>
<th>3rd Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Training Equipment</td>
<td>27.35</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>2.</td>
<td>Consumables &amp; Overhead charges</td>
<td>1.40</td>
<td>1.40</td>
<td>1.20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>28.75</td>
<td>1.40</td>
<td>1.20</td>
</tr>
<tr>
<td></td>
<td>Grand Total:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>31.35</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3.2.4 Itemized Budget for Training Equipment (Rs. in Lakhs)

<table>
<thead>
<tr>
<th>S.No</th>
<th>Name</th>
<th>1st Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Solar PV Training &amp; Research Kit</td>
<td>9.60</td>
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<tr>
<td>2</td>
<td>Solar PV Grid Tied Training Kit</td>
<td>8.25</td>
</tr>
<tr>
<td>3</td>
<td>Solar Emulator</td>
<td>9.50</td>
</tr>
<tr>
<td></td>
<td>Total:</td>
<td>27.35</td>
</tr>
</tbody>
</table>

3.2.5 Deliverables

The total number of beneficiaries is 50 members each year. The participants will be given enough practical exposure and theoretical knowledge.
Climate change and the need to manage diminishing fossil fuel reserves are, today, two of the biggest challenges facing the planet. It is high time that one should look for the alternative sources of energy.

There are several important reasons that make renewable energy extremely important for the future of the society. Positive environmental impact is certainly one of the most important reasons. Fossil fuels when burn, create harmful greenhouse gas emissions and our planet is already feeling the impact of climate change. By using renewable energy instead of fossil fuels the current levels of greenhouse gas emissions could be significantly decreased, and this would have positive environmental impact.

Renewable energy is not all about environment as it can also give strong boost to the economy. The number of people employed within the renewable energy industry is rapidly growing, giving many countries an excellent option to boost their economies in this post-recession period.

Renewable energy can also improve energy security by reducing the need for foreign oil import. The global oil market has been characterized by extremely volatile prices and the nation’s dependence on oil continues to grow. By switching to renewable energy and using more domestic renewable energy sources instead of importing foreign oil, the energy security and energy independence on foreign countries could be drastically improved.

In view of the importance of the renewable energy in the present context, an U.G course is planned.

3.3.1 Objective

To produce the competent and well-trained graduates to the nation to design the renewable energy systems
3.3.2 Content of the Program

Renewable energy is available in various forms such as energy, wind, solar, geothermal, hydroelectric, and biomass. The syllabus for the program is designed in such a way that it covers all the forms of Renewable energy. The syllabus for the course is given in Annexure – I.

3.3.3 Learning Outcomes

Students will be able to

- Realize the significance of renewable energy
- Understand the principles of solar radiation
- Design and develop the solar-based equipment
- Learn to design the wind energy systems
- Understand the working principles of geothermal, ocean, biomass, tidal and wave energy techniques.
- Know the functioning of direct energy conversion techniques.

3.3.4 Budget Details (Rs. in Lakhs)

<table>
<thead>
<tr>
<th>S.No</th>
<th>Head</th>
<th>1st Year</th>
<th>2nd Year</th>
<th>3rd Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Equipment</td>
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<td></td>
</tr>
<tr>
<td>2</td>
<td>Spare parts &amp; Consumables</td>
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<td>2.50</td>
<td>2.00</td>
</tr>
<tr>
<td>3</td>
<td>Contingencies &amp; Overhead charges</td>
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<td>1.40</td>
<td>1.20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>24.64</td>
<td>3.90</td>
<td>3.20</td>
</tr>
<tr>
<td></td>
<td><strong>Grand Total:</strong></td>
<td><strong>31.74</strong></td>
<td></td>
<td></td>
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</table>
3.3.4.1 Itemized Budget for Equipment (Rs. in Lakhs)

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Name</th>
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</thead>
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<td>1.</td>
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<td>2.</td>
<td>Wind Turbine Emulator</td>
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<tr>
<td></td>
<td><strong>Total:</strong></td>
<td><strong>21.74</strong></td>
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</table>

3.4 Total budget requirement for Satellite Institute -1 (Rs. in Lakhs)

<table>
<thead>
<tr>
<th>Activity</th>
<th>1st Year</th>
<th>2nd Year</th>
<th>3rd Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project on “Design and Development of Solar-powered products”</td>
<td>22.98</td>
<td>20.98</td>
<td>17.70</td>
</tr>
<tr>
<td>Training programs on “Design of Solar-photovoltaic equipment”</td>
<td>28.75</td>
<td>1.40</td>
<td>1.20</td>
</tr>
<tr>
<td>U.G Course on “Renewable Energy Sources”</td>
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<td>3.20</td>
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<td><strong>Grand Total</strong></td>
<td><strong>76.37</strong></td>
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<td><strong>22.10</strong></td>
</tr>
</tbody>
</table>

RESEARCH TEAM
Dr. S.V. Jagadeesh Chandra, Professor, Department of ECE, LBREC
Dr. A. Narendra Babu, Professor, Department of ECE
Mr. J. Sivavara Prasad, Associate Professor, Department of EEE
Dr. Dileep Kumar, Associate Professor, Department of Mechanical Engineering
Dr. P. Vijaya Kumar, Professor, Dept. of Mechanical Engineering
4. SATELLITE INSTITUTION - 2:

MAHARAJ VIJAYARAM GAJAPATI RAJ COLLEGE OF ENGINEERING (MVGR)

This college is being run with the motto "Service to Society" by an educational trust with Shri P Ashok Gajapathi Raju as the Vice-Chairman. Shri P Ashok Gajapathi Raju is currently in the cabinet of Central Government and holding the portfolio of Union Minister for Civil Aviation. He is acclaimed to be an ideal politician for his upright principles of democracy, truthfulness to public service and for his honesty and modesty.

This institute was established in 1997 and is accredited by NBA and also NAAC with 'A' Grade. The college is listed under Section 2(f) & 12 (b) of UGC Act 1956. MVGR College of Engineering strives to become a center par excellence for technical education where aspiring students can be transformed into skilled and well-rounded professionals with strong understanding of fundamentals, a flair for responsible innovation in engineering practical solutions applying the fundamentals, and confidence and poise to meet the challenges in their chosen professional spheres.

The college, over the last several years, has been receiving several recognitions and rewards from external agencies for its innovative activities.

- Department of Science and Technology (DST) under the Ministry of Science and Technology, Government of India has sanctioned a research grant of Rs 38.72 lakhs in the academic year 2009-10 for funded research in the area of intelligent CNC machine tool development.
• Another DST project carrying a research grant of Rs. 27.66 lakhs has been sanctioned in the academic year 2014-15 for research in the area of development of optode for fluoride detection by digital colour analysis.

• University Grants Commission (UGC) has sanctioned 4 Minor Research Projects with a total grant of Rs. 12.05 lakhs.

• AICTE, Ministry of Human Resource Development, Government of India has sanctioned an Entrepreneurship Development Cell with an initial funding of Rs 7 lakhs.

• The college is recognized as a Business Incubator Centre by the Ministry of Micro, Small and Medium Enterprises (MSME), Government of India.

• Askar Microns of Mysore, Parametric Technologies Corporation of Bangalore and Zeus Numerics of Mumbai have signed an agreement of collaboration with the college for extending training and research facilities to students and staff.

• The college has excellent rapport with major MNCs in the IT Industry. The college has been accredited by TCS and the college hosts placement drives annually by TCS, Infosys, Wipro, Sonata and many other IT and non-IT companies ensuring placement to 70% of eligible students.

• The college is undertaking consultancy/research projects from AICTE, DST, and Govt. of A.P etc. Around Rs.60lakhs worth equipment have been procured under MODROBS.
4.1 DESIGN AND DEVELOPMENT OF BIO-MASS FIRED WOOD GAS STOVES FOR RURAL APPLICATIONS

4.1.1 Introduction

Combating climate change by reducing greenhouse gas emissions arising from human activities is a top priority for many policy makers across the world to ensure that the most severe impacts can be avoided (or minimised). Goals are to halt global increases in greenhouse emissions by 2020, to halve anthropogenic greenhouse gas emissions by the middle of the century and then to ensure that they continue to fall.

Transport generally accounts for a major part of greenhouse gases, making it the second largest sector source, after the electrical supply industry. In addition to the objective of saving greenhouse gas emissions, it is noted that the transport sector is currently heavily dependent on imports of crude oil and that the sources of supply are limited and subject to political instability. Biomass would help mitigate climate change, provided that they produce real savings in greenhouse gas emissions. Since the beginning of civilization, cooking has been another major area of fuel requirement involving initially wood and biomass and later liquefied petroleum gas on a large scale. Again, with the rapid depletion crude oil and natural gas reserves, wood and biomass are once again gaining prominence in the urban sector while the rural sector has always been heavily dependent upon biomass.

Rural areas of India tend to rely on traditional biomass (including firewood, animal dung, and agricultural residue) for cooking, heating, and lighting because they lack access to other energy supplies. According to the 2011 India census (refer Table 1), 62.5% of rural households use firewood as the primary fuel for cooking, 12.3%
use crop residue as the primary cooking fuel, and 10.9% use dung. These uses can cause health problems from exposure to waste products and pollution or environmental problems when forests or crops are harvested unsustainably.

In view of the above, the present work is taken up to design a variety of biomass fired wood gas stoves. Initially, Biomass waste like sawdust, wheat straw, rice straw, corn stalk, rice husk, coconut shell, palm fiber and palm shell, sunflower stalk, forestry wastes, wood chips and other will be used for making the pellets. The composition of the pellets will be designed in such a way that it contains the maximum calorific value.

4.1.2 Objectives

- To design innovative wood gas stoves overcoming current design limitations using various pellet/briquette biomass shape combinations.
- To develop and optimise pelletisation blend and shape configuration for wood/agri-waste (rice husk, coconut shells, maize straw, saw dust, etc.) for use in wood gas stoves.
- To study and propose an effective process design for large-scale pelletisation of agri-waste depending upon availability of agri-waste.
- To impart awareness and skill on the access to the proposed technologies to pre-selected groups of rural youth for increased entrepreneurship.
4.1.3 Technology Innovation Scope

- The project develops innovative wood gas stove models using wood/agri waste biomass that will meet rural requirements as well as create entrepreneurial opportunities for the youth.

- It is intended to develop an optimised (in terms of properties like calorific value) wood/agri-waste blend as a product for wood gas stoves.
### 4.1.4. Activity schedule

<table>
<thead>
<tr>
<th>S. N.</th>
<th>Activity</th>
<th>Description</th>
<th>1st Year</th>
<th>2nd Year</th>
<th>3rd Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Equipment Purchase &amp; Field Survey</td>
<td>Procuring the equipment for biomass pellet preparation and testing</td>
<td>3</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>Recruitment of staff</td>
<td>Recruiting one research scholar and one technician</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Collection and Preparation of biomass pellets</td>
<td>The pellets are prepared by using Briquetting using wood/agriwaste</td>
<td>3</td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td>4</td>
<td>Characterisation of biomass</td>
<td>Testing of properties for biomass pellets</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Product development</td>
<td>Design and development of new wood gas stove/gasifier</td>
<td>3</td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td>6</td>
<td>Field implementation</td>
<td>Creating awareness and skill on the access to proposed technologies</td>
<td>3</td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td>7</td>
<td>Final report</td>
<td>Preparing the final feasible report</td>
<td>3</td>
<td>6</td>
<td>9</td>
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### 4.1.5 Budget details (Rs. in Lakhs)

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<th>Head</th>
<th>1&lt;sup&gt;st&lt;/sup&gt; Year</th>
<th>2&lt;sup&gt;nd&lt;/sup&gt; Year</th>
<th>3&lt;sup&gt;rd&lt;/sup&gt; Year</th>
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<td>6.48</td>
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<tr>
<td>3</td>
<td>Materials requirement</td>
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<td>3.00</td>
<td>3.00</td>
<td>9.00</td>
</tr>
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<td></td>
<td></td>
<td>60.48</td>
<td>11.48</td>
<td>14.84</td>
<td>86.80</td>
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### 4.1.6 Itemized Budget for permanent equipment (Rs. in Lakhs)

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<tr>
<th>S.No</th>
<th>Equipment</th>
<th>1&lt;sup&gt;st&lt;/sup&gt; Year</th>
<th>2&lt;sup&gt;nd&lt;/sup&gt; Year</th>
<th>3&lt;sup&gt;rd&lt;/sup&gt; Year</th>
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<td>Gas Calorimeter</td>
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<td>2</td>
<td>Ash and volatile matter tester</td>
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</tr>
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<td>3</td>
<td>Carbon residue tester</td>
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<td></td>
</tr>
<tr>
<td>4</td>
<td>Titration Apparatus</td>
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</tr>
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<td>5</td>
<td>Ultra Sonicator (With ear muffs)</td>
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<td></td>
</tr>
<tr>
<td>6</td>
<td>HPLC</td>
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<td>7</td>
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<tr>
<td></td>
<td>Software</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Briquetting Machine</td>
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<td></td>
</tr>
<tr>
<td>9</td>
<td>Pelletiser</td>
<td>2.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Wood chipper</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Hammer mill</td>
<td>5.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Saw dust dryer</td>
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<td>13</td>
<td>Cooler</td>
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<tr>
<td>14</td>
<td>Pellet machine</td>
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<td>15</td>
<td>Shearing Machine</td>
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<td>16</td>
<td>Seam Welding Machine</td>
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</tr>
<tr>
<td>S.No</td>
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<td>1st Year</td>
<td>2nd Year</td>
</tr>
<tr>
<td>------</td>
<td>-----------------------</td>
<td>-----------------</td>
<td>----------</td>
<td>----------</td>
</tr>
<tr>
<td>1.</td>
<td>Technicians (@Rs. 12,000 for first two years &amp; @Rs. 15,000 for third year)</td>
<td>2</td>
<td>2.88</td>
<td>2.88</td>
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<tr>
<td>2.</td>
<td>Internships (@Rs. 6,000 for six months in a year)</td>
<td>10</td>
<td>3.60</td>
<td>3.60</td>
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<td></td>
<td><strong>Total</strong></td>
<td></td>
<td>6.48</td>
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</table>

### 4.1.7 Itemized Budget for Manpower Requirement
(Rs. in Lakhs)

### 4.1.8 Itemized Budget for Material Requirement
(Rs. in Lakhs)

<table>
<thead>
<tr>
<th>S.No</th>
<th>Item</th>
<th>1st Year</th>
<th>2nd Year</th>
<th>3rd Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Consumables</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2.</td>
<td>Overhead charges</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
4.1.9 Deliverables

The project ultimately results in various designs of gas stoves. The following are a few examples of such products. The expected design variants are listed below:

a) Stove with Forced draught (side air flow)  
b) with bottom air flow  

c) Views of double chamber wood gas stove for preheating of air

Fig. 3 Typical products to be produced
The numbers of products that come out of the project are given below:

1st Year:
- To develop about 4 prototypes of upward-drift wood gas stoves/gasifiers
- To develop about 6 high calorific value bio-mass fuel-mix products from locally available agri-waste and bio-mass suitable for mass production.

2nd Year:
- To develop another 4 prototypes of upward-drift wood gas stoves
- To develop about 6 prototypes of downward-drift wood gas stoves

3rd Year:
- To develop about 6 prototypes of mixed burning wood gas stoves
- To develop and test about 6 sizes and shapes of briquettes and pellets both for optimal burning and storage.

The realization of products with respect to the timelines is given in Section 8.

4.2 TRAINING PROGRAM ON “DESIGN OF BIOMASS FIRED WOOD GAS STOVES”

4.2.1 Objectives
- Study of different types of biomass resources
- Understand and analyze performances of various conversions systems.
- Design and development of optimal bio-mass fuel blends.
- Design and selection of the materials for stove/gasifier units.
- To customize Control and Regulation of stove/gasifier unit performance.
• To assess and evaluate economic and commercial viability.
• To develop generic designs for scalability.
• To analyze and assess impact of bio-mass fuels on the environment.

4.2.2 Course contents

Module-1

• Generic study about biomass fuel characteristics
• Classification and Quantification of major biomass products
• Comparative study of biomass with traditional fuels,
• Biomass beneficiation process and enrichment
• Biomass conversion technologies (briquetting, pelletisation, gasification)
• Optimization of biomass configuration for rural household energy requirements
• Performance and comparative analysis of various bio-mass blended products

Module-2

• Introduction of wood gas stoves, components, combustion chamber, accessories.
• Principle of pyrolysis
• Gasification technologies (updraft/down draft/cross draft)
• Briquetting and pelleting technologies
• Types of draught (forced, induced and balanced)
• Methods of Control of combustion
• Prototype design, development and testing
• Design of wood gas stove, selection of materials

Module-3

• Fuel feeding mechanisms
• Impact of exhaust flue gases on materials
• Environmental impact (air pollution)
• Merits, demerits and commercial viability of bio-mass fuels against traditional fuels
• Design Safety validation

4.2.3 Benefits to the Rural Communities

• Entrepreneurship opportunities for rural youth in the establishment of pelletisation and briquetting units for bio-mass fuels

• Training to semi skilled and unskilled rural man-power on repair, replacement and maintenance aspects

• Facilitation of establishment of stove fabrication units thru promoting Govt agencies.
4.2.4 Work plan

<table>
<thead>
<tr>
<th>S. No</th>
<th>Activity</th>
<th>Description</th>
<th>1st Year</th>
<th>2nd Year</th>
<th>3rd Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Equipment Purchase &amp; Field Survey</td>
<td>Procuring the equipment for biomass pellet preparation and testing</td>
<td>3</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>Recruitment of staff</td>
<td>Recruiting one research scholar and one technician</td>
<td></td>
<td></td>
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<tr>
<td>3</td>
<td>Collection and Preparation of biomass pellets</td>
<td>The pellets are prepared by using Briquetting using wood/agriwaste</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Characterisation of biomass</td>
<td>Testing of properties for biomass pellets</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Product development</td>
<td>Design and development of new wood gas stove</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Field implementation</td>
<td>Creating awareness and skill on the access to proposed technologies</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Final report</td>
<td>Preparing the final feasible report with obtained results</td>
<td></td>
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</table>
4.2.5 Budget details for the training program

<table>
<thead>
<tr>
<th>S. No</th>
<th>Head</th>
<th>1st Year</th>
<th>2nd Year</th>
<th>3rd Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Spare parts &amp; Consumables</td>
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<td>2.</td>
<td>Contingencies &amp; Overhead charges</td>
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<td>1.40</td>
<td>1.20</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Grand Total:</td>
<td>3.90</td>
<td>3.90</td>
<td>3.2</td>
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</table>

4.2.6 Deliverables

All the expenditure associated with the conduct of the above training program will be borne by the institute. The above program is meant for 50 members and conducted each year. Timelines are given in Section 8.

Investigating team:

Principal Investigator: Dr. P. Ravindranadh, Professor of Mechanical Engineering

Co-Investigator:1 Sri. P. RangaRaju, Associate Professor of Mechanical Engineering

Co-Investigator:2 Dr. T. V. N. P. Sarathi, Professor of Chemistry

Co-Investigator:3 Dr. B. Sarva Rao, Professor of Chemical Engineering
4.3 Total budget requirement for Satellite Institute -2 (Rs. in Lakhs).

<table>
<thead>
<tr>
<th>Activity</th>
<th>1st Year</th>
<th>2nd Year</th>
<th>3rd Year</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design and Development of Biomass fired wood gas stoves for Rural applications</td>
<td>60.48</td>
<td>11.48</td>
<td>14.84</td>
<td>86.80</td>
</tr>
<tr>
<td>Training Programs on “Design of Biomass fired wood gas stoves”</td>
<td>3.90</td>
<td>3.90</td>
<td>3.2</td>
<td>11.00</td>
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<td>Total</td>
<td>64.38</td>
<td>15.38</td>
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</table>

Grand Total: 97.80
5. SATELLITE INSTITUTION - 3: GUDLAVALLERU ENGINEERING COLLEGE (GEC)

The institute was established in the year 1998 with the objective of establishing, aiding and maintaining technical, engineering and general educational institutions. The credentials of the college have been put under the following points:

- NBA Accreditation: B.Tech Program in CSE has been re-accredited for 5 years and B.Tech Programs in EEE, ME, ECE & IT have been provisionally re-accredited for 2 years w.e.f. 05-08-2013. Earlier all these 5 UG (B. Tech) programs were accredited for 3 years w.e.f. 19-07-2008.
- Accredited by NAAC
- Conferment of Autonomous Status by UGC, New Delhi for the period of Six year from the Academic Year 2014-15.
- Recognition under 2(f) & 12(B) Acts of UGC.
- ISTE A.P. Section Best Engineering College with Overall Performance for the year 2013 Award.
- The college has obtained the prestigious award of "ISTE Best Student Chapter in AP" for 2008.
- Departments of ECE, CSE & EEE are recognized as a Research Centers by JNTUK, Kakinada for the academic years 214-15 & 2015-16.
- Inspection for EEE & CSE departments is conducted by JNTUK for recognizing as research centers and result is awaited.
- IIT Bombay Remote Centre (ID 1273) for Improving Quality of Education.
- Microsoft Ed-va ntage Platinum with Innovation Centre.
- Member of Jawahar Knowledge Centre of A.P. State Government with Star Status.
- Member of Infosys Campus Connect Program.
- Recognized by ONGC, New Delhi for taking up ONGC Consultancy works.
5.1 DESIGN AND DEVELOPMENT OF ECO-FRIENDLY REFRI GERATION AND AIR CONDITIONING SYSTEMS

With global warming becoming an increasingly serious issue worldwide, the development of environmentally friendly refrigeration and air-conditioning systems have become increasingly important. Particularly the refrigerant used in those systems has a global warming potential itself as well as a great influence on the performance of refrigeration and air-conditioning systems. Therefore, the selection of a refrigerant has an important role in reducing carbon dioxide emissions that contribute to global warming.

Chlorofluorocarbons (CFCs) and hydrochloro fluorocarbons (HCFCs) known as refrigerants have been regulated in ozone depletion. Hydrofluoro-carbons (HFCs) as alternative refrigerants do not deplete the ozone layer, but, along with CFCs and HCFCs, they are greenhouse gases with higher global warming potential (GWP). Air-conditioning and heat pumps sectors are one of the principal users of these chemicals.

Since the demand for air conditioners by the people is increasing throughout the world day by day, considering the indirect Global Warming and Ozone Depletion, there is an urgent need to improve the energy efficiency of vapor compression system as it is most widely used in majority of modern cooling equipments.

5.1.1 Objectives

To

• Explore various Eco-friendy refrigerants for their thermo physical, chemical and transport properties.
• Compare the performance of the proposed refrigerant systems with the conventional vapour compression refrigeration systems with HFCs.
• Design and fabricate the refrigeration and air conditioners for various applications.

5.1.2 Principle of the proposed refrigeration system

The proposed system is graphically depicted in Figure 4 which contains primarily Compressor, Condenser, Expansion valve and Evaporator. In Fig. the low temperature, low pressure vapour at state B is compressed by a compressor to high temperature and pressure vapour at state C. This vapour is condensed into high pressure vapour at state D in the condenser and then passes through the expansion valve. Here, the vapour is throttled down to a low pressure liquid and passed on to an evaporator, where it absorbs heat from the surroundings from the circulating fluid (being refrigerated) and vaporizes into low pressure vapour at state B. The cycle then repeats.

The exchange of energy is as follows:

a) Compressor requires work, \( \delta W \). The work is supplied to the system from the surroundings.

b) During condensation, heat \( \delta Q_1 \) the heat equivalent of latent heat of condensation etc, is lost from the refrigerator.

c) During evaporation, heat \( \delta Q_2 \) equivalent of latent heat of vaporization is absorbed by the refrigerant.

d) There is no exchange of heat during throttling process through the expansion valve as this process occurs at constant enthalpy.
5.1.3 Principle of the proposed Air conditioning system

The refrigerant repeats the evaporation and condensation cycles in two separate units that transfer heat from a low temperature source (ambient air) to a high temperature source (outdoor air) as seen in Figure 5.
### 5.1.4 Budget Estimation (Rs. in Lakhs)

<table>
<thead>
<tr>
<th>S.No</th>
<th>Head</th>
<th>1&lt;sup&gt;st&lt;/sup&gt; Year</th>
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<th>3&lt;sup&gt;rd&lt;/sup&gt; Year</th>
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<td>32.48</td>
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Grand Total: 99.783

### 5.1.5 Itemized Budget for Permanent Equipment (Rs. in Lakhs)

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<th>3&lt;sup&gt;rd&lt;/sup&gt; Year</th>
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<td>Condensers of different capacities</td>
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<td>6</td>
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<td>Door panels</td>
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<td>Refrigerants</td>
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<td>23</td>
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<td>18.623</td>
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</table>
### 5.1.6 Itemized Budget for Manpower Requirement
(Rs. in Lakhs)

<table>
<thead>
<tr>
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<th>Type</th>
<th>Number required</th>
<th>1st Year</th>
<th>2nd Year</th>
<th>3rd Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Junior Research Fellow (@Rs. 25,000 for first two years and Rs. 28,000 for third year)</td>
<td>1</td>
<td>3.00</td>
<td>3.00</td>
<td>3.36</td>
</tr>
<tr>
<td>2.</td>
<td>Technicians (@Rs. 12,000 for first two years &amp; @Rs. 15,000 for third year)</td>
<td>2</td>
<td>2.88</td>
<td>2.88</td>
<td>3.24</td>
</tr>
<tr>
<td>3.</td>
<td>Internships (@Rs. 6,000 for six months in a year)</td>
<td>10</td>
<td>3.60</td>
<td>3.60</td>
<td>3.60</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td></td>
<td><strong>9.48</strong></td>
<td><strong>9.48</strong></td>
<td><strong>10.20</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Grand Total</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>29.16</strong></td>
</tr>
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</table>

### 5.1.7 Itemized Budget for Material Requirement
(Rs. in Lakhs)

<table>
<thead>
<tr>
<th>S.No</th>
<th>Item</th>
<th>1st Year</th>
<th>2nd Year</th>
<th>3rd Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Consumables</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2.</td>
<td>Overhead charges</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>3</strong></td>
<td><strong>3</strong></td>
<td><strong>3</strong></td>
</tr>
</tbody>
</table>
5.1.8 Deliverables

- The outcome of the project will be eco-friendly refrigerators and air-conditioners for varied applications.

- The numbers of products that will be developed at the centre are given in Table 3 and the development of products with respect to the timelines are provided in Section 8.

<table>
<thead>
<tr>
<th>Type</th>
<th>1st Year</th>
<th>2nd Year</th>
<th>3rd Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of different products</td>
<td>4</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>proposed to develop</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Investigating team/ Facilitators:

Principal Investigator: Dr. Thella Babu Rao, Associate Professor of Mechanical Engineering, Gudlavalleru College of Engineering.

Co-Investigator: Dr. P. Nageswara Reddy, Professor of Mechanical Engineering, Gudlavalleru College of Engineering.
5.2 U.G ELECTIVE COURSE ON "REFRIGERATION AND AIR-CONDITIONING SYSTEMS"

5.2.1 Course Objectives

To

- Study and analyze various refrigeration systems and understand the influence of operating variables on their performance.
- Introduce to various psychometric properties and processes and the design of air conditioning systems.

5.2.2 Content of the Program

This programme is aimed to provide a theoretical and practical knowledge of the principles of air conditioning and refrigeration. It provides a thorough understanding of the types of air conditioning systems, applications and operating principles including refrigeration and chilled water systems as well as basic ventilation needs and equipment. Emphasis is placed on vapour compression refrigeration system, how it works, the key components and the characteristics of refrigerants. It also introduces the student to the pressure/enthalpy chart and psychometrics. The content of the course is given in Annexure -2.

5.2.3 Learning Outcomes

At the end of the program, students will be able to

- Analyze air refrigeration cycles and know the various methods of air craft refrigeration.
- Analyze vapour compression refrigeration cycle and study the influence of operating variables on its performance.
- Learn the functioning of basic components of vapor compression refrigeration system and the refrigerants used in refrigeration industry.
- Understand the working of the aqua - ammonia and LiBr - water vapor absorption refrigeration systems and find the maximum C.O.P.
- Determine the heat and moisture removed or added during various psychometric processes.
- Design an Air-conditioning system for winter, summer air conditioning and industrial air conditioning.
- Know the functioning of equipment used in air conditioning and different heat pump circuits.

5.2.4 Budget details (Rs. in Lakhs)

No budget for the permanent equipment is sought for this program. The equipment that will be procured for the project proposed under the scheme will be utilized for running the course. The budget required to meet the other expenses are detailed in the following table.

<table>
<thead>
<tr>
<th>S.No</th>
<th>Head</th>
<th>1&lt;sup&gt;st&lt;/sup&gt; Year</th>
<th>2&lt;sup&gt;nd&lt;/sup&gt; Year</th>
<th>3&lt;sup&gt;rd&lt;/sup&gt; Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Spare parts &amp; Consumables</td>
<td>2.50</td>
<td>2.50</td>
<td>2.00</td>
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<tr>
<td>2</td>
<td>Contingencies &amp; Overhead charges</td>
<td>1.40</td>
<td>1.40</td>
<td>1.20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3.9</td>
<td>3.9</td>
<td>3.2</td>
</tr>
<tr>
<td></td>
<td>Grand Total:</td>
<td>11.00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5.3 Total Budget Requirement for Satellite Institute -3
(Rs. in Lakhs)

<table>
<thead>
<tr>
<th>Activity</th>
<th>1st Year</th>
<th>2nd Year</th>
<th>3rd Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project on Design and Development of Eco-friendly Refrigeration and Air conditioning systems</td>
<td>35.48</td>
<td>32.48</td>
<td>31.823</td>
</tr>
<tr>
<td>U.G Course on “Design of Refrigeration and Air-conditioning systems”</td>
<td>3.9</td>
<td>3.9</td>
<td>3.2</td>
</tr>
<tr>
<td>Total</td>
<td>39.38</td>
<td>36.38</td>
<td>35.023</td>
</tr>
<tr>
<td>Grand Total: 110.783</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

6. JNTUK – Hub

Being a Hub to the 3 satellite centres, JNTUK focuses on spread of design education and propels the R&D activities in design that becomes the catalyst for devising innovation solutions to societal challenges particularly in the grand challenge areas that suit to the Indian conditions. The university with its status as “Design Innovation Centre” performs the following functions:

- Creating an ecosystem facilitating students and faculty to take their innovative ideas from classrooms/labs to market.

- Conducting the programmes to sharing the knowledge and setting up collaboration among industry, academia of government institutions.

- Serving as a location for the industrial collaborators to encourage their new product development in the campus using the in-house facilities.
• Serving as a place that imparts design based education and practice systematic design through research projects for the students.

• Facilitating interdisciplinary design-focused education, research and entrepreneurial activities in order to create commercial opportunities.

• Promoting innovations with are both inclusive and disruptive.

• Setting up the central facility of research equipment at the hub and directing the students to have deeper practical knowledge on handing the equipments and involving them in core innovative research.

In essence, JNTUK will impart necessary skills and technical expertise to convert a prototype generated in the academic institutions into a physical product. The following programs are proposed at JNTUK:

6.1 CENTRE FOR DESIGN & DEVELOPMENT OF ADVANCED CUTTING TOOLS

Machining is the most important manufacturing process in any industry to produce a finished product. Most machining processes have very low set-up cost compared to other manufacturing processes such as forming, moulding, and casting. Machining is necessary where tight tolerances on dimensions and finishes are required. In order to improve the performance of a machining process, it is indispensable to have the efficient cutting tools.

Considering the growing environmental issues, industry is asked more and more to limit the use of cooling lubrication fluids and
to prefer dry or near-dry machining operations. As a matter of fact, wet machining (Figures 6 and 7) has many drawbacks from work piece contamination to environmental hazards, and high disposal costs. With green manufacturing trend, eco-friendly machining technique that can eliminate completely or nearly the coolants has become the need of the hour in industries. In such cases, dry machining could be solution to the above problems.

However, to pursue dry machining, one has to compensate for the beneficial effects of cutting fluids. One approach towards dry machining is to make the cutting tools more durable as high requirements arise concerning the wear, temperature, and oxidation resistance of the cutting tools. The centre is primarily aimed at design and development of more robust cutting tool inserts to withstand at dry machining.

Fig. 6 Machining in the presence of cutting fluid
6.1.1 Origin of the project

- Dry machining is ecologically desirable and it will be considered as a necessity for manufacturing enterprises in the near future. Industries will be compelled to consider dry machining to enforce environmental protection laws for occupational safety and health regulations. The advantages of dry machining include: non-pollution of the atmosphere (or water); no residue on the swarf which will be reflected in reduced disposal and cleaning costs; no danger to health; and it is non-injurious to skin and is allergy free. Moreover, it offers cost reduction in machining.

- High-speed machining is the direction of future machining technology, and the cutting tool material is the key to the development of high-speed machining technology.

- There has been a continued need for new cutting tool materials, which can withstand the very severe operating conditions at and near the cutting edge of the tool. Developing ceramic cutting tools for high-speed dry cutting is suitable for today's green philosophy.
In this work, high performance alumina and silicon nitride matrix composite ceramic cutting tool materials will be developed.

6.1.2 Outline

Ceramic tool materials consist primarily of fine-grained aluminium oxide, cold-pressed into insert shapes and sintered under high pressure and temperature. The prime benefit of ceramics is high hardness and hence good abrasive wear resistance at elevated temperatures. All tool materials soften as they become hotter, but ceramics do so at a much slower rate because they are not metal limited. Among the major advantages of ceramic cutting tools is also their chemical stability. In practical terms this means that the ceramic does not react with the material it is cutting, i.e., there is no diffusion wear, which is the weakest spot of carbides in high-speed machining applications. Ceramics are suitable for machining the majority of ferrous materials, including super alloys.

However, the downside of these ceramic materials is brittleness and poor fracture toughness. To improve them to some extent, coatings are used with ceramic inserts. On ceramics, coatings do some good but the cost is high and usually does not justify the end result, because of weak adhesion between the coating materials and ceramic substrate. In order to combat the above problems, the proposed work is envisaged to embrace a couple of advanced concepts of manufacturing the cutting tools.

Commercially available ceramic tools: The following types of ceramic cutting tools are widely being used in industry:
i) Al₂O₃-based ceramic cutting tools

- Alumina based ceramics are considered to be one of the most suitable tool materials machining high strengthened steels because of their high hardness, wear resistance and chemical stability at high temperature.
- Conventionally Al₂O₃-based ceramic cutting tools were strengthened and toughened by the addition of secondary particle to improve the mechanical properties.
- However, still they have the intrinsic drawbacks of low strength, low fracture toughness and low thermal shock resistance usually make them more susceptible to excessive chipping or fracture when machining hardened materials, leading to a short tool life.

ii) Si₃N₄-based ceramic tools

These show a greater strength, thermal shock resistance, wear resistance and fracture toughness than the traditional alumina-based ceramic cutting tools when machining cast iron.

Especially the mechanical properties of Si₃N₄ ceramic have been enhanced by adding the second phase in the form of whiskers or ultrafine particles, and obvious improvement is achieved. Yet these materials have not achieved better wear resistance.

The present work focuses on the development of improved Al₂O₃-based and Si₃N₄-based cutting tools primarily concerning on their drawbacks.
6.1.3 Objectives

To

- Design and fabricate the coated and the uncoated ceramic cutting tools
- Design and develop the coated Al₂O₃-based and Si₃N₄-based cutting tools by a recently emerged concept called functionally gradient coating method
- Design and develop the uncoated ceramic tools by reinforcing carbon nano tubes
- Perform mechanical characterization of the developed materials
- Conduct physical and thermal tests and
- Assess the viability of using them as better materials in place of conventional ceramic materials for cutting tool applications.
- Commercialise the improved cutting tools

6.1.4 Innovation

Although ceramic materials possess several advantages to be used as cutting tools in high speed machining, yet they have the certain drawbacks of high brittleness, low fracture toughness and greater thermal shock sensitivity to be used in high speed machining. To improve them to certain extent, earlier thin coatings on the cutting tools were being carried out on them. However, single layer films do not match all requirements needed for the application. In particular, good adhesion of the film on the substrate to prevent delamination, high hardness to increase the wear resistance against abrasion and chemical stability to avoid chemical reaction with the counterpart are required.
The following two recently emerged concepts would be used to eliminate the short falls of ceramic cutting tools:

FGM coatings:

Among other concepts to tailor the constitution and properties of thin film materials graded films have the advantage of a continuous structure without changing deposition parameters during film growth and a continuous transition of the composition and the properties in a single layer film.

The multi-layer and single layer FGM coatings based on some of the probable combination of TiCN, TiAlN, TiN, TiC, etc will be deposited on the commercially available cutting tool tips of Al₂O₃ and Si₃N₄ ceramics and their performances will be tested.

This could be the first-ever-attempt to study the physical, thermal and mechanical properties of the proposed FGM coated cutting tips. The study also involves the in-depth comparative analysis of the properties of the conventional ones with those of the proposed ones. Gradient and homogeneous coatings deposited onto the investigated substrates will be characterized by improved adhesion, greater hardness, taking effect in increasing of wear resistance.

CNT reinforcement:

This deals with the development of novel un-coated ceramic cutting inserts based on nano-size reinforcement. Carbon nanotubes (CNT) having exceptional material properties gained substantial interest as superior reinforcing phase over conventional microscopic
fillers in making advanced nano composites for high performance applications.

Since their discovery, carbon nanotubes (CNTs) have gained an extreme importance in the field of advanced materials due to their outstanding mechanical, electrical and thermal properties. The ultra-high modulus of elasticity and high tensile strength of CNTs make them a strong reinforcement candidate for ceramic composites. Although the CNTs exhibit exceptional mechanical properties, their response towards reinforcing the ceramics has not been yet studied in depth.

The dual role of CNTs, indirectly enhancing the mechanical properties and directly acting as lubricant, converts ceramic composites into an attractive wear resistance material, and various reports demonstrated the steady reduction of friction coefficient with CNT additions.

In the present work, CNT, graphene nanoplatelets or combined CNT/graphene reinforced Alumina and Silicon Nitride based ceramic cutting tools with the material such as TiCN and TiAlN, as secondary phase particles will be fabricated by using microwave sintering technique with MgO and Y2O3 as sintering additives. The effects of the content of the secondary phase on the microstructure and mechanical properties of composite ceramic cutting tool will be investigated. Toughening ceramic is one of the main research objectives for the nanocomposites, whilst other benefits such as flexural strength and hardness will also be obtained.

In summary, the centre designs and develops the both coated and uncoated ceramic cutting tools based on the above methodologies presented. The success of the project will be ensured by getting
improved machining performance. The cutting tools will be evaluated for tool wear, cutting forces and surface finish in machining operations.

The success of the project might lead to enormous benefits to manufacturing industry which eventually results in reduced unit production cost of a component.

Major Equipment required:

- Sputtering: To deposit thin functionally graded surface coatings with excellent microstructure on the cutting tool.

- Scanning electron microscope (FESEM) – Which is equipped with an Energy Dispersive X-ray analyzer (EDX) to perform chemical composition analysis.

- Vacuum arc deposition – to synthesise the fine quality carbon nano tubes of various sizes.

- Fourier transform infrared spectroscopy (FTIR) - to determine the quality and consistency of a sample, besides the magnitude of sub components.

- X-ray diffraction - to determine how the atoms pack together in the crystalline state and what the inter-atomic distance and angle are etc. The size and the shape of the unit cell for any compound could be estimated as well.

- Archimedes’ principle based apparatus – to estimate the density of the samples
Microwave sintering - to achieve rapid and uniform heating of materials and not to damage carbon nano tubes during sintering.

6.1.5 Milestones

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Milestone</th>
<th>Target Month</th>
<th>Work Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Procurement of required items</td>
<td>6th Month</td>
<td>1. Engagement of manpower</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. Procurement of equipment</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3. Procurement of consumables</td>
</tr>
<tr>
<td>2</td>
<td>Fabrication of proposed materials</td>
<td>18th Month</td>
<td>1. Preparation of powders</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. Design of dies</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1. Compaction</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. Sintering</td>
</tr>
<tr>
<td>3</td>
<td>Evaluation of characteristics</td>
<td>24th Month</td>
<td>1. Preparation of specimens as per ASTM standards</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. Physical tests</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3. Mechanical tests</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4. Thermal tests</td>
</tr>
<tr>
<td>4</td>
<td>Analysis of the results</td>
<td>36th Month</td>
<td>1. Comparative analysis</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. Statement of benefits and</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>3. Report writing</td>
</tr>
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<td></td>
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<td>4. Publication of results</td>
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</table>
### 6.1.6 Work Plan

<table>
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<th>S. No</th>
<th>Activity</th>
<th>Description</th>
<th>1&lt;sup&gt;st&lt;/sup&gt; Year</th>
<th>2&lt;sup&gt;nd&lt;/sup&gt; Year</th>
<th>3&lt;sup&gt;rd&lt;/sup&gt; Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Procurement of required items</td>
<td>To procure necessary raw material, consumables, and engagement of manpower</td>
<td>3 3 6 9 12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Establishment of set-up</td>
<td>Preparation of dies for compaction process and to procure equipment</td>
<td>3</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Manufacturing</td>
<td>To fabricate the proposed FGMs with different number of layers</td>
<td>3 6 9 12</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>To get ready the measuring devices</td>
<td>To perform the necessary devices for characterization</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>-----------------------------------</td>
<td>-----------------------------------------------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Physical characterization and Mechanical characterization</td>
<td>To test the physical properties and the mechanical properties</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Thermal analysis</td>
<td>To perform the thermal test to understand their thermal behaviour</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Analysis of results</td>
<td>Preparing the Final feasible report with obtained results</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
6.1.7 Budget estimate for the centre – JNTUK
(Rs. in Lakhs)

<table>
<thead>
<tr>
<th>S.No</th>
<th>Activity</th>
<th>1st Year</th>
<th>2nd Year</th>
<th>3rd Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Permanent equipment</td>
<td>306</td>
<td>98</td>
<td>25</td>
</tr>
<tr>
<td>2</td>
<td>Fablab Equipment</td>
<td>25.81</td>
<td>27</td>
<td>5</td>
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<tr>
<td>3</td>
<td>Man power</td>
<td>47.856</td>
<td>48.648</td>
<td>49.44</td>
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<tr>
<td>4</td>
<td>Tooling cost</td>
<td>9.00</td>
<td>8.00</td>
<td>8.42</td>
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<td></td>
<td><strong>Total</strong></td>
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<td><strong>181.648</strong></td>
<td><strong>87.86</strong></td>
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<tr>
<td></td>
<td><strong>Grand Total</strong></td>
<td></td>
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</tbody>
</table>

6.1.8 Itemized budget for the Permanent equipment
(Rs. in Lakhs)

<table>
<thead>
<tr>
<th>S. No</th>
<th>Item</th>
<th>1st Year</th>
<th>2nd Year</th>
<th>3rd Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Scanning electron microscope with EDX</td>
<td>125</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Coining, Sizing, other secondary operations equipment</td>
<td></td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Hydraulic presses, Vacuum microwave sintering furnace, &amp; Isostatic presses</td>
<td>133</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Tensile strength machine</td>
<td></td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Image analyzer</td>
<td></td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Density apparatus</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Wear testing machine</td>
<td></td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Thermal gravimetric analysis</td>
<td>38</td>
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<td></td>
</tr>
<tr>
<td>9</td>
<td>Vacuum arc deposition/sputtering</td>
<td>90</td>
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<td></td>
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<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>306</strong></td>
<td><strong>98</strong></td>
<td><strong>25</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Grand Total</strong></td>
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</table>
### 6.1.9 Itemized budget for Fablab Equipment
**(Rs. in Lakhs)**

<table>
<thead>
<tr>
<th>S.No</th>
<th>Item</th>
<th>1st Year</th>
<th>2nd Year</th>
<th>3rd Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Computers (25 numbers)</td>
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<td>20</td>
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</tr>
<tr>
<td>2</td>
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<td>Hard disks</td>
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<td>Interactive learning resources</td>
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<td>1</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>e-materials</td>
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<td></td>
</tr>
<tr>
<td>6</td>
<td>Journals</td>
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<td>1.5</td>
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<td>Printers</td>
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<tr>
<td></td>
<td>Total</td>
<td>25.81</td>
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<td>5</td>
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### 6.1.10 Itemized budget for Manpower requirement
**(Rs. in lakhs)**

<table>
<thead>
<tr>
<th>S.No</th>
<th>Item</th>
<th>1st Year</th>
<th>2nd Year</th>
<th>3rd Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Research Associate (@Rs. 36,000 for first year, Rs. 38,000 for second year &amp; Rs. 40,000 for third year with 10% HRA) 3 in number</td>
<td>14.256</td>
<td>15.048</td>
<td>15.840</td>
</tr>
<tr>
<td>2</td>
<td>M.Tech Internship @ Rs. 12,400/- for 10 numbers</td>
<td>14.88</td>
<td>14.88</td>
<td>14.88</td>
</tr>
<tr>
<td>3</td>
<td>Technical staff charges @Rs. 30,000 for 4 numbers</td>
<td>14.4</td>
<td>14.4</td>
<td>14.4</td>
</tr>
<tr>
<td>4</td>
<td>Non-technical staff charges @ Rs. 12,000 for 3 numbers</td>
<td>4.32</td>
<td>4.32</td>
<td>4.32</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>47.856</td>
<td>48.648</td>
<td>49.44</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>145.944</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### 6.1.11 Itemized budget for Tooling cost

(Rs. in lakhs)

<table>
<thead>
<tr>
<th>S.No</th>
<th>Item</th>
<th>1st Year</th>
<th>2nd Year</th>
<th>3rd Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Dies, crucibles, Glassware, Chemicals</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>2.</td>
<td>Specimen preparation &amp; Trial expenses</td>
<td>4</td>
<td>3</td>
<td>3.42</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>9</td>
<td>8</td>
<td>8</td>
</tr>
</tbody>
</table>

**Grand Total:** 25.42

### 6.1.12 Deliverables

The present work deals with producing high performance cutting tools for machining. Therefore the work has much broader scope and could find numerous beneficiaries. The manufacturing industries which are engaged in producing the automobile components could get immense benefit out of this project. Fig.8 below shows some samples of the cutting inserts that get manufactured in the due course of the project:
Fig. 8 Typical cutting inserts to be produced
The table lists the number of cutting inserts produced with respect to the year mentioned.

Table 4 Expected number of ceramic inserts produced

<table>
<thead>
<tr>
<th>No. of products to be developed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st year</td>
</tr>
<tr>
<td>2nd year</td>
</tr>
<tr>
<td>3rd year</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>15</td>
</tr>
<tr>
<td>20</td>
</tr>
</tbody>
</table>

Section 8 lists the deliverables with the respect to the time lines.

6.1.13 Sustainability of the Centre

The sustainability of the centre after the end of the project is described with the following points:

- **Continued operation and maintenance of project facilities** - The project receives the necessary support (both budgetary and institutional) after the project completion.

- **Continued flow of net benefits** - The project will guarantee an acceptable level of financial and economic return. The equipment proposed in the project will generate the quantum of revenue which is sufficient to meet the maintenance charges through consultancy.

- **Continued research community participation** - The University has 224 Engineering Colleges affiliated to it so that the respective teaching faculties of the affiliated colleges utilize the
facilities developed under the proposed project for research and teaching and learning processes in a better manner.

- **Institutional stability** - The project has considered adequately the institutional requirements and thus made provisions so that management support to project operations continues even after the end of the project. In addition, the institute is a participant of TEQIP-Phase II (Technical Education in Quality Improvement Program) so that there couldn’t be any crunch of funds to support the project.

**Principal Investigator/ Facilitator**

Dr. A. Gopala Krishna  
Professor  
Department of Mechanical Engineering,  
University College of Engineering,  
Jawaharlal Nehru Technological University Kakinada-533003  
Andhra Pradesh, India.  
E-mail: dr.a.gopalakrishna@gmail.com

**Brief details about the Principal Investigator**

- Dr. A. Gopala Krishna is Professor in the Department of Mechanical Engineering
- Ten Ph.D. students have been awarded Ph.D. degrees under his guidance.
- Published papers in International journals of high impact factor
- Papers possess high citation indices
- Member of Editorial Board and reviewer for International Journals
- Successfully completed four DRDO projects and two more projects are on-hand. The projects were quite beneficial to the recently launched hypersonic cruise missiles; BrahMos and Astra.
- Supervising the research works of Scientists from various Defence organizations
- Guided around 80 M.Tech theses and guiding 18 Ph.D scholars
- Reviewed two TMH and one Oxford University Press text books
- Invited twice to deliver lectures in the workshops exclusively meant for DRDO scientists across the country.
6.2 P.G COURSE ON “DESIGN WITH ADVANCED MATERIALS”

An M.Tech course on “Design with Advanced Materials” will be introduced in order to enable the students to learn the synthesis methods and property estimation techniques of exotic materials like precipitated hardened steels, titanium alloys, shape memory alloys, nanomaterials, smart materials, etc. The infrastructure that will be procured for the above centre will be utilized for running this course.

6.2.1 Objectives:

To enable the student acquire knowledge and understanding of:

- Advanced materials and their synthesis methods
- Characterisation of materials structures and properties
- The microstructure and properties of advanced materials;
- The relationships between processing parameters
- The design and operation of processes to engineer materials with advanced properties
- The mathematical modelling of processes to engineer materials with advanced properties.

The syllabus for the course is given in Annexure-1.

6.2.2 Budget Details (Rs. in Lakhs)

<table>
<thead>
<tr>
<th>Permanent Equipment</th>
<th>1st Year</th>
<th>2nd Year</th>
<th>3rd Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Micro hardness equipment</td>
<td>6.00</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Optical microscope</td>
<td>-</td>
<td>2.493</td>
<td>-</td>
</tr>
<tr>
<td>Grand Total:</td>
<td>6.00</td>
<td>2.493</td>
<td>-</td>
</tr>
<tr>
<td>Grand Total:</td>
<td></td>
<td></td>
<td>8.493</td>
</tr>
</tbody>
</table>
### 6.3 Total Budget for Hub-JNTUK (Rs. in Lakhs)

<table>
<thead>
<tr>
<th>Activity</th>
<th>1st Year</th>
<th>2nd Year</th>
<th>3rd Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Centre for Design &amp; Development of Advanced cutting tools</td>
<td>388.666</td>
<td>181.648</td>
<td>87.86</td>
</tr>
<tr>
<td>P.G course on “Design with Advanced Materials”</td>
<td>6.00</td>
<td>2.483</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>394.666</td>
<td>184.141</td>
<td>87.86</td>
</tr>
</tbody>
</table>

**Grand Total: 666.667**

### 7. TOTAL BUDGET FOR ALL THE INSTITUTES (Rs. in Lakhs)

<table>
<thead>
<tr>
<th>S. No</th>
<th>Institution</th>
<th>1st Year</th>
<th>2nd Year</th>
<th>3rd Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Satellite Centre-1 (LBRCE)</td>
<td>76.37</td>
<td>26.28</td>
<td>22.10</td>
</tr>
<tr>
<td>2.</td>
<td>Satellite Centre-2 (MVGR)</td>
<td>64.38</td>
<td>15.38</td>
<td>18.04</td>
</tr>
<tr>
<td>3.</td>
<td>Satellite Centre-3 (GEC)</td>
<td>39.38</td>
<td>36.38</td>
<td>35.023</td>
</tr>
<tr>
<td>4.</td>
<td>Hub (JNTUK)</td>
<td>394.666</td>
<td>184.141</td>
<td>87.86</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>574.796</td>
<td>262.181</td>
<td>163.023</td>
<td></td>
</tr>
</tbody>
</table>

**Grand Total: 1000.00**
8. SUMMARY OF THE DELIVERABLES WITH RESPECT TO TIMELINES

<table>
<thead>
<tr>
<th>S.No</th>
<th>Program</th>
<th>Major Deliverables</th>
<th>1-3</th>
<th>3-6</th>
<th>6-9</th>
<th>9-12</th>
<th>12-15</th>
<th>15-18</th>
<th>18-21</th>
<th>21-24</th>
<th>24-27</th>
<th>27-30</th>
<th>30-33</th>
<th>33-36</th>
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</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Satellite</td>
<td>A</td>
<td>No. of Products</td>
<td>4</td>
<td>6</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Institution -1</td>
<td>B</td>
<td>No. of beneficiaries</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Satellite</td>
<td>C</td>
<td>No. of beneficiaries</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Satellite</td>
<td>D</td>
<td>No. of Products</td>
<td>4</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Institution -2</td>
<td>E</td>
<td>No. of beneficiaries</td>
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<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Satellite</td>
<td>F</td>
<td>No. of Products</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5</td>
<td>5</td>
<td>6</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Institution -3</td>
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<td></td>
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<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td>50</td>
</tr>
<tr>
<td>Hub - JNTUK</td>
<td>H</td>
<td>No. of Products</td>
<td>2</td>
<td>8</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>6</td>
<td>8</td>
<td>2</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>I</td>
<td>No. of beneficiaries</td>
<td>26</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>26</td>
<td></td>
</tr>
</tbody>
</table>

Where:
A. Design and Development of Solar-powered products
B. Training programs on "Design of Solar Photo-Voltaic equipment"
C. U.G course on "Renewable Energy Sources"
D. Design and Development of Bio-mass fired wood gas stoves for Rural applications
E. Training Programs on "Design of Biomass fired wood gas stoves"
F. Design and Development of Eco-friendly Refrigeration and Air-conditioning systems
G. U.G course on "Refrigeration and Air-conditioning systems"
H. Centre for "Design & Development of Advanced Cutting Tools"
I. P.G course on "Design with Advanced Materials"
Annexure-I


RENEWABLE ENERGY SOURCES

UNIT-I


UNIT-II


UNIT-III


WAVE ENERGY: Waves-Theoretical Energy Available- Calculation of period and phase velocity of waves- wave power systems-submerged devices.

OCEAN THERMAL ENERGY: Principles-Heat Exchangers-Pumping requirements-Practical Considerations.

UNIT-IV

UNIT-V

DIRECT ENERGY CONVERSION SYSTEMS: Introduction to direct energy conversion systems, Peltier effect, Seebeck effect, Thomson effect, Fuel Cells, Efficiency of fuel cells and Solar cells-Thermionic and Thermoelectric Generation-MHD Generator-Open and Closed systems, applications of direct energy conversion systems.

TEXT BOOKS:


REFERENCES:

Annexure-II


REFRIGERATION & AIR CONDITIONING

UNIT - I

Introduction: Necessity and applications. Unit of refrigeration and C.O.P. Ideal cycles of refrigeration.

Air Refrigeration: Bell Coleman cycle, Open and Dense air systems. Actual air refrigeration system problems. and Refrigeration needs of Aircrafts - Aircraft refrigeration systems

UNIT - II


UNIT - III


Principle and operation of (i) Thermoelectric refrigerator (ii) Vortex tube

UNIT - IV


UNIT - V

Dear Sir,

Sub: MHRD Scheme - DIC Design Innovation Centre - Collaborative institute of JNTUK, Kakinada - Reg.

***

We are very much pleased to associate with the University as a Collaborative Institute of JNTUK, Kakinada for the MHRD scheme - Design Innovation Centre. May I request you to take early positive action in this regard and confirmation may kindly be sent.

With warm regards,

(Dr. E.V. Prasad)
Director
To

The Registrar,

J N T University, Kakinada,
Kakinada-533001.

Sir,

Sub: Acceptance to become part of Design Innovation Center (DIC) proposal - Reg

Ref: Instructions received over phone dated 12-01-2015.

With reference to the subject and reference cited above, we are very glad to inform you that MVGR College of Engineering accepts to become part of proposal for Design Innovation Center made by the University to MHRD. In this regard, we have already identified the area and prepared a proposal on “Design and development of biomass fired wood gas stove/gasifier for rural applications” as a part of the above proposal.

Thanking you sir.

Yours faithfully,

[Signature]
Dr. P. NAGESWARA REDDY,
Principal

To
The Registrar,
J.N.T. University Kakinada,
Kakinada – 533 001.

Sir,

SUB: Acceptance to become part of Design Innovation Center (DIC) Proposal – Regarding.

REF: Instructions received over phone dated. 12-01-2015.

***

With reference to the subject and reference cited above, we are very glad to inform you that Gudlavalleru Engineering College accepts to become part of proposal for Design Innovation Center (DIC) made by the University to MHRD. In this regard, we have already identified the area and prepared a proposal on “Design and Development of eco-friendly Refrigeration and Air Conditioning Systems” as a part of the above proposal.

Thanking You Sir,

Yours faithfully,

(P. Nageswara Reddy)

(Sponsored by A.A.N.M. & V.V.R.S.R. Educational Society, Gudlavalleru)
DESIGN INNOVATION CENTER

CRAFT SCIENCE & TECHNOLOGY

MAHARAJA RANJITSINH
GAEKWAD INSTITUTE OF DESIGN

&

CENTRE FOR GENOME RESEARCH
PROPOSAL FOR

DESIGN INNOVATION CENTER

AT

MAHARAJA RANJITSINH GAEKWAD INSTITUTE OF DESIGN
[FACULTY OF FINE ARTS]

&

CENTRE FOR GENOME RESEARCH [GRC]
[FACULTY OF SCIENCE]

Submitted to

Ministry of Human Resources and Development under the National Initiative for Setting up of Design Innovation Centers
Contents

INTRODUCTION

• About the Maharaja Sayajirao University of Baroda
  o MAHARA JRA RANJIT SINGH GAEKWAD INSTITUTE OF DESIGN [MRID]
  o CENTRE FOR GENOME RESEARCH [GRC]

CONCEPTUAL CONCERNS & VISION STATEMENT

• DESIGN REACHING TO THE BOTTOM OF THE CUSTOMER PYRAMID
• HOLISTIC APPROACH TO DESIGN AND SCIENCE WITH INNOVATION AS THE KEY FACTOR.
• INCLUSIVE DESIGN - ROLE OF CRAFT STUDIES
• FINDING NEW AVENUES FOR TRADITIONAL DESIGN - ROLE OF MODERN TECHNOLOGIES
• CONCEPT ORIENTED DESIGN EDUCATION

HUB AND SPOKE MODEL

• UPENDRA MAHARATHI SHILPA ANUSANDHAN SANSTHAN, Patna, Bihar [UMSAS]
• SCHOOL OF BIOTECHNOLOGY, AMRITA UNIVERSITY, Kollam, (KERALA)
• NETAJI SUBHASH INSTITUTE OF TECHNOLOGY [NSIT] New Delhi

PROPOSED ACTIVITIES OF DIC

• DESIGN EDUCATION [MRID] WITH UMSAS
  • Course to be offered
• CRAFT AND DESIGN RECHARGING CENTER [MRID] WITH NSIT & UMSAS
• RESEARCH CENTER FOR ORGANIC DYES [GRC] WITH SCHOOL OF BIO TECHNOLOGY AMRITA UNIVERSITY
• CRAFT INCUBATION CENTER [MRID] WITH NSIT & UMSAS
• CRAFT & DESIGN RESEARCH AND DEVELOPMENT [MRID, GRC along with Spokes]
• DESIGN INNOVATION [MRID, GRC along with Spokes]
• DESIGN INCUBATION [MRID, GRC along with Spokes]

PROTOTYPES

TIMELINE FOR DELIVERABLES

BUDGET
“Each of our practical objects is related to one or more structural elements, but at the same time they are all in perpetual flight from technical structure towards their secondary meanings, from the technological system towards a cultural system.”

- Jean Baudrillard

**INTRODUCTION**

Design is a very old activity and yet has a new perception. It is a responsible and creative activity that aims to understand human needs and aspirations in order to generate effective alternate solutions that can resolve these needs. Design, more easily explained than defined is everything from making a better safety pin to planning a new metro system. The ultimate objective of a designer’s education is to create within him a concern for the quality of his physical environment with relevance to human needs. Design and Design Education in India is at crossroads looking for further directions to tackle the new challenges cropped by globalization. Integrated design approaches targeting the bottom of the pyramid approach based on greener and progressive design seem to be lacking. India could not integrate the holistic cultural approach to design, unlike the other nations like China and Japan, which had to deal with tradition and modernity in design approach. While in these countries, design innovated with an inclusive and cultural approach, India due to the colonial dominance opted to cater to the colonial taste altogether forgetting to nurture the indigenous industry and the massive customer base.
The Maharaja Sayajirao University of Baroda, originally founded in 1881 as the “Baroda College” is a premier unitary residential University, established on 30th April, 1949. It is the state University with English as its medium of instruction, having 13 Faculties, 3 Constituent Colleges, 2 Institutions and 8 Centers of Specialized Studies, wherein more than 37,295 students pursue higher studies, under the care and supervision of 1112 teaching (662 permanent) and 1190 permanent supporting staff members. It houses 89 departments spread over 6 campuses (2 rural and 4 urban) covering 275 acres of land including a built up area of 418500 sq. mt. There are 16 hostels (12 Boys & 4 Girls) which accommodates about 4103 students. There are 475 residential quarters too for teaching and non-teaching staff.

The University offers a wide range of course, giving opportunity for education from early childhood to Ph. D. The pre-nursery school ‘Chetan Balwadi’ is a part of the Faculty of Family and Community Sciences and Experimental School, imparting education from Std. I to XII, is monitored by the Faculty of Education & Psychology. Applied Science subjects, like Applied Mathematics, Applied Chemistry and Applied Physics are separate departments under the Faculty of Technology & Engineering having interactive progressive collaborations with the Faculty of Science.

It is one of the few Universities in the country offering research opportunities in the Ancient Indian Traditions of India at the Baroda Sanskrit Mahavidyalaya and Indian Classical Vocal and Instrumental Music, Bharatnatyam and Kathak Dances at the Faculty of Performing Arts; Painting, Sculpture and Art History in the Faculty of Fine Arts. Preservation of Ancient India Literature and Vedic traditions at the Oriental Institute, and an extraordinary collection of excavations, including reliefs of Lord Buddha at Department of Archaeology and rare collection of like Dinosaurs egg, rock, etc. are some of the salient features. The University also offers courses in emerging areas, like Nanotechnology, Petroleum Geology, Medical Biotechnology, Bioinformatics, Disaster Management, Embedded Systems, Packing Engineering. Welding Technology has expertise in the latest technological innovations such as Centre for Biotechnology, Genome Research Centre. Bio-informatics network, Centre for Microbial Genomics and the latest, the Centre for Molecular Genetics.
The University offers 98 PG courses, 66 Ph. D programmes, 39 PG Diploma courses and 88 UG courses with an option from 347 programmes in 92 subjects. It also offers 11 certificate programmes and 3 post diploma certificate programme. As many as 205 students are currently enrolled in Ph. D. programme, out of which 33% of the students are from outside Gujarat State.

In the recent times, the university's academic leadership has vigorously pursued initiatives for research, teaching, training capacity development and consultancy in thrust areas of significant importance for economic, scientific, social or intellectual development by starting several new Institutes and Centers’ of Learning. Institute of Policy Research and International Studies, Maharaja Ranjitsinh Gaekwad Institute of Design, Institute of Fashion Technology, Institute of Hotel Management and Catering Technology, Centre for Industrial Mathematics, Centre for Excellence in Polymers.

University teachers publish a large number of research papers (over 500 per year) and many of the publications have high citation index. The ‘h-index’ of 26 scientists is above 10. Some of the teachers have filed patents (18 patents in last 5 years). On an average over 500 teachers participate every year in various conferences/Seminars/Symposia out of which over 300 teachers are invited to deliver talks/ chair sessions. The all time h-index of the University is 51 and the same for last 10 years is 40.

The Maharaja Sayajirao University of Baroda is a leading residential public funded English medium university located in the state of Gujarat in India. The university was established in 1949, and currently has 13 Faculties and 3 Colleges and Centers of Excellence with around 1200 faculty members and 37000 students. The University is recognized by Government of India under the Indian Universities Act, 1958 and is accredited by National Academic Accreditation Council.

**Faculties**

- Faculty of Arts
- Faculty of Science
- Faculty of Education & Psychology
- Faculty of Commerce
- Faculty of Medicine
- Faculty of Technology & Engineering
- Faculty of Law
- Faculty of Fine Arts
- Faculty of Family and Community Sciences
- Faculty of Social Work
- Faculty of Performing Arts
- Faculty of Management Studies
- Faculty of Journalism and Communications
The University has under it the following constituent colleges and recognized Institutions:

- Baroda Sanskrit Mahavidyalaya
- M. K. Amin Arts and Science College and College of Commerce, Padra
- Polytechnic
- Oriental Institute

In addition to this Maharaja Sayajirao University runs the following Research Centers and institutes for various professional, vocational and research oriented courses:

- Institute of Fashion Technology
- Institute of Hotel Management and Catering Technology
- Maharaja Ranjitsingh Gaekwad Institute of Design
- Dr. Vikram Sarabhai Institute of Cell and Molecular Biology
- Center for Life Long Learning and Extension
- Women's Studies Research Center
- Genome Research Center & Cluster Innovation Center
- Center for Canadian Studies
- Siemens Centre for Industrial Automation
- TIFAC CORE in NDDS
- Centre of Excellence in Polymers
- Anchor Institute
- Centre for Industrial Mathematics

The Senate is the supreme governing body and authority of the University.

The Syndicate, the executive authority of the University is responsible for governing the academic functioning of the University by co-coordinating the studies and teaching on the recommendations of the academic authorities like Council of Post-Graduate Studies and Research, Faculties and Boards of Studies.

With its multifaceted academic character and infrastructural strength in the form of equipments, laboratories, libraries and other facilities, the University is forging ahead towards creating spaces for interactive structures of knowledge, through mutual collaborations across the divisions of natural sciences and technology, social sciences and humanities, commerce and business studies etc. across national and international boundaries through collaborations and linkages. A strong interface with the industry and placement cells in different Faculties have empowered the illustrious alumni to hold high positions in various sectors in some of the best organizations in the world.
As part of the dissemination and expansion of the art and design curriculum, The Maharaja Sayajirao University through Faculty of Fine Arts established a National Level Design Institute under its auspices in 2013. The Design Institute is named after the alumni of the Faculty and the erstwhile Maharaja of Baroda, Shrimant Ranjitsinh Gaekwad. Hence the Institute is called as Maharaja Ranjitsinh Gaekwad Institute of Design [MRID].

MRID offers design courses on the Graduate and Post Graduate level and will be giving degrees with the nomenclature Bachelor of Design [B.Des] and Master of Design [M.Des]. MRID is intending to create an advantageous academic environment of creative minds working in pure visual arts along with Craft and Modern Design. MRID already offers courses in Design with five specialized branches.

Course Name: CERAMIC & GLASS DESIGN

Degree offered : MDes & BDes
Duration: MDes [4 Semesters in 2 Years]
          BDes [8 Semesters in 4 Years]

About the Course: The Structured course provides basic knowledge and practical skills for further design education with new innovations. Glass and ceramics not only approaches to design as problem solving but create a sensitive approach towards our rich cultural heritage of craft and traditions. Students are sensitized to the design culture through workshop, field trips, educational tours and working in hands with craftsmen and learning skills, techniques, lifestyle and tradition. Instead of instructional education there is a constructive approach of giving back to the tradition with relevant subtle and sensitive refinement. Through these rigorous practices the students are ready to bridge the gap between design, craft and industry.
Course Name: ACCESSORY DESIGN

Degree offered: MDes & BDes
Duration: MDes [4 Semesters in 2 Years]
BDes [8 Semesters in 4 Years]

About the Course: Indian consumers have become more global in their aspirations and desires and their appetite to consume products has only increased to match up with their lifestyle. The product life cycle has shrunk as the demand for newer and better product has increased due to the insatiable needs to be the best and trendy. The accessory design program is structured to enable students to understand the Modern day lifestyle of people and create either the next generation of products or in some cases, new product categories for them to flaunt.

Course Name: CRAFT AND DESIGN

Degree offered: MDes & BDes
Duration: MDes [4 Semesters in 2 Years]
BDes [8 Semesters in 4 Years]

About the Course: There is despair, confusion and misery among millions of Indian artisans faced with rapidly changing markets and intense competition from mass produced products, who otherwise have fine traditional skills of making fine hand crafted products. It is in this context the Craft and Design Program is conceived. The program is expected to sensitizing the learners with craft skills, craft history, craft practices, ethical and socio-cultural values of craft, inherent aesthetics of regional crafts and economic milieu within the crafts are being practiced to create either the next generation of products or in some cases, new product categories for them to flaunt.

Course Name: MOVING IMAGES

Degree offered: MDes & BDes
Duration: MDes [4 Semesters in 2 Years]
BDes [8 Semesters in 4 Years]

About the Course: While the specialized fields of film and video and animation getting more into modalities and technicalities and move away from the aesthetics of the image, the Moving
image course offered at MRID look into the traditional structure of the image and traditional ways of communicating with the image. The course introduces the students into 2D and 3D animation, Cinematography, Direction, Set Design, Sound and Visual editing and script writing. Theoretical input into the various genres of movies, history and appreciation are also given through the 8 semester course for BDes and 4 Semester course for MDes.

**Course Name: COMMUNICATION DESIGN**

Degree offered: MDes & BDes  
Duration: MDes [4 Semesters in 2 Years]  
BDes [8 Semesters in 4 Years]

**About the Course:** Every living organism has a desire to communicate. Man has been communicating since the Prehistoric Age to this date through Visuals. With the progress in Technology, it has become a mammoth task for man to communicate properly to others. The Communication Design Programme has been conceived to fulfil this task. It is expected to Design messages in form of Visual Language from print form to ever changing Modern Technology. The students will be introduced to areas of Branding, Publication, Information Design and other areas.
The "Centre for Genome Research" was established at the M. S. University in 2001 with the main objective to promote the use of new and emerging technologies, including genome analysis and bioinformatics for the study of microbial and plant genomes, with particular emphasis on applications for industry and agriculture. The major focus of the centre is on the use of biotechnological approaches such as improvements in crop productivity and the development of agricultural biotechnology in Gujarat. A modest Laboratory has already been created. Initial support was received from GSFC Science Foundation. During the subsequent years, funding
from various national and international agencies has been received for several research projects. Gujarat State Biotechnology Mission (GSBTM) has supported the centre as a Centre of Excellence in Microbial Genomics.

To provide our share of contributions towards design innovations, we want to focus on the field of 'Bioinspire' or 'Biodesign', which is emerging as the most promising area of research within the area of biological materials science and engineering. It is a design discipline that seeks sustainable solutions by emulating nature's time-tested patterns and strategies, e.g., a solar cell inspired by a leaf. The technological significance of this area ranges for applications as diverse as tissue engineering and drug delivery biosystems to biomimicked sensors and optical devices. The core idea is that Nature, imaginative by necessity, has already solved many of the problems. Instead of harvesting organisms, or domestecating them to accomplish a function for us, biomimicry differs from other "bio-approaches" by consulting organisms and ecosystems and applying the underlying design principles to our innovations. This approach introduces an entirely new realm for entrepreneurship that can contribute to innovative designs and solutions.

Cells and organisms consist of collections of molecular and supramolecular structures that perform a range of complex functions, including molecular recognition, ligand binding, signal transduction, information storage and processing, and energy conversion. The molecular organization of biological structures also underpins their mechanical properties. In addition, certain of these structures can self-heal, self-repair, and self-replicate. We, at Genome Research Centre, are exploring the biosynthetic potential of micro-organisms for applications in agriculture, human health and industry. One of the main projects being undertaken at the Centre is the study of crop disease with focus on the study of rice-blast disease. In addition, we use these new technology platforms for studies in gene expression for research on drug discovery and development. We also regularly isolate micro-organisms from various natural niches, characterize them and try finding novel applications possible.

We believe there has to be an interdisciplinary education and training plan that will break down existing boundaries between biology and engineering. Our approach will be to promote the use of biological principles as potential solutions for the design of various processes. We want to devote our expertise in building the following technology platforms along with the support of other disciplines present in the university:

1. **Biomimetic Microsystems**: This platform uses approaches to engineer tiny devices containing human cells, mimicking the blood vessels and tissues of living organs. Platform
scientists are using these organs-on-a-chips to accelerate development of new pharmaceuticals, identify toxins in the environment, and treat life-threatening diseases, such as sepsis in hospitalized patients.

2) **Programmable Nanomaterials:** This technology emulates the natural process of molecular self-assembly to create materials that can seek out injury sites, deliver drugs, and promote tissue repair. Scientists are working to engineer medical devices that can be controlled remotely, such as heart pacemakers triggered by magnets instead of wires, hormone production spurred by flashes of light, or limb regeneration stimulated by electric fields.

3) **Adaptive Material Technologies:** The biological designs of living organisms offer lessons in environmental responsiveness, optimization, and self-healing. This technology platform applies such lessons to create biomimetic materials and devices that respond to environmental cues like living organisms. The long-range vision is to design entire buildings that adapt their shape and function to continuously optimize energy efficiency, thermal gain, and other properties critical for sustainability.

Also, apart from this, a pilot initiative called Cluster Innovation Centre (CIC) began at the Genome Research Centre. This is a unique initiative that is being seeded in an academic setting for the first time mainly with an objective to sensitize young academicians on entrepreneurship. CIC-MSU was established in June 2012 and has mentored 4 entrepreneur groups since then. At CIC-MSU Vadodara, our aim is to foster an innovation ecosystem and provide a platform for entrepreneurship within the university system in order to contribute more researches to industries.

We can encourage biotech entrepreneurs to take up design innovations in biology and validate their concepts at CIC since the infrastructure is already available. Thus, this can be an effective way in which design innovations could be explored by young entrepreneurs and can finally lead to licensing of technology platforms to industries.
Library

Smt. Hansa Mehta Library is the Central Library. In addition to 14 constituent libraries and over 25 departmental libraries with over 8 lakh books/periodicals and above 1300 dissertations/thesis, 25 computers and 75 nodes are exclusively marked for surfing. It has a single largest reading room within its 80,025 sq. ft. built up area, which can accommodate about 1100 readers at a time and the library is open to readers 14 hours a day. In the year 2012-13 the University Library is ranked 17th amongst 200 + universities in the country in using E-Resource with 2,42,459 downloads from 5,000 online journal titles accessed from the University Library and MSU campus. University Library is recognized as Document Delivery Centre and was ranked 26th in terms of quality and quantity of collection with 21 other Universities of the country. Smt. Mehta Library is also under the project “SODHANGA” by INFLIBNET and ranked 24th in the year 2012.

There are more than 5,00,000 books and periodicals in various Libraries in the University with reading and reference facilities.
Exhibition Hall

Faculty of Fine Arts has an Exhibition Hall which provides space for display of art works by individual artists and Group of Artists. There are periodic exhibitions reflecting current trends through individual artists' works and hosting touring exhibitions organized by the British Council, American Centre, Max Mullar Bhavan and others.

Guest House and Hostels
MS University have well furnished guest house which can accommodate more 70 people at one time along with 11 Boys hostels and 5 girls hostels.

Auditorium

The University has few Auditoriums in various faculties like that of Faculty of Fine Arts, Faculty of Family Science, Faculty of Technology, Faculty of Commerce, Faculty of Performing Arts, and Faculty of Social Works. The central Auditorium named CC Mehta Auditorium can accommodate around 650 people.

Advantage of Location

The city of Baroda is well connected with mega cities like Mumbai, Delhi and Ahmadabad through Air, Road and Rail. The Maharaja Sayajirao University is situated in the heart of Baroda city. Baroda city is also surrounded by industrial hubs like Halol, Waghodia and Makarpura. The University also had initiated innovative interaction with the industries through Federation of Gujarat Industries [FGI].
DESIGN INNOVATION CENTER
— CONCEPTUAL CONCERNS & VISION STATEMENT

1. DESIGN REACHING TO THE BOTTOM OF THE CUSTOMER PYRAMID

One of the major drawbacks of the present design education in India is its inability to reach to the masses. The design graduate comes out of the design school are absorbed the corporate and their designs are marketed to a niche audience. The craftspeople like block printers, metal smiths, weavers and embroiders are used by the designers in India, but seldom as an equal where there can be any conceptual and intellectual give and take. Design solutions are achieved not looking into the indigenous traditions but aping international innovations.

There is a constant give and take of the education which will result in design innovations at both levels. There will be constant technological growth on the rural/tribal side enhancing the standard of living on the same side. The need of Updating of Traditional art keeping in mind the technological and scientific development without ruining their cultural, religious essence of the art can be supported by such Design Innovation centers.

2. HOLISTIC APPROACH TO DESIGN AND SCIENCE WITH INNOVATION AS THE KEY FACTOR.

The major distinction of art and design are in the realms of Intuition, structure, objectivity, freedom and functionality. An art piece may be considered as successful even it has not consumed by the mass but the success of good design entirely depend upon its mass appeal. For the artist aesthetics is the key to his creation not the functionality, although both works in the realm of conceptual creation.

The vision of DIC at MRID MSU will be to collapse the watertight compartmentalization of Design, Art, Craft and Science through the focus on innovations without losing the identity of the practitioners and the practice.

3. INCLUSIVE DESIGN - ROLE OF CRAFT STUDIES

The design schools in India over emphasize on the skill, techniques and structure of the product using many occasions the theories of the west. Indian crafts are looked as fossils in the museums but not for their technical expertise. An integrated approach looking for solution to modernize
the techniques of the craftsmen enhancing the craftsmen in their manual labor should be one of the goals of the designers and the craftsmen could inculcate into the designers the traditional knowhow which is organic and eco-friendly.

4. FINDING NEW AVENUES FOR TRADITIONAL DESIGN - ROLE OF MODERN TECHNOLOGIES

Identifying new avenues for the craft sector is crucial if India needs to nurture its traditional designs. The products based on the traditional skills and innate eco-friendliness are available in clusters but the consumer is hardly aware of the possibilities of the choices and neither the producer, the craftsmen are conscious about the possibilities. DIC MSU would endeavor to fill this gap between the customer and the crafts persons using digital technology.

5. CONCEPT ORIENTED DESIGN EDUCATION

Taking from traditions we also need to give back to the traditions with the growing technologies/technological development studding in depth the social, ecological, cultural, and economical and various other aspects in relation to the same. Design Education if understood and looked in a wider term it requires integrations of various faculties under one roof of creative holistic approach where various related disciplines are exposed to students with overall wider approach.
**HUB AND SPOKE MODEL**

As per the guidelines of MHRD the following hub & spoke model is proposed for DIC MRID MSU Baroda. MSU Baroda will be the ‘Hub’. For DIC MSU, MRID and GRC will be lead institutes. As MRID MSU is looking to exchange the research and innovative design development in craft and science sector, we have identified one craft institute, and one medical research institute.

**SPOKES**

**1. UPENDRA MAHARATHI SHILPA ANUSANDHAN SANSTHAN [UMSAS]**

Established in 1956 by the Department of Industries, Government of Bihar, UPENDRA MAHARATHI SHILPA ANUSANDHAN SANSTHAN [UMSAS] Patna aims to research, preserve and promote the various forms of Bihari handicrafts. UMSAS runs skill training program of six months duration throughout the year in 10 various forms of art and craft training in entrepreneurial skills, promotional activities connected with their traditional arts and crafts. The Institute conducts product development, research and training activities and also attempts to safeguard the languishing crafts.

**Why UMSAS:** UMSAS works exclusively with craft people, though at present with the region of Bihar. As a DIC Spoke, UMSAS will be able to reach the craftspeople of Eastern and North Eastern India. The envisaged crafts recharging and innovation can be done through UMSAS.

**2. SCHOOL OF BIOTECHNOLOGY, AMRITA UNIVERSITY**

Amrita University, Kollam, [Kerala State] is a Multi-campus, Multi-disciplinary research University, accredited 'A' by NAAC, ranked in the Ivy League of Indian universities in the 2009 review of Deemed Universities constituted by the MHRD. All dept are approved by the All India Council for Technical Education (AICTE)

Research Initiatives have the support of agencies like TIFAC, DST, ISRO, DIT, DRDO, Microsoft, HP, Infosys, MDS Pharma and Biocon.
**Why Amrita University:** The school of Biotechnology have set up state-of-the-art analytical research lab, in collaboration with agilent technologies. They have a separate Biosensor Research lab for developing affordable biosensors for early monitoring of diseases such as diabetes, cancer etc., and also active in the field of Biomedical Engineering with the aim to develop low cost diagnostics and biomedical devices. Genome Research Centre at MSU has collaborated with Amrita School of Biotech in the past for few projects. We believe there is synergy in our scientific objectives and the work carried out at both centres can be aligned to develop a commercial product/process. Also, the dean of Amrita School of Biotech, Dr. B. Nair happens to be alumni of Department of Microbiology & Biotechnology, MSU and has kindly agreed upon collaborative research model.

**3. NETAJI SUBHASH INSTITUTE OF TECHNOLOGY [NSIT] New Delhi**

An Autonomous Institution under Govt. of NCT of Delhi and affiliated to University of Delhi, Netaji Subhas Institute of Technology is a seat of higher technical education in India. It was established in year 1983 as Delhi Institute of Technology with the objective to meet the growing demands of manpower in the emerging fields of engineering and technology with a close social and industrial interface. Over a period of time the Institute has carved a niche for itself, both nationally and internationally, for excellence in technical education and research. All the departments of NSIT are recognized by AICTE.

**Why NSIT:** NSIT have departments specializing on Manufacturing Processes and Automation Engineering, and the head of the Prof. Sachin Maheshwari have worked with the craftspeople earlier. Also the other departments of NSIT like Instrumentation and Control Engineering specializes on Instrumentation Technology, modern control theory, Biomedical Instrumentation, Robotics, Industrial Electronics, Computer Controlled Instrumentation, Artificial Intelligence etc. Information Technology department at NSIT can be a good contributor to the project of DIC. Moreover the present Director of NSIT Prof. Yogesh Singh was the erstwhile Vice Chancellor of MSU who initiated the establishment of MRID.

**Interaction with Hub and Spoke**

As the DIC MSU is envisaged based on the collaboration of Design, Craft, Science and Technology, we have identified the spokes who are specializing in the Craft Pedagogy [UMSAS], Science [School of Biotechnology, Amrita University] and Technology [NSIT] as our spokes. The
work will be collaborative and inclusive in approach. HUB and SPOKES would act as arenas of interaction between the stake holders.

Spokes are also handpicked to act as regional centres addressing Regions as indicated in the map below.
The Maharaja Sayajirao University of Baroda already have established an Institute of Design based on the principles and concerns discussed above. The curriculum of the newly established Institute of Design namely Maharaja Ranjitsinh Gaekwad Institute of Design [MRID] is structured to act as a bridge to cross the gap between craft of traditional Design and contemporary Design which would benefit both the entities.

Maharaja Ranjitsinh Gaekwad Institute of Design [MRID] have 5 course on Design specialization as

1. Ceramic and Glass Design
2. Craft and Design
3. Accessory Design
4. Communication Design
5. Moving Images

When MRID would reach 4th year of its establishment in 2017 it will have 60 students in each course.

MRID and UMSAS would run short term certificate courses on skill development especially in the field of craft and Design with an intake of 20 students at a specific period.
<table>
<thead>
<tr>
<th>SI No</th>
<th>COURSE NAME</th>
<th>DURATION</th>
<th>KIND OF COURSE</th>
<th>TARGET STUDENTS</th>
<th>CONDUCTED BY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CRAFT AND DESIGN INNOVATION</td>
<td>3 Months</td>
<td>Certificate</td>
<td>Craftspeople / design students / other discipline students</td>
<td>MRID</td>
</tr>
<tr>
<td>2</td>
<td>CRAFT AND MARKETING</td>
<td>3 Months</td>
<td>Certificate</td>
<td>Craftspeople / design students / other discipline students</td>
<td>MRID</td>
</tr>
<tr>
<td>3</td>
<td>HISTORY OF INDIAN CRAFTS</td>
<td>3 Months</td>
<td>Certificate</td>
<td>Craftspeople / design students / other discipline students</td>
<td>MRID</td>
</tr>
<tr>
<td>4</td>
<td>CONTEMPORARY DESIGN THEORIES</td>
<td>3 Months</td>
<td>Certificate</td>
<td>Craftspeople / design students / other discipline students</td>
<td>MRID</td>
</tr>
<tr>
<td>5</td>
<td>DOCUMENTARY FILM MAKING</td>
<td>3 Months</td>
<td>Certificate</td>
<td>Craftspeople / design students / other discipline students</td>
<td>MRID</td>
</tr>
<tr>
<td>6</td>
<td>VEGETABLE DYING PROCESS</td>
<td>3 Months</td>
<td>Certificate</td>
<td>Craftspeople / design students / other discipline students</td>
<td>UMSAS</td>
</tr>
<tr>
<td>7</td>
<td>MATERIAL EXPLORATION</td>
<td>3 Months</td>
<td>Certificate</td>
<td>Craftspeople / design students / other discipline students</td>
<td>UMSAS</td>
</tr>
<tr>
<td>8</td>
<td>ENTREPRENEURSHIP</td>
<td>3 Months</td>
<td>Certificate</td>
<td>Craftspeople / design students / other discipline students</td>
<td>NSIT</td>
</tr>
<tr>
<td>9</td>
<td>CRAFT AND DIGITAL TECHNOLOGY</td>
<td>3 Months</td>
<td>Certificate</td>
<td>Craftspeople / design students / other discipline students</td>
<td>NSIT</td>
</tr>
</tbody>
</table>

**B. CRAFT AND DESIGN RECHARGING CENTER (MRID) WITH NSIT & UMSAS**

DIC MSU proposes to establish Craft Recharging workshops where the craftsmen and Designers along with Scientists, Historians and Design students would take up refresher workshops benefiting all the concerned groups. NSIT would look into the development and modification of the tools used by the craft and design practitioners along with providing the information and Technology inputs. UMSAS would focus on the training of the craft persons using the newly designed tools and machinery along with experimenting with organic alternatives to chemical components used in the production.
Organic dyes are derived from natural sources without any synthetic chemical treatment. They are obtained from sources like flowers, leaves, insects, bark roots and even minerals. They contain no heavy metals or other known toxic substances, and they meet all regulatory standards for eco-friendly pigments. At the proposed research centre, we wish to formulate natural dyes with colors that are brighter and provide excellent colorfast properties on various fabrics. The process combines quality with technology through applications of advanced research at every level – from planning to production. Doing this, we shall also be able to create a pool of trained and highly-qualified technicians. Another advantage of pursuing research in organic dyes would be to create sustainable and eco-friendly solutions by developing innovative natural harvest processes.

Both the centres are highly competitive to develop innovative approaches for extraction of such dyes from various natural sources. The available infrastructure can support research in extraction methods, characterization of these dyes and their final application. We wish to jointly conduct studies on properties of dyes from the microbes and the higher plants as well as on the use of natural dyes in industries such as paper, textile industries etc.

Proposed ‘Hub’ and the ‘Spokes’ would have Craft and Design incubation centers which would provide the Designer, Craftsmen and Students machine tool workshop and laboratories. The ‘Hub’ would also provide the logistic support and marketing input into the design and craft initiatives through research support and partnership with industries and business organizations. The center would act as catalyst between the industry and Crafts and Design. This approach is crucial to the overall development of the traditional crafts in India as this initiative would give boost to the crafts of India which has been neglected hitherto. MRID along with Federation of Gujarat Industries [FGI] would look into the possibilities of entrepreneurship.
Proposed center intend to bring in the Crafts and Design in the mainstream scholarly discourse. The center would provide funds and logistic support to the ‘Spokes’ for collaborative activities in the University organizing conferences, Colloquiums, Lectures, Workshops on traditional design and technology, crafts and Arts.

4 National conferences are envisaged to be organized by the HUB institution and 3 National conferences will be organized by the SPOKES. 3 International conferences at the HUB and 1 each in the SPOKES is also proposed.

Proposed center would also bring out a directory of traditional designers [craftsmen] to bring them in touch with society at large. The center also would encourage scholars to publish Books, Monographs and Catalogues of Individual craftsmen, Crafts and Crafts Clusters with collaboration of the ‘Spokes’. It is proposed to publish 1 peer reviewed National level Journal on crafts in Hindi and 2 peer reviewed International Level Journal in English.

The ‘HUB’ would have facilities to enhance Documentation, Research and development like the Archive for Material resources, Photo Archives, Library, laboratories and Machine and Tool Workshops. The departments who are already working on traditional and contemporary design, Science and technology will be stake holders of this activity and the resulting products will be patented by the University. The Research and development also will be supported through publication a scholarly peer reviewed journal. The Maharaja Sayajirao University being the ‘Hub’ would confer Doctorate and post Doctorate degrees to the research works.

The proposed center envisages providing the researcher, craftsman, scientists, engineers and technicians to explore, document, research and innovate new designs and technical augmentation to traditional designs. These designs will be studied and analyzed by the centre along with providing the designer with marketing and business guidelines.
## PROTOTYPES

<table>
<thead>
<tr>
<th>SL. NO</th>
<th>PROTOTYPE</th>
<th>DETAIL</th>
<th>BENEFICIARIES</th>
<th>BY</th>
<th>TIME FRAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CRAFT DIRECTORY</td>
<td>Collecting the data from the craft clusters and individual craftsperson through spokes, the hub will compile a directory of craftsperson/craft directory which will be published in Hindi and English.</td>
<td>Design students, designers, craftsperson and researchers</td>
<td>MRID</td>
<td>Year 3</td>
</tr>
<tr>
<td>2</td>
<td>CRAFT DIRECTORY WEB SITE</td>
<td>There will be an interactive web version of the craft directory with links to research materials and videos.</td>
<td>Design students, designers, craftsperson and researchers</td>
<td>NSIT/ MRID</td>
<td>Year 3</td>
</tr>
<tr>
<td>3</td>
<td>MOBILE APP FOR CRAFTS MEN</td>
<td>A MOBILE App version of the craft directory is envisaged.</td>
<td>Design students, designers, craftsperson and researchers</td>
<td>NSIT/ MRID</td>
<td>Year 3</td>
</tr>
<tr>
<td>4</td>
<td>JOURNAL - HINDI - 1</td>
<td>As there are no journals in Hindi for the craftperson a monthly Journal, informing about the new inventions and innovations and also about the history, heritage and culture is envisaged.</td>
<td>Design students, designers, craftsperson and researchers</td>
<td>UMSAS/ MRID</td>
<td>Year 1</td>
</tr>
</tbody>
</table>
| 5      | JOURNAL - ENGLISH - 2     | 1. Similar to above journal and peer reviewed International quarterly journal in English is proposed.  
2. Peer reviewed International quarterly journal on innovations in the field of Micro Biology | Design students, designers, craftsperson and researchers | MRID           | Year 1     |
<p>| 6      | BOOKS - 1 ENCYCLOPEDIA OF INDIAN CRAFTS | The encyclopedia of Indian craft would look into the history, sociology and anthropological profiling of Indian craft. | Design students, designers, craftsperson and researchers | MRID           | Year 3     |
| 7      | DOCUMENTARY FILMS - CLUSTERS/ CRAFTS/ CRAFTSPERSON | Small format documentaries and promotion films on the craft cluster; craft persons will be prepared and disseminated through the web. | Design students, designers, craftsperson and researchers | MRID           | Year 2     |
| 8      | TOOL INNOVATION           | Craftsmen: India uses traditional tools which are not ergonomically correct. DIC along with spokes would review and modify the tools. | Craftsperson                                        | NSIT           | Year 2     |
| 9      | TOOL KIT                  | NSIT in consultation with other spokes and hub would device a toolkit for the craftsperson. | Craftsperson                                        | NSIT           | Year 3     |
| 10     | ORGANIC ALTERNATES FOR CHEMICAL COMPONENTS | Most of the craftsmen use chemical dyes as an alternate to vegetable dyes these days including indigo. There is health hazard and chemical footprint created through this process. DIC would create and demonstrate to the craftsperson about the possibility using organic dying process. | Craftsperson                                        |                | Year 2     |
| 11     | PROGRAMMABLE NANOMATERIALS | The research will focus on finding Industries/                     | Industries                                         | CGR/ AMRITA    | Year 2     |
| 12     | DEVELOPING                | The research will focus on finding Industries/                     | Industries                                         | CGR/ AMRITA    | Year 3     |</p>
<table>
<thead>
<tr>
<th>SL NO</th>
<th>ACTIVITY</th>
<th>Number</th>
<th>Time frame</th>
<th>BENEFICIARIES</th>
<th>BY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>National Conferences</td>
<td>7</td>
<td>Between year 1 to Year 3</td>
<td>Craftspeople /design students / other discipline students</td>
<td>4 by HUB &amp; SPOKES</td>
</tr>
<tr>
<td>2</td>
<td>National Conferences</td>
<td>2</td>
<td>Between year 2 to Year 3</td>
<td>Craftspeople /design students / other discipline students</td>
<td>2 + 1 by HUB</td>
</tr>
<tr>
<td>3</td>
<td>Exhibitions</td>
<td>5</td>
<td>Between year 1 to Year 3</td>
<td>Craftspeople /design students / other discipline students</td>
<td>3 by HUB &amp; SPOKES</td>
</tr>
<tr>
<td>4</td>
<td>Craft recharge workshops</td>
<td>10</td>
<td>Between year 1 to Year 3</td>
<td>Craftspeople /design students / other discipline students</td>
<td>5 by HUB &amp; SPOKES</td>
</tr>
</tbody>
</table>
### Timeline for Deliverables

<table>
<thead>
<tr>
<th>YEAR 1</th>
<th>YEAR 2</th>
<th>YEAR 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1</strong> Design Education</td>
<td>Design Education</td>
<td>Design Education</td>
</tr>
<tr>
<td><strong>2</strong> National Level Conference</td>
<td>National Level Conference</td>
<td>National Level Conference</td>
</tr>
<tr>
<td><strong>3</strong> Design Journal in Hindi</td>
<td>Design Journal in Hindi</td>
<td>Design Journal in Hindi</td>
</tr>
<tr>
<td><strong>4</strong> Design Journal in English Scientific Journal</td>
<td>Design Journal in English</td>
<td>Design Journal in English Scientific Journal</td>
</tr>
<tr>
<td><strong>5</strong> Craft recharge workshops</td>
<td>Craft recharge workshops</td>
<td>Craft recharge workshops</td>
</tr>
<tr>
<td><strong>6</strong> Exhibitions</td>
<td>Exhibitions</td>
<td>Exhibitions</td>
</tr>
<tr>
<td><strong>7</strong> Inter National Level Conference</td>
<td>National Level Conference</td>
<td>National Level Conference</td>
</tr>
<tr>
<td><strong>8</strong> Genetic engineering for production of natural pigments</td>
<td>Genetic engineering for production of bamboo</td>
<td>Developing biomaterials for various industrial applications</td>
</tr>
<tr>
<td><strong>9</strong> Programmable nanomaterials</td>
<td>Organics alternates for chemical components</td>
<td>Organics alternates for chemical components</td>
</tr>
<tr>
<td><strong>10</strong> Tool innovation</td>
<td>Documentary films – clusters/crafts/crafts person</td>
<td>Tool innovation</td>
</tr>
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<td><strong>11</strong> Mobile App for Crafts Men</td>
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## BUDGET

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<p>| GRAND TOTAL [HUB + SPOKE] | 395 | 331 | 270 | 996 |</p>
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CONCLUDING REMARKS

☐ The Maharaja Sayajirao University is residential University with no affiliated colleges under it.

☐ Each Faculty works independently and has achieved higher academic standards.

☐ For the first time Under the DIC scheme Science, Design and Humanities departments are planning to work together to impact on the weaker social sector of the craftspeople along with achieving scientific, technological innovations.

☐ As the project progresses DIC MSU would collaborate with more stakeholders.

☐ We have created a mechanism- CLUSTER INNOVATION CENTRE by which we support young entrepreneurs who want to explore a novel idea, by providing them physical infrastructure, securing funds, patenting etc. This will be a unique way in which we can help entrepreneurs in taking up design innovations and validate their concept since the infrastructure is already available.