MESSAGE FROM THE DIRECTOR

I am delighted to see the preparations for publication of the R&D Profile of the Institute, highlighting the research strength and contributions made including a brief on sponsored projects being run. It is an important document for not only the Institute but also for the industry and research laboratories to learn about the research capabilities of the Institute so that they can avail the research services of the Institute, effectively. It would also serve the prospective employers to know about the training our students have undergone. Furthermore, it will help disseminating the R&D related achievements of the Institute among the academia of the country and abroad for appraisal and it may lead to possible collaborative research. I am sure it will give the potential future faculty to understand about the R&D status of the Institute on its journey to make a mark in the global map as a unique Institution of academic excellence. This would also serve to highlight the achievements of the contributing faculty members and may also provide encouragement to promote cutting-edge, innovative and socially relevant research.

I congratulate the Dean (R&D) and his team for bringing out this document and look forward to have its updated versions in future.

Prof. R. V. Raja Kumar
Director

MESSAGE FROM THE DEAN (R&D)

It gives me immense pleasure that the R&D Profile of the Institute is finally published as a consequence of the concerted effort of the team in presenting the significant R&D related activities, achievements, facilities of different Schools of the Institute. It is a useful and handy document for the faculty and students of the Institute. It showcases the research strength and outcome of the Institute both not only the academic community of the country but also the outside world as well. The brochure will also attract potential research funding organizations as well as employers for our students. A lot has been achieved and I am sure this is just the beginning as we strive for excellence.

I wish to express my deep sense of gratitude to the faculty members and Heads of the Schools for their co-operation and my sincere thanks to Dr. S. N. Panigrahi, School of Mechanical Sciences, for making it happen.

Prof. N. K. Panda
Dean (R&D)
ABOUT THE SCHOOL
The School of Basic Sciences is a cluster of disciplines like Bioscience, Chemistry, Mathematics and Physics with faculty strength of 28, having expertise in contemporary fields of research. The School envisions to be a part of the department with high quality education and cutting edge interdisciplinary research in science. The School started its Ph.D. program in 2012; presently about 62 research students are enrolled. Further, the School has initiated a number of post-doctoral programs to motivate researchers and scientists to build their career in academics and industries. The School has two centers of excellence (CoE) - one centers focus on novel materials for energy and the other focuses on biocompatibility and engineering research.

STATE OF THE ART FACILITIES
The School has procured state-of-art equipment to pursue advanced research. In addition, advanced instrumental facilities like X-ray diffractions (XRD), Scanning Electron Microscope (SEM), Nuclear Magnetic Resonance (NMR), Physical Properties Measurement System (PPMS), sources and Detectors etc. are being created through central instrumentation facilities. Further, there are collaborations with other research institutions; notably, JETI Collaboration and Belle II collaborations in KEK, Japan and is also a member of DMU collaboration at A large hadron Collider (LHC), CERN, Geneva. The School is fully equipped with a central computing system and is fully integrated and functional for all tasks of high computing research and analysis.

UNIQUE RESEARCH CONTRIBUTIONS
Our School works on interdisciplinary research cutting across science and engineering disciplines. Topics of research include catalysis, organic activity, bio-nano interfaces, studies on G protein coupled receptor, chemistry of materials, supramolecular chemistry, theoretical and computational molecular spectroscopy. Condensed matter physics, physics of matter, high energy physics, advanced electronics and photonics materials, energy materials, fluid dynamics, graph theory to computational molecular spectroscopy. Studies on enzyme, design and development of optical devices mostly sensors. Further, labs are equipped to study the interactions of charged particles with different systems along with nano-structured formation by Ion bombardment. The condensed matter theory group studies the phase coherent transport in mesoscopic electronic systems. In the magnetic materials laboratory, we work with the materials with unconventional magnetic and electronic properties. We are also involved in the study of nano-structured materials and energy storage devices, molecular dynamic simulations, quantum transport and quantum biology. Further, labs are actively engaged in computational areas of research such as computational fluid dynamics, stochastic modeling and simulation, computational applied probability models, numerical methods, soft computing and artificial neural networks.

LAbORATORIES
There are different laboratories in the school. These are equipped with systems for development of organochromatics and catalysis, metal complexes, magnetic materials, magnetostatical correlation and bio-inspired coordination chemistry, green chemistry, synthesis of novel organic and organic-inorganic hybrid materials, G-protein coupled receptor biology, pepptide / protein design and engineering, molecular modeling, computational biology, structure-function studies of various proteins of eye lenses, memory, leukotriens and mechanism and regulation of a class of enzyme, design and development of optical devices mostly sensors. Further, labs are equipped to study the interactions of charged particles with different systems along with nano-structured formation by Ion bombardment. The condensed matter theory group studies the phase coherent transport in mesoscopic electronic systems. In the magnetic materials laboratory, we work with the materials with unconventional magnetic and electronic properties. We are also involved in the study of nano-structured materials and energy storage devices, molecular dynamic simulations, quantum transport and quantum biology. Further, labs are actively engaged in computational areas of research such as computational fluid dynamics, stochastic modeling and simulation, computational applied probability models, numerical methods, soft computing and artificial neural networks.

RESEARCH PROJECTS
The research projects going in the school are related to complex dynamics, multi-objective decision and stochastic models. There are high value projects to address next generation energy problems using different 2-D materials along with Nanofabrication Genomics and biocompatibility engineering. Further, the projects deals with indigenous sensor and accelerometer developments for different applications by rising on the advantages of guided wave optics and next generation advanced materials such as graphene and hybrid materials for bioimaging applications. Also, thermoelectric properties of Hal-Hexagonal alloys with non-trivial topological order and disorder on magneto-dielectric properties are being studied. On other hand cosmolites on the structure, dynamics and hydrogen bond properties of water in aqueous solution is in progress, along with synthesis and biological evaluation of novel PZT inhibitors as potential anti bacterial agents, studies on the synthesis of sublimic on framework of gauze-like structures. Also work is on in V transition material fractional bosonic gold nanoparticles and high-dimensional BN (x)+, magnetic grids by Polymeric Ligand. Further, synthesis of biologically active drugs and bioactive Peptide-Hexacell in the temporal resolution of CBR application in way along with role of C-terminal regions of Mycobacterium. Tuberous Isocitrate Lyase is still under progress.

UNIQUE RESEARCH CONTRIBUTION FROM PHYSICS
1. Development of energy efficient devices
2. Nano-displacement Optical fiber sensor for position monitoring and precision alignment
3. Single Layer Semiconductor and metamaterial cluster
4. Superconductivity in Topological Insulator
5. Precise measurement of CP asymmetry in a charged meson decay
6. Quantum dissipation and decoherence

UNIQUE RESEARCH CONTRIBUTION FROM CHEMISTRY
1. Higher order accurate solutions for Navier-Stokes equations and their applications
2. Radial basis function (restrained) methods for unbounded domain/flow regions
3. Bilinear optimization in complex dynamics
4. Index-range monolithicity and index-prop splitting of matrices
5. Algorithm and convergence study of mixed variational like inequality B-Branch spaces

UNIQUE RESEARCH CONTRIBUTIONS
An integrated multidisciplinary approach in understanding the complex interactions among Earth-Ocean-Atmosphere has led to the establishment of MoES AT MoU/CoE Joint Centre / Innovation Centre for Climate Change (IOCC) - Bay of Bengal Coastal Observatory to predict extreme events, Regional climate variability, variability in Indian Monsoon, Impact of aerosol on Monsoon, marine seismology, ocean acidification to name a few.

SCHOOL OF BASIC SCIENCES

| 177 | Conferences and Proceedings |
| 39 | Masters Students Enrolled at Present |
| 60 | Ph.D. Students Enrolled at Present |
| 23 | Masters Students Graduated |
| 32 | Publications |
| 01 | Patents (filed) |

SCHOOL OF EARTH, OCEAN AND CLIMATE SCIENCES

| 16 | Ph.D. Students Enrolled at Present |
| 1 | Enrolled at Present |

STATE OF THE ART FACILITIES
The laboratories are equipped with state-of-art computational and scientific instruments viz. Broadband Seismometers, Engineering Seismograph, Digital Gas Detector, Resitivity meter. Continuously Operating GPS Receiver Stations, High precision Multi-parameter ocean profiler, Biosensor and Thermoimaging microscopes, High resolution stereo zoom microscope, range of ophthalmoic and hydrometeorological instruments, High Performance Liquid Chromatography, Total Organic Carbon Analyzer, Desorbed Water Purification System, Microbalances. In addition, a number of high-end workstations are available for simulation, modeling and visualization purposes.

RESEARCH PROJECTS
The thrust areas of research include Seismic and Tsunami Hazard evaluation, Ground water management, Paleoclimatology and Paleolimnology studies of Indian monsoon, Climate change and Urbanization, Bay of Bengal Circulation and Eddies, Regional modeling, Tropical cyclones, High impact weather systems, Extreme events, Monsoon dynamics, Air-sea land interaction processes. Collaborations have been established with various national and international institutions (U.S.), 60, DST, ISRO, NCAOR, IUSSTF within India and by NERC and SMTK International are being carried out.

UNIQUE RESEARCH CONTRIBUTIONS
- Contributions in interdisciplinary approach in understanding the complex interactions among Earth-Ocean-Atmosphere has led to the establishment of MoES AT MoU/CoE Joint Centre / Innovation Centre for Climate Change (IOCC) - Bay of Bengal Coastal Observatory to predict extreme events, Regional climate variability, variability in Indian Monsoon, Impact of aerosol on Monsoon, marine seismology, ocean acidification to name a few.

ABOUT THE SCHOOL
Established in 2012 with a vision of generating highly skilled manpower in different specialized areas of Earth System Sciences. Experienced and motivated faculty members with varied specializations has been one of the strengths of the School. Currently, the specializations of these faculty members include geochimistry, hydrogeology and watershed management, active and passive source seismology and geochemistry, paleoclimatology & paleolimnology, remote sensing & GIS applications, atmospheric aerosols & climate, data assimilation & analysis, ocean circulations & modeling, mesoscale modeling and prediction of extreme weather events, Tropical cyclones, storm surges due sea interactions, Tropical waves, modeling into-tropical convergence zone, intra-seasonal variability, monsoon dynamics and climate change etc.

LABORATORIES
Within the last three years, the following laboratories have been established with state-of-the-art facilities for Geophysical and Geochimical analysis, Paleoclimatological and Paleolimnological studies, Remote Sensing & GIS, Modeling and Visualization, Weather Analysis and Forecasting and Simulation of Atmospheric and Oceanic processes. In addition, Bay of Bengal Coastal Observatory has been established in the coast line near Puri.
State of the Art Facilities

The School provides VLSI system design and fabrication lab, RTDS lab, Renewable Energy system lab, Radiating system design lab and computational facilities for application development and research. Full-fledged FPGA implementation and development facilities linked with embedded system tool and MATLAB provides a onestop platform for ambitious developers.

Research Projects

The faculty members are currently carrying out many research projects funded by government and non-government R&D organizations from India and abroad. The ongoing and completed projects are in the research areas of Grid Connected Distributed Generations – Dr. S. R. Samantaray.

Consultancy Projects

- Technical and Functional test of the customized GAGAN enabled GPS PDAs – Proposal submitted to Orissa Forest Department.
- Vetting of Electrical Part of Project – MECON India- Submitted.

Unique Research Contributions

- Performance Studies of Silicon Carbide X-Ray Detectors in High-energy Neutron-γ Gamma Radiation (FTR-Ind Environ) – Dr. V. L. N. Murty.
- Design and development of an anti-islanding protection relay for Distributed Generations – Dr. S. R. Samantaray.

School of Humanities, Social Sciences and Management

Laboratories

The School provides a Language laboratory with integrated learning system, VLSI system design and fabrication lab, RTDS lab, Renewable Energy system lab, Radiating system design lab and computational facilities for application development and research. Full-fledged FPGA implementation and development facilities linked with embedded system tool and MATLAB provides a one-stop platform for ambitious developers.

Consultancy Projects

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promotion of team spirit, and refining their curricular activities, essential for development, principles, development of creative ability to.

The academic activities of the School emphasize deep understanding of fundamental principles, development of creative ability to handle the challenges of Civil Engineering, and the analytical ability to solve problems which are interdisciplinary in nature. The School also encourages its students to engage in extra-curricular activities, essential for development, promotion of team spirit, and refining their building management skills.

### Laboratories

**Department of Civil Engineering**, School of Infrastructure presents some with eight well-equipped undergraduate and postgraduate laboratories as follows:

- Advanced Compositional Engineering
- Concrete Technology
- Environmental Engineering
- Geotechnical Engineering
- Structural Engineering
- Surveying
- Transportation Engineering
- Water Resources Engineering

All the laboratories are equipped with modern facilities to carry out state-of-the-art research works in any micro specialization of Civil Engineering.

### Research Projects

Several research projects are being carried out in each of the micro specializations of Civil Engineering. The projects that are being conducted at present, comprise both the experimental as well as simulation oriented research works. These research projects are being funded by various Govt. Organizations as well as industries such as ISRI, CSLB, HAL, BHEL, etc. Both fundamental and application oriented research projects have been undertaken by the faculty members of the School. In this connection, it is worth mentioning that tremendous efforts are being made by the faculty members of the School to bring the projects to the market and solve the recent challenges of our modern society. These projects not only solve the present challenges but also generate potential human resources in the form of JRF, SRF and research scholars in the field of Civil Engineering.

### Consultancy Projects

The School is actively providing technical support to various public and private sector units through industrial consultancy, which is turning the School into an informal research and training institute. The School is providing technical support to the Rural Works Department of the state of Odisha and Jharkhand for development of Roads under the PMSY scheme. The School has been appointed as State Technical Authority (STA) for National Rural Roads Development (NRRDA), Ministry of Rural Development, Govt. of India for technical scrutiny of PMSY proposals. School of Infrastructure, IIT Bhubaneswar is also the State Technical Authority (STA) for Rural Water Supply and Sanitization (NWSS), Govt. of Odisha. The School has already undertaken several consultancy projects of utmost importance in each of the micro specializations of Civil Engineering.

### About the School

In the area of world-class infrastructure, School of Infrastructure at IIT Bhubaneswar has come up to the mark in providing excellence in engineering education, creation of knowledge, innovation in research and leadership in professional services. The vision of the School is to offer undergraduate academic environment in its undergraduate and postgraduate teaching, doctoral program, research, and public service. Presently the School offers programs as follows:

- B.Tech., Program in Civil Engineering
- M.Tech., Program in Structural Engineering
- Transportation Engineering
- Ph.D. Programs in Civil Engineering

The academic activities of the School emphasize deep understanding of fundamental principles, development of creative ability to handle the challenges of Civil Engineering, and the analytical ability to solve problems which are interdisciplinary in nature. The School also encourages its students to engage in extra-curricular activities, essential for development, promotion of team spirit, and refining their building management skills.

### State of the Art Facilities

The Environmental Engineering Laboratory of the School are equipped with state-of-the-art equipment like GC, Fisons Oxy, Radiometer, UV-Vis, Spectrophotometer, Delta potential cell-unit, solar analyzer, etc. for various sophisticated analysis of water and wastewater.

Water Resources Engineering Laboratory is capable of various experiments and simulations related to river hydraulics. Flow through submerged and emergent vegetation. The lab is equipped with state-of-the-art equipment like laser scanning, looking Acoustic Doppler Velocimeters. Acoustic Doppler Profilers, relating rating curves with wave generator and sensors like water depth recorder, digital flow meter, etc.

Geotechnical Engineering Laboratory hosts many sophisticated instruments such as SoSf, Auto-trial setup, Calorimeter, Flexible wall permeameters, etc. for carrying out the advanced research.

Concrete and Structural Engineering laboratories have state-of-the-art equipment such as Shake table, servo controlled compression testing machines, NDT equipment, corrosion analysis, etc.

Similarly, the Transportation Engineering Laboratory has the sophisticated instrumentation like Dynamic Shear Rheometer, Replicated Low Travel Test, etc.

### Research contributions

1. **Research works on the development of an integrated zero energy modular system for the treatment of rural domestic wastewater.** The proposed hybrid system can successfully be installed in a rural domestic wastewater for nutrient removal in decentralized way. It can operate in individual housing complex and at the neighborhood level also. Also the device can operate in combination with primary treatment units. One more striking feature is that the device can operate without any energy input. Hence the energy autonomy, modular and integrated device can be envisaged as a best decentralised and sustainable option for treating domestic wastewater in order to remove nutrient and major heavy metals.

2. **Research works on the development of structural lightweight concrete using oriented fine aggregate.** In this work, we have developed a new and reliable mix design methodology for the development of structural lightweight aggregate concrete having compressive strength of 80 MPa and density was maintained well below 2000 kg/m³.

3. **Research works on the flow through emergent and submerged vegetation have resulted in the formulation of drag and lift within a vegetative array and the flow characteristics around a single submerged structure have been determined experimentally and validated numerically.**

### Research Projects

- **Numerous research projects are being carried out in each of the micro specializations of Civil Engineering.**
- **Projects that are being conducted at present, comprise both the experimental as well as simulation oriented research works.**
- **These research projects are being funded by various Govt. Organizations as well as industries such as ISRI, CSLB, HAL, BHEL, etc.**
- **Both fundamental and application oriented research projects have been undertaken by the faculty members of the School. In this connection, it is worth mentioning that tremendous efforts are being made by the faculty members of the School to bring the projects to the market and solve the recent challenges of our modern society.**

### Consultancy Projects

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The School of Minerals, Metallurgical and Materials Engineering at IIT Bhubaneswar, established in 2012, is a unique initiative where minerals, metals and materials have come into a collaborative existence with a mission to be locally relevant and globally competitive. Currently, the School is offering B.Tech. program in Metallurgical and Materials Engineering, Masters Program in Materials Science and Engineering and Ph.D. Program. The faculty members are engaged in wide range of research areas that include metal matrix composites to high entropy alloys, lithium ion batteries, solid oxide fuel cells, nanomaterials, MEMS, electronic materials and modeling of simulations of processes and materials.

The School is developing fourteen laboratories to cater to undergraduate and post graduate teaching and well as various research activities of the School and the Institute. The School is in process of creating facilities for microstructural characterization of materials. Some of them include the microscopy facilities like Field Emission Scanning Electron Microscope with EDX and EBSD, Inverted Optical microscopes with image analysis facility, Melting and heat treatment facility, Metallography facility for sample preparation, Universal Hardness Testing Machine, Electrochemical workstation and Computer workstation. Many more equipments are in pipeline for procurement.

The School has procured a Field Emission Scanning Electron Microscope with EDX and EBSD facility which is under Central Instrumentation Facility.

The School has been active in research with sponsored projects worth Rs. 1 crore being carried out. Also project proposals worth Rs. 4 crores has been submitted to various funding agencies.

The School has consultancy projects worth Rs. 50 lakhs from various agencies like Tata Steel, Department of Agriculture and Food Processing (Odisha) and Ganesh Sponge Pvt. Ltd.