COMPONENT 4
QUALITY AND EXCELLENCE IN STATE UNIVERSITIES

I. Short Listing Criteria Indicators & Weights (Total 100marks)

S.N.	Short Listing Criteria	Indicator	Weights	Remark
A.	NAAC Score for Institution (20marks)	CGPA 3.51-3.59	07 Marks	**07**
B.	Faculty Positions filled in regular mode for Institution (20marks)	60-69.9%	05 Marks	**05**
C.	Student-Teacher Ratio for Institution (20 marks)	Above 1:20 – 1:30	15 Marks	**15**
D.	Functional Governance Structure for Institution (20marks)	Governing Council/ Board: **YES** (**Syndicate**)	05 Marks	**20**
		Academic Council/ Board: **YES** (**Academic Council**)	05 Marks	
		Research Council: **YES** (**URC and SRC**)	05 Marks	
		Board of Studies: **YES**	05 Marks	
		Finance Committee: : **YES**	05 Marks	
E.	Funding Priority for Cluster as a whole (20marks)	Does the Institution have Vision – Mission Statement: **YES**	03 Marks	**15**
		Does the Institution offer inter-disciplinary Program? **YES**	03 Marks	
		Does the Institution offer: UG & PG: **YES**	03 Marks	
		Does the Institution have research Program? **YES** (**M.Phil, PhD, D.Litt**)	03 Marks	
		Has the Institution been conferred CPE status by UGC? **NO**	0 Mark	
		Does the Institution have an Alumni Association? **YES**	02 Marks	
		What is the percentage of students getting placed in the Institution? **Over 50%**	01 Mark	

II. BASELINE DATA
Particulars of the University

Information/details	
Details of the State University	
i.	Name: **UTKAL UNIVERSITY**
ii.	Address: **VANI VIHAR, BHUBANESWAR – 751 004, ODISHA**
iii.	Location (~~Metropolitan /~~**Non-metropolitan**~~/ Non-urban area):~~
iv.	Contact details of the Vice-Chancellor, Registrar and Nodal Person identified for this purpose. (Name, designation, landline, mobile, fax, email):
	1. Professor Soumendra Mohan Patnaik **Vice-Chancellor** Land: +91 674 256 7700 Mobile: +91 94370 15893 FAX: +91 674 256 7850 E-mail: vcuu@rediffmail.com 2. Mr. Dayanidhi Nayak **Registrar** Land: +91 674 256 7387 Mobile: +91 94370 15891 FAX: +91 674 256 7850 E-mail: registrar@utkal-university.org 3. Dr. Himanshu Sekhar Rout **Nodal Person** Land: +91 674 256 7387 Mobile: +91 94371 008138 FAX: +91 674 256 7850 E-mail: rusa.utkal@gmail.com

III. VISION OF THEUNIVERSITY

S.No.	**Information to be provided**
a.	Fifteen-year Vision Plan including Mission Statement, Values, Institutional Goals and Vision to meet the objectives and Characteristics of a University with quantified milestones and timelines to achieve world class repute as expected in the Regulations.
	Vision To be a centre of excellence in higher education with focus on innovative teaching, learning, research, consultancy and extension activities in building a creative, enlightened and productive civil society with the following core values • Stimulate innovation, creativity and scholarship • Foster equality and gender sensitivity • Excellence, quality and spirit of service • Transparent, accountable and responsive governance with a human touch • Promote respect for human dignity • Cultivate openness of mind and catholicity of outlook

	Mission 1. To provide the students with knowledge, skill, values and sensitivity needed to be a successful citizen. 2. To create and disseminate knowledge through interdisciplinary research and creative inquiry in developing a meaningful and sustainable society. 3. To equip the students with problem solving, leadership and teamwork skills and inculcating a sense of commitment to quality, ethical behavior and respect for others. 4. To provide a platform for free flow of ideas where discovery, creativity and professional development finds a scope for fulfillment in making the world a better place to live in. 5. To ensure academic excellence in this dynamic knowledge economy by exposing the students to new ideas, new ways of understanding, new ways of knowing in their journey of intellectual transformation. **Core Values** 1. Quality Teaching with affordable prices for all sections of the society 2. Stimulate innovation, creativity and scholarship 3. Foster equality and gender sensitivity 4. Excellence, quality and spirit of service 5. Transparent, accountable and responsive governance with a human touch 6. Promote respect for human dignity 7. Cultivate openness of mind and catholicity of outlook **Strategic Goal** 1. Supporting the overall academic success of students 2. Curriculum reform commensurate with global knowledge level 3. Pursuing cutting-edge research for new knowledge production and societal benefits 4. Creating opportunities to gain knowledge, skills, and credentials in high demand fields 5. Identifying new sources of funding for university activities 6. Enhancing the university's regional, national and international reputation 7. Improving the employment placement rate of students after graduation 8. Improving communication with key stakeholders 9. Increasing the retention rates of disadvantaged students 10. Increasing support for the academic success of disadvantaged students 11. Increasing grants and contracts activity 12. Enhancing institutional network capacity at national and international level 13. Improving alumni engagement 14. Fostering greater engagement with the local community 15. Building environmentally sustainable campus facilities 16. Reaching students in remote and inaccessible areas through distance and continuing education and also to improve equity
b.	How far are the Institution/ University from becoming a University, including the present status of the institution, the status which seeks to achieve to become as world class and gap in each parameter.
	The University will take the following steps for moving towards World-class University. 1. Developing World class infrastructure such as, International Hall, International Collaboration Cell, Sophisticated Instrumentation Centre, Technology-enabled class rooms and laboratories. 2. World class digital library including e-resources 3. Going for International Accreditation 4. Engagement of Internationally reputed faculty 5. Attracting high quality students across the globe

6. Scholarship to high performing students and scholars
7. Research awards for best quality publications
8. Encouraging presentation of research papers in International conferences / workshop / seminars.
9. Creating research groups in collaboration with reputed national and international laboratories, Universities and Institutes.
10. Encouraging the faculty to file patent and other IPRs for original research work.
11. Establishing Scientific and Academic Chairs
12. Establishing International Advisory Boards for quality enhancement in academics, research and administration
13. Facilitating distinguished lecture / Scientist Programs
14. Creating Endowments with the help of Individuals, Industries and Alumni
15. Establishing research centers to address local issues and cutting-edge research

c. Plan for becoming a University. The plan should give the status of the Institution at the present stage on all relevant parameters, the status to which they seek to reach after ten years and fifteen years on each of the parameters, and how they target to reach the same on each of the parameters.

S.No	Indicator	Present Status	Status after 10 year	Status after 15 year
1.	Infrastructure	Inadequate but work-in-progress	World class facilities shall be available	World class status can be achieved
2.	Library	Partly digitalized	Fully digital library	Fully digitized with global connectivity
3.	Accreditation	NAAC A+	NAAC A++ and will go for International Accreditation	In the top 200 Institutions of the world
4.	International Faculty	Nil	5% visiting International faculty	10% visiting international faculty
5.	International Students	Nil	1% International Student of the total strength	5% International Student of the total strength
6.	Scholarship	Available to around 50% (National)	Available to around 70% (National) and to all International Students	Available to around 80% (National) and to all International Students
7.	Research Awards	Nil	At least one in each discipline	At least one in each subject
8.	Presentation of research papers / Resource Person (RP)	**2016-17:** 60 International 121 National 15 RP International 106 RP National	Twice of the present status	Thrice of the present status
9.	National and International Collaboration & MOUs	38 Collaboration & 12 MOUs	60 Collaboration & 25 MOUs	100 Collaboration & 40 MOUs
10.	Patent and creation of other IPR	01	10	15
11.	Scientific and Academic Chairs	Nil	05	10
12.	International Advisory Boards	Nil	05	10

13.	Distinguished lecture / Scientist Programs	20 per year on average	35 per year on average	50 per year on average
14.	Endowment	49	70	100
15.	Research Centre	Three	Ten	Fifteen

d. SWOC analysis of the institution focusing on its present status in the quality hierarchy and the proposed measures to address the shortcomings?

SWOC Analysis:

Strengths:

a. Grade 1 (NAAC A+) University declared by MHRD, Government of India
b. Identified as a Highly Graded University by GOI to go for Research Collaborations with reputed National labs.
c. Intellectual Assets
d. Enriched Alumni base
e. Continuous Industry-academia interface
f. Being Mother University it has the advantage of winning trust of various stakeholders.

Weakness:

a. ICT Infrastructure
b. Inadequate support staff
c. Inadequate research support

Opportunities:

a. Collaboration with National and International Institutes / Universities
b. Skill and Knowledge Hub
c. Advanced research centre
d. Major contributor for policy initiatives

Challenges:

a. Unstructured database
b. Financial Constraint

VI. PROPOSED YEARS STRATEGIC PLAN (FOR EACH YEAR):

a. An academic plan showing the courses proposed and a research plan focusing on current thrust / niche area(s) of expertise and proposed plan in pursuit of excellence in those areas.

1. Courses to be floated during 2018-19 and 2019-20
   a. M.Sc Physics (High Energy Physics & Condensed Mater Physics)
   b. Master in Big data Analytics
   c. M.Sc in Biochemistry
   d. Master of Public Health (MA/M.Sc)
   e. MBA in Rural Management
   f. Master in Social Work
   g. Bachelor in Education (2 Years)
   h. Master in Education (2 Years)
2. Institution of School of Public Policy and Governance (COE) with following Centres
   a. Centre for Policy Research and Modeling (CPRM)
   b. Advanced Centre for Labor Research (ACLR)
   c. Global Centre for Rural Studies (GCRS)
   d. Centre for Climate Change and Disaster Management (CCCDM)
3. Intellectual Property Rights (IPR) Cell
4. Centre for Study of Languages, Literature & Culture

	5. Advanced Materials and Application 6. Centre for North-Eastern Studies 7. School of Health Sciences (Non-Clinical) 8. Courses to be floated within ten years a. Masters of Public Policy and Governance b. Masters in Development Studies c. Masters in Corporate Innovations and Strategy d. Masters in Liberal Arts e. Bachelor in Education (Four Years) f. PGD in CSR Management g. PGD in Electronic and Web Journalism h. PGD in Communication for Development i. PGD in Project Monitoring and Evaluation j. PGD in Women Empowerment and Entrepreneurship k. PGD in Skill and Entrepreneurship Development l. PGD in Bioinformatics
b.	Afacultyrecruitmentpolicyandplantomeettheacademicplanrequirements andtoachieve1:10faculty-studentsratio.
	To achieve 1:10 the faculty - student ratio university is in the process of new recruitment as per the UGC rules. Government has also given importance in different Vice Chancellors' meetings to fill up the posts at the earliest. To manage the faculty: student ratio, different departments have engaging DST-INSPIRE Faculty, UGC-FRP Faculty, Emeritus Professors (UGC, CSIR, DST), Adjunct Professors, Visiting Professors, Research Associates, Doctoral Fellows under UGC-JRF-BSR Scheme, INSPIRE Fellow, Rajib Gandhi Fellow, Moulana Ajad Fellow, Post-Doctoral Fellows (Kothari Fellows, Ramlingam Fellow etc.) for taking regular classes and for contributing to research activities in the University.
c.	Proposal, if any, to recruit faculty from industry, Government, Non-profit organizations, etc. Including foreign faculty.
	1. **Foreign Faculty Engagement**: For the first years (2018-19 and 2019-20), the University proposes to recruit foreign faculty on contract one each in the departments of Psychology, Anthropology, Economics, English, Physics, Biotechnology, Botany, Chemistry, Management, and PMIR at least for three months in a semester. 2. **Faculty Engagement from Industry and Government**: For the first years (2018-19 and 2019-20), the University proposes to recruit faculty five each from Industry and Government on contract one each in the departments of Political Science, Public Administration, Commerce, Business Administration, Archeology, Computer Science and Application, Statistics, Geology and Geography at least for three months in a semester. 3. **Faculty Engagement from NGOs**: For the first years (2018-19 and 2019-20), the University proposes to recruit faculty one each on contract in the departments of Philosophy, Sociology and Law at least for three months in a semester.
d.	Student admissions policy mentioning plan to select Indian and foreign Students
	1. All India Entrance: In the first year (2019-20), the admission test will be conducted in seven major cities (Mumbai, New Delhi, Kolkata, Chennai, Hyderabad, Pune and Bengaluru) will be conducted through Regional Coordinators and this will be expanded all over India in following years. 2. Foreign students will be admitted through ICCR, New Delhi: At least 20 during 2019-20.

e.	Plan to provide scholarship to meritorious Indian.	
	1. Library Interns for MA/ M.Phil Student one in each department on merit as per UGC Rule in Project Mode with an objective to earn while learns. 2. Scholarships / Teaching Assistanceship for PhD students one in each subject in which PhD degree is being offered in the campus as per UGC Rule in Project Mode	
f.	A comprehensive plan to develop research laboratories / COEs with demonstrable progress towards it.	
	CPRM (COE)	It is noticed that the state government and national government launch various schemes for eradicating poverty and generating employment. In many cases such schemes do not yield the desired results. Similarly, if a few schemes are successful, no systematic studies are done to assess the impacts of economy, society and environment. There is a need to formulate standard framework for the implementation of government schemes. All government policies should be tested in a standard framework for maximising the chances of success. Similarly, after the implementation of schemes, government policies should be scrutinised in a standard framework for assessing the social, economic and environmental impacts. For effective policy design and their implementation, there is an urgent need to do the scientific evaluation of the public policies before and after the implementation. At present impact assessments are carried out with the help of non-governmental organisations that lack adequate expertise. In this context the department of Analytical and Applied Economics along with other social science, science and management departments proposes to set up a centre to carry out scientific evaluation of the public polices formulated and implemented by the state and national government. **Vision** To use the academic research for raising the living standard of the people through effective design of public policy in the state and country **Mission** To design, guide and facilitate the implementation of Sustainable Development plans in a participatory and multi-disciplinary framework **Objectives** 1. To develop an Integrated Framework for Social, Economic and Environmental Impact assessment (IFSEEIA) of different developmental projects through an inter-disciplinary mode 2. To formulate proto-type robust policy models for different developmental projects / policies / plans / programs 3. To develop a Standard Framework for the Pretesting of the Government Policies (SFPGP) before implementation 4. To suggest appropriate policy measures for ensuring high economic growth, poverty eradication, creation of more employment, and management of public funds. 5. To develop Big Data Analytic Skills **Thrust Areas** 1. Impact assessment through IFSEEIA of different developmental projects 2. Efficiency and Compliances of Direct and Indirect Taxes 3. Assessment, Allocation and Efficient use of Natural and Human Resources 4. Public Policy formulation, implementation, governance and evaluation • Two years

			Interdisciplinary Approach The success or failure of the public policies depends upon economic, social and cultural factors. Therefore, the implementation of the public policies needs to be evaluated in an interdisciplinary framework. Keeping this in mind the department of Analytical and Applied Economics, Sociology, PMIR, Mathematics, Statistics and Computer Science and Application will work together and analyse the impact of public policies in an interdisciplinary manner. Wherever, required other departments like geography and other science departments will be roped in for providing the technical and scientific expertise **Core Values** • Participatory Policy Design and Assessment • Multi Disciplinary Approach • All Stakeholder consultation • Sustainability **Outcome** 1. Collaborative interdisciplinary research with at least one national and one international University / Institute 2. Support to government in formulation, implementation, monitoring and evaluation of policies and programs 3. Produce 100 experts in policy research and modelling through training and continuous feedback 4. Produced eight international standard PhD degrees 5. Publication of ten research papers in journals having at least impact factor of 1. **Collaboration** 1. Academic Staff College of India, Hyderabad 2. Department A&A Economics 3. Department of Statistics 4. Department of Mathematics 5. Department of Computer Science & Applications 6. Department of Sociology 7. Department of Public Administration 8. Department of PMIR
		ACLR	Labour in unorganized sector continues to be a major provider of jobs to a disproportionately large majority of labour force throughout the world. Its growth has been accelerated in recent years due to casualization, contractualisation and informalisation of the economy. Labour in this sector which is neither strongly organized nor comes under the purview of regulatory framework, plays a pivotal role in Indian economy. Consequently unorganized labour is often subject to flagrant abuse of basic rights. Unorganized workers which constitute 93 per cent of the workforce are engaged in agriculture, construction, manufacturing, trade and transport, communication & services, and home based occupations and they contribute to 50 per cent of national products. In spite of presence of various labour laws and other welfare schemes, construction workers, migrant workers, contract labour, child labor and bonded labour are exploited in manifolds particularly in Odisha. Thus they need special attention. The proposed Advanced Center for Labour Research shall be a hub on research, training, consultancy and publications, and to reach all those who

			are concerned with diverse facet of workers, in the unorganized sector. In addition to research on construction workers, migrant workers, contract labour, child labour and bonded labour, the centre will impart training to them for upgradation of skills, and undertake consultancy and publication of research findings in the form journal and newsletter. **Vision**: "An advanced centre of research and training for improving the quality of life of unorganized workers" **Mission:** • Undertake training and research concerning labour and employment • Address the issues encountered by unorganized workers • Dissemination of knowledge and ideas among all stakeholders for improvement of labour standard in the sector **Objectives** ▪ To conduct a base line research to develop a data base of the sector ▪ To act as a capability enhancement center offering training to workers engaged in unorganized sector ▪ To undertake research in collaboration with other agencies at regional, and national levels; ▪ To provide support to government and other agencies in policy formulation for transformation of labour standard ▪ To address the issues in implementation of policies relating to unorganized labour and to suggest remedial measures ▪ To help in sharing of knowledge among all social partners by publication of newsletter and journal of national repute. **Deliverables:** The centre aims at creating its own brand value by fostering a climate of research and innovation. Further, it aims at generating a pool of database in relation to labour, employment and skill workforce for formulation of policies in the concerned area. The research centre would intend to complete the projects related to the assessment of the current status of workers engaged in unorganized sector and support the government in policy formulation. Furthermore, the centre would involve itself in continuous diagnosis of the possible bottlenecks and recommend action plans for constructive reforms and sustenance. The research publications of the centre would enrich the body of knowledge of specific domain. It would yield as a pragmatic model of industrial growth attracting all stakeholders' involvement. **Collaboration** 1. VV Giri National Labour Institute, Noida 2. Academic Staff College of India, Hyderabad 3. Department of PMIR 4. Department A&A Economics 5. Department of Sociology 6. National Institute of Personnel Management, Kolkata 7. NALCO, Bhubaneswar 8. NLC India
		CCCDM	As many acute environmental/climate challenges are still waiting to be solved. The ultimate objective is to stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. The proposed center i.e. **Centre for**

			Climate Change and Disaster Management will deal with different aspects related to impact of regional environmental issues on global climate change emphasizing the following research areas • Estimation and assessment of projected greenhouse gases emission from various energy sectors in India and its impact on temperature trend and climate. • Establishing the tele-connection between human cultures / behavior and the environment from prehistoric times to the present climatic condition. • Assessment of socio-economic loss due to changing climate and its mitigation strategies. • Linkage between climate change and Indian monsoon, which play a vital role in shaping India's economy. • The assessment of social impacts on public health, ecosystem, increased population movement, obstacles to development and environmental damage due to climate change. • Climate modeling and to understand the impact of transboundary pollutants on snow/ice cover over Himalayan, Antarctica and Arctic. • Understanding the challenge that climate change poses and creating appropriate adaptation and mitigation mechanisms of the natural and social sciences in an interdisciplinary approach. • Advancement in alternative clean energy sources. • Impact of alarming climate agents/GHGs level on food security through agriculture, biodiversity and human health. **The proposed center has four research segments as follow** 1. Research on Climate Change 2. Mapping of Vulnerability of the environment & community 3. Research on Community resilience 4. Capacity building of community to counter climate change 5. Impact of climate change human being and adaptability **Collaboration** 1. IMD, Pune 2. Department of Geography 3. Department of Botany 4. Department of Geology 5. Department of Public Administration 6. Department of Chemistry 7. Department of A&A Economics 8. Department of Biotechnology 9. RMRC-ICMR 10. IIPH Bhubaneswar
		Botany	Proposal for creation of a centre for Environmental Management **Attenuation of heavy metal stress through green technology by plant and microbe interaction** Quantification of metals in soil and water Possible bioremediation (green technology) for attenuation of metal stress **Component 2: Air quality monitoring, modelling and assessment in smart city Bhubaneswar** Continuous measurement of ambient air quality for various air pollutant. Preparation of emission sources and its source apportionment studies through modelling studies. Useful for policy maker to frame new mitigation strategy in city.

		Biotechnology	Proposal for Cluster Research Hub. The practice of public health has been dynamic in India, and has witnessed many hurdles in its attempt to affect the lives of the people of this country. Since independence, major public health problems like malaria, tuberculosis, leprosy, high maternal and child mortality and lately, human immunodeficiency virus (HIV) have been addressed through a concerted action of the government. The recent agenda for Public Health in India includes the epidemiological transition (rising burden of chronic non-communicable diseases), demographic transition (increasing elderly population) and environmental changes. The unfinished agenda of maternal and child mortality, HIV/AIDS pandemic and other communicable diseases still exerts immense strain on the overstretched health systems. Besides, the tobacco-attributable deaths range from 800,000 to 900,000/year, leading to huge social and economic losses. Mental, neurological and substance use disorders also cause a large burden of disease and disability. According to recent estimates, premature death and illness due to major environ mental health risks accounts for nearly 20 percent of the total burden of disease in India. Odisha, one of the coastal states of Indian sub-continent is rich in bio-diversity and endowed with wide range of flora and fauna owing to its peculiar topography and geographically distributed various microclimatic locations. These natural resources are neither being properly exploited nor even utilized for their therapeutic potentials. Most of the people in Odisha live in rural areas and use traditional herbal medicines for treatment of different diseases. This project will provide a strong scientific linkage with traditional knowledge in the field of Ethno-pharmacology. **With this background** we have a strong rational to propose a cluster research hub on environmental and public health with the following objectives Basic Objectives:- Objective 1: To understand the process of ageing, geriatric health and neuronal plasticity in response to environmental toxicants and stress. Objective 2: Validation of traditional and ethnopharmacological knowledge for the development of natural compound based therapeutics against common health elements. Objective 3: Bioprocess development of therapeutic enzymes / proteins / biosimilars Objective 4: Genomic and epigenomic landscape of ethnic group of people with reference to disease prevalence and resistance.
		Psychology	**Proposal for setting up of Language Lab** Due to the recent revolution in information technology, computer-assisted language learning is becoming the trend in foreign/second language teaching as well as teaching of communication skills. Computer-assisted language learning can reduce the anxiety of students by allowing time and pace for each individual learner in acquiring language and communication skills. It also provides the privacy that encourages the shy students to speak without any hesitation. In addition instructor can speak to individual or group of students in privacy without interrupting rest of class. **2. University Counselling Centre upgradation** Counselling services are offered to the students of Utkal University, who face

			difficulties in making decisions and adjustments in day -to -day life situations. People from outside the university also visit the centre for counselling. Individual as well as group counselling services are provided by the faculty members and other counsellors to alleviate the problems of the clients in a specially arranged counselling setting. Psycho-educational diagnoses as well as remediation programs are also recommended to the children with learning disabilities and other social and emotional problems. The proposed up gradation will help students to develop insight and skills in solving problems and discovering the strengths in their personality. **Upgrading the the DISABILITY Unit, Samarthya** Department extended its expertise to the university students through Higher Education for Person with Special Needs (HEPSN) project funded by the UGC. Aptly named as **Samarthya** (meaning Capability), the centre aims at capacity building of the students with disabilities and to further their power to struggle for equal rights in the competitive world. Over and above these, the use of technology to ease the handicapping situation of the disabled has been promoted through the installation of **Job Access with Speech** (**JAWS) software**. This software gives immediate auditory feedback of the keys pressed and programs executed so that a person can work on the computer even without **vision.** We have plans to install the **dictation software** that will accept verbal input into the word processor and execute commands. This will finally replace the use of amanuensis for the persons with visual impairment and whose writing is affected through Cerebral Palsy, polio or accidents.
		Zoology	**1. Studies on Genomic diversity of sea turtles of Odisha** Sea turtles are reptiles that exhibit complex life traits, such as long generation and wide-ranging migrations, inhabiting both different tropical and subtropical regions. As soon as they reach sexual maturity, adults make migrations to their natal beaches for reproduction, termed natal homing. Feeding grounds, where they spend most of their lives, are composed by individuals from different natal origins, known as mixed stock populations. However, such information is not available for the breeding grounds. The aim of this study is to assess genetic composition, natal origins and demographic history of olive ridley sea turtles (*Lepidochelysolivacea*) along the Odisha coast, one of the heritage sites for this turtles. **2. Molecular characterization of beta thalassemia and G6PD deficiency among the coastal population of Odisha.** Beta thalassemia, an autosomal disorder of human, affects 3 to 4% of population in India whereas Glucose-6-phosphate dehydrogenase (G6PD) deficiency, a X-linked disorder of human affect up to 10% population of India. These are leading cause of hemolytic anaemia in human. The clinical complications due to beta thalassemia and G6PD deficiency are highly variable due to multiple molecular variants of the genes affecting the patients with these disorders. The knowledge of each molecular variant of beta thalassemia and G6PD deficiency can give better clinical treatment to the patient according to specific mutations. Therefore, the present study will assess the prevalence and clinical importance of such disorders to eradicate these diseases in coastal population of the state.

		Physics	**1.High Energy Physics, Gravitation & Cosmology:** **a)** The Physics potential of the upcoming 50 kt magnetized iron calorimeter (ICAL) detector at the India-based Neutrino Observatory (INO) to study the atmospheric neutrinos and antineutrinos have been discussed with particular emphasis to determine the neutrino mass hierarchy, precision measurement of atmospheric neutrino mixing parameters at ICAL, how to probe new physics scenarios like CPT violation, presence of magnetic monopoles. b) Accretion of radiation in the radiation dominated era and evaporation rates of rotating and non rotating Primordial black holes (PBH) have been obtained in the context of standard cosmology as well as in Brans-Dicke theory of Gravitation in which the gravitational interaction is mediated by a scalar field as well as the tensor field of General theory of relativity**.** We plan to study the inflation, scalar tensor ratio, accelerated expansion of the universe in the context of Brans-Dicke theory. c) In the field of String theory and supergravity, a new formalism has been developed to compute the macroscopic and microscopic entropy of a class of black holes including higher order curvature corrections. This prescription makes use of a very fundamental symmetry called "duality symmetry" and this, in turn, has given a very important result elucidating the relationship with the partition function and free energy of the topological string theory**.** d) The study of relativistic heavy ion collisions provides an excellent means to study the existence of new form of matter at extreme conditions of energy density and temperature. The bulk properties of the system created in such collisions can be studied via the transverse momentum distribution of the charged particles produced. Implementing the Tsallis q-statistics in the Weibull model of particle production, the transverse Momentum distribution of the charged hadrons in Heavy Ion Collision at RHIC (BNL) and LHC has been obtained and the model describes the data remarkably well for the entire transverse momentum range measured in nucleus-nucleus and nucleon-nucleon collisions**.** The gravity dual description and various hydrodynamic properties of anisotropic space time in the context of quark gluon plasma will be studied. e) New methodology has been developed for testing the statistical isotropy of Cosmic Microwave Background Radiation which is supported by the Cosmological Principle and to study the various cosmological anomalies present in the both temperature and polarization data provided by WMAP team and recently by PLANCK team with greater accuracy. We plan to develop methods to study the various cosmological anomalies present in the both temperature and polarization data provided by WMAP team and recently by PLANCK team with greater accuracy, to estimate the parameters of the cosmological model with unprecedented precision from the Power Spectrum of Cosmic Microwave Background Radiation, to investigate anisotropic metrics in order to establish the observed anisotropies or to consider alternative explanations for the observed anisotropy. f) Gauge-Gravity duality has been used to understand the strongly coupled regime of physics. At present, there does not exists any other proposal to understand the strongly coupled regime of e.g. QCD apart from lattice QCD and with the help of such duality we can understand such regimes. g) We plan to investigate quark hadron phase transitions at finite density and temperature in the context of compact star in Quark Meson Coupling model. We also plan to study Parity non-conservation (PNC) in heavy atoms which

have provided an important confirmation of the electro-weak sector of the Standard Model. One can explore the possibility of new physics beyond the Standard Model by combining the very accurate measurement of PNC in atomic cesium with sophisticated many-body calculations. A high precision measurement of parity non-conservation in atomic cesium has reduced significantly the uncertainty in the determination of the weak charge of the Cs nucleus. In particular, variations in the neutron distribution among the isotopes affect the weak charge. Thus nuclear structure could become a crucial factor in the interpretation of PNC experiments of increasing accuracy. There have been earlier studies to determine nuclear structure effects in PNC in atomic cesium using relativistic Hartree approximation. The nuclear structure effects in PNC using the relativistic Hartree-Fock approximation with correlations is an interesting aspect which requires a detailed study. Also we would like to study the properties of finite nuclei including these correlations which can give us the information beyond the mean field calculation.

h. Study of the measurement of direct CP violation in charmless B meson decays. B meson is a bound state of b anti-quark and either a u or d quark having a mass of 5:28GeV . CP symmetry states that the law of physics should be the same if a particle is interchanged with its anti-particle and when its spatial co-ordinates are inverted. There are di erent ways of study of CP violation, namely CP Violation (CPV) in decay (direct CPV), CPV in mixing and CPV through mixing-decay interference. CP violation, resulting in different properties of matter and antimatter, plays an important role in explaining the matter and anti-matter asymmetry. CP violation was observed in K meson system. The magnitude of the CPV in the SM is very small to explain the asymmetry between matter and antimatter. Explaining of matter and anti-matter asymmetry requires the new source of CPV in other meson system. The search of these sources is one of the main goals of current and future generation collider experiments. CP violation in the B-meson sector has been established by the Belle experiment at KEK, Japan through a systematic study of B meson decays. In this analysis, we study the branching fraction and CP asymmetry in the charmless B meson system.

i. In the TIFR-Utkal GRAPES 3 collaboration, we study cosmic rays with an array of air shower detectors and a large area muon detector. It aims to probe acceleration of cosmic rays in acceleration of particles to nearly 100 MeV in atmospheric electric fields through muons, nearly 10 GeV in the Solar System through muons, 1PeV in our galaxy through measurement of diffuse gamma ray flux.

2. Condensed matter Physics, Material Science, Complex systems in Physics and Nonlinear dynamics, Cellular Automata, its applications to phase transitions

a) Accelerator based research in the area of materials science during the last five years has been focused on probing the evolution of materials under swift heavy ions. A new mode of ion-matter interaction has been established where secondary electrons emitted along the ion paths, selectively displace specific ions in a high Tc superconductors. It has been demonstrated how the high energy ions in the form of formation of new phases can play a constructive role and induce structural transformations instead of generally perceived destructive role of ions in the form of disorder and defect creation.

It has been established how in the nanoscale of particle size, the highlyinsensitive metallic systems like gold can show extreme sensitivity to swift heavy ion irradiation.

(b) The laser induced diffusion of Bismuth into chalcogenide matrix changes the optical properties that are being used for non-linear optical devices. The irreversible nature of such type of changes in these materials are used for creation of optical mirrors, integrated optical elements, which need high local changes of optical parameters. The kinetics of optical band gap changes studied under in-situ-optical measurement shows the expeontial behaviour. The increase in refractive index with irradiation makes the material a useful candidate for optical switching, photo voltaic applications.

(c) Copper Zinc Tin Selenide (CZTSe/CuZTS) which is a promising candidate as an absorber layer in solar photo voltaic applications. Each component of CZTSe(S) is abundant in the earth's crest and possesses relatively low toxicity, high absorption coefficient of the order of the 104 cm-1and direct band gap of about 0.8 eV that makes CZTSe(S) as one of the most valuable material for low cost thin film solar cells.

(d) Magnetic properties of Spintronic based magnetic oxide based nanoparticles and thin film has been studied at room temperature, low temperature and high temperature. XRD, SQUID, PPMS, SEM, TEM instruments have been used for the measurement purpose.

e) The modeling of acoustic emission (AE) that is commonly observed during plastic deformation with particular emphasis on the nature of acoustic signals during plastic deformation instabilities. This contains mainly the theoretical framework to construct a dynamical model that can solve both intermittent plastic deformation and acoustic emission self-consistently and multifractality nature of acoustic emission spectra.

f) Phase transition in ising model has been studied with different boundary conditions using Cellular automata techniques. This also has been extended to different lattice configurations.

Testing Isotropy of Cosmos with Planck data

A major assumption of the cosmological standard model is the cosmological principle which states that the universe is homogeneous and isotropic on large distance scale. Today there is considerable evidence, which may support this assumption. The possible violation of global isotropy in the CMB has been a subject of intense research after the publication of WMAP data. It would be interesting to explore new observables to determine whether the CMB sky is a realization of statistically isotropic or not.

Acoustic oscillations in relativistic heavy-ion collisions with cosmic microwave background radiation

Relativistic heavy-ion collision experiments (RHIC) are often termed as Little Bangs in analogy of the Big Bang representing the initial stage of the Universe. Indeed, there are tempting similarities between the early universe and these experiments. We plan to explore the similarity of acoustic oscillations observed in CMBR with that of the acoustic oscillations in RHIC.

Materials Engineering using Ion Beams

			Ion implantation and ion beam synthesis of compounds, control of implantation profiles by multiple ion implants and use of ion beam mixing are the emerging new techniques having profound implications in such areas of research as nano-technology, tribiology, biotechnology, bactericidal activity, magnetoelectrics polymer modification etc. Thus, ions ranging from a few keV to several hundred MeV available at different accelerators in the country can induce new and advanced functionalities in materials. **Nanoscience with ion beams** The issue of the evolution of nano-particles under ion-irradiation has generated a lot of controversy over the last decade. We plan to focus on surface morphology of nano particle thin films under swift heavy ion irradiation, texturing of nano particle thin films by thermal annealing and ion irradiation, ion irradiation induced structural phase transition in nano particles. **Materials modification by energetic ion induced secondary electrons** Secondary electrons emanating from ion paths are generally ignored in the process of materials modification due to their low energies. Our in-situ temperature dependent resistivity and x-ray diffraction study has established the suppression of superconducting transition. This study has opened up yet another mode of ion irradiation induced materials modification. The consequences of this new way of modifying matter will be explored in different systems. **Photo induced Optical properties study in chalcogenide Thin films** Diffusion in amorphous materials remains a fundamental open question for understanding many physical processes that occurred in disordered system. The photo induced diffusion is exhibited by Ag, Zn, Bi, and Se and the mechanism of photo induced diffusion for different elements may be different. So our problem is to study the effect of diffusion of Bi into some specific chalcogenides like As2Se3, As2Te3 etc. induced by light, heat and by energetic ions. The optical parameters like refractive index and optical band gap will be modified by this process which can be useful candidates for various device applications in the field of optical communication and solar cell.
		Chemistry	**Development novel materials for waste water treatment and sustainable energy** Water and energy are fundamental resources used for economic, social and cultural development which have been long presupposed as abundant. With the increase of population and the developments brought by the industrial revolution, their demand has been increased to many folds in last few decades. Water, being a universal solvent dissolves all kinds of contaminants like, metal ions, inorganic anions, organic dyes, pesticides and insecticides, radioactive elements, etc.Therefore, great challenges lie in the removal of undesired species from contaminated water to make the water useable in variety purposes. Wastewater reuse is becoming a common necessity. A wide variety of methods based on different principles has been tested and are in use for treatment of contaminated waters from different sources. Most of these methods are dependent on various factors like nature and matrix of contaminants, pH, concentration contaminants, presence of organic matters,

microorganisms etc. and often most of these methods are not universally used. It is, therefore, essential to develop suitable method taking the above factors into consideration and optimised as per local conditions for best results. In most of the methods, the materials used is of primary importance and an extensive amount of research works have been done in last few decades in developing a variety of materials for water treatment processes. Developing new materials with improved properties for water treatment continues to be active area of research worldwide. Moreover, the development of cost-effective and stable materialsand methods for providing the fresh water in adequate amounts is the need of the water industry.

The current global energy problem originates not only from limited fossil energy supplies, but also its environmental impacts for its entire energy lifecycle, from mining and processing to emissions, waste disposal and recycling. One solution to achieve energy sustainability is to develop sustainable technologies to gradually replace non-renewable fossil fuels. Electrolysis and photo catalysis of water (H_2O) to produce H_2 and O_2 play key role in the formation of clean, low cost and environment friendly energy source then other conventional source. Hydrogen evolution reaction (HER) is important for cleanest fuels and oxygen evolution reaction (OER) is important for fuel cells and air batteries. In last few decades, a great deal of research has been devoted to catalytic systems with potential to catalyse the electrolysis and photo catalysis of water for production of H_2 and O_2.

g. Plan for Teaching and Research Collaborations with Global Universities figuring in the most reputed global rankings.

Five Global Universities will be collaborated for teaching and research in 2018-19 and 2019-20 each year.

h. Networking plan outlining the teaching and research collaborations and Partnerships

1. **Industry Partnership**: University has already signed MOU with NALCO and NLC India Ltd and proposes to sign five more MOUs with other Industries and Consortia.
2. **Being the lead University**, Utkal has started initiating collaborations in research and teaching with Institute of Physics, Bhubaneswar; NISER, Bhubaneswar; ILS, Bhubaneswar; IMMT, Bhubaneswar; RMRC, Bhubaneswar; CIPET, Bhubaneswar; IIT Bhubaneswar; AIIMS, Bhubaneswar.
3. **Being the lead University**, Utkal has proposals for initiating collaborations in research and teaching with XIMB, Bhubaneswar; NCDS, Bhubaneswar; BGU, Bhubaneswar; IMI, Bhubaneswar; PHFI/IIPH, Bhubaneswar; IIIT, Bhubaneswar.

i. Infrastructure development plan. (Existing and Proposed infrastructure with financial repercussion and time line for development)

a. New Facilities

S. No.	Name of the Infrastructure	Existing	Proposed	Timeline	Cost in ₹crore
1.	International Hall	Nil	50 seated (12000 Sqft)	2 Years	2.0
2.	Student Utility Centre	Nil	One (7500 Sqft)	2 Years	3.0
3.	Academic Block and CDC Block	25 Blocks	Two Blocks (15000 Sqft each)	2 Years	4.0
5.	Administrative Block	01	One	2 Years	4.0
4.	Market Complex	One	One (4000 Sqft)	2 Years	0.5

5.	Alumni / IQAC/ RUSA Secretariat	Nil	One	2 Years	1.0
b. Renovation / Up-gradation of existing facilities					
S. No.	Name of the Infrastructure	Existing	Proposed	Timeline	Cost in ₹crore
1.	Academic Block including toilets and classrooms	18	07	2 Years	3.0
2.	Administrative Block including Auditorium	1	1	2 Years	1.5
3.	Laboratory	30	7	2 Years	2.0
4.	Campus Development	Water Supply, Drainage	Water Supply, Drainage, Water Harvesting, Alternate Energy Sources	2 Years	4.0
5.	Canteen	2	1	2 Years	0.3
6.	Playground	2	1	2 Years	0.3
7.	LH (Visitors' Lounge)	Nil	07	1 Year	0.3
C. Equipment					
1.	Equipment including energy saving / efficient vehicles	-----	------	2 Years	4.0

j. Administrative plan for getting accreditation from National and International Agencies as well as marketing and promotion.

The University is already accredited by NAAC with A+ and will go for National and International accreditation from the agencies like AICTE, NBA, IAU, and SAQS.

k. Governance plan elaborating the proposed Institutional structure and how it overlaps with ownership, decision-making process and social engagement.

Besides the three Apex decision making authorities (***Syndicate: Administrative, Academic Council: Academics Activities and Senate: Financial***), the following institutional structures act for development in different areas:

Post-Graduate Council: Enjoys academic autonomy to decide on all post-graduate courses
Board of Studies: Enjoys autonomy to decide on course structures and related regulations
URC and SRC: Decision making bodies on higher research degrees
Examination Regulation Committee: Takes care of all regulations of examinations held
Finance Committee: Preparation and approval of Financial Budget
Building Committee: Besides new constructions, it decides on renovation and up-gradation of infrastructure
Affiliation Committee: Decides on affiliating new institutions
College Development Council: Takes care of academic and infrastructural developmental activities of the affiliated institutions

l. Clarify as to how Governance plan will be committed to the highest global standards of transparency, accountability and efficiency.

1. e-Governance (Office and Accounting Automation)
2. Adaptation of Odisha Right to Public Service Act(ORTPSA)2012
3. Successful implementation of RTI Act 2005.
4. Adoption of Anti-Plagiarism software for ensuring transparency in research publication and project reports
5. Robustfeedbackmechanismfrom all stakeholdersfortakingcorrectivemeasures in both

	academics and administrative system. 6. Anti-ragging Cell, Internal Complain Committee, Discipline Committee and so on are in place to make it grievance free campus.
m.	Plan for involving the alumni in the management of the Institution and leveraging alumni financial resources.
	1. Creation of Database 2. Creation of Alumni Hall and Secretariat 3. Annual Meet 4. Bringing out an Alumni Newsletter 5. Leveraging Alumni Financial Resources: Donation 6. Facilitating the involvement of the Alumni to avail their expertise in academics, research and innovation
n.	Intended target on possible world ranking after five years.
	Intended to participate in different World Ranking Agencies during 2020 onwards
o.	A research plan indicting the research laboratories and other facilities proposed to be established. In case of humanities, social sciences and other interdisciplinary faculties, the research plan should indicate the broadareas and nature of field work and research sought to be done
	1. Please refer sub-section (f) of this section 2. All Research Laboratories 3. Centre of Excellence: School of Public Policies and Governance (Four); School of Health Sciences; Centre for Study of Languages, Literature & Culture; Advanced Materials and Application; Centre for North-East Studies 4. Research Proposals in Thematic Areas: 5. Research / Teaching Assistants: 27 (One in each Department) 6. Organizing Conference/Seminar:50 in two years 7. Travel (Domestic and International) and field Trip: 8. Hiring the services of Technical / Industrial / Secretarial assistance:
p.	Sustainability plan for the period when the additional public funding ceases.
	1. Overhead charges from extra-mural funding 2. Self-financing courses 3. CSR funding from industries: NALCO, CIPET, NLI, MCL 4. Returns from start-up projects 5. Consultancy, Contract Research & Patents 6. Alumni donations & Endowments 7. Revenue from admission of foreign students
q.	Plan of affiliating any other HEI, if Act permits [Please refer Guideline 6.4.3(e)(i)]
	Under consideration

V. PROPOSED TWO YEARS IMPLEMENTATION PLAN (FOR EACH YEAR)

a.	Mention the detailed and tangible action plan, milestones, and timelines by which it seeks to achieve high performing status, mentioning milestones to be achieved in two years with an annual work plan.		
	SN	***Action Plan***	**Milestones by 2020**
	1.	Recruitment Process	Targeted to reach 88% above of the sanctioned strength
	2.	Recruitment of Teachers	To bring the teacher student ratio from 1:20 to 1:10

	3.	Recruitment of Teachers from Industry, Government and NGOs including foreign	10 foreign faculty, 5 faculty each from Industry and Government, Three faculty from NGOs
	4.	Admission Process	International students will be admitted in Master program through ICCR, New Delhi
	5.	Award of Scholarship and Fellowship	35 PhD fellowships / Internship, 54 Master's Students for outstanding projects
	6.	Laboratory Development	All laboratories will be upgraded
	7.	Collaboration with Global Universities / Institutes	International collaboration with five reputed global Universities / institutes for research and teaching.
	8.	Developing new infrastructure	One International Hall, One Student Utility Centre, Two Academic Blocks, One Administrative Block, One market complex, One Computer Centre, One Alumni / IQAC / RUSA Secretariat, and All laboratories
	9.	Renovation and Up-gradation	Academic Blocks, Administrative Block, All Laboratories, Campus Development, One Canteen, One Auditorium and One Playground
	10.	Accreditation Initiatives	Accreditation with AICTE, NBA, IAU and SAQS
	11.	Governance Initiatives	a. Activating Decentralized Decision Making System through democratic Statutory and non-statutory committees functioning in transparent manner b. Activating e-governance system c. Executing a strong accountable governance mechanism by implementing the related legal provisions
	12.	Involvement of Alumni	Creation of Database, Creation of Alumni Hall and Secretariat, Annual Meet, Bringing out an Alumni Newsletter, Leveraging Alumni Financial Resources: Donation; Facilitating the involvement of the Alumni to avail their expertise in academics, research and innovation, Endowment Lectures
	13.	World Ranking Initiative	Presently aspirational
	14.	Research Activities	Establishment of School of Public Policies and Governance (Four); School of Health Sciences; Centre for Study of Languages, Literature & Culture; Advanced Materials and Application; Centre for North-Eastern Studies; Start-up project Proposals in Thematic Areas; Organizing Conferences / Seminars, Creating Research Groups, Enhancing the number of research publications in WOS and Scopus based journals, Collaboration with reputed national and international institutions, Joining in Mega-projects
	15.	Mentoring Affiliated collages	Mentoring six affiliated colleges (two autonomous, two rural and two tribal) for quality up-gradation and NAAC Accreditation
	16.	Library Development	Books / e-books, Journals beyond Inflibnet and NKC;Access to Database & e-Archive; Centre for Rare & Ancient Manuscript' Complete surveillance, RFID; Hiring DEO & Technical Staff ; Connecting to National & International Libraries
	17.	Academic Engagement	Visiting Fellows, Emeritus Professors, Adjunct Faculty, Post-Doctoral Fellows, Research Associates and Teaching Assistants
	18.	Exchange Program	Initiate faculty and student exchange program with reputed global Universities and Institutes
	19.	Industry-Academia Interface	Five MoUs to be signed in next two years

	20.	Entrepreneurial Activities	Entrepreneurship Development Program, Skill Development Program
	21.	Procurement of Equipment	Sophisticated Laboratory Equipment for up-gradation of Laboratories, energy saving / efficient vehicles
	22.	Baseline Survey	Ten Villages to be surveyed
	23.	Social Extension and Outreach	Ten villages to be adopted, Propagation of AKRUTI Technology developed by BARC, Mumbai
	24.	Computer and ICT Infrastructure Development	Procurement of Computers and Accessories
	25.	Staff Excellence and Organizational Stewardship	Leadership, Motivational, and Accounting training for effective administration (Induction Training, Orientation Training, Training on Financial Management, Soft Skill, Exposure Visit, Refresher Courses)

b. Timelinetoachievetheexpectationsforeachoftheparametersasproposed in two-year.

S.N.	Parameter	Period I (2018-19)	Period II (2019-20)
1.	Faculty Position: Above 85%	85 %	88%
2.	Teacher Student Ratio 1:10	1: 15	1:10
3.	Recruitment of faculty from Industry, Government , NGOs including Foreign Faculty (**23**)	23	23
4.	Admission of Foreign Students (**20**)	00	20
5.	Scholarship to Meritorious Students		
	PhD Fellowship	27	27
	Scholarship to Master's Students	54	54
6.	Development of Research Laboratory	5	5
7.	Teaching and Research Collaboration with Global Universities	05	05
8.	**A. Infrastructure Development (New Construction)**		
	International Hall	1 (50% work)	1 (Complete)
	Student Utility Centre	1 (50% work)	1 (Complete)
	Staff Facility Centre	1 (50% work)	1 (Complete)
	Academic Block	2 (50% work)	2 (Complete)
	Administrative Block	1 (50% work)	1 (Complete)
	Market Complex	1 (50% work)	1 (Complete)
	Computer Centre	1 (50% work)	1 (Complete)
	Alumni Secretariat	1 (50% work)	1 (Complete)
	B. Infrastructure Development (Renovation/Up-gradation)		
	Academic Block including toilets and classrooms	3	4
	Administrative Block	1 (50% work)	1 (Complete)
	Laboratory	3	4

		Campus Development	Two Activities	Two Activities
		Canteen	1 (50% work)	1 (Complete)
		Auditorium	1	0
		Playground	1 (50% work)	1 (Complete)
	9.	Administrative plan for Accreditation	AICTE, NCTE	NBA, IAU, SAQS
	10.	Governance Plan for Transparency, Accountability and Efficiency	Office Automation and e-Governance	Office Automation and e-Governance
	11.	Plan for Involvement of Alumni	Creation of Database, Creation of Alumni Hall and Secretariat, Annual Meet	Bringing out an Alumni Newsletter, Leveraging Alumni Financial Resources: Donation
	12.	World Ranking	Preparation	Participation
	13.	Research and Development Plan		
		Research Proposal	20	00
		Teaching / Research Assistants	27	27
		Organizing Conference / Seminar/ Workshop	25	25
		Travels / Field facilities / Field trips for Faculty members only (Domestic and International)	5.0	5.0
		Hiring the services of Technical / Industrial / Secretarial assistance as relevant to the Program	15	15
	14.	Sustainability Plan	Overhead charges from extra-mural funding Self-financing courses CSR funding from industries: NALCO, CIPET, NLI, MCL Returns from start-up projects Consultancy, Contract Research & Patents Alumni donations & Endowments Revenue from admission of foreign students	Overhead charges from extra-mural funding Self-financing courses CSR funding from industries: NALCO, CIPET, NLI, MCL Returns from start-up projects Consultancy, Contract Research & Patents Alumni donations & Endowments Revenue from admission of foreign students
	15.	Mentoring of Affiliated Colleges to improve the NAAC Accreditation	03	03
	16.	Library Development	Books / e-books, Journals beyond Inflibnet and NKC;Access to Database & e-Archive; Centre for Rare & Ancient Manuscript' Complete surveillance, RFID; Hiring DEO & Technical Staff ; Connecting to National & International Libraries	Books / e-books, Journals beyond Inflibnet and NKC;Access to Database & e-Archive; Centre for Rare & Ancient Manuscript' Complete surveillance, RFID; Hiring DEO & Technical Staff ; Connecting to National & International Libraries

	17.	PDF, Visiting Fellow & Emeritus Professor	21	21
	18.	Faculty-Student Exchange Program with World-class Institutions	Exploring Opportunities	Start the Program with at least two global Institutes
	19.	Industry-Academia Partnership	At least two MOUs will be signed	At least three MOUs will be signed
	20.	Entrepreneurial Activities / Innovation Hub	Incubation Centre, EDP	Incubation Centre, EDP
	21.	Procurement of Equipment		
		Lab Equipment	63	11
		Other Equipment (Conveyance)	Five energy saving / efficient vehicles will run in the campus	Five energy saving / efficient vehicles will run in the campus
	22.	Baseline Survey / Research Projects	Ten Villages	Ten Villages
	23.	Social Extension / Outreach	Six Villages will be adopted	Four Villages will be adopted
	24.	Staff Excellence	25 Program	25 Program
	25.	Centre of Excellence	Eight Centers will star	They will be fully functional
	26.	Computer and ICT Infrastructure	200	100
	27	Participate in FIP by UU faculty (Training & STC) (Not more than one months) in Global Universities	10	15

Detailed annual financial plan of expenditure for two years with an annual break up, for total not exceeding ₹100 crore

S.N	Parameter	Period I (2018-19) in ₹ crore	Period II (2019-20) in ₹ crore	Total in ₹ crore
A.	**Improvement of Quality in Teaching and Learning**			
1.	Engagement of Adjunct faculty / Visiting faculty / Emeritus Professor from Industry, Government, NGOs (*Persons of Eminence*)	1.5	2.5	4.0
2.	Adjunct faculty / Visiting faculty / Emeritus Professor from foreign	2.0	2.0	4.0
3.	International and National Academic Networking and Collaborations	0.4	1.0	1.4
4.	Faculty Improvement Program (Training & Short Term Courses)	0.25	0.75	1.0

B.	**Research and Innovation**			
1.	COE in High Energy & Condensed Matter Physics (Identified as Model Department under RUSA 1.0)	4.0	6.0	10.0
2.	**Budget estimate** of other research centers			
2.1	Post-Doctoral Fellow	1.30	1.30	2.60
2.2	Conference/Seminar/ Workshop / Training	0.3	0.22	0.52
2.3	Furniture / Fixture	0.4	0.3	0.7
2.4	Field Work / Lab Consumables	0.8	0.6	1.4
2.5	Documentation / Photography / Publications	0.5	0.62	1.12
2.6	Incentive to faculty members based on achievements, awards, research publications	0.3	0.3	0.6
2.7	Travel (National / International)	0.3	0.39	0.69
2.8	PhD Fellow / Research Assistant / Technical Assistant	0.78	0.78	1.56
2.9	Equipment	3.7	3.0	6.7
2.10	Hiring Technical Services / Secretarial Assistants	0.35	0.35	0.7
2.11	Contingencies	0.35	0.35	0.7
3.	**Research Plans for all Departments**			
3.1	Start-up Grant for faculty at Entry-Level	0.5	0.5	1.0
3.1	PDF (National Post-Doc)	1.2	1.2	2.4
3.2	PDF (International Scholars)	0.25	0.25	0.5
3.2	Teaching / Research Asst.	0.5	0.5	1.0
3.3	Organizing Conference / Seminar / Workshop	0.3	0.3	0.6
3.4	Support to Faculty Members for attending International Conference / Workshop	1.0	1.0	2.0
3.5	Travels / Field facilities / Field trips for Faculty (Domestic)	0.5	0.5	1.0
3.6	Hiring the services of Technical / Industrial / Secretarial assistance as relevant to the Program	0.4	0.5	0.9

3.7	Fellowship to PhD Scholar (National Students)	0.2	0.2	0.4
3.8	Fellowship to PhD Scholar (International Students)	0.25	0.25	0.5
3.9	Stipend to Non-Fellowship PhD Scholar for Documentation of PhD Thesis	0.1	0.1	0.2
4.	Establishment of traditional technology and soft skill park	0.6	0.4	1.0
C.	**Library and Learning Resources**			
1.	Library Resources	3.0	5.0	8.0
2.	Computer and ICT Infrastructure	2.0	2.0	4.0
D.	**Community Linkages and Networking**			
1.	Plan for Involvement of Alumni	0.1	0.1	0.2
2.	Mentoring of Affiliated Colleges for Accreditation	0.1	0.1	0.2
3.	Industry-Academia Partnership	0.1	0.1	0.2
4.	Community Linkages (Adoption of villages, residency for trainee / participant, travel and transport for outreach and rural connectivity: hiring vehicle, procurement of vehicle and maintenance of it, engaging driver)	0.4	0.5	0.9
E.	**Enriching Students**			
1.	Scholarship to Meritorious Students Master	0.15	0.15	0.3
2.	Fee Waiver / support to for Meritorious-cum-economically weaker students / PWD	0.05	0.05	0.1
3.	Engagement of regional co-ordinators for catchment of students / counselling / admission / research facilitation	0.4	0.7	1.1
4.	International Student Exchange Program	0.1	0.1	0.2
5.	Start-up grants for developing entrepreneurial activities among Students	1.5	1.5	3.0

F.	**Governance & Transparency**			
1.	Governance Plan for Transparency, Accountability and Efficiency	0.3	0.4	0.7
2.	Administrative plan for Accreditation / World Ranking	0.0	0.1	0.1
3.	Staff Excellence	0.2	0.3	0.5
G.	**Hard Component including Equipment**			
	I. Infrastructure Development (New Construction)			
	International Hall	1.0	1.0	2.0
	Student Utility Centre	1.0	1.0	2.0
	Academic Block	2.0	2.0	4.0
	Administrative Block	2.0	2.0	4.0
	Market Complex	0.3	0.2	0.5
	Alumni/IQAC/RUSA Secretariat	0.5	0.5	1.0
	II. Infrastructure Development (Renovation / Up-gradation)			
	Academic Blocks including toilets	1.0	2.0	3.0
	Administrative Block	0.2	0.3	0.5
	Laboratory	1.0	1.0	2.0
	Campus Development (Water supply, Drainage, Water Harvesting & Alternative Source of Energy)	1.5	1.9	3.4
	Canteen	0.1	0.2	0.3
	Auditorium	0.5	0.5	1.0
	Ladies Hostel (Visitor's Lounge)	0.1	0.2	0.3
	Playground	0.1	0.2	0.3
	III. Equipment for all departments			
	Laboratory Equipment including energy saving / efficient vehicle to run in the campus	1.5	2.5	4.0
H.	Contingencies (1% of the total grant)	0.5	0.5	1.0
I.	Project Implementation Cost / PMU	1.0	1.0	2.0
	Grand Total in ₹ crore	45.736	54.264	100

Proposal for Setting up

CENTRE FOR HIGH ENERGY AND CONDENSED MATTER PHYSICS

UTKAL UNIVERSITY
Bhubaneswar

Executive Summary

The Physics Department of Utkal University will be 50 years old in 2017. The department pioneered modern physics research in the state. The Institute of Physics was conceived from the core this department. The department played a pivotal role in the establishment of Orissa Physical Society for modernizing Physics Education in the State of Odisha. Presently, the Department offers Post Graduation, M. Phil. and Ph.D. courses in Physics. Presently, two special papers are offered in M.Sc. final year: i) Advanced Particle Physics, ii) Advanced Condensed Matter Physics. Two more special papers like Nuclear Physics, Electronics and Instrumentation have been discontinued due to shortage of staff. Over the years, this department has produced a large number of students who have occupied eminent positions in India and abroad. To cite a few, it has produced three Bhatnagar awardees amongst many others who have contributed to national mission departments. The strength of the department lies in two major areas, namely high energy physics and condensed matter physics. Though the department has acquired very high reputation in theoretical research in these areas, the areas related to experimental high energy physics and experimental condensed matter research needs to be boosted up. In this context, the present project of establishing a centre of excellence in physical science focuses on joining some of the mega science experiments in high energy physics to upgrade the experimental high energy physics activities. Similarly, the second component of the proposal looks at intensifying research on experimental condensed matter physics particularly at the nano scale for applications in semiconductors, solar converters, magnetic materials and sensors. Since the university is in the process of setting up a central instrumentation facility with support from the state government, the proposal looks at setting up an ion accelerator for material characterization and diagnostics. The third component of the proposal aims at establishing a moderately high performance computing facility for multiscale computation. Simultaneously, with RUSA support, the centre will run a vastly improved curriculum in physics to produce students who are core competent to join and contribute to any international megaproject in this area. The project will be executed by Department of Physics with full support from the University. The projected Budget is a modest ₹10crore.

A Few Words about the Physics Department, Utkal University

Vision

Department of Physics, Utkal University will take the leadership in setting the standard of Physics Education in terms of Teaching and Research in the State and in the Country. We are committed to create and sustain the conditions for our students to experience a unique educational training that is intellectually, socially and personally transformative.

Mission:

1. To make quality education accessible to talented boys and girls.

2. Strive to maintain high academic standard in teaching and research.

3. Reach out to the peripheral sectors and public at large in spreading the culture of scientific education and research.

Brief History of Physics Department, Utkal University:

The Department of Physics Utkal University was established in the year 1967. The department pioneered modern physics research in the state. The Institute of Physics was conceived from the core this department. The department played a pivotal role in the establishment of Orissa Physical Society for modernizing Physics Education in the State of Odisha.

An IBM 1130 gifted by the UGC in the year 1970 marked the beginning of Computer age in the state of Odisha. In fact, for many years, this remained the only computer in the state which was used by most of the educational institutions as well as commercial and state organisations like OSEB, FCI, PPD, HSL, Paradeep Port, CRRI, CPBF, BSE etc. Subsequently the department initiated the PG DCA programme, which emerged as a full fledged department of Master in Computer Science and Applications with its own independent infrastructure. Regarding reaching out to the peripheral sectors, this department was a nodal point for the NCERT 'CLASS' project

for schools for about a decade. Faculty members (past and present) have been involved in writing a Large Number of School and Degree Level Text books, Popular Science Books and have contributed their bit to the Dissemination of Modern Physics through Refresher courses for college teachers, Seminars, Lectures, Articles, TV and Radio Programmes.

Programmes Offered:

- The Department offers Post Graduation, M. Phil. and Ph.D. courses in Physics.
- There are 32+ 32 seats in M.Sc. 1st year and 2nd year; 10 seats in M.Phil. and the number of Ph.D. programme varies with a maximum intake of 10 students per year.
- Presently, two special papers are offered in M.Sc. final year: i) Advanced Particle Physics, ii) Advanced Condensed Matter Physics. Two more special papers like Nuclear Physics, Electronics and Instrumentation have been discontinued due to shortage of staff.
- M.Sc. examinations are based on Semester and Choice Based Credit System (CBCS) having mid and end semester examinations with 30% and 70% weightages, respectively. The course structure is given in a separate section.
- M. Phil. and Ph.D. examinations are also based on semester system. The Ph.D. course work is for one semester of four papers with i) an elective paper on Advanced Particle Physics/Advanced Condensed Matter Physics; ii) IT & Research Methodology; iii) Experiments on Nuclear & Particle Physics, Condensed Matter Physics; iv) Seminar presentation and viva-voce examination.

(a) The syllabus under CBCS has been developed as per UGC guideline and the following Courses are offered for the students of other Departments (Mathematics, Chemistry, Bio-technology):

- Computational Methods
- Basic Electronics
- Basic Quantum Mechanics
- Basic Solid State Physics

(b) The students of Physics department have been given the choice to opt for courses offered by other departments. Add on courses on "Basic Instrumentation and Material Characterization" and " Scientific Computation and Networking" for final year M.Sc., M.

Phil. and Ph.D. course work students have been introduced from the academic session 2016-17.

Profile of the Faculty members

Faculty	Designation	Area of Research
1. Dr. (Mrs.) S. Mahapatra	Professor	: High Energy Physics, Gravitation and Cosmology
2. Dr.SeshansuSekhar Pal	Reader	: High Energy Physics
3. Dr. Prafulla Kumar Panda,	Reader	: Nuclear and High Energy Physics
4. Dr.Pramoda Kr. Samal	Asst. Professor	: Cosmology
5. Dr.Jagadish Kumar	Asst. Professor	: Nonlinear Dynamics
6. Mr. BhagabanKisan	Asst. Professor	: Expt. Condensed Matter Physics
7. Dr. R. Naik, DST INSPIRE Faculty		: Expt. Condensed Matter Physics

There were 14 UGC sanctioned faculty positions in the Department. Four faculty positions have been abolished by the State Govt. in the year 2009. Presently there are only 6 faculty members

(1 Professor, 2 Readers, 3 Asst. Professors) and 1 DST-INSPIRE Faculty managing the academic programme of the department and 4 permanent faculty positions are lying vacant.

Areas of Research: Faculty members of the Department are engaged in the emerging areas of research such as: High Energy Physics (Particle Physics Phenomenology, Neutrino Physics, String Theory, Heavy-ion Collision), Gravitation and Cosmology, Experimental High Energy Physics; Experimental Condensed Matter Physics (Nano-Science and Nano-Technology, Accelerator based studies. Spintronics, Multiferroic materials, Material Science, Amorphous semiconductors, Glassy materials, Superconductivity); Statistical Mechanics, Quantum Optics, Quantum Computation and Non linear dynamics.

ACHIEVEMENTS OF OUR STUDENTS AS FACULTY MEMBERS IN REPUTED ACADEMIC INSTITUTIONS& IN ADMINISTRATIVE POSITIONS

Prof. Asoka Kumar Das	(Present Vice-Chairman, OSHEC, Odisha)
Prof. B. B. Deo	(Former VC, Berhampur University, Odisha)
Prof. K.C.Mishra	(Former VC, Sri Sri University, Odisha)
TIFR, Bombay:	Dr. RudrajyotiPalit,
	Dr. GaganBihariMohanty ,
	Prof.S.N.Mishra,
	DrPravata Kumar Mohanty
IUCAA, Pune:	Dr. R. Srianand (*BHATNAGAR AWARDEE*)
IOP, Bhubaneswar:	Prof. D.P. Mahapatra (Visiting Scientist, JPL, NASA)
	Dr. PradipSahu
	DrArun Kumar Nayak
	DrDebakantaSamal
NISER, Bhubaneswar:	Dr. Bedanga Das Mohanty (SWARNA JAYANTI AWARDEE &*BHATNAGAR AWARDEE*)
	Dr. Sanjay Swain, (Spokesperson, CMS B-Physics)
	Dr. SubhankarBedanta,
	Dr. PrasanjitSamal,
	Dr. Ashok Mohapatra ,
	Dr. KartikSenapati
	Dr. Collin Benjamin
	Dr. AjayaNayak
IISER, Bhopal:	Dr. Sukanta Panda
IISER, Trivandrum:	Dr. Ramesh Nath
IISER, Kolkata:	Dr. Satyabrata Raj
IIT, Bhubaneswar:	Dr. NiharikaMohapatra,
	Dr. SeemaBahinipati
	Dr. Chandra Sekhar Rout
IIT, Madras:	Dr. PrafullaBehera,
	Dr. DillipSatapathy
IIT, Bombay:	Dr. Basanta Nandi(*HOTTEST RESEARCHER, 2007*),
	Dr. Sadhana Dash
IIT, Delhi :	Prof. U.C.Mohanty (*BHATNAGAR AWARDEE*),
	Dr. PranabMuduli,
	Dr. Amruta Mishra
	Dr. SatyanandKar
IIT Guwahati	Dr. Tapan Mishra

IIT, Roorkee: Dr.TulikaMaitra
IIT, Hyderabad: Dr. AnjanGiri
IIT, Indore: Dr. RagnunathSahu
VECC, Kolkata: Dr. Tapan Kumar Nayak (Deputy Spokesperson, ALICE),
Dr. TapanRana
SINP, Kolkatta: Dr. KalpataruPradhan
IISc. Bangalore: Dr. BalaramSahoo
IMSc, Chennai: Dr. SanatanDigal
NPL, New Delhi Dr. Manas Kumar Dalai
National Inst. Immunology Dr. BichitraBiswal
Central University, Hyderabad Dr. RukminiMohanta
Central University, Punjab Dr. Prakash Kumar Parida
IIST, Trivandrum DrAnandamayeeTej
JNU, New Delhi: Dr. TanujaMohanty
Delhi University: Dr. SupriyaKar,
BHU, Banaras: Dr. ChandanaRath
PRL, Ahmedabad: Dr. SachindraNayak,
Dr. Bijay Kumar Sahoo
Michigan Technological University,USA Prof. RanjitPati
University of California,USA Prof. AsishSatpathy
University of Texas, A&M, USA: Prof. Bibhudutta Rout
IAS MrGopinathMohanty,
MsTinkuBiswal
IFS Mr. Sidhanta Das
Bhabha Atomic Research Center(BARC) / Defence Research & Development Organization (DRDO) : – About 50

Partial List of students in National Institutions for Ph.D. (2010-16)

Sl. No.	Name	Institute
1	KASINATH DAS	HRI
2	MIHIR RANJAN SAHOO	IIT BBSR
3	JITENDRA KUMAR PRADHAN	IIT Kanpur
4	SUBRAT SENAPATI	IISc, Bangalore
5	SUDIPTA MAHANA	IOP

6	BISWAJIT BEHERA	UTKAL Univ
7	KISHORA NAYAK	NISER
8	NAMRATA PATTANAYAK	IISER Pune
9	SUBHALAXMI RATH	IIT Roorkee
10	NARENDRA TANTY	IISc, Bangalore
11	PRAGATI SAHOO	IIT Indore
12	DEBADEEPTI MISHRA	NISER
13	ANTARJAMI SAHOO	IIT Chennai
14	SORNA PRAVA BARIK	IIT Kharagpur
15	MANAS KUMAR KHATUA	INO,Mumbai
16	JAGANNATH JENA	IIT Kanpur
17	NIRAKAR SAHOO	IIT Hyd
18	PRADIP KUMAR ACHARYA	IIT Gouhati
19	SAGAR SEKHAR MAHALIK	IPR Ahemedabad
20	SUSHREE SUBHADARSHINEE SAHOO	NISER
21	GYANA RANJAN SAHOO	IIT Kanpur
22	BISWARANJAN BEHERA	IIT Hyderabad
23	JOGESH ROUT	JNU
24	SHASHIBHUSAN MISHRA	IIT Chennai
25	BIKASH CHANDRA SWAIN	ISM Dhanbad
26	SAGARIKA NAYAK	NISER
27	HIMANSHU BHUSAN NAYAK	ISM, Dhanbad
28	ARAVIND KHUNTIA	IIT Indore
29	PRADOSH KUMAR SAHOO	IGCAR

30	DUSHMANTA KARA	NISER
31	ASCHARYA KUMAR KAR	IIT-BBSR
32	DEEPALI MISHRA	NISER
33	RUDRA PRASAD JENA	IUC Indore
34	P. KARUNA KUMARI	IIT Hyd
35	DEBASISH MALLICK	NISER
36	SASWATI DHARA	IIT Mumbai
37	ANIL KUMAR BEHERA	IGCAR
38	BISWAJYOTI MOHANTY	ISM Dhanbad
39	RAJESH SATPATHY	SOA Univ
40	MANORANJAN SAHOO	IIT Patna
41	SANTANU KUMAR PARIDA	IGCAR
42	RANJIT KUMAR NAYAK	IIT Mumbai
43	GOPINATH SAHOO	IGCAR
44	SWAYAMSIDHA MISHRA	NISER
45	SAGARIKA NAYAK	IIT BBSR
46	SNIGDHA SARITA PATI	NISER
47	PRASANT KUMAR ROUT	SINP
48	SHAKAMBHARI SADANGI	BARC(DRP)
49	SOUMENDRA PATTANAYAK	BARC
50	BIBHUTI BHUSAN JENA	SINP
51	ITISHREE SETHI	IIT Hyd
52	SATYABRATA SINGH	USA
53	PRAVASINI SWAIN	NISER
54	PRAGYNA PARIMITA SWAIN	IGCAR

55	IJEE MOHANTY	IGCAR
56	DILLIP KUMAR SAHOO	BARC(DRP)
57	RADHANATH MISHRA	IIT BBSR
58	ANINDITA DAS	ISM DHANBAD
59	SURYAKANTI DEBATA	ISM DHANBAD
60	JAGYASENI PRADHAN	IGCAR
61	JAYAKRUSHAN SAHOO	IGCAR
62	SANJAY NAYAK	CIPET
63	RAJESH SAHOO	CIPET
64	BIBEKANANDA DAS	IIT MADRAS
65	AMIT KUMAR SENAPATI	IIT MADRAS
66	SUDHIR KUMAR SAHOO	IISc, Bangalore
67	DEBASISH SAHOO	TIFR
68	PRATYASHA SAHANI	IIT KANPUR
69	BINOD BIHARI PANDA	IOP
70	POOJA SAHOO	ISM DHANBAD
71	HRUSIKESH MAHAPATRA	TIFR (OOTY)
72	PARBATI NAIK	IIT BBSR
73	ASIRBAD MOHANTY	IIT MADRAS
74	LAXMIDHARA NAYAK	CIPET
75	PARTHA SARATHI PRUSTY	BARC
76	LAXMIKANTA MOHAPATRA	IOP, BBSR
77	SAMAPIKA MALLICK	IIT Patna
78	RANJAN KUMAR BEHERA	IIT Patna
79	BAIDYANATH SAHOO	IIT Bombay

80	NIBAGANI NARESH	Pondichery Univ.
81	NAMITA BEHERA	PondicheryUniv
82	PRATIDHWANI SAWIN	NISER

Collaboration with faculty members and Institutions outside India

1. Prof. Bernard de Wit,
   Senior Scientist, NIKHEF (National Institute for Subatomic Physics), Amsterdam, The Netherlands
2. Prof. Gabriel Lopes Cardoso,
   Centre for Mathematical Analysis, Geometry and Dynamical systems, Instituto SuperiorTechnico, Lisbon, Portugal
3. Prof. Dieter Luest, Director
   Max Planck InstitutfuerPhysik, Munich, Germany
4. University of New South Wales, Australia, University of Minnesota, USA
5. CFC, Departamento de Fisica, Universidade de Coimbra, Coimbra, Portugal
6. Department of Physics, Danish Technical University, Denmark
7. Departamento de Física, CFM, Universidade Federal de Santa Catarina, Brazil, InstitutoTecn´ologico de Aeron´atica, Brazil

Main Proposal : Establishment of Centres of Excellence in the Department of Physics

Department of Physics proposes to establish the following Centres of Excellence and a High Performance Computing Facility (HPCF) to upgrade its curriculum to international standards:

(A) Centre of Excellence in High Energy Physics, Cosmology and Neutrino Physics

(B) Centre of Excellence in Nanoscale Material Characterization

(C) High Performance Computing Facility (HPCF)

Prof SwapnaMahapatra, Professor and Chairman Board of Studies will be the Principal Investigator

All Faculty of Department of Physics will be Co principal Investigators

Duration : 60 months

(A) Centre of Excellence in High Energy Physics, Cosmology and Neutrino

Physics:

Objectives:

- The Department of Physics proposes to join the international BELLE collaboration at KEK, Japan to study CP violation in B-meson system. Presently, the collaboration with KEK is through Tata Institute of Fundamental Research, Mumbai. This collaboration aims at understanding the matter anti-matter asymmetry in the Universe through CP violation B meson system.

- The Department of Physics proposes to join the International CMS-India collaboration at Large Hadron Collider (LHC) at CERN to study CP violation with B Physics, dark matter as well as Physics of Higgs Boson.

- The Department of Physics proposes to join the International ALICE-India collaboration at Large Hadron Collider (LHC) at CERN to study the physics of early Universe through Heavy-ion collision, formation Quark-Gluon plasma and its phenomenology.

- Study of the evolution of the Universe with precise measurement of cosmological parameters through Cosmic Microwave Background Radiation with recent WMAP, PLANCK and BICEP data.

- Department of Physics has joined the INO (India-based Neutrino Observatory) collaboration with Prof. S. Mahapatra as the Principal Investigator, which is a multi institutional collaborative National project with the aim to study the properties and interactions of the fundamental weaklyinteracting particles called Neutrinos through the proposed underground laboratory. The study of neutrinos has attracted much attention over several decades as it is intimately related to various fundamental aspects of Particle Physics, Cosmology, Origin of the Universe, energy production mechanism in Sun and other stars. The aim is to determine more precisely the neutrino oscillation parameters using atmospheric neutrinos; to study CP violation in leptonic sector, possible CPT violation, and to study very high energy neutrinos and multi muon events.

Outcome/Deliverable:

- Generation of Students who will be core competent to join any international mega activity in High Energy or condensed matter physics

- Developing competence of students to drastically upgrade R & I Output

- Precise determination of the neutrino oscillation parameters using atmospheric neutrinos at INO-ICAL; understanding of neutrino mass hierarchy, CP violation in leptonic sector, new physics scenario like CPT violation and analysis of very high energy neutrinos and multi muon events.

- Search for CP Violation in B meson decaying to phi phi K mesons at Belle and measurement of direct CP violation in charmless B meson.

- Understanding of the i) properties of Quark-Gluon-Plasma through dual gravitational description ii) transverse momentum distribution of the charged hadrons in Heavy ion collisions at RHIC and LHC

implementing the Tsallis q-statistics for particle production iii) strongly coupled regime of physics using gauge-gravity duality.

- Testing the statistical isotropy of CMBR and various cosmological anomalies present in temperature and polarization data. Estimation of the CMB Polarization and Temperature Power Spectra and understanding the effect of foregrounds on CMB multipole alignment.

- Constructing inflationarymodels in the context of standard cosmological model and in string inspired cosmology for understanding dark energy as a possible explanation for the accelerated expansion of the universe, primordial black holes as dark matter candidate, and constraints on the parameters coming from CMBR data.
- Understanding of the properties of infinite nuclear matter at zero and finite temperature; quark matter equation of state including strange quarks with gluon condensates; computation of orbital energy loss of the Hulse-Taylor binary by radiation of massless particles; quark meson coupling and properties of compact star.

Research in the above areas is expected to result in

- increased research publications in peer reviewed journals with high impact factors
- trained scientific man power
- national and international collaboration
- propagation of the culture of research in emerging areas in the state of Odisha.

Collaboration with KEK, Japan

KEK, the High Energy Accelerator Research Organization, is one of the world's leading accelerator science research laboratories, using high-energy particle beams and synchrotron light sources to probe the fundamental properties of matter. With state-of-the-art infrastructure, KEK is advancing our understanding of the universe that surrounds us, its mechanisms and their control. The objective of KEK is :

• To make discoveries that address the most compelling questions in a wide range of fields, including particle physics, nuclear physics, materials science, and life science.
• To act as an Inter-University Research Institute Corporation, a center of excellence that promotes academic research by fulfilling the needs of researchers in universities across the country and by cooperating extensively with researchers abroad
• To promote national and international collaborative research activities by providing advanced research facilities and opportunities. KEK is committed

to be in the forefront of accelerator science in Asia-Oceania, and to cooperate closely with other institutions, especially with Asian laboratories.

Preamble:

Department of Physics had an active official collaboration during 1992-2000 with the KEK, the National High Energy Physics Laboratory of Japan in the BELLE experiment. Our Faculty and Research Scholars had contributed significantly to the research output of the laboratory. Impressed by the quality of our former students, High Energy Physics Laboratories around the world are willing to support the Department of Physics at Utkal University joining research collaborations. However, the basic requirement that the Institution must have at least two Faculty members in the field of experimental High Energy Physics to start any formal collaboration has hampered our cause for several years as the total number of faculty of the Department dwindled from 14 to 3 over the years and we have not been able to fulfil this criterion as there was only one faculty left specializing in High Energy Physics. Though yet to regain the status of a collaborating Institution, the Department has started active participation in the BELLE experiment of KEK, Japan through TIFR, Mumbai with one research scholar of Utkal University selected for this collaboration. Department looks forward to reviving the direct collaboration with KEK and contribute to the theoretical studies, data acquisition and analysis.

Work element and deliverables:

Research on violations of the symmetry between particles and anti-particles and new physics laws are conducted using large numbers of particles, such as B mesons, produced by the KEKB accelerator. We are currently studying the branching fraction and Charge conjugation Parity (CP) asymmetry in the charmeless B-meson system, specifically the decay of B meson to twoϕ mesons and a K meson, subsequently, ϕ decaying to two charged K mesons. This analysis is based on the full Υ (Upsilon) data set with about a thousand million B meson and anti-B meson pairs collected by the BELLE detector at KEKB asymmetric energy electron-positron collider.

The decay mainly proceeds via flavour changing neutral current transition where one can observe large CP violation in the decay mode (B going to $\phi\phi$K). The result is expected to supercede the earlier BELLE measurement with nine times larger and refined techniques. The study of such problems not only can improve our understanding of charmless B decays but also the observation of direct CP violation in B meson system would be a clear sign of physics beyond standard model. For specific decay modes the "Evtgen" simulation package generates the event after the appropriate Environment parameters for our experiment in KEK is correctly set. Data analysis program is written with the software framework BASF for BELLE. After generating the event the detector simulation "gsim" of the GEANT 3 programme is used which simulates the passage of the particles through the matter in the detector to record the particle trajectories and the response and sensitivity of the detectors. The reconstructed momentum, energy of the particles and different kinematic variables isolate the signal from the background.

With appropriate modifications, the methodology will be applicable for montecarlo simulations, data analysis, study of particle identification, tracking, motion in magnetic field, determining the radius of curvature and momentum measurement etc for different detectors at CERN such as CMS, ALICE and ATLAS.

Collaboration in GRAPES-3 Experiment

The **GRAPES-3 experiment** (or **Gamma Ray Astronomy PeVEnergieS phase-3**) located at Ooty in India started as a collaboration of the Indian Tata Institute of Fundamental Research and the Japanese Osaka City University, and now also includes the Japanese Nagoya Women's University.

GRAPES-3 is designed to study cosmic rays with an array of air shower detectors and a large area muon detector. It aims to probe acceleration of cosmic rays in the following four astrophysical settings. These include acceleration of particles to, (i) ~100 MeV in atmospheric electric fields through muons, (ii) ~10 GeV in the Solar System through muons, (iii) ~1 PeV in our galaxy, (iv) ~100 EeV in the nearby universe through measurement of diffuse gamma ray flux.

The GRAPES-3 is located at N11.4^{o}, E76.7^{o}, 2200m above mean sea level. The observations began with 217 plastic scintillators and a 560 m^2 area muon detector in 2000. The scintillators detect charged particles contained in extensive air showers produced by interaction of high energy cosmic rays in the atmosphere. At present the array is operating with ~400 scintillators that are spread over an area of 25,000 m^2. The energy threshold of muon detectors is 1 GeV.

Objectives:

- To study the origin, acceleration and propagation of cosmic rays with energies more than 10^{14}eV in the galaxy and beyond.
- To analyse the existence of “Knee” in the energy spectrum of cosmic rays.
- To understand the production, acceleration of highest energy (~10^{20}eV) cosmic rays in the universe.
- To study the astronomy of multi-TeV γ-rays from neutron stars and other compact objects.
- To study the effect of Sun, the closest astrophysical object as well as accelerator of energetic particles, on the Earth.

Overview of Grapes-3

The first cosmic ray experiment was started in 1955 by Prof. B.V. Sreekantan, TIFR by setting up Cloud chambers that started the beginning of research at the Cosmic Ray Laboratory in Ooty. The next decade witnessed a variety of experiments involving high energy interactions and extensive air shower studies in this laboratory. World's largest multiplate cloud chamber was operated here as part of an air shower array and significant results on the high energy nuclear interactions and cores of extensive air showers were obtained. Even before the advent of the first CERN accelerator of energy 30 GeV, a triple set-up comprising of an Air Cerenkov Counter, a multiplate cloud chamber and a total absorption spectrometer was operated in the early seventies to study the differences in the characteristics of interactions with nuclei of protons and pions in the energy range 10-40 GeV. This enabled the time structure study of the nuclear active component of air showers and led to the discovery that the nucleon-anti-nucleon production cross-section considerably increases with energy.

In continuation of this high profile and pioneering work on cosmic ray research at CRL (Ooty), GRAPES-1 experiment was upgraded in various stages to GRAPES-2. Then a new experiment was set up 8 km from the old site which is called GRAPES-3. The GRAPES-3 experiment at present is operating with ~400 (each 1 m^2) plastic scintillator detectors with a separation of 8 meters, to record the density and arrival time of particles in cosmic ray showers. At present, GRAPES-3 array is the highest density conventional extensive air shower array in the world, and also, this experiment is associated with a huge 560 m^2 area tracking muon detector which is the largest area tracking detector anywhere.

Interesting Results

Several fascinating results have recently been obtained from the GRAPES-3 experiment on a variety of topics, a few of which are listed below.

- Measurement of primary composition in the energy 50 TeV - 1 PeV overlapping with direct measurements.
- Precision measurements of rapid decrease in the observed galactic cosmic ray intensity resulting from a coronal mass ejection.
- Measurement of turbulent magnetic field in the shock-sheath region in the Coronal mass ejections (CMEs) by using multi-rigidity muon data.
- Precision measurement of the solar diurnal anisotropy and its higher harmonics including its rigidity dependence.
- Precision measurement of the density gradient of cosmic rays in the solar system by probing Swinson flow.
- Precision measurement of the anti-correlation between changes in solar wind velocity and cosmic ray intensity

R&D on Detector and Electronics

The Cosmic Ray Laboratory at Ooty has been at the forefront for the development of state-of-the-art detectors and electronic instruments in an effort to produce and use world-class equipment. Most of the equipment costs much less than the imported equipment and maintenanceare inexpensive and prompt because of the in-house expertise. Moreover, this equipment can be optimized depending on the specific requirement of the experiment. Some of these equipmentare:

- High quality fast plastic scintillators (first time in India) with long attenuation length and high photon output
- Ultra-fast amplifiers and discriminators with time jitter ~100 ps
- Time to digital converters (TDCs)
- General purpose boards with USB and Transmission control protocol (TCP)/ Internet protocol (IP) interface
- Field-programmable gate array (FPGA) boards for triggering and for data acquisition purposes

Grapes-3 Collaboration

At the moment, the Grapes-3 collaboration consists of the following Institutions:

Tata Institute of Fundamental Research

Osaka City University, Osaka, Japan

Aichi Institute of Technology, Toyota, Japan

J.C. Bose Institute, Kolkata, India

Indian Institute of Science & Engineering Research Pune, India

Indian Institute of Technology, Kanpur, India

Chubu University, Kasugai, Aichi, Japan

Hiroshima City University, Hiroshima, Japan

Kochi University, Kochi, Japan

Aligarh Muslim University, Aligarh, India

North Bengal University, Siliguri, India

Vishwakarma Institute of Information Technology, Pune, India

Present status of Grapes-3 and work under progress

4000 (6m x 0.1m x 0.1m) proportional counters are being fabricated and all these also need to be tested for muon detection. This, particularly the testing of each of the module before their final assembly, requires a lot of manpower. University students and postdoctoral fellows are expected to participate in this for project completion in time.

University participation and expected outcome

Along with fabrication and testing of long proportional counters, there are also some requirements of development of data acquisition front end electronics and software packages. Another important activity going on at Ooty site is the fabrication of fast scintillator tiles. These plastic scintillator tiles have been found to have better timing characteristics as compared to those produced by Bicron, one the biggest suppliers of scintillating materials. Scintillating materials have a high utility as radiation detectors very important in medical applications. Student involvement in this activity and knowing the technology of detectors would be very important for the country. Students are also expected to learn handling and developing fast electronics commonly employed in other areas. The other important aspect where the university would gain is through the use of the fast computing facility developed for data collection and analysis. This high performance computing facility has been developed primarily using young postdoctoral students procuring individual CPUs and other related items. Training at Utkal University is expected to give the university members enough competence to build such systems elsewhere. Therefore getting involved in a mega research program like Grapes-3 activities with experts from within the country and external collaborators, is expected to expose the university researchers to cutting edge technologies and contribute trained scientific manpower to the country.

Our plan and activities

1. To participate in detector fabrication and testing.
2. To participate in data acquisition activities at Ooty
3. To participate in data analysis both at Ooty and Utkal University

To participate in activity-1, one needs to train students in standard electronics involving radiation (particularly muons) detection. This needs setting up a laboratory for both energy and time spectroscopy. This activity has started in Utkal University by setting up a muon detection facility with the help of the Grapes-3 collaboration. Two 500 x 500 x 25 mm3 scintillator tiles together with two fast photomultiplier tubes donated by the Grapes team have been setup in a dark box. Some electronic modules required for muon detection, available in the Physics Department are pooled up for

setting up the facility. Some of the available electronic modules, not used for a long time and non-functional, are being repaired for this. We have already seen muon signal but a data acquisition system is required for recording the data and analysis. This year, a series of lectures have been arranged for M.Sc. students on detector techniques.

To participate in activity -2, a few students were sent to Ooty to participate in the summer training programme 2016 and winter school 2016 organized by CRL, TIFR at Ooty. The collaboration has also selected one student from the department of Physics through interview by the TIFR High Energy group managing the Ooty CRL facility.

Participation in activity-3 will go on simultaneously once we join the collaboration with our role defined as above.

Collaboration in ALICE and CMS experiments at LHC, CERN:

Department of Physics has the tradition of having a strong High Energy Physics Theory Group since 1970. The Department also had collaboration with KEK, the National High Energy Physics Laboratory of Japan for nearly a decade. 10 students and alumni of this Department were awarded Ph.D. degrees for their experimental research work at KEK and have contributed significantly to the experiments and half a dozen alumni are still participating in the experimental programmes. Along with these former students and other alumni, Physics Department of Utkal University has a very strong presence at the leading laboratories of the world such as CERN, BNL, KEK. Faculty of the Department have worked and are actively pursuing theoretical research in the field of Particle Physics phenomenology, Grand Unified models, Supersymmetry, String theory and Cosmology. The machine and detectors at CERN are specifically searching for signals of SUSY particles, Dark matter, CP violation and rare decays beyond standard model, studying Quark-gluon plasma besides trying to discover indications of new physics. If some suitable new recruitment can be made, then the Department can officially collaborate in LHC at CERN in a fruitful manner. Neibouring Institutions NISER, IoP, IIT are already part of LHC. The collaboration involves a large number of our alumni in these Institutions who are interested to help in making the Department a part of LHC. Combined effort will be beneficial for all and also to build a strong base for state of the art common facilities to produce quality research and students. For example, detectors have been designed and built for CERN by our former students at the Institute of Physics and other laboratories. We have the benefit of having one senior Visiting Professor in the Department who was instrumental in commissioning these detectors at CERN and BNL. Our research student working with BELLE 2 is familiar with the GEANT 3 programme of CERN and analysis of the data from BELLE experiment at KEK, Japan.

ALICE (A Large Ion Collider Experiment)

ALICE is one of the largest experiments in the world devoted to research in the physics of matter at an infinitely small scale. Hosted at CERN, the European Laboratory for Nuclear Research, this project involves an international collaboration of more than 1500 physicists, engineers and technicians, including around 350 graduate students, from 154 physics institutes in 37 countries across the world. ALICE experiment is focusing on the physics of strongly interacting matter at extreme energy densities. The existence of the quark–gluon plasma and its properties are key issues in Quantum Chromodynamics for understanding Color confinement and Chiral symmetry restoration. Recreating this primordial form of matter and understanding how it evolves is expected to shed light on questions about how matter is organized, the mechanism that confines quarks and gluons and the nature of strong interactions and how they result in generating the bulk of the mass of ordinary matter.

Quantum chromodynamics (QCD) predicts that at sufficiently high energy densities there will be a phase transition from conventional hadronic matter, where quarks are locked inside nuclear particles, to plasma of deconfined quarks and gluons. The reverse of this transition is believed to have taken place when the universe was just 10^{-6} s old, and may still play a role today in the hearts of collapsing neutron stars or other astrophysical objects.

CMS (Compact Muon Solenoid):

The **Compact Muon Solenoid** (**CMS**) experiment is one of two large general-purpose particle physicsdetectors built on the Large Hadron Collider (LHC) at CERN in Switzerland and France. The goal of CMS experiment is to investigate a wide range of physics, including the search for the Higgs boson, extra dimensions, C matter-antimatter asymmetry and particles that could make up the dark matter. CMS is 21.6 metres long, 15 m in diameter, and weighs about 14,000 tonnes.Approximately 3,800 people, representing 199 scientific institutes and 43 countries, form the CMS collaboration who have built and now operate the detector.

The main objectives of joining the collaboration at LHC, CERN would be

- To explore physics at the TeV scale
- To study the properties of the recently found Higgs boson
- To study CP violation in B physics
- To look for evidence of physics beyond the standard model, such as super symmetry, dark matter, extra dimensions
- To study aspects of heavy ion collisions and phenomenology of quark-gluon-plasma.

Budget

a. Setting up of a testing laboratory for research as well as training in electronics: **Rs 50 lacs**

Items to be procured are:

1. Plastics scintillations (some will come from Grapes)
2. Fast Photomultiplier tubes (about 4)
3. NIM crates (min 2)
4. NIM electronics (Power supplies, amplifiers, timers, time-to-amplitude converters, discriminators, Aanalog-to-digital converters, Gate and delay generators etc). The requirement is about two of each.
5. Cables and connectors
6. Fabrication cost

b. Manpower requirement

1. Two faculty members (Assistant professor) (necessary for joining the collaboration) **~ Rs 66 lacs for 5 years (Rs. 55,000 pm x 12 x 5 x 2)**
2. Two Research Associates/Post doctoral fellows ~ **Rs. 60 lacs for 5 years**
   (Rs. 50,000 pm x 12 x 5 x 2)
3. Two JRFs for 5 years: ~**Rs. 40 lacs (Rs. 25,000/Rs.28,000 x 12 x 5 x2)**
4. Two Senior visitors (Associate Professor or Professor for a total duration of 3 months in a year for two out of five years) with honorarium of @ Rs 50,000 pm ~ **Rs 6 lacs** (in 5 years)
5. One Emeritus Professor with honorarium of @ Rs 50000 pm : **Rs. 30 lacs (for 5 years)**
6. Travel for visitors : **Rs. 5 lacs (for 5 years)**
7. Travel for faculty members and Research students: **Rs 10 lacs**and Per diem allowance of**Rs. 5 lacs** for a maximum duration of two months.
8. One technical assistant(salary @ 20000/- for 5years) ~ **Rs 12 lacs**

Total requirement for man power= Rs. 234 lacs

c. Initial One time Fund required for joining the Collaboration in KEK, JAPAN; CMS and ALICE, CERN~ **200 lacs**

Total requirement for (a+b+c): 484 lacs

(B)Centre of Excellence in Nanoscale Materials Characterization

The faculty members of Physics department are involved in many areas of condensed matter physics at both experimental and theoretical level. They are working in different emerging and application oriented fields. Some of the ongoing research work carried out by the faculty members are outlined below.

- The experimental research aims at metal based oxide and selenidematerials atnano level which have received wide attention over the years. One of the key materials like spintronics based oxide materials includes ZnO, TiO_2, SnO_2, ZnTe, In_2O_3, Cu_2O thin films. In particular, the spintronics based on diluted magnetic semiconductors (DMSs) provides a new technology that transforms reading and writing information by spin rather than by electronic charge.
- The metal based selenium compounds like Bi_2Se_3, Bi_2Te_2Se etc. which are well known topological insulators that are new states of quantum matter in which surface states residing in the bulk insulating gap of such systems are protected by time-reversal symmetry.The study of such states was originally inspired by the robustness to scattering of conducting edge states in quantum Hall systems. Recently, such analogies have resulted in the discovery of topologically protected states in two-dimensional and three-dimensional band insulators with large spin–orbit coupling.Still a key challenge in condensed matter research is the optimization of topological insulator (TI) compounds for the study and future application of their unique surface states.
- Another area of research carried out by the faculty member includes Copper Zinc Tin Selenide (CZTSe) which is a promising candidate as an absorber layer in solar photo voltaic applications. Each component of CZTSe is abundant in the earth's crest and possesses relatively low toxicity, high absorption coefficient of the order of the 10^4 $cm^{-1}$and direct band gap of about 0.8 eV. These properties make CZTSe as one of the most valuable material for low cost thin film solar cells.
- The Bismuth diffusion into Selenidematerials like (As_2Se_3) tailors the electrical and optical properties of the host matrix for much useful application. The impurity Bi brings remarkable changes in the electrical switching behavior of the chalcogenide glasses and changes the conductivity from p- to n-type. Swift heavy ion irradiation is expected to induce diffusion of Bi into As_2Se_3 through the process of ion beam mixing. Diffusion under SHI irradiation is restricted along the path of a single ion. Such a process is expected to provide control over the extent of diffusion just by controlling the ion fluence and hence provide a platform for the study of the percolative type response of electrical conductivity observed in similar Bi containing systems under thermal annealing.
- Work is being done in the interesting area of simulation study of acoustic emission during intermittent plastic deformation. The main aim is to construct a dynamical model that can solve both intermittent plastic deformation and acoustic emission self-consistently. A large scale simulation is required to deal with both dislocation and transient elastic waves simultaneously.

So, looking at the research activities of the faculty members in various directions, we propose to establish a Centre of Excellence in "**Nanoscale Materials Characterization".** The different facilities along with the intuitive objectives that we want to develop are listed below.

(a) Proposal to establish High Current Ion Beam Facility (50 keV)

Utkal University, Bhubaneswar envisages to setup a low energy high current ion beam facility to serve as a user facility for the faculty members and students of its science departments like Physics, Chemistry, Zoology, Biotechnology, Botany, Geology, Geography, Pharmacy and Medical Sciences as well as for researchers outside the University setup. With a 3 MV pelletron accelerator already available at the neighboring Institute of Physics, a lower energy (50 to 400 keV) but high fluency accelerator at the University will provide a synergy for collaborative research among the two sister and the neighboring medical research institutions. This in-house facility at the University will provide its researchers a platform to collaborate with such centre having still higher energy accelerators like Inter University Accelerator Centre, New Delhi, VECC, Kolkata, as well as with researchers of other government laboratories like DRDO, DAE, CSIR and DST establishments and the end users of such research efforts like the industries. This will create an environment conducive to attract younger generation to accelerator based research on the state of art areas like nanotechnology, biotechnology, medical physics and optoelectronics etc.

Accelerators have played crucial roles and opened new horizons in many areas, where novel matters with unique properties are emerging. Some of these include Assembly & Control on the Nanoscale, Developing New Physics in Extreme Conditions, Developing Quantum Physics for New Quantum Technologies, Towards the Smart Design of Functional Materials, and Understanding Physical Phenomena Far from Equilibrium etc. The power of accelerator based materials research thus demolishes the barriers among different branches of science and makes ion beams an ideal tool for researchers dealing with a great many different kinds of materials. Ion beam related research in materials science is therefore an interest to a majority of researchers working in different areas. There has also been a great deal of activity in surface processing of body implants, particularly prosthesis of various kinds, where implantation of different ions has been shown to be resulting in greater bio-compatibility.

Energetic ion beam is a tool to engineer materials for specific applications as well as to unravel the mysteries at the fundamental level in materials science. The establishment of an accelerator involves development of competence in varieties of technologies like, high vacuum technology, magneto-optics, computer control, advanced electronics with analog and digital instrumentation, cryogenics, mechanical and high voltage electrical engineering, radiation safety etc. The novel attempt of bringing the technology gap in National Accelerator Grid by establishing a complementary facility at Utkal University is of paramount importance as it signifies the trend reversal of taking up the challenges by a University. This will be major step for the University to develop to become a University of Excellence.

Objective:

Accelerator based research using ion beams and material modification has been an active area of research in the Utkal University over last 20 years. This work at the Utkal University has produced some very good researchers who are now faculty of some of the best institutions in the country. The students of the university have also distinguished themselves as excellent researchers working in several leading institutions in the country and abroad. However, due to paucity of funds and manpower, it has not been possible to set up even a small accelerator facility for our research and teaching activities. Here it is proposed to set up such a system in Utkal University. The proposed facility would deliver energetic ions of different species to implant them into various substrates producing novel materials with potential applications in various fields.

Ion implantation can be used to synthesize new materials involving foreign atoms in the target. It can be used to stitch a surface film to a substrate surface through movement of atoms of different layers across the interface induced by the ions impinging into the system. In this case the ion energy is tuned so that maximum energy is deposited at the interface causing the much-needed movement of atoms across the interface. In fact under certain conditions implantation of heavy foreign ions can result in a total mixing of atoms of a surface film with those of the substrate producing a new material that cannot be formed through chemical means. It is important to mention that the technique involves non-equilibrium processes that can give rise to novel phases not achievable by conventional chemical or thermodynamic means. Synthesis of novel materials involving specific ions in a given layer, with precise control of the implantation depth profile through control of the ion energy, is now an emerging area of applications. Ion implantation, as a technique, first came into existence in early seventies and today it has become arguably the most favored technique in semiconductor processing involving making of various electronic chips from simple transistors to very complex integrated circuits. At present it has invaded several important areas of research in diverse fields such as Condensed Matter Physics (Materials science), Atomic & Molecular Physics, Nuclear Physics and even Life Science. Because of this advantage of its applicability in such diverse fields a large number of “ion-implanters” are being built every day for research in university and R&D sectors. The technique has found applications in tribology, Corrosion science, Biotechnology, Nanotechnology, Optoelectronics, Magneto-electrics, Polymer modifications etc. The use has really expanded with applications in newer areas emerging every day.

At the moment, university activities on accelerator based research is being coordinated by the Inter-University Accelerator Centre, New Delhi, which is

helping in building small accelerators for teaching and research in universities. Some of us are associated with IUAC for several years which has helped us in understanding various aspects of building and installing such systems in addition to getting involved in other research activities. We would like to use this expertise to build our own accelerator in the Department of Physics, Utkal University, together with IUAC, New Delhi. With physics and inter disciplinary research capability involving several other fields, this facility is expected to be very useful for the university as a whole.

Student training

Department of Physics, Utkal University has a rich tradition of producing good students who have proved themselves as top class researchers. Many of them have played a major role in some of the mega science programs running in collaboration with CERN, Brookhaven National Laboratory (BNL) and Stanford Linear Accelerator Centre (SLAC), USA. The Department has also been a direct collaborator in the Belle experiment at KEK, Japan. Keeping this tradition, it has recently joined the INO (India Based Neutrino Observatory) experiment. Currently, we are participating in the software and data analysis programs and cannot participate in detector making due to lack of trained manpower. Building a facility of this type with students and research scholars would train them to handle a) high voltage, b) high vacuum, c) computer automation, and d) sophisticated data analysis techniques. This is of absolute importance regarding the university joining other mega National and International research programs related to activities at centers like CERN, Fermilab, BNL, KEK etc. We intend to involve students in this activity assigning them various small jobs in the form of projects. This is expected to enhance their understanding in various experimental aspects making them better prepared for a research carrier ahead.

Work elements:

Currently, we, at Utkal University are working together with scientists of IUAC, New Delhi on this proposed facility that would be useful for the researchers of Odisha. With practically no infrastructure facility available, we have realized, it would be prohibitive to ask for a regular large ion accelerator. On the other hand it would be ideal to have a small system with all its control systems that can fit in a research lab presently available at the Department of Physics of Utkal University. The proposed facility will not be a turnkey type system that usually does not allow for training of students or research scholars in instrument building. The idea here is to procure major components (ion source, analyzing magnet + all power supplies) that cannot be developed here and set that together as a highly useful composite system.

We have carried out some relevant beam optics calculations to arrive at a configuration (arrangement of different modules, transporting the ion beam from the source to the experimental chamber) that is suitable for our University research scholars. We propose to develop the necessary control system as well based on Lab view, using our research scholars and students from Utkal University.

Looking at our needs, a small implanter with a maximum energy of ~50 keV for heavy ions up to Au seems most useful. Keeping this in mind we have fixed a basic design with a sputter or penning type ion source (sitting on a high voltage deck) that can deliver singly charged gaseous and metal ions with currents ~ 200 nA. A 60 deg double focusing magnet with ME/Z^2 ~ 30 amu MeV is proposed for mass analysis. IUAC has already built a similar system for Kurukshetra University. Our system is expected to be an improved version of that. A three port electrostatic switcher will be used instead of a switching magnet. The first experimental setup will be developed along the zero deg line. The other important component is a beam scanner, for sweeping the beam on the target for a uniform implantation. The system is fairly simple to be operated by even M.Sc. students and research scholars of the department. This manpower will be of great help for catering to the needs of researchers from other universities and research institutions of the state. Their involvement in the operation and maintenance of this small accelerator will also tune them to take up the technology culture ahead to many other different sectors. It must be added that, at the moment, there are many accelerator facilities in India. But most of them are for ion energies in excess of several hundred keVs. Our plan is to set up a system with a maximum energy around 50 keV to restrict the ion-target interactions to a near-surface region. This is a very important consideration.

Methodology:

What is proposed is to set up an ion accelerator that will be used to irradiate various samples with desired ions that would result to change of certain properties of the target. The incident ion would deposit its energy in the target material resulting in production of damage in a ear surface layer. The broken bonds together with the implanted ions, after a suitable annealing process, can get rearranged to result in new properties. The surface layer thickness over which such modifications are expected is decided by the energy and the ions species. The ion fluence, in terms of the number of ions entering into the target per unit area, is also a critical parameter that can result in a dynamic annealing of the target surface through the energy deposited. Technique is rather straightforward. One needs an ion source that can produce singly or multiply charged ions of different species together at a desired energy. The ions are then mass and charge selected using a

bending magnet also called analyzing magnet. The mass analyzed ions of the desired energy are then made to fall on the target/sample to get finally implanted in the sample material. A raster scanner is usually employed to put the ion beam uniformly on the sample surface. Following the implantation work, depending upon requirement the sample may or may not be thermally treated at different temperatures to result in changes in physical properties.

The proposed ion beam facility is expected to enhance interdisciplinary research involving Physics, Chemistry, Zoology, Botany, Biotechnology, Geology and Bio-Medical disciplines etc, giving a great boost to research activities in the University. It is expected to train young students and researchers in accelerator based research activities to join other mega research programs undertaken by the country. In the following subsections are some examples of research that could be carried out using the proposed facility.

Different areas of research using Ion beams

Implantations of Si (production of Silicon on Insulator (SOI) structures, direct band-gap nano-structures etc.

This is an area which has direct impact on electronic industry. Ion implantation in semiconductor industry has been going on in Si for over 40 years. Semiconductor device processing is probably the largest application of the implantation technique. Ion acceleration of dopants and other ions is a critical, and nearly universally employed, tool for the fabrication of transistors in semiconductor devices and the various forms of electronic, photovoltaic and photonic materials.

A topic of great interest is related to the formation of shallow source and drain junctions using ion implantation in the ongoing scaling of microelectronic devices. Heavy elements like Ga, with a short projected range, have an advantage for shallow p-type doping. At higher ion energies, the usage of a thin dielectric cover layer of SiO_2 or SiN_Xcan provide additional benefits like implantation depth modulation, protection of the implanted area against ambient impact and improved control of device parameters.3On the other hand, these cover layers can modify the layer doping due to band bending and transient enhanced diffusion. Furthermore, the implantation through thin SiO_2coverlayers introduces a high amount of oxygen in the Si substrate by ion mixing which could form SiO_Xclusters. It was shown that after implantation, a strain field can occur at the original SiO_2/Si interface, which can change the redistribution behavior of the implanted dopants. From this point of view, low energy ions, with a small projected range, as would be obtained using the proposed system would prove to be useful. In sputter ion sources with possibility of generating cluster ions would prove to be very useful regarding shallow implantation.

Separation by implantation of oxygen in Si is an established technology for a variety of applications such as ultralow scale integration, high voltage devices, and micromachining of sensors and actuators. Nitrogen implantation has also been proposed to synthesize silicon-on-insulator (SOI) layers because of the better stability, the lower doses required, and the excellent barrier against impurity diffusion of the Si_3N_4 compared to SiO_2.More recently the use of SOI layers as compliant substrates has been reported. For this O^+ ion implantation followed suitable thermal processing is a favored rout. Low energy implantation is expected to result in a buried oxide layer close to the surface leading to a stress relaxed thin Si surface layer ideally suited as an SOI structure. Similar structures with an insulating nitride layer could be produced with low energy N implantation

It is also important to mention that obtaining direct band-gap Si has been the subject area of intense research for potential applications in the next level computers proposed to be working on fast optical pulses rather than electrical pulses. Use of this in blue LED is another potential application. This material is also important for applications in the energy sector for production of photovoltaic solar cells with much improved efficiency. There has been considerable effort in preparing size selected Si nano-clusters in SiO_2 matrix. Embedded in SiO_2, such silicon nano-crystals are fully integrable into today's silicon CMOS technology and consist solely of non-toxic, abundant materials. The material is thus well suited for optoelectronic applications or as an absorber material for so-called "all-silicon" high efficiency solar cells. High dose Si implantation into SiO_2 followed by thermal annealing has been shown to produce Si nanoclusters with interesting optical properties. It is intended to carry out similar studies of high technological importance.

Research in Biomedical applications

TiO is known to be an important material helpful for growth of bone tissue over it. Ag incorporation into this is extremely important for the anti-bacterial effect of Ag. Sr incorporation into the tissue material is expected to result in enhanced growth . We intend to prepare TiO nanotubes on suitable substrates using chemical means and incorporate various elements such as Ag, Sr into that through ion implantation. The substrate material thus prepared would be used for deposition of bone tissue whose subsequent growth would be studied.

It is also important to mention that surface roughness in the substrate material is known to be a key factor regarding an efficient growth of an

additional layer on top. This correlation needs to be studied for efficient growth of tissue of importance in Life Science applications. Effect of this key roughness parameter can be studied using irradiation/implantation of the surface with ions of suitable mass and energy. A low energy facility as proposed is better suited for this with Nuclear energy loss dominating over electronic effects.

Creating materials under highly non-equilibrium conditions

An attractive point of ion beams for materials science is the non-equilibrium conditions produced by them. 1 eV corresponds to a temperature of ~10^3 K, 50 keV is ~50 million degrees K. Of course, the comparison is not directly applicable to materials effects, since the energy stored is rapidly relaxed. However, the highly non-equilibrium states, create unusual material processes inducing novel material properties. These are never obtained under thermal equilibrium conditions. Investigations will thus be tuned to extend this unique capability of ions for studying materials driven to far from equilibrium states and preparing materials under these conditions.

Creating Metal Nanoparticles in optical media with tunable optical properties

Ion implantation technique is sometimes viewed as a brute force method to deposit a material of one type into another type, which as such may not miscible. This drives the system to a metastable state. Post implantation thermal annealing can thus lead to phase segregation of the implanted material and nanoparticle formation at a pre-determined depth in the target material. This unique capability of accelerators opens up avenues for preparing nanoparticles embedded in a matrix.

In this context, metal ions such as Ag, Au etc play an important role in optical media such as glass. Post implantation annealing always results in formation of embedded metal nanoparticles with tunable absorption properties (dependent on size). The implanted samples can be further subjected to swift heavy ion beams of hundreds of million electron volts before thermal annealing for creation of uniform size/shape-altered nanoparticles with drastically different optical properties.

Development of Localized Surface Plasmon Resonance (LSPR) substrates

Substrates with Au nanoparticles on their surface are often used to enhance the local electric field of incident light wave enormously at the nanoscale. They have potential applications in many fields such as chemical or biosensors, solar cell designs and surface-enhanced Raman scattering (SERS) studies. This is of particular importance for SERS applications where the enhancement of Raman scattering by molecules adsorbed on rough

metal surfaces can be as much as 10^{14}–10^{15}. This allows the technique to be sensitive enough to detect single biological molecules. It has direct relevance in such areas as drug delivery, bacterial culture etc. Gold as a noble metal is ordinarily favored for LSPR based studies due to its resistance to oxidation. Shallow implantation of other cheaper ions on oxygen free substrates can be used as an alternate to gold and facilitate plasmonic based applications at much reduced cost.

Ion implantation in topological insulators

A topological insulator behaves as an insulator in its interior but whose surface contains symmetry protected conductingstates by particle number conservation and time reversal symmetry. Carriers in these surface states have their spin locked at a right-angle to their momentum, thus strongly suppressing scattering and making the conduction on the surface highly metallic. The surface states of a 3D Topological insulator is therefore a new type of two-dimensional electron gas. It is reported that the states cannot be removed by surface passivation if it does not break the time-reversal symmetry. Implantation at a controlled dose by both magnetic and non-magnetic ions at a sallow depth beneath the surface will be interesting to explore the effect of these ions on the time reversal symmetry and their consequences on this peculiar insulator, the mechanism of which is still not well understood.

Ion induced modification of micro structural, compositional and optical properties of Ge-Sb-In system

Among the III–V semiconductors, InSb attracted special attention because of the lowest band gap and high electron mobility, making it a promising candidate for developing infrared emitters and detectors as well as low power, high speed electronic devices. The addition of Ge modifies the properties of InSb. Though crystalline InSb nanowires were used in device applications, quantum confinement effect similar to those observed in crystalline nanostructures was demonstrated for amorphous InSbnanostructures. Ion irradiation can amorphize the system, create nanoparticles of InSb and even cause doping of Ge into these nanoparticles. We propose to study the quantum confinement effect in Ge doped amorphous InSb for possible technological applications.

Photo induced diffusion of implanted Bi in As_2Se_3 matrix for tailoring its optical properties

Photo induced changes in optical transmission of chalcogenide glasses has many potential applications ranging from waveguide writing to holographic recording. These photo-induced effects are prominently visible in the class of amorphous chalcogenide materials due to the flexible structure, which are instantaneously affected by the external stimuli like heat, laser light, e-

beam, pressure, etc. These create different metastable states and related changes of the optical, electrical parameters. Such changes could be reversible or non-reversible, directed from amorphous to crystalline state or from crystalline to crystalline one, depending on the composition, structure, technology or type of excitation. Investigations of induced diffusion in layered films have potential applications in optical recording, fabrication of optical elements with spatial phase or amplitude modulation reliefs.

Ion Beam Induced magnetic ordering

Ion beam induced controlled damages, can be utilized to induce ferromagnetism in varieties of system even with non transition group elements (e.g. in s- and p- shell electron elements) such as fullerene, graphite, TiO_2 etc. This unusual phenomenon induced by ion beams has been of immense interest in recent years and a lot of research activity, theoretical as well as experimental, has been initiated since the emergence of ferromagnetic ordering in Highly Oriented Pyrolytic Graphite (HOPG) by 2.25 MeV energy proton beams. The nature of ion species and defects play a very crucial role in attaining large ferromagnetism. Ion beam flux (ions cm^{-2} sec^{-1}) can be optimized, so that defects produced are not annealed in the process due ion beam induced temperature rise (since apart from creating defects, ion beam irradiation also triggers thermal effect on the sample). The low energy system proposed would be very much suitable for such studies.

Ion-irradiation induced phase transformation

Though ion irradiation is generally viewed as inducing disorder and amorphization, in many situations, irradiation has been shown to induce transformation from one crystalline state to another crystalline state without inducing disorder. Rare earth sesquioxides Dy_2O_3, Er_2O_3, $Lu_2O_3$for example transform from monoclinic to tetragonal structure on high fluence 300 keV Kr ion irradiation. Examination of these and other systems under low energy ion irradiation can be interesting, where the contamination by the electronic energy loss can be safely neglected and the observed modification can be solely ascribed to the nuclear energy loss.

Spintronic based oxide materials

Spintronics (also termed as spin electronics), at the interface between the magnetism and electronics, is a new field of research in multidisciplinary level and emerging technology, exploiting both the intrinsic spin of the electron and its associated magnetic moment, in addition to its fundamental electronic charge in solid state devices . In particular, the spintronics based on diluted magnetic semiconductors (DMSs) provides a new technology that

transforms reading and writing information for many uses by spin rather than by electronic charge. Hence, DMS materials are considered as a new kind of materials for spintronic applications, especially those whose Curie temperatures (T_C) are above room temperature. However, the practical applications of spintronic devices are strongly challenged by low reproducibility of room temperature ferromagnetism and controversial observations concerning over the origins of the room temperature ferromagnetism in DMSs. Nevertheless, more reports on high T_C ferromagnetic DMS have appeared including ZnO, TiO_2, SnO_2, ZnTe, In_2O_3, Cu_2O based DMS, after the discovery of the room temperature ferromagnetism in Cobalt doped TiO_2 thin films. Among these, *n*-type ZnO, TiO_2, and NiO based DMS have attracted wide attention. Several kinds of elements, such as Mn, Co Ni and V have been doped into ZnO, in which magnetism has been observed beyond room temperature. The observation of ferromagnetism in the above materials has generally been attributed to (1) transition of double sublattice to multisublattice states, (2) number of uncompensated spins from surface and particle core by reducing the average particle size, and (3) lattice exchange and enhanced surface anisotropy occurs between the uncompensated surfaces and particle core spins. However, the exact contributions of the various factors to the ferromagnetic behavior in these systems are still unclear.

On the other hand, the study of magnetism in fine particles has recently acknowledged increasing interest due to their unique magnetic properties as well as their vast technological applications. For example, antiferromagnetic nanoparticles (AFN) have gained increased attention by virtue of their potential for exhibiting magnetization reversal by quantum tunneling. For example, NiO is an antiferromagnetic (AFM) material with a Neel temperature (T_N) of 523 K which shows semiconducting behavior after the Ni^{2+} vacancy or doping. Above T_N, NiO has a cubic rocksalt structure. But below T_N, the magnetic moment are aligned ferromagnetically on the (111) plane, and the moments between the adjacent planes are coupled antiferromagnetically with each other. The AFM structure of NiO consists of ferromagnetic (111) sheets, stacked in an antiferromagnetic sequence. In 1961, Neel suggested that the fine particles of such AFM materials should exhibit magnetic properties such as superparamagnetism and weak ferromagnetism due to an uncompensated number of spins on two sublattices. Since then, large magnetic moments in AFM materials have been observed. However, the origin of magnetism is still not clear. While some investigators have reported that these moments are due to nonstoichiometry, presence of superparamagnetic metallic nikel clusters, or Ni^{3+} ions within the NiO lattice, Richardson et al reported that these moments are only slightly changed by mild reduction (to eliminate Ni^{3+}) or oxidation (to eliminate Ni metal) process and hence the observation of

superparamagnetism in NiO was attributed to incomplete compensation between AFM sublattices. Recently, many reported reported that the magnetic crossover of NiOnanocrystals occurs at room temperature, which is strongly dependent on the particle sizes and the NiO nanoparticles (31.5 nm diameter) showing the ferromagnetic nature due to the finite size effect of the NiO and found to exhibit large moments, high coercivities and loop shifts at low temperatures. These features are absent in NiO of larger size at room temperature. As a consequence, the room temperature magnetic properties of the transition metal oxide particles as a function of their physical dimension can be expected to have many applications and in developing an understanding of the origins of room temperature ferromagnetism in DMS nanostructures. In addition, the presence of multisublattice magnetic structure in the NiO and the increase of number of magnetic sublattice with the size reduction are considered as one of the dominant cause for the room-temperature ferromagnetism.
Similarly, Titanum dioxide (TiO_2) is non-toxic oxide semiconductor which has many industrial uses as DMS and photocatalyst, and strong stability in UV light. TiO_2, especially in bulk or thin film form, has drawn wide attention over the years because of its interesting optical, photocatalytic, electronic and magnetic properties. The anatase phase has been used for photocatalyst of photo-decomposition and solar energy conversion because of its high photoactivity. However, the anatase TiO_2 phase with band gap energy of 3.23 eV requires light below 388 nm to create an electron-hole pair, which is out of the visual light range (400-800 nm) of solar radiation. Hence, to improve photocatalytic effect, both reducing the average particle size for producing large specific surface area and increasing the absorption threshold of TiO_2 to visible light are very important factor. It has been reported that threshold of TiO_2 can be shifted to visible light range by doping with transition metal ions like Fe, Ni, Cr and Co. In addition, these transition metal oxides can be used to introduce magnetism into an oxide semiconductor host. Nevertheless, no one has concentrated on the relation between magnetic behavior and photocatalytic effect in details with their particle size variation so far.

These are a few representative proposals that will be pursued using the proposed accelerator. Once the facility is set up we expect a large number of other proposals from different science faculties of UU and other institutions will emerge leading to an enhancement in research activity around the system.

(b) Establishment of Nano-Science and Nano-Technology Lab

Nanoscience and nanotechnology – not so long ago thought to be only futuristic and speculative ideas, are now vibrant real areas of scientific research and engineering development. The excitement and the private and public investment to back it comes from nothing less than the promise of

revolutionary advances in medical biology, communication, computation, transportation, microelectronics, electro-optics, nonlinear optics, catalysis, photography, electro-chemistry and other areas of contemporary technology. Nanomaterials have now emerged as real functional materials. Fundamental studies and application of these materials have led to the birth of a new era of research called Nanoscience and Nanotechnology. These areas will continuously generate new capabilities, new products, new markets and their impact in society will be broad.

The most obvious idea is the emergence of nanotechnology as a fundamental, enabling technology, allowing doing new things in almost every conceivable technological discipline and emerging with large applications piercing through all the discipline of knowledge, leading to industrial and technological growth. One of the major impact of this technology is miniaturization– ultimately to the nanometer scale with promises to provide unique opportunities to such areas as drug delivery to treat tumour, cancer (without using radiotherapy & chemotherapy), solar energy, batteries, display technologies, opto-electronic devices, semiconductor devices in nanoelectronics, biosensors, ultra-light weight but super hard carbon nanotubes, catalysis, luminous paints etc. Less obvious is that materials comprising of these devices when reduced in scale from large to small to truly tiny or nanoscopic can begin to behave in fundamentally different ways, solid turn to liquid, opaque substances become transparent, and forgotten physical forces like dispersion interaction dominate interactions between tiny objects leading to remarkable self organizational and self ordering behavior. The new behavior and new properties found at the nanoscale are a large part of what make new nanotechnology possible.

This new frontier area has not only made an impact at the International level, at the National level also, a surge of activities have emerged due to the tremendous thrust and encouragement given by DST, Govt. of India. Indian industries have started understanding the commercial viability of nanotechnology based products and their impact on national economy. It will be targeted towards the main streams like electronics, healthcare markets, and other industrial products.

The programme will comprises of conceptual knowledge of nanoscience and nanotechnology, including preparation of nanomaterials, their characterization and applications. It is desired to have hands on training in latest equipment like FESEM, TEM, AFM, STM, XRD, RAMAN Spectroscopy, etc, clean room and internet facilities, and access to a library housing the latest publications in nano-science and technology. Close linkage with national scientific institutions in the country like NPL, SSPL, IITs, BARC, TIFR etc and regular interactions with the scientists from these organizations through visits and guest lectures will accelerate the academic pursuits of the centre. The products of such an academic programme will be able to (i) discuss the concept and context of nanotechnology within society, (ii) describe top-down and bottom-up approaches to nanotechnology, (iii) describe methods by which nanoscale manufacturing can be enabled, (iv) design a concept for a nanoscale product or process and hence will have

wide acceptability in a society heading forward with nanotechnology as the vehicle for progress.

Some of the equipment, which will be needed for undertaking research and teaching in the area of Nanoscience and Nanotechnology are listed below with brief justification.

I. Sample Preparation Facilities

1. Pulsed Laser Deposition (PLD) System:

Various techniques that have been used for the fabrication of thin films can be broadly classified into two categories (1) Physical vapour deposition and (2) Chemical vapour deposition based on the underlying principle. The basic principle behind any such deposition technique is the controlled condensation of either a liquid phase or a vapor phase of the constituent material over the surface of the substrate. Pulsed laser deposition (PLD) belongs to the category of physical vapor deposition and it has emerged as a unique method to obtain epitaxial and nearly singlecrystal like thin films of multi-component oxides. Moreover, it facilitates a controlled fabrication of even a single monolayer over the substrate surface. Pulsed laser ablation is one of the most efficient and probably one of the simplest techniques available today for the fabrication of multi-component thin films. It consists of a rotating target holder and a heatable substrate stage housed in a vacuum chamber. Evacuation of the chamber is carried out by a diffusion pump to about 10^{-6} mbar. A high power laser is used as an external source to vaporize the target material and deposit thin films of target material on the substrate. A set of optical components such as quartz window and quartz lenses is used to guide and focus the laser beam onto the target surface. For thin film growth, a PLD system with an excimer laser and a growth chamber is proposed for acquisition.

2. Rapid Thermal Processing Unit

Rapid Thermal Processing (RTP) refers to a semiconductor manufacturing process which heats silicon wafers to high temperatures (up to 1,200 °C or greater) on a timescale of several seconds or less. During cooling, however, wafer temperatures must be brought down slowly so they do not break due to thermal shock. Such rapid heating rates are often attained by high intensity lamps or lasers. These processes are used for a wide variety of applications in semiconductor manufacturing including dopant activation, thermal oxidation, metal reflow and chemical vapor deposition. One of the key challenges in rapid thermal processing is accurate measurement and control of the wafer temperature. Monitoring the ambient with a thermocouple has only recently become feasible, in that the high temperature ramp rates prevent the wafer from coming to thermal equilibrium with the process chamber. One temperature control strategy

involves *in situ*pyrometry to effect real time control.Used for melting iron for welding purposes. Rapid thermal anneal (RTA) is a subset of Rapid Thermal Processing. It is a process used in semiconductor device fabrication which consists of heating a single wafer at a time in order to affect its electrical properties. Unique heat treatments are designed for different effects. Wafers can be heated in order to activate dopants, change film-to-film or film-to-wafer substrate interfaces, densify deposited films, change states of grown films, repair damage from ion implantation, move dopants or drive dopants from one film into another or from a film into the wafer substrate.

3.Planetary Ball Mill with a single grinding station. Capacity- 250 ml

Planetary Ball Mill with a single grinding station can be used for fine-grinding of laboratory samples down to < 1 µm as well as for mixing, homogenising, emulsifying and alloying purpose. It is used wherever the highest degree of fineness is required. Since researchers of this university prepare their sample by mixing, homogenizing and sintering of materials at high temperatures, a Planetary Ball Mill will be an asset in these studies.

4. High Temperature Vacuum Furnace

A vacuum furnace is a type of furnace that can heat materials, typically metals, to very high temperatures and carry out processes such as brazing, sintering and heat treatment with high consistency and low contamination. In a vacuum furnace, the product in the furnace is surrounded by a vacuum. The absence of air or other gases prevents heat transfer with the product through convection and removes a source of contamination. Some of the benefits of a vacuum furnace are:Uniform temperatures in the range 1100–1500°C (2000–2800°F), Temperature can be controlled within a small area, Low contamination of the product by carbon, oxygen and other gases, Quick cooling (quenching) of product. The process can be computer controlled to ensure metallurgical repeatability. Heating metals to high temperatures normally causes rapid oxidation, which is undesirable. A vacuum furnace removes the oxygen and prevents this from happening.

II. Sample Characterization Facilities

1. Scanning Electron Microscope with Energy Dispersive Spectroscopy

The scanning electron microscope (SEM) uses a focused beam of high-energy electrons to generate a variety of signals at the surface of solid specimens. The signals that derive from electron-sample interactions reveal information about the sample including external morphology (texture), chemical composition, and crystalline structure and orientation of materials making up the sample. The SEM is also capable of performing analyses of selected point locations on the sample. It is a valuable tool for the non-

destructive inspection, examination and evaluation of materials, both metallic and non-metallic, as well as assemblies. The SEM is an instrument that produces a largely magnified image by using electrons instead of light to form an image, and hence can extend the resolution to the nanometric scale. For in-depth surface characterization of materials in thin films, nano and bulk form of materials of diverse kind, scanning electron microscope has therefore proved to be an extremely powerful imaging technique. One of the unique advantages of Scanning Electron Microscopy is the fact that many specimens can be examined with minimal specimen preparation activity and the thickness of the specimen is not a consideration. Researchers from different science departments of this university prepare inorganic, organic and bio-materials of their research interest and this facility will be extensively used for the characterization of their samples.

2. **Scanning Probe microscope (Atomic Force Microscope with Scanning Tunneling Microscope)**

Scanning Probe microscope comprises of about dozen types of scanned-proximity probe microscopes including atomic force microscope, scanning tunneling microscope and magnetic force microscope for the study of morphology of a varieties of systems. All of these microscopes work by measuring a local property - such as height, optical absorption, conductivity, or magnetism - with a probe or "tip" placed very close to the sample. The small probe-sample separation (on the order of the instrument's resolution) makes it possible to take measurements over a small area. To acquire an image the microscope raster-scans the probe over the sample while measuring the local property in question. These techniques have the ability to operate on a scale from microns down to nanometers and can image clusters of individual atoms and molecules. Unlike traditional microscopes, scanned-probe systems do not use lenses, so the size of the probe rather than diffraction effects generally limit their resolution and hence extend the ability of these equipments to atomic resolution. Also unlike the conventional imaging microscopes which provide two-dimensional projection or a two-dimensional image of a sample, the SPM provides a three-dimensional surface profile. Additionally, samples viewed by SPM do not require any special treatments (such as metal/carbon coatings) that would irreversibly change or damage the sample. Since expensive vacuum environment is not a pre-requisite for proper operation, most SPM modes can work perfectly well in ambient air or even a liquid environment. This makes it possible to study biological macromolecules and even living organisms. Researchers of this university study varieties of materials in nanoparticle, thin film and bulk form, where surface characterization of their systems to nano-scale using these techniques will be of immense use. The recent experimental research works in the Department of Physics in particular focus in growing and characterizing thin films of several oxides,

superconducting, multi-ferroic and spintronics materials and the effect of swift heavy ion irradiation on thin films made out of these materials. So a complete SPM set up will be an asset in furthering research in these areas.

3. Cryogen free Physical Properties (AC/DC susceptibility and transport)Measurement System

The cryogen free PPMS system is essential to probe into the evolution of magnetic and transport properties down to 4 K in a varieties of system. Some of the studies intended to be undertaken by researchers of this university with the PPMS are the effect of swift heavy ion irradiation and doping of foreign elements into a host matrix. The carrier mediated ferromagnetism is the heart of dilute magnetic semiconductor (DMS) materials which is essential for realizing spintronic devices. Some of the recent study shows that the Hall effect measurement can give valuable information about carrier mediated in DMS systems. The PPMS set up can probe into valuable information about the carrier mediated ferromagnetism along with the physical origin. Not only the DMS system, the physical properties of different materials like superconductors, correlated materials, multi-ferroics materials etc can be studied through PPMS. Since researchers of physics and chemistry departments synthesize and study different class of materials, a PPMS system in the ambit of the university will be an extremely useful asset for furthering our research. A cryogen free system for measurement of physical properties such as electrical transport and ac/dc susceptibility as a function of temperature (1.8-400 K) and magnetic field up to 9 T is proposed.

4. Ellipsometer for spectroscopic thin film measurement at varying temperatures

Ellipsometric technique determines thin-film characteristics by measuring how the films interact with light. It can measure the thickness, roughness, and optical constants of a film, which may be related to other material parameters, such as composition and band gap. The films prepared by the students of our department need to be characterized for these characteristics important to specific applications. These characteristics must often be measured, both during and after thin film fabrication. Since ellipsometer is an accurate nondestructive method and require little or no sample preparation, we would like to procure this equipment for the study of the films prepared by our students.

5. DSC/TG-DTA

Thermo gravimetry (TG) is a technique that measures the variation in mass of a sample when it undergoes temperature scanning in a controlled atmosphere. This variation in mass can be either a loss of mass (vapour

emission) or a gain of mass (gas fixation). Differential thermal analysis (DTA) is a technique for measuring the difference in temperature between a sample and a reference (a thermally inert material) as a function of the time or the temperature, when they undergo temperature scanning in a controlled atmosphere. The DTA method enables any transformation to be detected for all the categories of materials. Differential scanning calorimetry (DSC) is a technique determining the variation in the heat flow given out or taken in by a sample when it undergoes temperature scanning in a controlled atmosphere. With heating or cooling any transformation taking place in a material is accompanied by an exchange of heat; DSC enables the temperature of this transformation to be determined and the heat from it to be quantified. In DSC/TG-DTA system, both thermal and mass change effects can be measured. With this equipment, mass change, decomposition, thermal stability, oxidation, transformation enthalpy, specific heat (Cp), phase transformation temperature, glass transformation temperature, crystallization, phase diagrams etc. analysis can be processed. Since researchers of this university synthesize different materials and study their evolution with temperature and different processing condition, a DSC/TG-DTA system will be an essential tool for probing into the changes in the systems under study under different conditions.

6. Acoustic Emission during Intermittent Plastic Deformation

Prelude:

One area that has received very little attention in terms of modeling is acoustic emission (AE) that is commonly observed during plastic deformation with particular emphasis on the nature of acoustic signals during plastic deformation instabilities. AE refers to high frequency transient elastic waves generated due to deformation of material. AE is reported in a large variety of systems ranging from geological to laboratory scales. In the context of plastic deformation of metals and alloys, AE studies have been carried out on metals and alloys for over five decades. Correlations have been established between the nature of the AE signals and dislocation sources in variety of deformation conditions. In the case of the Portevin-Le Chatelier (PLC) effect, a specific type of spatio-temporal plastic deformation instability, studies have established that the AE signals follow a power law distribution for the static type C, partially propagating type B and fully propagating type A bands. The existence of multifractality of AE signals for the three types of bands have been reported. However, there has been little progress in constructing models that explain the nature of acoustic emission and it's statistical and dynamical features.

Objectives:

The major obstacle is the inability to bridge the widely differing time scales corresponding to the AE signal (MHz) and applied strain rate ($\sim 10^{-5} s^{-1}$). Recently, we developed a general framework for calculating AE signals during any kind plastic deformation. The dissipated acoustic energy is represented by the Rayleigh-dissipation function which is the square of the gradient of elastics train rate. Then, the amplitude of the AE signals is proportional to the square of the local strain rate that depends on the number of dislocations involved in the plastic instability. The origin of different types of AE signals during the PLC instability is explained by employing a dynamical model for the PLC effect. The nature of the AE spectrum associated with these three different types of serrations is distinct. Our results show that for the type C bands where the serrations are large, acoustic emission pattern consists of well separated burst type AE signals. With the increase of strain rate, these burst type of AE signals merge to form nearly continuous signals with overriding bursts for the continuously propagating type A bands.

The main aim of the project is as follows.

AIM-1: To construct a dynamical model that can solve both intermittent plastic deformation and acoustic emission self-consistently. A large scale simulation is required to deal with both dislocation and transient elastic waves simultaneously.

AIM-2: In real materials, one always finds that serrations over ride stress-strain curve that displays work hardening. In general work hardening is the strengthening of metal during plastic deformation. This refers to the gradual decrease in slope of the stress-strain curve beyond the yield stress. Hardening occurs due to the increased level of interaction between dislocations leading to lesser mobility for the dislocations. Here, the aim is to deal with both dislocation dynamics and elastic degrees of freedom (inertial time scale) simultaneously with the work hardening mechanism.

AIM-3: Multifractality nature of model acoustic emission spectra during intermittent plastic deformation need to be verified with the experiment. A multifractal is an interwoven structures of infinitely many fractals. It describes the statistical properties of singular measures associated with the non-uniform distribution in terms of their singularity spectrum or their corresponding generalized dimensions.

Detail Budget:

I. Hard Component

Sl. No.	**Item for a**	**Cost in Rs. Lakh**
1.	Ion Source (mass up to Au, current ~200 nA)	15
2.	Source Power supplies	25
3.	5kVA isolation transformer with 150 kV isolation	3
4.	60 deg Bending magnet with ME/Z^2 =30	40
5.	200 A Power supply for dipole magnet	10
6.	Pumps (Turbo-molecular, 500l/s, roughing pumps) with controllers and gauges (3 sets)	30
7.	Raster Scanner with Power supply	10
8.	Beam profile monitor with Power Supply (two sets)	5
9.	High current Faraday cup + controller	5
10.	Einzel / Quadrupole lens + Power supply	15
11.	Drift tubes + Accelerating tube (100 kV) + stands	30
12	Electronics (Power supplies, Current integrator, Timer etc)	10
13.	National Instruments based Control electronics	15
14.	Experimental chamber with cold-finger sample mount	15
15.	Infrastructure development (laboratory space, stabilized power, etc)	30
16.	Compressed air and chilled water facility	10
17.	Air Conditioning	2
	Total	**270 lakhs**
	Item for b	
18	Physical Vapour Deposition (PLD) System	100 lakhs
19	Rapid Thermal Processing Unit	10 lakh
20	High Temperature Vacuum Furnace	10 lakh
21	Planetary Ball Mill with a single grinding station	8 lakh
22	Glove Box	20 lakhs
23	Wire Bonder	10 lakh
24	Ellipsometer for spectroscopic thin film measurement at varying temperatures	30 lakh
25	DSC/TG-DTA	20 lakh
	Total	**208 lakhs**
	Equipment Grand	**478 lakhs**

	Total	
	Salary Component	
1.	**Remuneration for one Assistant Professor @ 55000 for 5 years**	**33 lakh**
2.	**Remuneration for one emeritus Professor @ 50000 for 5 years**	**30 Lakh**
3.	**Salary for Research Associate /PDF @ Rs.50000 pm for 5 years**	**60 lakh**
4.	**JRF/SRF (two) for 5 years**	**40 Lakh**
5.	**Contingencies**	**25 Lakh**
6.	**Salary Total**	**188 Lakh**
	Grand Total	**666 Lakh**

(C) Proposal for Establishment of a High Performance Computing Facility

Preamble:

Computational Science is recognized as the third pillar of science along with the traditional areas of theory and experimentation. There are many computationally hard problems arising across various fields of science and engineering like physics, chemistry, bioinformatics, genomics, cloud computing, VLSI and embedded system whose algorithms takes enormous computing time and system resources. The solutions with high accuracy for these kind of problems are not feasible to meet the real time requirements using limited computing resources. In such scenario parallel computer is an obvious advantage, which not only provides the exact solutions but also takes less computing time exploiting heavy computing resources as oppose to the serial computer. This motivates us to give a proposal for setting up a Center. So, we propose to create a **Center for High-Performance Computing facility (HPCF)**, which will provide supercomputing, networking, research, and educational resources to the diverse academic community in Odisha including college and university level education, research and technology dependent industry. This HPCF will provide a platform for undertaking cutting edge research and accessibility to researchers in all disciplines independent of resource or location and to promote high performance computing facility nationally and internationally. This Center will facilitate computational power at other state universities, colleges, research institutions by linking their computing resources with the HPC.

We propose to create a Center for High-Performance Computing facility (HPCF), which will provide supercomputing, networking, research, and educational resources to a diverse community in Odisha. This Center will facilitate computational power at other state universities, colleges, research institutes by linking their computing resources with the HPCF.

Objective:

The main objectives of the Center will be:

(i) To provide a high-performance computing infrastructure for academic research, industry, thereby opening new research opportunities and

(ii) To develop innovative technologies and applications that require the use of high performance computers with potential commercial application. The said facility
will be used for data analysis and will be updated for GRID computing involving International collaboration in subsequent years.

Research Areas dependent on the proposed HPCF

1. Precision Cosmology with Cosmic Microwave Background Data Analysis:

The cosmological principle, coined by Einstein, says that the Universe is homogeneous and isotropic on large distance scales. Observationally the assumption appears to be true on distance scales larger than about 100Mpc. Remarkably, a number of anomalies, by which we mean theobserved CMBR temperature fluctuations that are not statistically consistent with the CDM model, have been reported in both the WMAP and PLANCK data. These anomalies raised a lot of curiosity both from the theoretical side as well as from the data analysis side. These includes alignment of quadrupole (l = 2) and octopole (l = 3), hemispherical power asymmetry, and quadrupolar power modulation to CMBR. Apart from CMB dipole, quadrupole and octopole, it was found that the axes corresponding to radio and optical polarization also point towards virgo. The CMBR observation also suggests parity asymmetry i.e. excess power in odd multipoles compared to even multipoles on large angular scales and a region of significant temperature decrement known as cold spot. Its radius was found to be 10o and it was located at l = 207o and b = −56o in the southern hemisphere. The existence of five different axes (radio, optical,CMBR dipole, quadrupole and octopole), all aligned very close to one another, provides considerable evidence of violation of the cosmological principle. The physical origin of these phenomena is so far also not clear. This suggests to study these phenomena as much detail as possible. One can determine cosmological parameters precisely by measuring these anisotropies through its Power Spectrum. But in real life the extraction of angular power

spectrum of CMB anisotropy is complicated by foreground emission within our galaxy and extragalactic radio sources, as well as detector noise. Now the problem is how can we obtain a reliable estimate of CMB angular power spectrum? Next we will focus on the theoretical models aiming to explain the inhomogeneous and anisotropy Universe. The Bianchi models represent a homogeneous and anisotropic Universe. The study of Inflationary Universe has played an important role in analyzing various aspects of cosmological problem in the big bang model. In particular, inflation and the fluctuations observed in CMB are supposed to be related to each other. The measurement of CMB anisotropy also indicates that the Universe is made up of 72.8% of dark energy, 22.7 % of dark matter and 4.5% of ordinary matter. There is no clear understanding of the dark matter candidate or dark energy which is related to the accelerated expansion of the Universe and how they are related to CMBR though there are several models. Some of these issues have been addressed in the context of String cosmology. It is therefore, one of the important areas of study in order to have a better understanding of the early universe and the experimental data obtained from CMBR probes. The accuracy of these experiments has helped us to estimate the parameters of the cosmological model with unprecedented precision so that in the future we shall be able to test not only cosmological models but General Relativity itself on cosmological scales.

The Linux cluster is required for the large scale computation involving CMBR and other cosmological data analysis, particularly the recently released Planck data.

2. Data analysis and computation in Grapes 3 experiment, KEK, CMS, ALICE experiments at LHC , INO collaboration

3. Precision Calculations in Nuclear and Atomic many body problems:

There have been attempt to go beyond the mean field (MF) method to be able to estimate the nuclear properties more accurately. One of such approaches is random phase approximation (RPA). However, limitation of this method is it accounts only the core-polarization effects to all orders and neglects completely the pair-correlation effects. In that respect the coupled-cluster (CC) method, which is an all order many-body perturbation theory, is very powerful to evaluate the wave functions very accurately. It takes care of both the core-polarization and pair correlation effects to all orders. Moreover, this theory has the inherent properties like it obeys the size consistency and size extensivity behavior. In fact, a truncated CC method can also account contributions from the higher excitations through the non-linear terms as the wave function in this method has the exponential form. Though this method was initially established in nuclear physics, but it has been quite extensively applied to study many sophisticated problems and to provide

very accurate results in the atomic and molecular systems. While its development to perform more accurate calculations in the nuclei are rather recent. Again, these nuclear CC methods are developed using the non-relativistic methods that have very limited applications. In the proposed project, we would like to develop a suitable CC method in the relativistic framework to study the nuclear structures more rigorously, in general, and would like to apply to investigate few important problems involving fundamental physics, in particular, that are mentioned briefly towards the end of this proposal.

We would like to consider the MF wave function solving the Dirac-Hartree-Fock (DHF) method as our starting point. In this method, the relativistic Hamiltonian described by the nucleons interacting through scalar and vector mesons. Though our planned CC method can be applied to study variety of properties in a large of number nuclear systems, but we are particularly interested to study the following problems immediately.

Combining measured electric dipole moments (EDMs) of closed-shell atomic and molecular systems with the atomic calculations provide limits on the nuclear Schiff moment. It is possible extract limits on θ_{QCD} parameter and chromo-EDMs of up and down quarks if the appropriate nuclear calculations are carried out . For example the most precise EDM limit is obtained for ^{199}Hg, three nuclear calculations estimate completely different results. This even becomes more complicated in other atomic nuclei like Xe, Rn, Ra etc, where EDM measurements are in progress, the signs in the results also defer. In such a situation, it is imperative to establish a more valid nuclear and atomic many-body method that can provide more reliable results.

It has also been predicted that nuclei possessing finite nuclear spin can acquire anapole moment which violates parity symmetry transformation. Observation of this phenomena has been reported by measuring parity violation effects in the Cs atom. However, this result is in disagreement with the nuclear shell model. To support absolute existence of this property, it would be useful to perform a proper nuclear calculation. We would like to investigate this ambiguity when our CC method is developed.

Accurate determination of nuclear charge can provide a lot more information about the structures of the atomic nuclei. Their precise knowledge are very useful as input parameters to determine the atomic and molecular wave functions. Moreover, comparison of their values from the isotope shift measurements with the atomic and nuclear calculations together serve as testing validity of theoretical methods employed for their determination. We would like to estimate these values for as many as atomic nuclei possible using our CC method.

Though CC methods are known to be very powerful to give very accurate wave functions for the nuclear, atomic and molecular systems, however one of its bottleneck is it involves heavy computation. Thus, it will be necessary to use high performance computing (HPC) facility to perform these

computations. Moreover, we also need man power to develop the proposed CC method.

4. Computational Material Science/Condensed Matter Physics:

Computational material science/condensed matter physics is an interdisciplinary research area. The main objectives of this area of research are to understand the properties of realistic materials. The complex theoretical works includes modeling, numerical simulation, statistical analysis etc to predict the experimental results. The main emphasis so far is to implement the non-linear method for modeling the complex spatio-temporal dynamics. Prediction of macroscopic and microscopic properties of material can only be possible by significant increase of computational power and numerical algorithm. For example, to study the dislocation dynamics and acoustic emission phenomena simultaneously during plastic deformation requires high performance computing (HPCF) facility. Solving this kind of problem is highly computation intensive because it involves non-linear stiff differential equation with spatial coupling. A large system size and improved algorithm is always required to predict the experimental results. Sometime the mathematical package like MATLAB with parallel computing facility or user define code (MPI) is very much essential to reduce the simulation time. Other software package like MATHEMATICA and GRAPHPAD PRISM are essential for symbolic calculation and statistical analysis respectively. The complex package Vienna ab-initio simulation package (VASP) is required for electronic structure calculation, density functional theory, force-field simulation that includes molecular dynamics (MD), Monte Carlo simulation etc. So the high performance computing (HPC) facilities are the weapons to simulate the complex mathematical model that describes the physics of material.

5. Computational Fluid Dynamics :

In engineering science high performance computing (HPC) facility is largely used by computational fluid dynamics (CFD) community. The main scientific challenge in this area is to understand the turbulence phenomena and its consequence for the transfer of momentum, heat and mass in many engineering applications like aerodynamics, industrial flow and combustion systems. The statistical data generated by numerical simulation with the help of HPC will provide the valuable insight into the physics of turbulent flow. ANSYS fluid dynamics computational software is largely used to study the fluid dynamics phenomena. Again the high-performance computing (HPC) adds tremendous value to the researcher expectations because their extremely accurate simulations. For example, solving of Navier-Stokes equations using finite-difference method with high accuracy for a realistic situation requires HPC facility.

BUDGET ESTIMATION (in INR)

Sl. No.	Product description	Estimated Cost (Rs. in Lakhs)
1	Renovation of existing Building for HPCF	10
2	**MASTER NODE–Qty** 1: 2xIntel Xeon E5-2630 V3 8core, 2.4Ghz Processor 64GB DDR4 Reg ECC 2133Mhz RAM Memory 3x1TB NL-SAS 7.2K, 6Gbps Hot Plug Hard Drive (3TB total) InfiniBand Card 40Gbps or Higher 4x Gigabit Ethernet Ports	4
3	**COMPUTE NODE–Qty** 12: 2xIntel Xeon E5-2670 V3 12core, 2.3Ghz Processor 64GB DDR4 Reg ECC 2133Mhz RAM Memory 2x 1TB SATA/NL SAS 7.2K RPM 2.5-in Hot-Plug Hard Drive InfiniBand Card 40Gbps or Higher 2x Gigabit Ethernet Ports	56
4	**Storage Node–Qty** 2: (2x MDS Nodes & 2 x OSS Nodes) 2xIntel Xeon E5-2630 V3 8core, 2.4Ghz Processor 32GB DDR3 Reg ECC 2133Mhz RAM Memory 2x 1TGB NL-SAS 7.2K RPM 2.5-in Hot-Plug Hard Drive InfiniBand 40Gbps or Higher Card Dual 8Gbps/16Gbps FC HBA 2x Gigabit Ethernet Ports	7.0
5	**IB Switch** (Mellanox) **–Qty** 2: 18 port 40Gbps or Higher IB switch with suitable no of IB cables	9.0
6	**Networking (High Speed Infinite Band Connection)**	5
7	**Rack–Qty** 1: 42U Industry Standard Server Rack with all accessories	0.6

8	**Gigabit Ethernet Switch–Qty** 1: 24port Gigabit switch along with required cables	0.4
9	Supply and Installation of 10KVA UPS system with half an hour battery backup	4
10	Supply and Installation of 7.5TR Precision AC air cooled system	5
11	Software	34
12	Man Power (System Administrator @Rs. 25,000 pm for 5 years)	15
13	AMC	5
14	Contingency @ 1 lakh per year for 5 years	5
	Total	**160 lakh**

Details of Software Requirement

Sl. N.	Items	Amount (in Lakhs)	Justifications
1	**HPC Software** Red Hat Linux Cluster Management Software with GUI web based Management & Monitoring Job Scheduler Software C/C++, Fortran Compilers and Parallel Libraries GUI Portal for Job Submission	5.0	System software

2	Matlab	5.0	Numerical Computation
3	Mathematica	5.0	Numerical Computation
4	IDL	1.0	Data Analysis and imaging
3	Maple	5.0	Numerical Computation & GTR Calculation
4	Gaussian 09 (Revision D.01) for Linda	9.0	Electronic structure theory calculation/Density Functional Theory (DFT) calculation
5	Ansys Fluent	4.0	Computational Fluid Dynamics
	Total	**34lacs**	

SYSTEM S/W

Red Hat Enterprise Linux 7

Red Hat Enterprise Linux 7 delivers dramatic improvements in reliability, performance, and scalability. A wealth of new features provides the architect, system administrator, and developer with the resources necessary to innovate and manage more efficiently. Red Hat® Enterprise Linux® 7 is ready for whatever infrastructure choices you make, efficiently integrating with other operating environment, authentication, and management systems. It provides a rich application infrastructure with built-in mechanisms for security, identity management, resource allocation, and performance optimization. Container-based isolation and enhanced performance tools allow you to see and adjust resource allocation to each application. And, of course, there are continued improvements to scalability, reliability, and security.

APPLICATION S/W

Matlab

MATLAB is a high-level language and interactive environment for numerical computation, visualization, and programming. Using MATLAB, you can analyze data, develop algorithms, and create models and applications. The language, tools, and built-in math functions enable you to explore multiple

approaches and reach a solution faster than with spreadsheets or traditional programming languages, such as C/C++ or Java. One can use MATLAB for a range of applications, including signal processing and communications, image and video processing, control systems, test and measurement, computational finance, and computational biology. More than a million engineers and scientists in industry and academia use MATLAB, the language of technical computing.

Mathematica

Almost any work flow involves computing results, and that's what *Mathematica* does from building a hedge-fund trading website or publishing interactive engineering textbooks, to developing embedded image-recognition algorithms or teaching calculus. *Mathematica* is renowned as the world's ultimate application for computations. But it's much more—it's the only development platform fully integrating computation into complete work flows, moving seamlessly from initial ideas all the way to deployed individual or enterprise solutions.

Maple

It enriches classroom & accelerate research work, demonstrates and explore concepts using intuitive Click-able Math techniques taking advantage of hundreds of tools specially designed for teaching and learning mathematics. It creates course notes, assignments, interactive apps, and research reports that include live computations, plots, and mathematics. It is useful in solving advanced problems and developing algorithms with sophisticated, math-aware commands and programming language.

IDL

IDL, short for Interactive Data Language, is a programming language used for data analysis. It is popular in particular areas of science, such as astronomy and medical imaging. IDL shares a common syntax with PV-Wave and originated from the same code-base, though the languages have subsequently diverged in detail. IDL is the trusted scientific programming language used across disciplines to extract meaningful visualizations from complex numerical data. With IDL you can interpret your data, expedite discoveries, and deliver powerful applications to market. Additionally, IDL is a truly cross-platform solution, providing support for today's most popular operating systems, including Microsoft Windows®, Mac OS X, Linux and Solaris.

Gaussian 09 (Revision D.01)

Gaussian 09 is the latest in the Gaussian series of programs. It provides state-of-the-art capabilities for electronic structure modeling. Gaussian 09 is licensed for a wide variety of computer systems. All versions of Gaussian 09 contain every scientific/modeling feature, and none imposes any artificial limitations on calculations other than your computing resources and patience.The Gaussian 09 versions for Windows computers and Power-PC-based Mac OS X computers are known as Gaussian 09W and Gaussian 09M (respectively). Gaussian 09 for Intel-based Mac OS X computers is generally

licensed in the same way as other Linux/UNIX versions. A single-CPU 32-bit version is also available as a shrink-wrap licensed product which is known as Gaussian 09IM.All Linux/UNIX versions of Gaussian 09 can run on single CPU systems and in parallel on shared-memory multiprocessor systems. Gaussian 09W is available in separate single CPU and multiprocessor versions. Gaussian 09M is available in a single-CPU version only. For cluster and network parallel execution, the Linda parallel computing environment software must also be licensed. An updated version of Linda is required for all versions of G09.

Outcome/deliverable:

Establishing a HPCF in Utkal University will not only help in enhancing the research output, it will also be extremely useful in capacity building in R&D, related to various disciplines.

Total BUDGET OF A,B,C in Lakhs

(A) Centre of Excellence in High Energy Physics, Cosmology and Neutrino Physics: Rs. 484 lakh

(B) Centre of Excellence in Nanoscale Materials Characterization: Rs. 666 lakh

(C) Proposal for Establishment of a High Performance Computing Facility: Rs.160 lakk

Grand Total: Rs. 1310 lakh

Equipment:

The University is currently setting up a Central Instrumentation Centre with the help of the State Government. The following equipments have been planned to be procured for the purpose which will be used by the members of Science Departments, some of the Social Science departments of the University as well as researchers from other Institutions in the State. It is expected that the CIC will be of great support to condensed matter research in the Department of Physics.

Equipment to be procured for the CIC:

1. Field Emission Scanning Electron Microscope with EDS and EBSD
2. Atomic Force Microscope (AFM) with Scanning Tunneling Microscope

(STM)

3. Powder X-ray Diffractometer (XRD)
4. Fourier Transform Infrared (FTIR) Spectrometer
5. X-ray Photoelectron Spectroscopy (XPS)
6. Cryo Microtome
7. Liquid Chromatography Mass Spectrometer
8. NGS ION S5 and 3500xl 24 capillary genetic analyzer
9. Automated Protein Purification System
10. Laser Bench top Flow cytometer with Multicolour Capability
11. Spectral Confocal Laser Scanning Microscope
12. Water purification system
13. X-ray Fluorescence (XRF) Spectrometer
14. MotorisedStereozoom Microscope

Immediate Need for establishing the Centres of Excellence and for floating new advanced courses:

(a). **Faculty Recruitment** : In order to achieve a level of excellence in teaching and research at par with the National level, the Department proposes to recruit 4 new faculty members in the areas of experimental high energy physics, experimental condensed matter physics with very good research publications and teaching ability. The Department can join the International collaborations
at LHC (CERN), KEK (JAPAN) only if there are atleast two faculty members working in these fields.

(b). **Emeritus Professors :** The Dept. Proposes to have 2 Emeritus Professors under the centre of excellence scheme in order to enhance the research and teaching activities of the Department.

(c) **JRF and Research Associates/Post doctoral fellows** in the above research areas

(d) **Technical assistants**

(e) **System Administrator for HPCF**

(f) **Infrastructure:** The Department needs one more building with conference hall, lecture halls, library, faculty rooms, research labs, computer lab and reading room, Girls' common room etc.

Proposal for Setting up

CENTRE FOR POLICY RESEARCH AND GOVERNANCE

UTKAL UNIVERSITY

Bhubaneswar

Background

It is noticed that the state government and national government launch various schemes for eradicating poverty and generating employment. In many cases such schemes do not yield the desired results. Similarly, if a few schemes are successful, no systematic studies are done to assess the impacts of economy, society and environment. There is a need to formulate standard framework for the implementation of government schemes. All government policies should be tested in a standard framework for maximising the chances of success. Similarly, after the implementation of schemes, government policies should be scrutinised in a standard framework for assessing the social, economic and environmental impacts.

For effective policy design and their implementation, there is an urgent need to do the scientific evaluation of the public policies before and after the implementation. At present impact assessments are carried out with the help of non-governmental organisations that lack adequate expertise.

In this context the department of Analytical and Applied Economics along with other social science, science and management departments proposes to set up a centre to carry out scientific evaluation of the public polices formulated and implemented by the state and national government.

Vision

To use the academic research for raising the living standard of the people through effective design of public policy in the state and country

Mission

To design, guide and facilitate the implementation of Sustainable Development plans in a participatory and multi-disciplinary framework

Objectives

1. To examine the existing public policies on national importance in the field of education, health, livelihood, industry, marginalized communities and suggests appropriate policy measures for ensuring high economic growth, poverty eradication and creation of more employment.
2. To develop an Integrated Framework for Social, Economic and Environmental Impact assessment (IFSEEIA) of different developmental projects through an inter-disciplinary mode
3. To formulate proto-type robust policy models for different developmental projects / policies / plans / programs

4. To develop a Standard Framework for the Pretesting of the Government Policies (SFPGP) before implementation
5. To develop Big Data Analytic Skills.

Thrust Areas

1. Impact assessment through IFSEEIA of different developmental projects
2. Efficiency and Compliances of Direct and Indirect Taxes
3. Assessment, Allocation and Efficient use of Natural and Human Resources
4. Public Policy formulation, implementation, governance and evaluation

Period of the Project

- Two years

Interdisciplinary Approach

The success or failure of the public policies depends upon economic, social and cultural factors. Therefore, the implementation of the public policies needs to be evaluated in an interdisciplinary framework. Keeping this in mind the department of Analytical and Applied Economics, Sociology, Public Administration, Anthropology, PMIR, Mathematics, Statistics and Computer Science and Application will work together and analyse the impact of public policies in an interdisciplinary manner. Wherever, required other departments like geography and other science departments will be roped in for providing the technical and scientific expertise

Core Values

- Participatory Policy Design and Assessment
- Multi Disciplinary Approach
- All Stakeholder consultation
- Sustainability

Outcome

1. Collaborative interdisciplinary research with at least one national and one international University / Institute
2. Support to government in formulation, implementation, monitoring and evaluation of policies and programs
3. Produce 100 experts in policy research and modeling through training and continuous feedback
4. Produced eight international standard PhD degrees
5. Publication of ten research papers in journals having at least impact factor of 1

Proposal for Setting up

CENTRE FOR ENVIRONMENT, CLIMATE CHANGE AND PUBLIC HEALTH

UTKAL UNIVERSITY
Bhubaneswar

The centre aims for

CCCDM mission- *to act as* a *knowledge hub on climate change information and cater to the knowledge needs of community masses, policy makers, academicians, researchers and practitioners.*

A changing climate and environment is probably one of the most pressing challenges of this century, which has directly or indirectly impact on quality of life on the Earth. Indian subcontinent is both a major greenhouse gas (GHGs) emitter and one of the most vulnerable countries to the negative impact of future climate change. Indian CO_2 emissions have been rising steadily and expected an rapid growth in next couple of decade due to anthropogenic activities from various energy sectors followed by changing land use land cover pattern are few important key factors responsible for changing climate. Consequently, a warming climate more moisture can be hold in the atmosphere, which could lead to heavier rainfall, increase in frequency of extreme events, more flash flood, delay in onset of monsoon, severe drought, temperature rise, urban heat Island effect, etc. Therefore, the increasing population with changing life style followed by need for food security challenge and improving the scientific understanding are of utmost importance areas needs special attention and further research/studies.

Odisha is one of the most vulnerable states to climate change. it has 480s long sensitive coast line, which is a periodic recipient of climate risks such as cyclones and coastal erosion. Odisha is also rainfall dependent for its most non-irrigated land. Rice, a water dependent' crop is the mainstay food for Odias. The agriculture sector is vulnerable to vagaries of climate-induced weather changes; The vector-borne disease malaria is rampant in most of the tribal areas of State due to many reasons. Poverty and malnutrition's sometimes are hindering way to development. Climate change as predicted may impede poverty alleviation programmes in State directly and indirectly compromising the current growth strategy. The direct impacts may be loss of life, livelihoods, assets, infrastructure etc. from climatic extreme events. So also, the indirect impacts could be the lagging behind in

economic growth path etc.

Odisha is the one of the first states to begin work on a Climate Change Action Plan in 2009. The climate plan has been formulated in two distinct phases. The first phase is characterized by tight deadlines with the aim of generating a slew of new ideas for departments to pursue. In the second phase, the process was reined in to accommodate greater civil society participation, Odisha is in many ways a pioneer in drafting a climate plan as it had no framework to refer to at the time.

The implementation of SAPCC has been a challenge due to cross cutting thematic responses required and minimal research available to frame effective solutions. While the state has calculated need of 30000 Crs as bill to implement climate solutions, much can be achieved through intelligent implementation of ongoing schemes also directed towards climate co-benefits on mitigation and adaptation.

The climate variable factors like precipitation, temperature and sea level affect mostly weather dependent sectors like agriculture, forests, water and coastal management, it has been noticed that there are already schemes to reduce dependence on climate variables or to align with the changing patterns; climate co-benefit approach can be beneficial in reducing the budget and enhancing the implementation. However the climate agenda unlike development agenda, cannot be implemented without coordination of various departments, in absence of science based knowledge and regular monitoring by high level committee of policy makers. Department of Geography, Utkal University proposes to establish **"Centre for Climate Change and Disaster Management"** which will bededicated to mainstreaming climate change concerns in planning and development policies/ programmes of the state as well as nation.

It will be transdisciplinary in nature. Transdisciplinarity suggests that the nature of research would not be confined to strict parent disciplines of social sciences or natural sciences but transcend their boundaries and limitations to absorb both the scientific findings which provoke decision making and social sciences sensitivities to decipher and direct these findings to communities and institutions of decision making. The three key

functional areas are, first; natural sciences, GIS and satellite imagery, second; communities interface.

As many acute environmental/climate challenges are still waiting to be solved. The ultimate objective is to stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. The proposed center i.e. **Centre for Climate Change and Disaster Management** will deal with different aspects related to impact of regional environmental issues on global climate change emphasizing the following research areas

- Estimation and assessment of projected greenhouse gases emission from various energy sectors in India and its impact on temperature trend and climate.
- Establishing the tele-connection between human cultures/behavior and the environment from prehistoric times to the present climatic condition.
- Assessment of socio-economic loss due to changing climate and its mitigation strategies.
- Linkage between climate change and Indian monsoon, which play a vital role in shaping India's economy.
- The assessment of social impacts on public health, ecosystem, increased population movement, obstacles to development and environmental damage due to climate change.
- Climate modeling and to understand the impact of transboundary pollutants on snow/ice cover over Himalayan, Antarctica and Arctic.
- Understanding the challenge that climate change poses and creating appropriate adaptation and mitigation mechanisms of the natural and social sciences in an interdisciplinary approach.
- Advancement in alternative clean energy sources.
- Impact of alarming climate agents/GHGs level on food security through agriculture, biodiversity and human health.

The proposed center has four research segments as follow

1. Research on Climate Change

2. Mapping of Vulnerability of the environment & community
3. Research on Community resilience
4. Capacity building of community to counter climate change

Cluster Research Hub on Environmental and Public Health

The practice of public health has been dynamic in India, and has witnessed many hurdles in its attempt to affect the lives of the people of this country. Since independence, major public health problems like malaria, tuberculosis, leprosy, high maternal and child mortality and lately, human immunodeficiency virus (HIV) have been addressed through a concerted action of the government. The recent agenda for Public Health in India includes the epidemiological transition (rising burden of chronic non-communicable diseases), demographic transition (increasing elderly population) and environmental changes. The unfinished agenda of maternal and child mortality, HIV/AIDS pandemic and other communicable diseases still exerts immense strain on the overstretched health systems. Besides, the tobacco-attributable deaths range from 800,000 to 900,000/year, leading to huge social and economic losses. Mental, neurological and substance use disorders also cause a large burden of disease and disability.

According to recent estimates, premature death and illness due to major environ mental health risks accounts for nearly 20 percent of the total burden of disease in India.

Odisha, one of the coastal states of Indian sub-continent is rich in bio-diversity and endowed with wide range of flora and fauna owing to its peculiar topography and geographically distributed various microclimatic locations. These natural resources are neither being properly exploited nor even utilized for their therapeutic potentials. Most of the people in Odisha live in rural areas and use traditional herbal medicines for treatment of different diseases. This project will provide a strong scientific linkage with traditional knowledge in the field of Ethno-pharmacology.

With this background we have a strong rational to propose a cluster research hub on environmental and public health with the following objectives.

Objective 1: Validation of traditional and ethenophrmacological knowledge for the development of natural compound based therapeutics/health supplements as antioxidant, anti-inflammatory, immunomodulatory and anti-proliferative agents

Objective 2: Bio-prospecting and bioprocess development of novel molecules/bioactive compounds/Proteins/peptides as therapeutics and diagnostics.

Present Project work will enable us to explore resource potential of medicinal and aromatic plants used by ethnic peoples of Odisha and adjoining states, identification of active anticancer, anti-inflammatory and

immunomodulatory phytochemical compounds, drug designing, nanoformation, drug delivery, and optimization of bioproducts by *in vitro* and *ex vitro* techniques. Traditional knowledge based plant identification, screening of drugs and characterization at molecular level for distinguishing different potential genotypes in terms of ecotypes, morphotypes and cytotypes will also be addressed. Moreover the potential candidate ecotypes will also be identified with its potentiality of producing active principle of medicinal importance.

The proposed work has huge relevance to emerging India which is now focussing on utilizing its natural resources to manage numerous lifestyle based disorders. This is a nationwide attempt to reduce dependency on medicines that is imported thereby affecting the economy of the country. Moreover, many such drugs have addictive effects and damage vital organs by excessive and unsupervised use.

In the view of the 2015 Nobel Prize that was given for the discovery of Artemisinin, one of the potent anti-malarial drugs, was derived from plants. The global market for natural resource based drugs was an estimated USD 26 million in 2011, and is going up every year. Many plant derived molecules are now to be active against infectious and parasitic diseases. They are known modulators of immune response and act as anti-allergens. Many anti-cancer drugs are also discovered from natural resources. The major source of anti-oxidants that are necessary to manage life-style disorders are also derived from plants.

Participating departments

- Biotechnology
- Anthropology
- Chemistry

In collaboration with

- Institute of Life Sciences, Bhubaneswar,
- Regional Plant Research Center, Bhubaneswar
- Regional Medical Research Center, Bhubaneswar

Strength and competency of the faculty of the Department:

- Faculty associated with the programm have the competenacy and expertise in the subject domain.
- Since last 10 years and more the department is actively involved in doing relevant work on natural compounds, isolation and bioassay of the plant extracts/ active phytocompounds endowed with to health benefits.
- State of the art infrastructure in the departmentand in the participating collaborating Institutes.

- Generation of new knowledge and bridging of knowledge gap between traditional ethnic knowledge and validation of the claims through scientific outcome, production knowledge through validation.
- New formulation/ generation of new products
- Discovery of predictive bioactive principles / biomarkers
- Development of natural compounds based therapeutics
- Application for patents

Proposal for Setting up

CENTRE OF EXCELLENCE IN ADVANCED MATERIALS AND APPLICATIONS

UTKAL UNIVERSITY
Bhubaneswar

Background

Development of new materials with tailor-made properties for better performance is a thrust area in the contemporary research. Design and synthesis of materials with tunable properties are crucial and hold the key for developing more efficient processes/sustainable technologies to meet the ever changing need of society in various sectors including **Environment and Health Care**. Based on the expertise of faculty of P.G. Department of Chemistry, Utkal University proposes for a '**Centre of Excellence in Advance Materials and Applications' (CEAMA)** to develop state-of-art infrastructural research base for interdisciplinary research and development activities in the broad areas encompassing **advanced materials and their applications** besides in-depth understanding of the complex interaction between the materials and their environment of applications.

CEAMA envisages to develop novel materials for various applications that include, but are not limited to, materials for Carbon sequestration, Sensors for heavy metal ion and biomolecules detection and biopolymeric materials for health and environmental sector. Apart from establishing collaboration between researchers within and outside Utkal University, CEAMA will promote for patenting the research findings and implementation of developed process in real fields.

VISION

- To be a national leader in research and develop expertise in the synthesis, characterization, modification of materials for applications in the area of environment and health sectors.

MISSION

- To develop state-of-art facility staffed with a competent interdisciplinary resource pool for cutting-edge research in materials synthesis, characterization, modification and applications.
- To provide green/environment friendly solutions for some of the emerging environmental problems in the state.
- To develop strong industry interaction for technology oriented research as well as teaching.
- To train and develop manpower for research in the area of Material Science & Applications.
- To offer a two years programme in nanoscience and technology
- The Centre proposes to achieve its vision and mission through a planned and phase wise research in the following modules.

Module I: **Carbon dioxide capture, Catalytic conversion and molecular level understanding by computational studies**

The present proposal aims at development strategies to capture and utilize CO_2, a common gaseous air pollutant widely abundant in the atmosphere. Carbon dioxide is one of the finale products of combustion, and is not a benign component of the atmosphere. Increase in carbon dioxide content in the atmosphere is a global concern and researchers across the

world and in search of developing technologies which can address the issues related with CO_2 pollution. In view of the inevitable depletion of fossil fuels, a possible solution to this problem is the recycling of carbon dioxide, possibly captured at its point of generation to guiding them to and store, known as sequestration; then conversion $CO_2$to fuels or other usable forms of chemicals.

CO_2 capture, storage and conversion by imidazoluim NHC, Metal-NHC complexes and metal organic framework (MOF)

Imidazolium or benzimidazolium salts (ionic liquid), zeoliticimidazolate frameworks (ZIFs) have extensively used for CO_2 absorption and conversion. Because of their versatile chemical functions, imidazolylidene NHCs have application in capture, activation and fixations of CO_2 in recent years. CO_2 can potentially be converted into a variety of valuable chemicals, such as formic acid and methanol. The insertion of **CO_2**into M-H bonds, and the synthesis of formic acid from CO_2, in general, is of great industrial interest. In addition, the fixed CO_2 was completely released under an N_2 flow at high temperature. These results demonstrated the potential of NHC scaffolds for CO_2 capture in a heterogeneous fashion, which has greater potential for practical applications**.**

The metal organic framework (MOF) can be used to adsorb CO_2. It is the MOF where the organic part (ligand) and the metal bind in an array of three dimensional structures. These structural arrangements integrate with voids leads to formation of porous materials; the void spaces of porous materials are capable of storing / adsorbing CO_2. In an average the surface area of one gram of MOF could be equivalent to the surface area of forty tennis courts. This means that MOFs possess large gas storage capacities with numerous locations for gas molecules to bind or adsorb. At a given pressure a tank filled with MOF material can usually store much more gases than an empty tank does. Study of MOF of transition metal with functionalised organic molecules, such as dicarboxylates, polypyridine or multidentate ligands suitable of binding metal in three dimensional fashions could produce MOF capable of storing carbon dioxide

Selective catalytic conversion and molecular level understanding by Computational Studies for Environmentally Benign and Sustainable Chemistry

Recently considerable attempts have been made to explore the utilization of 'waste carbon from CO_2' to 'working carbon. CO_2 being a thermodynamically stable molecule it can be activated only at very high temperature. Nevertheless, uses of catalysts have proven to be effective in conversion of carbon dioxide into an array of chemicals. Here we aim to use single site heterogeneous catalysis for the CO_2 conversion under mild reaction conditions. Single site catalysis provides identical and isolated sites having uniform interaction with the substrate to maximize the conversion along with improving selectivity. Active functional species such as Pt, Pd, Rh, Ni, Cu etc., metal complexes, or metal oxides will be coated on a

nanoporous solid supports to achieve single sites and these materials can be studied for selective conversion of CO_2 to useful chemicals.

Computational chemistry methods have witnessed a steady growth in understanding chemical transformation by providing various information such as structural parameters, energetic details, orbitals interactions, effect of medium (solvent) and other external perturbation. The approach needs chemical intuition as well as molecular level understanding of the reaction through electronic structure calculation by applying the state of art density functional theory (DFT). This molecular insight will provide energetics details associated with the trapping of CO_2 via metal/bio-mimetic catalysts.

Objectives

- Sequestration of atmospheric CO_2 by chemical method.
- Conversion of CO_2 to valuable chemicals like methanol, formic acid, carbohydrates and other fuels.
- Theoretical studies of probable mechanism, molecular dynamics.

Outcome/deliverable

- Design, synthesis of new materials capable of CO_2 capture, storage and conversion to valuable chemicals

Outreach/consultancy

- The expertise and development can exchange experimental finding with different research groups, institutes, industries and finally to take a policy in the country regarding CO_2 sequestration.

Module II: Nanomaterials for waste water treatment and sustainable energy

Water and energy are fundamental resources used for economic, social and cultural development which have been long presupposed as abundant. With the increase of population and the developments brought by the industrial revolution, their demand has been increased to many folds in last few decades.Water, being a universal solvent dissolves all kinds of contaminants like, metal ions, inorganic anions, organic dyes, pesticides and insecticides, radioactive elements, etc.Therefore, great challenges lie in the removal of undesired species from contaminated water to make the water useable in variety purposes. Wastewater reuse is becoming a common necessity.Developing new materials with improved properties for water treatment continues to be active area of research worldwide. Moreover, the development of cost-effective and stable materialsand methods for providing the fresh water in adequate amounts is the need of the water industry.

The current **global energy problem** originates not only from limited fossil energy supplies, but also its environmental impacts for its entire energy lifecycle, from mining and processing to emissions, waste disposal and recycling. One solution to achieve energy sustainability is to develop sustainable technologies to gradually replace non-renewable fossil fuels. Electrolysis and photo catalysis of water (H_2O) to produce H_2 and O_2 play key role in the formation of clean, low cost and environment friendly energy

source then other conventional source. Hydrogen evolution reaction (HER) is important for cleanest fuels and oxygen evolution reaction (OER) is important for fuel cells and air batteries. In last few decades, a great deal of research has been devoted to catalytic systems with potential to catalyse the electrolysis and photocatalysis of water for production of H_2 and O_2.

Objectives

- Removal of different water contaminates from waste water using high adsorbing capacity and selectivity nanoadsorbents*(mesoporous oxide/phosphate, nanoporous silica, Polymer/Polymer nanocomposites etc.) with high capacity and selectivity*
- Visible/Solar light driven hybrid materials for removal of different water contaminates from waste waters and their suitability for their use in hybrid treatment method.
- Hybrid materials for design of catalyst modified anode and cathode towards water splitting study (HER and OER).

Outcome/deliverable

- Design and synthesis of new materials with tuneable properties as potential adsorbent/photocatalysts for their use in remediation processes of contaminated water.
- Development of suitable hybrid treatment method for purification of water during natural calamity (flood, cyclone etc.).
- To be a nodal centre of different working groups in the State of Odisha for developing efficient water treatment processes with a mission to provide clean and safe potable water to all.
- Development of high performing catalyst for hydrogen generation from water.

Outreach/consultancy

The finding of this research will be exchanged with other research groups/Government to take effective measures for waste water remediation process and sustainable energy generation.

Sustainability of the Centre

In order to run the centre beyond RUSA support, funds will be generated by submitting research proposals to different funding agencies of Govts. of India and Odisha. The centre will extend consultancy to various industries to generate funds as well as participate in international collaborative projects.

Proposal for Setting up

CENTRE FOR STUDY OF UNORGANIZED LABOUR

UTKAL UNIVERSITY
Bhubaneswar

Introduction

Unorganized or informal sector constitutes a major part of the Indian economy. More than 93 per cent of workforce and about 50 per cent of the national product are accounted for by the informal economy. A high proportion of socially and economically underprivileged sections of society are concentrated in the unorganized activities. The growth of the Indian economy during the past two decades is accompanied by increasing informalisation. There has been new dynamism of the informal economy in terms of output, employment and earnings. Faster and inclusive growths need special attention to unorganized sector. Sustaining high levels of growth are also intertwined with improving domestic demand of those engaged in informal economy, and addressing the needs of the sector in terms of credit, skills, technology, marketing and infrastructure.

Majority of unorganized workers are engaged in agriculture, construction, manufacturing, trade and transport, communication & services, and home based occupations. Agricultural labour, migrant workers, bonded labourers, contract and casual labourers are mostly engaged in above occupations. They suffer from cycles of excessive seasonality of employment, lack of a formal employer- employee relationship and absence of social security protection. It is also widely acknowledged that the informal sector in India suffers from a low productivity syndrome, compared to the formal sector. The prominent features of the sector are lower wages, poor working / living conditions, excessive seasonality of employment, preponderance of casual and contractual employment, migration, absence of proper social security and welfare measures, denial of minimum wages and so on. In spite of presence of labour laws and other welfare schemes, construction workers, migrant workers, contract labour, child labor and bonded labour are exploited in manifolds. Thus they need special attention.

Hence, the Advance Center for Labour Research is proposed to deal with various aspects of unorganized workers specifically in the State of Odisha. The proposed center shall be a hub on research, training, consultancy and publications, and to reach all those who are concerned with diverse facet of workers, in the unorganized sector. The outcome of the centre will help in

policy formulation, legislative reforms and action plans to ensure a just and proper place for unorganized workers in an egalitarian and democratic society.

Vision:

"An advanced centre of research and training for improving the quality of life of unorganized workers"

Mission:

- Undertake training and research concerning labour and employment
- Address the issues encountered by unorganized workers
- Dissemination of knowledge and ideas among all stakeholders for improvement of labour standard in the sector

Objectives

- To conduct a base line research to develop a data base of the sector
- To act as a capability enhancement center offering training to workers engaged in unorganized sector
- To undertake research in collaboration with other agencies at regional,and national levels;
- To provide support to government and other agencies in policy formulation for transformation of labour standard
- To address the issues in implementation of policies relating to unorganized labourand to suggest remedial measures
- To help in sharing of knowledge among all social partners by publication of newsletter and journal of national repute.

Activities

A. Research

Research will occupy a primary place in the activities of the Centre. The subject of research will comprise a broad spectrum of labour-related issues and problems, in the unorganised sectors in general and the more disadvantaged groups such as construction worker, child labour, women labour, migrant workers and contract labour, in particular. While deciding the topics of research, care will be taken to identify subjects and issues of concern and relevance to policy formulation. The research wing will be guided by a Research Advisory Committee which consists of experts in the

respective areas. The centre's resource persons shall be allocated to this wing in accordance with their specializations, experience and interests. Major areas of research to be carried out by the centre are:

- **Construction Workers**- Construction activities are an integral part of an Indian economy and have attracted considerable amount of finance in both public and private sectors. It is the second largest unorganized sector. It is one of the few industries in which operations are discontinuous making the industry a mobile one. Construction workers are characterized by ignorance, poverty, illiteracy and poor health, lack unionization due to mobility. The major legislations exended to construction workers are The Building and other construction Workers (RECS) Act, 1996 and BOCWWC Act, 1996. Apart from this other laws like Employees Compensation Act, 1923, Payment of WagesAct, 1936, The Contract Labour Act, 1970, Minimum Wages act, 1948, Payment of Gratuity act, 1972, etc. are also applicable to them. Under the Building and other construction workers welfare Board is functioning in Odisha under the Building and other construction Workers (RECS) Act, 1996. As per the provisions of the act, cess and annual contribution are collected from the employer and construction workers respectively. The welfare Board expends its fund for the welfare of the construction workers. But in actual practice, state welfare board has failed to disburse the welfare benefits to construction workers. The centre will make an assessment of the initiatives of State Welfare Board towards the welfare of construction workers. Awareness programmes will be conducted to make the construction workers aware of various benefits available under the welfare board. The programme will also help them how to register under the welfare board to become beneficiary under it.
- **Contract Workers –** Contract Labour is a significant and growing form of employment in various types of industries. The practice of employing labour through contractors and other agencies, thus, avoiding the direct nexus between the employers and their workmen,

is very common in almost all occupations. The exploitation of contract labour is now biggest issue in the era of globalization and liberalisation. To protect and safeguard the interests of contract labourers in India, the Contract Labour (Regulation and Abolition) Act 1970 has been exclusively passed. But in actual practice it has failed to solve the purpose. As Bhubaneswar is going to be the smart city the infrastural development is going on rapidly. Considering this, the migration of labour to construction sites are matter of concern. In practice contract workers are facing problems like inadequate Remuneration, discrimination at workplace, Inadequate Social Security Provisions, Poor Working Conditions, weak labour law enforcement mechanism, etc. Thus centre will make a baseline survey to assess the existing problems encountered by contract labourers with respect to working conditions, safety and welfare provisions. Data will also be collected from contractors and principal employers. On the basis of interpretation a report will be published. Awareness programme will be conducted to make them aware of their rights.

- **Migrant Workers –** Migration in our country is the result of push and pull factors. More than 30 million people in India are seasonal Migrant Workers. Majority of them are employed in the agriculture and plantations, brick kilns, quarries, construction sites and fish processing. Most of the migrant workers are illiterate, ignorant and belong to scheduled castes, scheduled tribes and others socially, economically, weaker sections of the society. They are abused, tortured or harassed in some parts of country. In odisha, there are 11 migrant prone disticts i.e. Bolangir, Bargarh, subarnapur, Kalahandi, Nuapada, Gajapati, Ganjam, Koraput, Nabarangpur ,Rayagada and Khorda from where people are going outside states. The centre will collect the data regarding the effectiveness of the existing social security and welfare measures provided to them under various laws like Inter-state Migrant Workmen's Act, Minimum Wages act, payment of wages act. and make suggestions to the Govt. of Odisha. In addition to this focus will be made on generating awareness regarding

voluntary registrations of migrants and registration of migrant workers under OBOCWB, 1996. Skill gaps of migrant workers will identified and accordingly training programmes will be conducted to make them self-reliant.

- **Child Worker -** Child worker occupies a very high place in the agenda of the research wing.It is a step towards contributing to the on-going efforts of prevention and elimination of child labour in the country. The focus of research shall be to explore the unexplored issues and to assess the magnitude, enforcement of legislation, impact of state and non state interventions, living and working conditions, occupational health hazards, etc. relating to child labour. After identifying the child labour, the centre will conduct awareness training programmes for the parents.
- **Women Workers** – The objective of this research will be to address and strengthen the understanding of gender issues in the world of work. Women workers are mostly engaged in the informal employment as domestic workers, self-employed, casual workers, piece-rated workers, home based workers and migrants workers with poor skills, less earnings and low productivity. The majority of women's works are being concentrated in a narrow range of sectors that remain vulnerable and insecure. Further, the gender pay gap and wage differentials remain a serious concern that needs to be addressed. The research will focus on the challenges women are facing in the labour market, promotion of gender equality and empowerment of women which is fundamental for achieving the new targets of full productive employment and social inclusion to mark the goals on sustainable development.
- **Bonded Workers -** Unfortunately, despite lots of measures, India has such large numbers of bonded labourers. It is due to poor enforcement of the four-decade-old bonded labour law, its under-resourced policy and judiciary, and deep societal and economic inequities. The only way to reduce bonded labour is taking a preventive approach, by reducing the conditions that perpetuate

bondage-like conditions by promoting decent work, and by removing possible elements of bondage and coercion in the worker-employer relationship. It also involves inter-state coordination mechanisms, including workplace improvements and linking them to social security schemes.

B. Training

Imparting training will be one of the activities of the centre with the objective to develop capabilities of target groups. Imparting training will be one of the activities of the centre with the objective to develop capabilities of various target groups. It will conduct a number of Sensitisation programmes, Capacity Building programmes, Training of Trainers programmes and Awareness Generation Programmes. The training programmes will be designed to meet the training needs of different target group. Attempt shall be to make them change agents in their respective spheres. Training programmes equally emphasize on attitudinal change, skill development and enhancement of knowledge. The training programmes will use an appropriate mix of audio-visual presentation, lectures, group discussions, case studies and behavioural science techniques. Participants for these programmes are drawn from different Government Departments, Employers' Organisations, Trade Unions, Non-Governmental Organizations, Rural Workers' Organisations, parents of Child Labour, Employers, Panchayati Raj Institutions (Local Governing Bodies), Academic and Training Institutions, Research Scholars, and Students.

The centre will also conduct various in-house, state-level and national seminars on various themes with the objective of sharing knowledge and information and to decide on the modalities and course of action for dealing with specific issues relating to different categories of labour engaged in informal economy

Sensitization and awareness programmes:

- sensitization and awareness programmes will be conducted for migrants in migrant prone districts of odisha

- sensitization and awareness programmes will be conducted for construction workers in major cities of odisha
- sensitization and awareness programmes will be conducted for parents of child labour
- sensitization and awareness programmes will be conducted for reduction of bonded labour
- Awareness training regarding the provisions of Health & safety statutory norms to the employers and contractors

Skill Development Training:

- The programme aims at providing the requisite skill to make migrant workers self-reliant
- The programme aims at enhancing the skills of construction workers
- Training will be imparted for enriching the capabilities of the workers aiming at promotion of livelihood
- Training of Trainers for improving the skills of workers

Health & safety Training

- Health & safety Training for migrant workers
- Health & safety Training for construction workers
- Health & safety Training for contract workers

C. Consultancy

The centre will provide major consultancy services regarding the issues related construction workers, migrant workers, contract labour, child labour, bonded labour and women workers. The centre will be responsible for data generation, mining, analysis and compiling of issues related to above categories of unorganized workers. It would aim at providing end-to-end solution to government machineries i.e. Central and State Labour Departments, Odisha Skill Development Authority, ILO, UNDP, UNICEF. It will facilitate collaborative research with national and international institutions like State Labour Institute, V VGiri National Labour Institute, XLRI, TISS, Global Labour Unversity, Central Board for Worker Education (CBWE). Consultancy assignments include in-house training, diagnostic research and internal change programmes in informal sectors.

D. Publications

The centre will have a publishing programme for dissemination of various labour related information in general and its research findings and experiences in particular. In order to fulfill this task, the centre will bring out research reports.

The centre aims at publishing research findings in the area of unorganised workers through quarterly newsletter which would propagate the activities and attract various govt. and non-govt. agencies and corporate houses from national and international level collaborations.

The centre also proposes to publish a research Journal of Labour Studies which would capture, publish and disseminate the research findings. It would be a peer-reviewed, indexed, bi-annual, internationally acclaimed journal encouraging multidisciplinary research in Labour Studies.

The journal will include empirical, conceptual and application oriented papers. That will provide valuable input to researchers, policy-makers, consultants, academicians and students of management and other related disciplines. It would contribute towards the advancement of ideas at the local, national and global levels.

Deliverables:

The centre aims at creating its own brand value by fostering a climate of research and innovation. Further, it aims at generating a pool of database in relation to labour, employment and skill workforce for formulation of policies in the concerned area. The research centre would intend to complete the projects related to the assessment of the current status of workers engaged in unorganized sector and support the government in policy formulation. Furthermore, the centre would involve itself in continuous diagnosis of the possible bottlenecks and recommend action plans for constructive reforms and sustenance. The research publications of the centre would enrich the body of knowledge of specific domain. It would yield as a pragmatic model of industrial growth attracting all stakeholders' involvement.

Organogram

The centre will be headed by a Director (i.e. Professor) and the four wings of the centre i.e., Research, training, Consultancy and Publications will be led by respective associate coordinators who will be an academician or industry expert. They will be assisted by assistant professor and SRF, supported by research investigators, data analysts, field instructors and support staff (technical and administration). The activities of the centre would follow a value chain as the output of one wing would serve as the input of the other. The output of research wing would enrich training programs in one end and consultancy on the other end.All the wings would also strengthen the publication division. On the other hand, the training and development programs would take the support of publication wing to attract more research and consultancy to sustain the centre.

Equipment:

- Computer Desktops
- Printers, Scanners, Xerox machine etc
- Video Conferencing facilities
- LCD Projectors
- Inverter
- Gen Set
- Statistical Software facilities like SPSS, AMOS, etc.

Sustainability:

The centre will be self-sustaining one. The training wing of the centre will generate revenue from sponsored training programmes and also in form of collection of fees from the participants. Continuous networking will enable the research wing to get funded projects from the government and other agencies. User fees also will be collected by research wing from the researchers for using the internal database of the centre. More revenue will be generated from the consultancy i.e. from central & States government, Odisha Skill Development Authority, ILO, UNDP, UNICEF and other agencies. The publication wing will also contribute to generate funds through subscription fees of journal, processing and purchasing fees of articles.

Research Proposal

(***This is a part of activity of the centre to carried out within two years***)

INTRODUCTION

In recent years, labour marketing the construction industry has come under considerable public scrutiny. A host of contemporary social and economic malaises- inflation, unemployment, discrimination in employment, inadequate housing have heavily involved victim, culprit or source of opportunity. Yet social scientists are just beginning to invest the magnitude of research effort commensurate with the industry's importance. Apart from earlier work the field has received little scholarly attention owing in part to significant gap in statistical information. Over 94% of India's labour force that includes construction workers is employed in the unorganized sector, exposed to exploitation, job and wage insecurity with no legal protection. To further add to their woes, there is no appropriate addressing of quality, skills, education, employability for higher wages, safety, environment and social aspects of these workers. In addition, the long term market instability and uncertainty has negatively impacted the opportunities and prevented expansion, training and development facilities. Most of them are not registered with the Labour Commission and therefore do not have any legal entitlement, with no provisions like social security and benefits in terms of labour welfare, pension and insurance schemes, financial aids or loans for childrens' education and medical needs or even accident and death claims. The recruitment of construction workers is through a long chain of middlemen (contractors and subcontractors) or roadside recruitment (street corners/Nakas), where workers wait every morning to be picked by contractors and many of these small and medium level contractors have no capacity to upgrade. More than often, workers in the construction sector, the second biggest after agriculture, are generally treated as second-class citizens with no means to protect their dignity.

Migration is a social, economic and universal phenomenon in modern times, through which human being move from one place to other places in pursuit of certain cherished objectives like avenues of better employment, better wages, better working and living conditions, better quality of life and better

livelihood. Migration becomes objectionable only when the element of freedom in movement is replaced by coercion and all the normal hopes and expectations associated with migration are subjected to exploitation culminating in a lot of misery and deprivation of the irreducible barest minimum to which every worker as a human being and a citizen is entitled. It becomes objectionable when human greed, rapacity and aggressively selfish and acquisitive instincts over take the finer aspects of human character such as kindness, compassion and commiseration and where human being are driven to a situation characterized by the denial of human dignity decency, justice, equity. Labour migration is complex. Streams differ in duration, origin, destination and migrant characteristics. Economic and social impacts on migrants and their families are variable. Migration often involves longer working hours, poor living and working conditions, social isolation and poor access to basic amenities. At destination, migrant labour affects markets, lowering the cost of labour. Migration also affects the labour market at the place of origin. Migrant earnings affect income, expenditure patterns and investment and changes relations at household and community levels. While there seems to be some positive impact on incomes and investment, the major function of migration is to act as a 'safety valve' in poor areas. The impact on asset and income inequality is more mixed.Internal mobility is critical to the livelihoods of many people, especially tribal people, socially deprived groups and people from resource-poor areas. However, because of lack of data, migration is largely invisible and ignored by policy makers. There is a large gap between the insights from macro data and those from field studies

Thus, centre will make an attempt to study the profile and problems of construction and migrant workers in Odisha in first two years.

Problems

- Lack of awareness
- Poor working condition
- Inadequate social security and welfare measures
- Poor housing and living condition
- Inadequate wages

- Unregulated working hours
- Unregister construction workers
- Issues related health and safety
- Unsafe migration
- Sexual harassment
- Occupational diseases
- Improper enforcement of labour laws

Proposal

To make baseline survey on construction workers and migrant workers in Odisha. The survey will cover the following aspects:

Construction Workers

- To study the factors for the push to the construction works
- To understand the aspect of construction workers recruiting mechanism and entry to job market
- To understand the process of skill development through training
- To find out the regulation of govt. on social security and welfare measures and efficacy of laws & regulations
- To study the socio-economic status of construction workers

Inter-State migrant workers

- To study the profile of migrant workers
- To find of socio-economic status of migrant workers
- To explore problems and prospective of migrant workers in the source and destination areas
- To investigate the impact of migration on socio economic condition of workers in source areas
- To make awareness programmes at pachayat level for safe migration

Proposal for Setting up

GLOBAL CENTRE FOR RURAL STUDIES (GCRS)

UTKAL UNIVERSITY
Bhubaneswar

Genesis

"The Soul of India lies in its villages," Mahatma Gandhi said this by realizing the importance of villages in India. In the present day also villages and villagers are playing very important role in the economic, social and environmental paradigms of the nation. Being still in the developing and reforming processes, rural areas need emerging professionals equipped with appropriate knowledge and skill sets to meet the challenges and bring sustainable development in those places. Going beyond the traditional academic boundaries Centre of Rural Studies intends to provide theoretical and applied knowledge combined with practical field exposures to students for rural management by following an interdisciplinary approach. It will make student understand the contemporary scenario of rural areas and further motivate for research and developmental ideas generation and implementation.

In Odisha more than 85% of population is living in the villages. The incidence of poverty combined with unemployment is a serious matter in rural Odisha forcing villagers to migrate to other states as Dadan labourers. Poor infrastructure facilities particularly power and transport sectors, communication bottleneck, higher poverty rate, low per capita income, low level of capital formation, inadequate exploration of natural resources, poor progress in industrial front, insurgency and poor credit facility from bank, all these factors together make unemployment problem the biggest obstacle towards development of Odisha.

Rationale

In this context, the need for higher education in Rural Development is very much needed in this University which considered as fountains of ideas, with emphasis on thought and materialization, should take the lead in resolving the vicious cycle of less development in Odisha.

The Global Centre for Rural Studies (GCRS) under Utkal University will be set up in its new campus at Chandikhol with the assistance from RUSA-II from in the year 2018. The Various activities of the centre can broadly be of two types - Academic Research & Extension. The Centre will act as a nodal point to transform the rural resources into global products. In this

context initially the centre will be set up to cater to the needs of the local people and later on will be linked with other countries to study their developmental activities. In this context the following initiatives are suggested.

1) **New courses to be opened**
   a) MBA (Rural Management)
   b) Master Degree in Rural Development (PGDRD)
   c) Master in International Studies for Rural Areas
   d) Diploma course on Post-Harvest Management
   e) Diploma Course on Farm Management
2) **Research centres**
   a) Centre for Rural Women's Studies
   b) Rural Living Lab
   c) Centre for Study on Rural Enterprises and Entrepreneurship

3) **Extension Activities**
   a) Rural Fairs for Interaction between Rural Producers and Consumers
   b) International Seminar on Rural Management/ Studies
   c) Rural Expo

The centre will make its initial beginning in the local area i.e. Odisha, and later on will make its headway to other states of the country and finally to other countries. The centre will get the grant through Govt. funding and ultimately be linked with corporate houses for its growth and sustainability. A commercial model for the centre will be worked out later on. This centre will have some employment oriented skill development programmes for rural youth.

To enrich the quality of teaching and learning the research centres within the centre will be the focal points by making it financially sustainable through action research and evaluation studies. It will provide a link between the development agencies and Govt. in one hand and the corporate houses and the donors on the other. The Rural living lab will work to bridge

the gap between the theories taught within the four walls of the class rooms and the real life situations. It will also create opportunity for employment for the local people.

This Centre of Utkal University will transform the rural economy to a vibrant economy by energizing the rural space. **The centre will be dedicated to the nation on the "150th Birth Anniversary of Mahatma Gandhi ji, the Father of Nation."**

Proposal for Setting up

CENTRE OF EXCELLENCE IN LANGUAGE, CULTURE AND HERITAGE

UTKAL UNIVERSITY
Bhubaneswar

1. This Centre of Excellence would have three components:

(a) It would strive to engage in cultural studies of language research through translation, Polyglot Anthropology, Creative Writing and Children's Literature.

As a forum beyond strict disciplinarian limits, it aims at translating ancient manuscripts for greater intelligibility, accessibility; and to facilitate translation of knowledge texts with distinct goal of cultural exchange and exploration between the vernacular and mainstream language and literature.

(b) Research in Odia language with special focus on Natural Language Processing, Historical semantics and Textual analytics. It will also serve as a centre for preservation of tribal languages of the states.

In addition, the Centre will promote translation, digital humanities and help to equip researchers and students with localizing skills so that they move between languages and cultures with facility at the everyday level and become conduits of specialized knowledge at the higher level of scholarship.

(c) The centre will also take up Documentation of Archaeological Vestiges and Built Heritage of Odisha in the Districts of Mayurbhanj, Keonjhar, Balasore, Bhadrak, Ganjam, Gajapati, Boudh And Kandhamal.

Most of the documentation work done till date has confined itself to the district of Cuttack, Puri and the coastal region. Negligible work has been done in the tribal districts of Mayurbhanj and Keonjhar in the north and Gajapati, Kandhamal and Boudh in the southern parts of Odisha, despite their having a rich heritage in terms of art and architecture. Same is the situation in the coastal districts of Balasore, Bhadrak and Ganjam.

These regions are very rich in Buddhist, Jaina and Brahminical remains. Most of the temples are in ruins and it is in these ruins that one

can see artifacts, architectural and sculptural remains, for instance at Viratgarh, Haripurgarh, Khiching, Podasingidhi, Ayodhya, Kupari, Raibania fort, Bhusandheswara, Jaugada, lathi, Gurandi, Palur, Potagarh and many such sites.

2. Scope & Objective:

The objectives of proposed Centre of Excellence are including, but not limited to:

- To provide an institutional framework designed to heighten collaboration between the involved units and maximize the use of available resources;
- Activate localization and translation, language preservation and acquisition, besides helping to strengthen general and subject specific communicative and expressive skills in the languages under study; and
- Improving language communication among all sections of its stakeholders.
- Create a data base of archaeological / sculptural remains of these districts which does not exist.
- Focus on the fast depleting / moribund tangible heritage of these districts and preserve it for posterity.

3. Participating Departments

P.G. Department of Odia, Utkal University

P.G. Department of English, Utkal University

P.G. Department of Sanskrit, Utkal University

P.G. Department of Computer Science, Utkal University

P.G. Department of Anthropology, Utkal University

P.G. Department of AIHCA, Utkal University

P.G. Department of History, Utkal University

Proposal for Setting up

CENTRE FOR NORTH-EAST STUDIES

UTKAL UNIVERSITY
Bhubaneswar

Introduction

The North Eastern region of India comprising of eight (8) states has, over the centuries, been seen as an extraordinary mixing of different race, culture, language and religion leading to diversity, rarely seen elsewhere in India. Region's demographic diversity offers huge variety of cultural tourism opportunities. The Sangai Festival in Manipur and the Horn Bill Festival in Nagaland have already acquired a place in the global tourism circuit calendar.

Tourism has an untapped potential in the region. The region offers possibilities for tourism industry especially eco-tourism, adventure-based tourism and cultural tourism. It offers breathtaking natural beauties_ Loktak Lake, the only floating freshwater lake in the world, Tawang's snow-capped mountains and glaciers, Cherrapunjis' amazing seven sisters waterfall, are worth mentioning. With its famous hotspots of bio-diversities, the region is still largely unexplored.

North-eastern region has its uniqueness; having borders with 5 countries rubbing shoulders with the Tibetan Autonomous Region of China, Myanmar, Bangladesh, Bhutan, and Nepal. In the last one decade, there has been a great tendency to look at the region as the 'Hub' or 'Pivot' of India's Act East by becoming a gateway to ASEAN South-East Asian countries.

Due to the above stated facts, it has necessitated a thorough exploration and a rationale for stronger linkages with the rest of the country for holistic growth. Significant issues of the region which calls for concerted attention are: conflict and livelihood, ethnicity and identity, human rights, cultural practices, land and its resources, environment and climate change; North East India and its peripheral areas, traditional institutions, youth and employment, tradition and modernity, state and civil society, disaster management, etc.

Utkal University, known as the Mother University in the State of Odisha, has a distinguished status. The university with a vision and mission to create an enlightened and productive civil society and disseminate knowledge through interdisciplinary research and creative inquiry in developing a meaningful and sustainable society offered a sustainable platform for better understanding of the north east region. More

significantly, the Utkal University being situated at a strategic point in the eastern region of India, students and scholars from the north eastern states can easily access to it and indulge in a pragmatic study of the north eastern region. Moreover, the university with an enormous resource can widen the role of being a leading research and resource Centre of excellence and a cosmopolitan hub for the academic community, researchers, professionals and policy-makers on key issues of North Eastern region and its neighbourhood as well as to create a bridge between field and policy, between the North East and the rest of India.

In this connection, the role of Regional Institute of Education- a constituent unit of NCERT is immense. Since the inception of the institution in 1963 has been functioning as a "Mini India", where students and faculty from diverse background act as a resource centre catering to the educational needs of pre-service and in-service teachers of eastern Indian region.

This vision in tandem with inclusive growth and the look east policy of the Government need a collaborative effort of academicians, administrators, policy makers, civil society actors and activists interested in the region and its neighboring areas. To debate and dialogue on various challenges and prospects through workshops, seminars, lectures, research collaborations and cultural events as well as research publications while also tapping the potential for research. In this context, it is pertinent to begin with an academic body to chart a framework for setting a space at the University for Centre of North East India studies. Actualization of these objectives will pave way for achieving the aspiration of comprehensive and inclusive growth of the Nation.

Objectives:

1. To study, collect and document the tangible and intangible cultural heritage of some selected North Eastern communities including different forms of their art, craft and performing art and oral traditions, folklore, fairs and festivals, games and sports as well as works on their language and literature.

2. To examine how these tangible and intangible cultural traits have facilitated the inter-generational transfer of their heritage and supported the livelihood.

3. To explore the rich biodiversity and traditional knowledge systems, including ethnomedicine, existing in North Eastern states and through interdisciplinary mode of research take attempts to validate them.

4. To explore the sustainable travel practices that promote the conservation of protected natural areas, while also benefiting local economies, in the light of eco-tourism in North Eastern states.

Deliverables:

1. Validation of some traditional knowledge systems that can be linked to the economic, health and development needs of the community on one hand and market on the other.
2. Enabling local travel agencies in Odisha and in the North Eastern states to promote some ethno-tourist spots as tourist destinations more effectively, and to provide better service to customers.
3. Monographs/ Occasional papers, Publications of articles and books