

## List of Courses from IIT Bombay available under Technical Education Quality Improvement Programme ( TEQIP- III)

Course Name Course Coordinator Duration of the course	About the Course
<b>Biology for Engineers</b> Prof. A Kunwar 5 days	The first part of course will be molecular biology which will bring forth the components building a cell. The second part of the course will be Physical Biology/Biophysics which shall illustrate how one can use Physics and Mathematics to understand various biological systems/phenomena. The last part shall use a few notable examples to illustrate the engineering perspective with an emphasis on applications.
<b>Laboratory and Ergonomic Safety for Engineers</b> Prof. A Kunwar 5 days	The short term course is intended to create awareness of the potential hazards and risks involved among faculty as well as laboratory staff members of engineering colleges who are involved in laboratory activities. Course Contents includes Chemical Safety, Bio Safety, Fire Safety, Laser Safety, Radiation Safety, Gas Cylinder Safety, Electrical Safety, Machine safety, Cryogenic safety and Ergonomic Safety.
<b>Computer Simulation of Complex Biological Systems</b> Prof.A Kunwar 5 days	This short term course is intended to train the faculty members of engineering colleges for molecular dynamics and Monte-carlo simulations. The course content assumes that faculty members have an exposure to Physics and Mathematics at 10+2 level. This short term course aims to cover basics of Molecular Dynamics and Monte-Carlo Simulations along with several examples of its applications.
<b>Analysis of Research Problems through Design of Experiments</b> Prof.Suhas Joshi 3 - 5 days	The course will provide a step-by-step learning of classical as well as modern designs for experimentation using Taguchi Methods followed by analysis of the results. Design of experiments, if adopted efficiently, would aid in performing experiments to the desired level of resolution thereby avoiding unnecessary investment in resources.
<b>Expo creative Design Methods and Innovation</b> Prof. Ravi Poovaiah 3 days	The course will inform the participants about the complete aspects of Design Process including Need Finding, Design Analysis, Problem Space Visualisation, Visual Affinity Mappings, Concept Diagrams, Prototyping Tools, User Testing and Feedback, Iterative Creative Concept Generation, Scenarios and Presentation Techniques. The workshop will also delve upon Design and Innovation, Information Visualisation, Product Form and Visual Elements, Designing for Products and Interactions, etc.
<b>Energy Efficiency and Management</b> Prof.Santanu Bandyopadhyay 3 days	Energy efficiency is the use of technology that requires less energy to perform the same function without compromise. The course will cover following topics: Overview of India's energy scenario; Fundamentals of energy engineering; Energy auditing; Energy economics; Energy management in thermal systems; Energy management in electrical systems.
<b>Advances in Control System</b> Prof.Ravindra Gudi 3 days	The course is planned to provide academicians and practicing engineers with the principles and techniques for better understanding of issues related to advances in control of process and manufacturing systems.

<p><b>Computational Fluid Dynamics: Development Application and Analysis</b> Prof. Atul Sharma 5 days</p>	<p>Computational Fluid Dynamics (CFD) is a methodology for computer simulation of fluid mechanics and heat transfer problems. The present course is structured for a module-by-module code-development of the two-dimensional numerical formulation; the codes are given for 2D heat conduction, advection and convection. The present subject involves learning to develop and effectively use a product -a CFD software.</p>
<p><b>Data Analytics for Process Monitoring, Soft Sensing Controller Performance Assessment</b> Prof. Ravindra Gudi 3 days</p>	<p>The course is oriented towards Data Analytics for Process Monitoring, Quality Prediction and Performance Assessment. This workshop will aim on introduction to the tools, these tools will be very useful in overall plant optimization. These methods promote operation excellence in the batch and continuous process industry through their ability to benchmark process operations with respect to performance limits and play an important role in detecting aberrant operation and initiating remedial measures so as to align the plant back along prior established superior benchmarks.</p>
<p><b>Fuels and Combustion</b> Prof. Neeraj Kumbhakarna 5 days</p>	<p>The phenomenon of combustion is ubiquitous in power producing devices such as engines and turbines. This course introduces students to various aspects of the science of combustion from an engineering point of view while covering some necessary concepts of chemistry. It will also introduce the characterization of different fuels in terms of their composition and properties, both of which affect combustion.</p>
<p><b>Optimization for Engineering System Design and Operations</b> Prof. Ravindra Gudi 3 days</p>	<p>This course will provide a tutorial introduction to the optimization based modeling tools and solution methods. It will also involve hands-on sessions on representative software platforms that showcase the technology advances in problem representation and solution methods and to provide practicing engineers with the principles and techniques for better understanding of issues related to process monitoring, performance assessment, soft sensing and control.</p>
<p><b>Innovation Entrepreneurship and Incubators</b> Prof. Milind Atrey 5 days</p>	<p>The course on offer will share with the participants, in terms of teaching of Entrepreneurship, forming a venture around an idea, as well as creating an Incubation center in the institute or university. The course will also expose the participants to the ecosystem or the enabling mechanisms on the IIT Bombay campus which motivate students to come out with innovative ideas.</p>
<p><b>Basics of Combustion and Modeling</b> Prof. S Sreedhara 3 days</p>	<p>The phenomenon of combustion plays a major role in power producing devices such as engines, turbines and furnaces. This course introduces students to various aspects of the science of combustion from an engineering point of view while covering some necessary concepts of chemistry.</p>
<p><b>Solar Photovoltaics : Fundamentals Technologies and Applications</b> Prof. Chetan S. Solanki 3 days</p>	<p>This course with the title “Solar Photovoltaics: Fundamentals, Technologies and Applications” is designed to provide introduction to various aspects of solar PV technologies. The course is designed in a manner that any engineering and science graduate without background in solar photovoltaic can attend and understand it.</p>
<p><b>3D Printing: A Disruptive Technology</b> Prof. K P Karunakaran 3 days</p>	<p>The goal in this course is to give an overview of the various RM technologies. After giving the necessary background in CAD modeling and Reverse Engineering, various popular RP processes will be discussed in detail. These will include Fused Deposition Modeling (FDM), Selective Laser Sintering (SLS), Stereo- Lithography Apparatus (SLA), 3D Printing and Laminated Object Manufacturing (LOM).</p>
<p><b>Academic Leadership Programme</b> Prof. Pooja Purang 3 days</p>	<p>This academic leadership programme will be a national level activity. The program shall focus on challenges faced by Indian institutions engaged in higher education with changing times. The main objective of the course is :To develop skills for effective leadership and Development of strategies and practices to overcoming current and future challenges in higher education</p>

<p><b>Innovative Teaching Methodology</b> Prof. Kannan Moudgalya 3 days</p>	<p>The developments in Information and Communication Technologies (ICT) have revolutionized the way education is delivered. Industry free Research has shown that use of ICT in teaching enhances student learning. This course will give an overview of ICT based teaching methods, such as flipped method and clickers based live lectures. This workshop will also cover free and open source software, such as Moodle, Scilab, LaTeX, OpenModelica and R. Scilab provides a powerful numerical computing environment for engineering and scientific applications, and is an alternative to the expensive Matlab.</p>
<p><b>Enhancing Analytical Skills in Basic Electronics</b> Prof. Mahesh Patil 5 days</p>	<p>The purpose of this workshop is to enhance analytical skills of college teachers teaching Electronics courses. Problem solving session will be conducted for the participating teachers. The problems to be covered will be related to a variety of topics in electronics courses such as RC/RL circuits in time domain, Diode circuits, network theorems, phasors, BJT amplifier, digital circuits and op-amp circuits, Bode plots. The participants will be expected to solve each problem in about 30 minutes. After successfully working out the solution, participants will simulate the concerned circuit and verify the results. In addition, some suggestions will be given to the participating teachers to make their teaching more effective in terms of explaining basic concepts.</p>
<p><b>Free and Open source software in teaching and learning</b> Prof. Kannan Moudgalya 2-3Days</p>	<p>The developments in Information and Communication Technologies (ICT) have revolutionized the way education is delivered. Industry free Research has shown that use of ICT in teaching enhances student learning. The aim of this two-day workshop is to give hands-on training to the participants on using Free and Open Source Software (FOSS) such as Scilab, OpenModelica, LaTeX and R in teaching and learning. Scilab provides a powerful numerical computing environment for engineering and scientific applications, and is an alternative to the expensive Matlab.</p>
<p><b>ICT Based Teaching Methods</b> Prof. Kannan Moudgalya 3 days</p>	<p>Information and communication technologies can be used effectively in teaching and learning. These can help improve the quality of teaching. These methods can also be used to scale: a large number of students can be trained effectively through ICT based training methods. Topics will be covered as: New educational methodologies: Moodle, LaTeX, Scilab and Open Modelica</p>
<p><b>Digital Control from Scratch</b> Prof. Kannan Moudgalya 3 days</p>	<p>Control of systems is getting extremely important for reasons of safety, and competitiveness in industry. It has a great role to play in home automation. All controllers implemented in modern times are digital. This is because digital devices are rugged, inexpensive, easy to use and noise tolerant. Most digital control courses assume a good knowledge of analog control. These courses mostly discretise the analog controllers to arrive at a digital form. At IIT Bombay, we have been teaching digital control more or less from scratch.</p>
<p><b>End to End Innovation</b> Prof. Sanjay Mahajani 5 days</p>	<p>This is a course developed to help understand the challenges of designing and implementing technology solutions, using an end to end innovation approach.</p>

<p><b>Mathematics fundamentals for engineering Teachers</b> Prof. Sachin Patwardhan 5 days</p>	<p>Applied mathematics and computations have assumed a central position in engineering research and design. In particular, it is important to teach applied mathematics with engineering flavour. As a consequence, applied mathematics has to be taught in a different approach. The aim of this course is as:</p> <p>1. Transforms &amp; their Engineering Applications: A vector space view of functions and signals, geometric interpretations of signal processing operations and signal theoretic concepts, how one can explain several linear system theoretic ideas by taking recourse to geometric interpretations, eigenfunctions of linear systems, the Fourier Transform, interpreting the frequency and time domains and duality, generalization in the form of the Laplace transform, operating in time and frequency simultaneously, time-frequency methods, multiresolution analysis and the wavelet transform, engineering applications of these ideas.</p> <p>2. Matrix Computations: In this day and age, one is more or less completely dependent on computers for everything. As far as computing is concerned, however, not everything that the computer churns out may be exact. The existence of round-off errors and overflow/underflow errors are well known but the effects of these are quite often underestimated. It is therefore rather important to understand the extent of errors that actual computation can bring into a problem. These lectures are aimed at emphasizing this gap between actual theory of linear algebra and numerical linear algebra using some examples from matrix computations.</p> <p>3. Mathematical Modelling based on Multivariate Regression: A large variety of grey-box and black-box mathematical models are used in all engineering disciplines for capturing static/dynamic behaviour or engineered systems.</p>
<p><b>Digital Signal Processing</b> Prof. V M Gadre 3 -5 days</p>	<p>The aim of this course is to introduce the basic principles and developments that have taken place in this rich and evergreen subject while providing some expertise in DSP system design.</p> <p>Main Objectives of the course(s):</p> <ol style="list-style-type: none"> <li>1. To understand the requirements for, and implications of, working with a discretized independent variable: sampling theorems; correlating the analog and discrete domain.</li> <li>2. To build up the elements of discrete system theory.</li> <li>3. To learn to specify requirements for discrete time systems and to design them.</li> <li>4. To translate these systems into realizations in hardware and software.</li> <li>5. To explore practical applications of DSP.</li> <li>6. To gain some awareness in advanced DSP concepts with an exposure to current developments.</li> <li>7. To deal with specific advanced topics in detail.</li> </ol>

<p><b>Advanced Multivariable Control</b> Prof. Sachin Patwardhan 3-5 days</p>	<p>This course introduces fundamentals of control relevant model development and adaptive predictive control of multi-variable systems.</p> <p>Introduction to Digital Control systems- sampling, model discretization, and open loop stability Development of Predictive Control Relevant Linear Time Series Models using System Identification- Output Error models, introduction to stochastic processes, development of ARX, ARMAX and Box-Jenkins models, model structure selection and issues in model development, state space realizations. Recursive on-line parameter estimation using RLS and extended least squares approaches Adaptive and Model Predictive Control: Model based future prediction, constrained optimization based MPC formulation, quadratic programming and linear programming based reformulation, adaptive predictive control formulations with on-line recursive parameter estimation, simulation studies using quadruple tank system and experimental studies using single board heater system.</p>
<p><b>Modern Biophysical Techniques</b> Prof. Ambariash Kunwar 5 days</p>	<p>The horizon of modern biosciences and bioengineering are rapidly expanding due development of various new biophysical manipulation and measurement techniques. The course is intended for faculty members of engineering colleges, engaged in teaching biology courses, who seek an introduction to modern biophysical experimental techniques. Due to the interdisciplinary nature of the course, basic knowledge of physics and mathematics is expected but strong attempts will be made to give an intuitive understanding of the mathematics and physics involved. The topics covered in this course include fluorescence microscopy, confocal microscopy, NMR spectroscopy, Fluorescence Resonance Energy Transfer (FRET), Fluorescence-activated cell sorting (FACS), optical tweezers and bio-AFM.</p>
<p><b>Expo 'Designing for Computer Interactions'</b> Prof. Ravi Poovaiah 3 days</p>	<p>Methodology and process of designing interactive products, services and events with focus on physical, cognitive and social interactions. It includes design of tangible, gestural and expressive interfaces, products that enrich user experience encompassing design of integrated systems, products for future use, products for social interactions and devices used in public spaces.</p> <p>In addition, the course will cover user studies, affinity mappings, information theory, ordering of information, methods for structuring and visualization of Information, as well as introduction to Information Architecture.</p>
<p><b>E-Mobility and Innovations in Sheet Metal Forming</b> Prof. P P Date 3- 5 days</p>	<p>Challenges of E-Mobility is demanding in terms of high power and energy density storage in batteries, fast charging, better management of heat generated and higher mileage per charge.</p> <p>Till a battery operated car reaches its peak development, and infrastructure necessary for that is developed, a hybrid engine concept is seen as an intermediate solution.</p> <p>Such a hybrid engine would have an IC engine as well as a battery drive. Hence it is absolutely essential to think of lightweighting an IC Engine. This programme focusses on current and future battery technology and hybrid engine concepts.</p>