

Current Refresher Courses:

1. Refresher Programme in Mathematical Sciences During ((May 16 – June 05 , 2017) [Click Here for details and Application Form](#)
2. Refresher Programme in Physics with special focus on Nano-Biotechnology During (May25th – June 14th , 2017) [Click Here for details and Application Form](#)
3. Refresher Programme in Chemistry *with a special focus on Material Chemistry* During (June 1 – June 21 , 2017) [Click Here for details and Application Form](#)

1. Introduction and Origin of Faculty Development Centre

The Faculty Development Center (FDC) at Indian Institute of Technology (ISM), Dhanbad, has been sanctioned by the Ministry of Human Resource Development Government of India, under the Scheme of Pandit Madan Mohan Malaviya National Mission on Teachers and Teaching (PMMMNTT). Faculty development has a critical role to play in promoting academic excellence and innovation. FDC will incubate and nurture, on a continuous basis, the professional development of teachers and will create opportunities for professional growth. Research Cell located within FDC will help to undertake research on different aspects for professional development of teachers. Faculty development is an essential element of institutional effectiveness. The extent to which the institution supports faculty development will be strongly reflected in levels of the engagement in learning activities, conduct of research and ultimately fulfilling the objectives and goals of the college/university/institute. Faculty development programmes include the four possible types of development: personal (interpersonal skills, career development, and life planning issues); instructional (course design and development, instructional technology); organizational (ways to improve the institutional environment to better support teaching); and professional (ways to support faculty members so that they fulfill their multiple roles of teaching, research, and service).

Faculty development is a broad range of activities that institutions use to renew or assist faculty, supervisors, preceptors, field instructors, educators, and status appointees in their roles. These activities are designed to improve an individual's knowledge and skills in teaching, education, administration, leadership and research.

The extent to which the institution/universities supports faculty development will be strongly reflected in levels of the engagement in learning activities, conduct of research and ultimately fulfilling the objectives and goals of the university/institute. Faculty who is engaged in professional development, experiences benefit also in terms of increased vitality, better informed in terms of development taking in various spheres of education and allied fields, innovations and scholarly learning. Moreover, faculty professional development contributes to the effective use of emerging technologies and establishes a firm foundation for the overall development of high quality programs and curricula.

Faculty development programmes include the four possible types of development:

- ✚ *Personal*: this includes development of interpersonal skills, career development, and life planning issues
- ✚ *Instructional*: Course design and development, instructional technology are major component of this type.
- ✚ *Organizational* type describes the ways to improve the institutional environment to better support teaching, and
- ✚ *Professional* ways to support faculty members so that they fulfill their multiple roles of teaching, research, and service.

These faculty development programs are designed so that the teachers are helped to update their subject knowledge, learn new teaching and research methods, and utilize the information technology to understand the developments in their subjects as well as other interrelated areas of study. They are also required to analyze the course contents vis-a-vis the requirements of the society. The main emphasis is on inculcation of certain teaching, research, extension and managerial skills and conceptions among the college, university and national level Institutional teachers. The teachers are made to realize their role in solving the problems of the society. They are motivated to become self-reliant and competent for shouldering the responsibilities of education in the contemporary society. So, all-in-all, faculty development has a critical role to play in promoting academic excellence and innovation.

The major part of this FDC demands the training of teachers, researchers of very young age (basically entry level) to different age group (senior level) through systematic programs starting from the entry-level (School/Colleges) to highest level (University/Institutional level) in the different areas for teaching to specialized/advanced areas of research for all-around enhanced institutional quality and innovation.

In the same pursuit, the Department of Applied Physics, Applied Chemistry and Applied Mathematics of Indian Institute of Technology (ISM), Dhanbad have very good infrastructure and sound expertise to fulfill the objectives. We have very advanced laboratories in various departments of IIT (ISM). These laboratories have several very high end, latest state-of-art sophisticated equipments/facilities. Apart from these three above mentioned Departments, there are many potential departments under the banner of IIT (ISM), whose infrastructure and expertise can also be utilized to fulfill the goals.

To fulfill the objectives of this center we also propose one **“Research Cell”** under the banner of proposed **“Faculty Development Centre (FDC)”**. This “Research Cell” under “Faculty

Development Centre (FDC)" will provide a very sound, in-depth knowledge/awareness to the teachers coming for different training programs regarding the latest research being carried out worldwide. This will motivate these teachers for doing high end research in their field of choice/liking in their own school/college/university or Institute. As we know, interdisciplinary vision is vital for the professional growth of any institution and their teachers, we believe, under available expertise of Department of Applied Physics, Applied Mathematics and Applied Chemistry of Indian Institute of Technology (ISM), Dhanbad, the proposed FDC will help the trainees to enhance their institutional quality and innovation.

Research Cell under Proposed Faculty Development Centre (FDC):

Apart from the other potential training programs, as a prime component/requirement of the center, a competitive and well established research cell should be an integral part of the faculty development center (FDC) for the professional growth of the faculty members under training. Therefore, we the Department of Applied Physics, Applied Chemistry and Applied Mathematics propose here to establish a research cell under the umbrella of FDC under our interdisciplinary expertise. The prime objective of the research cell will be to provide exposure to the faculty members in various research topics that will cover from basic to higher level research at the current stage. With respect to our interdisciplinary expertise, we further classify the research cell into three major thrust areas:

i. Material Science including Nanoscience and Nanotechnology

Materials science, also commonly known as materials science and engineering, is an interdisciplinary field which deals with the discovery and design of new materials. Though it is a relatively new scientific field that involves studying materials through the materials paradigm (synthesis, structure, properties, and performance), its intellectual origins reach back to the emerging fields of chemistry, mineralogy, and engineering. It incorporates elements of physics and chemistry and is at the forefront of nanoscience and nanotechnology research. In recent years, materials science has become more widely known as a specific field of science and engineering.

It is an important part of forensic engineering (the investigation of materials, products, structures or components that fail or do not operate or function as intended, causing personal injury or damage to property) and failure analysis, the latter being the key to understanding, for example, the cause of various aviation accidents. Many of the most pressing scientific problems that are faced

today are due to the limitations of the materials that are available and, as a result, breakthroughs in this field are likely to have a significant impact on the future of technology.

Nanotechnology ("nanotech") is the manipulation of matter on an atomic, molecular, and supramolecular scale. The earliest, widespread description of nanotechnology referred to the particular technological goal of precisely manipulating atoms and molecules for fabrication of macroscale products, also now referred to as molecular nanotechnology. A more generalized description of nanotechnology was subsequently established by the National Nanotechnology Initiative, which defines nanotechnology as the manipulation of matter with at least one dimension sized from 1 to 100 nanometers. This definition reflects the fact that quantum mechanical effects are important at this quantum-realm scale, and so the definition shifted from a particular technological goal to a research category inclusive of all types of research and technologies that deal with the special properties of matter that occur below the given size threshold. It is therefore common to see the plural form "nanotechnologies" as well as "nanoscale technologies" to refer to the broad range of research and applications whose common trait is size. Because of the variety of potential applications (including industrial and military), governments have invested billions of dollars in nanotechnology research. Until 2012, through its National Nanotechnology Initiative, the USA has invested 3.7 billion dollars, the European Union has invested 1.2 billion and Japan 750 million dollars.

Nanotechnology as defined by size is naturally very broad, including fields of science as diverse as surface science, organic chemistry, molecular biology, semiconductor physics, microfabrication, etc. The associated research and applications are equally diverse, ranging from extensions of conventional device physics to completely new approaches based upon molecular self-assembly, from developing new materials with dimensions on the nanoscale to direct control of matter on the atomic scale.

Scientists currently debate the future implications of nanotechnology. Nanotechnology may be able to create many new materials and devices with a vast range of applications, such as in medicine, electronics, biomaterials energy production, and consumer products.

Department of Applied Physics and Chemistry at Indian Institute of Technology Dhanbad are very old departments having good infrastructural facilities and highly qualified faculty members. Most of the faculty members of the department are working on the synthesis, characterization and applications of organic and inorganic materials such as transition metal mediated catalysis, nano catalysis, corrosion inhibitors, electro-catalyst, polymer nanocomposite, super capacitor, metal-organic framework, molecularly imprinted polymer, functional materials, biomaterials, hydrogels, nano gels etc.

ii. Optics, Opto-mechanics and Biomedical optics

Optics is the special branch of physics where we study the properties and behaviour of light, including light-matter interactions and ultimately the design/ construction of instruments that use it or detect it. Light plays a central role in science, technology and culture. The study of light and electromagnetism is fundamental to the evolution of essentially all modern science. Light underpins the existence of life itself through photosynthesis, and is our main messenger from investigating the large-scale universe to the infinitely small. Light-based technologies have already revolutionized medicine and opened up international communication via the Internet, and will continue to underpin the future development of human society. In addition, the phenomena of linear optics can very well extended to the field of nonlinear optics for advance studies. Nonlinear optics is one of the magical branches of Physics which has invaluable contributions towards the current research fields. Intense laser light which is the prime requirement in the field of nonlinear optics enables a large number of fascinating phenomena such as changing the color of light, ultrafast switching of light by light, or even relativistic effects. Origin of the nonlinear response in materials describe basic nonlinear optical processes such as second harmonic generation, difference frequency generation, optical parametric oscillators and phase conjugation. Lastly, Biomedical optics is the application of optical principles and design concepts to medicine and Biology for health care purposes. This includes motivation and optical imaging, image characterization, general behavior of light in biological tissue, and biological origins of absorption, fluorescence, scattering, & polarization. As we know, tremendous impact of life sciences to our modern world is a day-to-day fact now. However, to the best of our knowledge fully understood biological mechanisms rarely exist. Therefore, on the level of individual proteins and nucleic acids those are believed to be the smallest functional units in biological systems, the current biological research mainly focuses not only the identification, but also the precise physico-chemical characterization of elementary processes. To address these processes very sensitive single molecule techniques are used.

Therefore, here, we are going to educate and train the faculty members from basic to higher level research areas under this category. In addition, there will also be many hands on sessions for building and practice of research instruments for various applications.

iii. Mathematical and Computational Science

Computational science (also known as scientific computing or scientific computation) is concerned with constructing mathematical models and quantitative analysis techniques and using

computers to analyze and solve scientific problems. In practical use, it is typically the application of computer simulation and other forms of computation from numerical analysis and theoretical computer science to problems in various scientific disciplines. The field is different from theory and laboratory experiment which are the traditional forms of science and engineering. The scientific computing approach is to gain understanding, mainly through the analysis of mathematical models implemented on computers.

The Mathematical and Computational Science part of research cell is to provide faculties with a core of mathematics basic to all the mathematical sciences and an introduction to concepts and techniques of computation, optimal decision making, probabilistic modeling and statistical inference. This part is interdisciplinary in its focus, and students are required to complete course work in mathematics, computer science, statistics, and management science and engineering. A computational biology track is available for students interested in biomedical applications. The program prepares students for careers in academic, financial and government settings as well as for study in graduate or professional schools.

Learning Outcomes

The program expects undergraduate majors to be able to demonstrate the following learning outcomes. These learning outcomes are used in evaluating students and the department's undergraduate program. Students are expected to be able to demonstrate:

1. Understanding of principles and tools of statistics.
2. Command of optimization and its applications and the ability to analyze and interpret problems from various disciplines.
3. An understanding of computer applications emphasizing modern software engineering principles.
4. An understanding of multivariate calculus, linear algebra, and algebraic and geometric proofs.

The Department provides an outstanding research environment complemented by excellent teaching for its students to flourish in different arena of academics and industry as well. The thrust areas of research are

- Mechanics of Solids and Fluid
- Dynamical system and Chaos
- Algebra, Integral transform and Topology
- Sampling theory, software reliability and optimization techniques

- Graph Theory

The academic programs of the department are focused in Mathematics and Computation. Students of different post graduate programs (M. Sc. & M. Tech. in Mathematics & Computing) get opportunities to be tuned for research in Mathematical computations. This job is supported by well-equipped software laboratories. Inter-disciplinary research is one of the integral part of department. In addition to research in topics of Pure Mathematics (Algebra, Topology, Number theory, Wavelet analysis) recent topics of research includes some inter-disciplinary problems of Geophysics, Mining, Computer science, etc. Department produces number of Ph.D. students every year. About 50 students have received Ph.D. in last five years.

We strongly believe that these kinds of training will definitely help the trainees towards their professional growth and will ultimately fulfill the role of FDC in promoting academic excellence and innovation.

iv. Vision and Mission

- To inculcate among teachers, the motivations to promote institutional effectiveness through the development of personal, instructional, organizational, and professional growth of faculty.
- To promote organizational strategies for faculty development so as to incentivise teachers to grow professionally and enable the institutions to grow.
- Faculty development is expected to result in improved teaching performance and better learning outcomes for students and teachers.
- To promote new ways of thinking about the student-teacher relationship, and increased commitment to educational scholarship.
- Developing all round skills are a prominent aspect for faculty development.

v. Objectives

- Training programme will be planned for the college/university/institute teachers for his/her sensitized roles and responsibilities in their respective organizations.
- Improving the quality of teaching in colleges /universities/Institutes.
- The Faculty Development Centre will also offer a wide variety of services, as outlined below.
 - Teaching & Learning
 - Research & Creative Activity
 - Career Planning
 - Collegial Conversations

○ Communication Technology

Resources & Support

Infrastructure Development

Soon a multiple story independent/dedicated building will come up for catering all the needs of FDC. This will include, Faculty rooms, Lecture Halls/Conference Rooms, Research Cell etc equipped with state-of-art multimedia interactive facilities.

Future Upcoming Programmes and Courses

FDC-IIT (ISM) Dhanbad has already started its functioning and is going to organize series of programmes/events in near future. These programmes include:

1. **Refresher Programme** under FDC - IIT (ISM) Dhanbad in the subject area **MATHEMATICAL SCIENCES** during **16th May 2017 to 05th June 2017**. Application form can be downloaded from [here](#).
2. **Refresher Programme** under FDC - IIT (ISM) Dhanbad in the subject area **PHYSICS (Special focus on Nano-Biotechnology)** during **25th May 2017 to 14th June 2017**. Application form can be downloaded from [here](#).
3. **Refresher Programme** under FDC - IIT (ISM) Dhanbad in the subject area **CHEMISTRY** during **01st June 2017 to 21st June 2017**. Application form can be downloaded from [here](#).
4. **National Training Programme** under FDC - IIT (ISM) Dhanbad in **Fuel & Mineral Resources and Technology** during **08th May 2017 – 12th May 2017**.
5. **International Conference** on **“Recent Advances in Science and Engineering”** during **31st January 2018 to 02nd February 2018**.

The orientation and refresher programmes are opened for College/University/Institute Teachers who are in continuous service of the University/Institute. The details can be also found at IIT (ISM) website (www.iitism.ac.in).

Team Members of Faculty Development Centre, IIT (ISM) Dhanbad

Prof. A. K. Nirala, Dr. Mahendra Yadav, Dr. Prashant K. Sharma, Dr. Umakanta Tripathy, Dr. H P Nayak, Dr. P K Kewat and Dr. S A Sahu are associated with this Centre.



FDC Team Members at IIT (ISM)-Dhanbad