Programme outcomes

Indian Institute of Science, Bengaluru.

Program outcomes suggested by the NBA for engineering programs

PO1.

Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2.

Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3.

Design/development of solutions:

Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4.

Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5.

Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6.

The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7.

Environment and sustainability:

Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8.

Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9.

Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10.

Communication:

Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11.

Project management and finance:

Demonstrate knowledge understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12.

Life-long learning:

Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme specific outcomes

Indian Institute of Science, Bengaluru.

Department of Computer Science and Automation, IISc

Programme: PhD (CSA)

The objective of this programme is to train students to solve substantial and novel research problems in a comprehensive as well as deep manner. Traditionally, bright students with ME/MTech degree in a relevant discipline have been admitted into this programme. Over the last decade, outstanding students with BE/BTech degree are also being admitted into the direct PhD programme. After an intensive research training programme, which reinforces fundamentals and imparts advanced training, PhD students pursue cutting-edge research in one of three streams – theory, computer systems, and intelligent systems. A typical PhD thesis results in several high-quality research publications in reputed journals and conferences. The training and research experience enables the graduates to successfully pursue academic careers or leadership roles in the industry. Many PhD graduates are successful academicians in various leading institutions and researchers in national research labs.

Programme : M Tech (Res) in CSA

The M.Tech. (Res) programme of the CSA, earlier known as M.Sc. (Engg.), trains the students to work on research and development problems in one of the following major areas – theory, computer systems, and intelligent systems – leading to peer-reviewed publications in journals and conferences. After the completion of M.Tech (Res) programme in 2-3 years, the students are well trained to pursue academic careers in research and R&D careers in industry in computer science and engineering. The programme introduces the students to research as an exciting career option and many of the graduates choose to pursue Ph D either at IISc or in reputed Institutions elsewhere, before choosing careers in academia or industrial research.

Programme: M. Tech (Computer Science and Engineering)

Description: The MTech programme in Computer Science and Engineering (CSE) is a two-year course-based programme offered by CSA department. It consists of two parts (a) course work based on core courses from 3 different pools and (b) a year-long research-oriented project. The students go through several foundational courses. Further the students are also offered elective courses from three pools (theory, systems, and intelligent systems). The students carry out cutting edge projects with a flexibility to balance between research- and application-oriented work as per their interest. The programme enables students to find opportunities for higher studies in top ranking universities abroad or find high-tech jobs in the industry.

Department of Electrical Communication Engineering, IISc

Programme: PhD (ECE)

This programme at ECE trains the students to pursue cutting-edge research in the areas of communications and networking, information and coding theory, microelectronic devices and circuits, microwave antennas and RF circuits, optical communications, machine learning, and signal processing. The training and research experience enables the graduates to successfully pursue academic careers or leadership roles in the industry. Many alumni are faculty members at leading institutions or researchers in reputed national research laboratories.

Programme : M Tech (Res) in ECE

The M.Tech. (Res) programme of the ECE, earlier known as M.Sc. (Engg.), trains the students to work on R&D problems in communications and networking, information and coding theory, microelectronic devices and circuits, microwave antennas and RF circuits, optical communications, machine learning, or signal processing. After the completion of M.Tech (Res) programme in 2-3 years, the students are well poised either to pursue academic careers in research or R&D careers in hi-tech industry. Several graduating students are likely to have contributed to further knowledge in their domains through high impact conference and journal publications.

Programme: M. Tech (Communication and Networking)

The MTech programme in Communication and Networking is a flagship two-year graduate programme offered by the ECE department. It consists of two parts: (a) solid foundational training consisting of coursework on topics such as digital communications and a host of advanced and cutting-edge topics such as communications and networking, information and coding theory, microelectronics devices and circuits, microwave antennas and RF circuits, optical communications, machine learning, and signal processing; followed by (b) a one-year research-oriented project. Graduating students are well-trained to pursue technology-development roles in the high-tech industry or pursue higher studies at any leading higher education institute in the world.

Programme: M. Tech (Microelectronics and VLSI) (ECE and ESE)

The MTech Microelectronics and VLSI Design programme is a two-year degree programme jointly offered by the ECE and ESE departments in the EECS division. The programme consists of coursework and a year-long research project, with the coursework offering a comprehensive exposure to electronic devices and VLSI/ circuits areas. Graduating students often pursue chip design, fabrication, and/or device characterisation roles in the high-tech industry or higher studies.

Programme: M. Tech (Online)

The programme is designed for early-career professionals (with 2-10 years of experience) to strengthen their fundamentals and expose them to cutting-edge topics in the fast-changing areas of communications, networks, signal processing and information sciences, and high-frequency circuits and systems. The coursework contains core courses, which provide the necessary foundation, and several elective courses, which provide exposure to the state-of-the-art and advanced material. These learnings are coupled with a semester-long capstone project that enables the student to apply the knowledge gained to a project relevant to the industry. The courses are taught online by faculty from the Department of ECE.

Department of Electrical Engineering, IISc

Programme: PhD (Electrical Engineering)

The PhD (Electrical Engineering) programme is one of the oldest doctoral programmes in electrical engineering in the country. Traditionally bright students with ME/MTech degree in a relevant discipline have been admitted into this programme. Over the last decade, outstanding students with BE/BTech degree are also being admitted into the direct PhD programme. After an intensive research training programme, which aims at reinforcing the fundamentals and imparting advanced training, PhD students get opportunities to pursue cutting-edge research on interesting topics and develop new technologies. The present areas of research include electromagnetism, electric machines, high voltage engineering, power systems, power electronics, renewable energy, digital signal processing, speech processing, image processing, computer vision, medical imaging, control systems, machine learning, auditory neuroscience, language technology, and artificial intelligence. A typical PhD thesis results in several high-quality research publications in reputed journals and conferences. There has also been an increasing trend of patents being filed out of PhD theses. The training and research experience enables the graduates to successfully lead R&D teams in the industry. Many PhD graduates are successful academicians in various leading institutions and researchers in national research labs. A few past PhD graduates are successful entrepreneurs as well.

Programme : M Tech (Res)

The M.Tech. (Res) programme of the Electrical Engineering at the Indian Institute of Science, earlier known as M.Sc. (Engg.) was started as a Masters programme by research in early 1970s. It trains the students to work on research and development problems in one of the following major engineering areas: power systems, high voltage, power electronics, signal processing, image processing, computer vision, medical imaging, control systems, machine learning and machine vision to develop innovative techniques and technologies, leading to publications in reputed, refereed journals and potentials for new products or enhancement of current engineering systems. After the completion of M.Tech (Res) programme in 2-3 years, the students are well trained to pursue academic careers in research and R&D careers in industry in the areas of electrical engineering. The programme introduces the students to research as an exciting career option and many of the graduates choose to pursue Ph D either at IISc or in reputed Institutions in USA or Europe, before choosing careers in academia or industrial research.

Programme: M. Tech (Artificial Intelligence) (offered by CSA, ECE, EE, and ESE)

Description: Artificial Intelligence (AI) refers to our ambitious goal of understanding and reproducing human cognition. AI today outperforms humans in games like Chess and Go, enables translation at scale, and enables object recognition and tracking at scale. We anticipate that AI will further help us provide better transportation, better and personalised delivery of healthcare, better control of processes that affect our environment, better delivery of citizen services, and in general enablement of data-driven and informed decision making. With many countries taking big strides in the domain, we foresaw a need for AI capacity building in India so that we can become an intellectual force in this emerging domain. The M.Tech. (AI) programme was created to address this need in 2019-20.

A variety of fields have to come together to help us make progress in this field – computer science, signal processing, information theory, system theory, cognitive science, learning theory and epistemology, mathematics, statistics, game theory, optimisation, algorithms, etc. The application domains pull the field in various directions, and this is as it should be. But the countless approaches call to attention the immediate need for a systematic study of this field. The M.Tech. (AI) programme at IISc has been designed to impart training to systematise the study. It deals with both the foundations and the technologies that drive AI. Further, it has been designed with the requirement that AI should not be an end in itself, but rather a driving force for transformative applications. The development of the tools of AI must be guided by the very applications it will impact – healthcare, transportation and mobility, education, environment, etc.

In keeping with the above aims, the two-year M.Tech. (AI) programme has been designed to impart rigorous training in Foundations and Tools, Algorithms and Techniques, Architecture and Computing Platforms, and Transformative Applications. The core courses are particularly designed to provide a solid foundation in data structures and algorithms, stochastic modeling, analysis of linear and non-linear systems, and numerical optimization. A year-long project work leading to a thesis allows the student to specialize in one or more fields, such as signal processing, computer vision, machine learning and artificial intelligence, control systems, game theory, and communication networks. Graduates are placed in top international and national companies and some of them are faculty in leading academic institutions across the globe.

Programme: M.Tech (Electrical Engineering)

The two-year Master of Technology degree program in Electrical Engineering (EE) imparts specialized training in classical as well as modern topics in the broad field of power electronics and drives, power systems and high voltage engineering, eventually enabling graduates to analyze, design, operate and integrate electrical systems. A hallmark of this program is to allow students to choose courses from any of the above fields, while prescribing a small set of compulsory ones. Advisors help students to choose courses to strengthen their skill-sets with the project (12-month) work in mind. Our graduates occupy top positions in industry and academia, both in India and abroad. A small percentage of the graduates (10 to 20%) also choose to pursue higher studies, leading to a doctoral degree.

Programme: M.Tech (Signal Processing) (offered by ECE and EE)

The M. Tech program in Signal Processing at the Indian Institute of Science has been designed to train the students in mathematical foundations and computational tools necessary to design systems required for acquisition, storage and retrieval of information from signals encountered in communication, medical technologies, biometrics, and many other scientific and industrial applications. The students go through several foundational courses such as matrix and linear algebra, computational optimization, random process and so on. Further the students are also offered with elective courses ranging from advanced image processing to machine learning. The students carry out cutting edge projects with a flexibility to balance between research- and application-oriented work as per their interest. The program enables the students to find opportunities for higher studies in top ranking universities abroad, and to find jobs in companies such as General Electric, Philips, Siemens, Analog Devices and so on.

Electronic Systems Engineering

Research programme: PhD and M. Tech (Research)

From Atoms to Systems: Research activities in the Department of Electronic Systems Engineering span the whole range, from nanoscale devices to Internet-scale communication networks. Core research areas include: Nanoelectronics and Power Semiconductor Devices, Signal and Quantum information Processing, Very Large-Scale Integration (VLSI), Neuromorphic Computing, Biomedical Electronics, Internet of Things and Embedded Systems, Power Electronic Drives, Renewable Energy and Energy Harvesting, Mechatronics and Healthcare Instrumentation, and Communication Networks.

The overall objective of the PhD and M. Tech (Research) programmes is to produce very well-trained researchers who are ready to embark on their individual careers. To realize this goal, a three-fold approach is followed:

- Course-based learning: Students get well-grounded in the fundamentals of their work areas by attending the very high-quality courses available in the Institute; both depth and breadth are emphasized
- Acquiring extensive knowledge of the literature: Through regular reading of published literature, group meetings and interactions with speakers in conferences, symposia and workshops, students develop awareness of frontier research areas and cutting-edge problems
- Developing research aptitude through continuous interaction with supervisor(s): Students acquire invaluable research skills through sustained and close interaction with supervisors.

M. Tech (ESE)

The M. Tech programme at the Department of Electronic Systems Engineering is oriented towards system-building with an emphasis on hardware. Students take courses in foundational subjects like digital and analog system design, digital and analog chip design, power electronics, electronic system packaging as well as mathematics. Each course has a prominent lab component, offering hands-on training and exercises on numerous practical aspects of crucial importance. Based on many years of feedback from industry professionals as well as academics, graduating M. Tech students are extremely well-trained in system-building. They are in great demand from the industry, and invariably, are among the first to be placed during campus interviews.

Department of Civil Engineering, IISc

Ph D program: The program provides rigorous research training to doctoral students in contemporary areas of Civil Engineering and allied disciplines. The approach for solving research problems by students span, analytical, computational, experimental techniques and often straddle multiple approaches. The students graduating from this program aim for career in academia, research labs, industries related to civil, mechanical, and aerospace engineering.

M Tech (Res.): This is a graduate program focused on research in contemporary areas of Civil Engineering and allied disciplines. Students of this Master's program credit few courses and devote majority of their stay in producing a thesis which is the mandatory documentary output of this program. The students are trained to prepare for research career in doctoral programs, though students tend to branch out to industry as well.

M Tech (Civil Engineering) This is the main course-based Master's program of the Department. The programme is the outcome of a merger of two erstwhile streams, one in Civil Engineering and another in Transportation and Infrastructure Engineering. The curriculum emphasizes on rigorous training of students in key civil engineering disciplines through the courses it offers. Students Major in one of the chosen areas namely, Geotechnical Engineering, Structural Engineering, Water Resources and Environmental Engineering, Transportation Engineering. Students also have the option to do Minor in one of the above areas. Students do dissertation project in their chosen Major area. The program is designed to give students the flexibility to choose between further journey into either industry or academia.

Department of Aerospace Engineering, IISc

Program: Ph.D. in Aerospace Engineering

Department of Aerospace Engineering at IISc is the first University in India to start a Ph.D Program way back in 1950's. The department has four verticals, namely Aerospace Structures, Aerodynamics, Guidance, Navigation and Control and Aerospace Propulsion, and the department admits students with degrees in practically all fields. The candidate, is selected in any one of the four verticals and he/she pursues research in the selected vertical, while simultaneously acquiring the basic knowledge in other verticals through courses and comprehensive examination. The candidate has to take a minimum of 12 credits of courses and has to pass a comprehensive examination at the end of 2 years after joining the program. The Programme helps in developing the intellectual capability of the student and help in getting necessary experience in performing cutting-edge research in his chosen vertical. After completion of this programme, the student is well poised to pursue a career in academia and industry in the broad aspects of aerospace engineering.

Program: M.Tech (Res) in Aerospace Engineering

This is a Master's Programme by Research and the candidate is admitted to any one of the four verticals, namely Aerospace Structures, Aerodynamics, Guidance, Navigation and Control and Aerospace Propulsion. As a part of the programme, the candidate has to complete 24 credits of courses and a thesis in the chosen vertical. This Programme will introduce the candidate to research, thinking skills and experience in conducting cutting- edge research in his chosen vertical and prepares him/her to undertake Ph.D Program. At the end of the programme, the student is well poised to pursue a career in academia and industry in the broad aspects of aerospace engineering.

Program: M.Tech In Aerospace Engineering

This is a 2-year course based Master's Program in Aerospace Engineering. The Programme aims to prepare the student to pursue careers in Industry and at the same time, the broad spectrum of courses the department offers in all the four verticals of the department, namely the Aerospace Structures, the Aerodynamics, the Guidance, Navigation and Control and the Aerospace Propulsion, prepares solid ground for the student to purse Ph.D. Program. In the first two semesters, the student will take all the basic courses in Aerospace engineering and at the end of first year, he/she will choose the thesis advisor depending upon the vertical he/she wishes to purse the M.Tech thesis dissertation. The candidate has to complete 64 credits out of which 19 credits is allocated for the Master's thesis dissertation and the rest 45 credits is distributed among core courses and electives.

Department of Chemical Engineering, IISc

Master of Technology, M.Tech

The M.Tech program is a two-year course based program designed to prepare students to address complex industrial and technological problems through an advanced knowledge and exposure to modern ideas and techniques in chemical engineering. The program is designed to give students a strong foundation in basic chemical engineering subjects during the first year followed by a year of project work in a chosen area of interest. Courses range from core subjects, such as transport phenomenon, thermodynamics, mathematics and reaction engineering to a range of elective courses related to nanotechnology, bioengineering, statistical mechanics and molecular simulations, interfacial phenomenon, polymers and complex fluids to name a few. Students are also encouraged to pursue a summer internship in an industrial RandD laboratory at the end of the first year. Majority of our MTech students are placed in national and multinational industries, RandD laboratories in areas ranging from pharmaceuticals, process engineering and design, polymers, fast moving consumer goods (FMCG), and petrochemicals. Several students pursue a PhD program either in India or overseas.

Master of Technology Research, M.Tech (Res)

The Master of Technology (Res) program is a research based program designed to prepare students for advanced chemical engineering practice through research, development, production, design and/or management. A bachelor's degree in engineering or a master's degree in sciences with mathematics as a subject at the bachelors level (at least) is required to enter the program. The emphasis is primarily on independent research which is conducted over a 2 year duration followed by a thesis defense. Majority of our MTech (Res) students are placed in national and multinational industries, R&D laboratories or continue for higher studies

Doctor of Philosophy, PhD

The Doctor of Philosophy program is designed to prepare each student to actively participate in the development and growth of the field of chemical engineering at all levels in the industry or in research and teaching in a university or a research organization. Students can enter the PhD program either with a master's or a bachelor's degree in engineering and select their research areas at the end of the first semester. Research is carried out in a wide range of modern chemical engineering areas ranging from nanotechnology, bioengineering, energy and sustainability, transport and reaction engineering. Students are exposed to advanced experimental and theoretical techniques, attend national and international conferences as well as workshops and specialised schools during the program. Several research areas are interdisciplinary in nature and others are funded by industry, giving students a flavour for both applied and basic research. Students with a PhD degree either pursue a post-doctoral position aiming for an academic career or find employment in industrial R&D laboratories.

Centre for Product Design and Manufacturing

Programme: PhD in Product Design and Engineering

The research programme at CPDM (MTech by Research and PhD) in Product Design and Engineering is carried out in a variety of areas in advanced design and engineering, including ideation, PLM, medical diagnostics, human factors, product and process informatics, virtual/augmented reality, engineering safety and sustainability. Major thrust of research at CPDM is developing knowledge-intensive and testable tools for supporting development of complex products and systems. Outcomes include the world's most advanced Digital Human Models, a biomimetic tool called Idea-Inspire that pioneered systematic bio-inspired ideation, and lightweight 3D compression systems for fast transfer of complex geometric models across the internet. Research from CPDM directly impacts practice: it enables product developers and manufacturers tackle challenges more efficiently, and stretches the boundaries of what can be tackled.

Programme: M.Des in Product Design and Engineering

Started in 1996, the Master of Design (MDes) programme is a two-year full-time graduate programme that aims to impart education in design and development of new products that are innovative and competitive. The programme aims at developing skills, knowledge and aptitude among students so that they can, through creative problem solving, bring about innovation in product design and manufacturing industry. The students are trained to approach product design from a holistic viewpoint, integrating in a balanced and harmonious manner industrial design and engineering design perspectives, to develop products that are well-engineered, aesthetic, usable and sustainable, with enhanced feasibility.

Programme: M.Tech in Smart Manufacturing

Started in 2019, the Master of Technology (MTech) programme is a two-year full-time graduate programme that aims to impart education in smart manufacturing and development of new manufacturing systems that are innovative and competitive. The programme aims at developing skills, knowledge and aptitude among students so that they can have a 360 degree view of manufacturing as "physical production at the centre of a wider manufacturing value chain" where "highly agile, networked enterprises use information and analytics as skillfully as they employ talent and machinery to deliver products and services to diverse global markets". The course is intended to create future leaders in manufacturing who not only master the state of the art in current design, manufacturing, technology, management and business aspects in the area of smart manufacturing, but also can usher in manufacturing innovation in these through creative problem solving and integration of deep technology from diverse, multiple disciplines.

Department of Management Studies

Programme: Master of Management

Technology based R&D intensive industries need executives with exposure and training in Management and Business Analytics. Formal education in analytics will strengthen the capability of these executives to perform robust analyses to make decisions in information and data driven organizations. It is to meet this need in the high-tech industries of India that our Masters Program will focus on training the students in Business Analytics. It is year program targeting engineering graduates. The students get trained in both the functional areas of management and business analytics. Courses in the functional areas of management includes Finance & Accounts, Marketing Management, Operations Management and Human Resource Management. The students do courses in Probability & Statistics, Operations Research, Data Mining, Time series analysis to get trained in Business Analytics. Further all the students do an intensive industry sponsored project in their last semester. Our students get placed in national and multinational industries on completion of the program.

Programme: PhD

The research program trains the next generation of scholars to pursue research questions with sophisticated skills and insights through an intensive, methodologically-based curriculum. Understanding and solving problems of public policy, management and IT demands a program that integrates disciplinary perspectives, advances theoretical models, and improves the quality of methodological and computer-based tools.

Interdisciplinary programmes

Programme: Interdisciplinary PhD in Water Research

The PhD program offered by the Interdisciplinary Centre for Water Research (ICWaR) provides an opportunity for the students to work on interdisciplinary topics related to water, under the joint supervision of faculty from two or more departments/centres in IISc. With the current faculty associated with the Centre, the PhD students have an opportunity to carry out research on contemporary topics such as Urban water systems; Urban hydrology/ hydrogeology, Watershed and river basin hydrology, Prediction and assessment of environmental extremes (Floods and droughts), water management, Agro hydrology, Satellite hydrology, Wetland science, Land-atmosphere interactions, Lake ecosystems, Aquatic geochemistry, Geothermal reservoir modelling, Global water cycle and impacts of climate change, Isotope hydrology, Applications of sensor and satellite technologies and Water and wastewater treatment.

Programme: PhD in ICER

The interdisciplinary PhD programme of the Interdisciplinary Centre for Energy Research (ICER) at the Indian Institute of Science, started in 2012, aims to train students in energy. Various areas of energy are being pursued in the department such as biofuels, combustion, concentrated solar power (CSP), next generation solar photovoltaic (PV), high storage density battery, green buildings, sustainable technologies and climate change issues have been undertaken. Advised by two faculty members with complementary expertise, the students in this programme acquire knowledge, critical thinking skills, and experience in conducting cutting-edge research. After completion of this programme, the students are well poised to pursue careers in academia and industry in the areas of energy science and technology.

Department of Bioengineering

Programme: PhD in Bioengineering

The interdisciplinary PhD programme at the Indian Institute of Science, started in 2012, aims to train students in bioengineering wherein engineering principles could be used to probe biological questions or to develop biomedical techniques, devices, and systems that require substantive expertise in biology, engineering, and clinical research components. Advised by two faculty members with complementary expertise or by those who are themselves experts in the interdisciplinary area of bioengineering, the students in this programme acquire knowledge, critical thinking skills, and experience in conducting cutting-edge research. After completion of this programme, the students are well poised to pursue careers in academia and industry in the areas of bioscience, bioengineering, and biotechnology.

Programme: MTech in Bioengineering

The tremendous advances in the recent years in our ability to observe, understand, and manipulate biological systems have spawned the promising and fast-growing discipline of Bioengineering. We are poised to see major contributions from the discipline, impacting global efforts to address the key challenges our society faces, from food and energy security to healthcare and environmental preservation. The M. Tech. program in Bioengineering is envisioned to produce highly trained professionals who can occupy the centre-stage in catalysing these transformations.

Recognizing the diversity of pursuits in Bioengineering, the program offers core courses that are central to Bioengineering, and a set of specializations representing key modern divisions in the field. The program envisions strong connects with the industry. The curriculum has been designed with inputs and feedback from industry stakeholders. Throughout the program, participation of colleagues from the industry is planned.

In addition, the students in the program will be part of the highly engaging and cutting-edge research environment in IISc, preparing them for doctoral studies and careers in research, should they choose that path.

Centre for Ecological Sciences

Programme: PhD

The CES PhD programme is centered around empirical laboratory and field studies with theoretical and computational explorations aimed at addressing fundamental issues in ecology, evolution, animal behaviour and climate change. Graduate students have the freedom of using a multitude of techniques and approaches ranging from molecular biology to sophisticated computational methods to address scientific questions in broad areas of ecology. The biological sciences building where we are housed fosters interactions with other laboratories in neighboring departments within the institute. In addition, students are encouraged to interact with ecology laboratories in nearby research institutions in Bangalore, thus promoting collaborative and interdisciplinary scientific inquiry.

Centre for Atmospheric and Oceanic Sciences

Programme: MTech in Earth and Climate Science

This is a new two-year program (starting in 2023) being offered jointly by CAOS and the Centre for Earth Sciences (CEaS). The program is designed for students with a Bachelor's degree from any branch of Engineering, or Master of Science in the Physical Sciences. It consists of course work for the first year and a project. The program aims to provide a sound foundation in the theory of the earth-atmosphere-ocean-climate system, and to develop skills in computational, data analysis and observational techniques. Alumni of the M.Tech. program from CAOS (in Climate Science, from 2009-2022) have gone on to pursue doctoral studies at CAOS and various universities in the US, UK and the European Union. In addition, students have been successfully placed in private companies such as Risk Management Services (RMS), Swiss Re and ReConnect, etc.

Mechanical Engineering

Programme: MTech in Mobility Engineering

The program is anchored in Mechanical Engineering, with faculty from Electrical Engineering, Department of Electronic Systems Engineering, Robert Bosch Centre for Cyber Physical Systems, Centre for Product Design and Manufacturing, Aerospace Engineering, CiSTUP, Civil Engineering playing an active role in the program.

The development of hybrid/electric and autonomous vehicles is rapidly changing the automotive industry and IISc's MTech program in Mobility Engineering will prepare engineers to face the industry's major transformation and the challenges that lie ahead. This new program will train engineers to develop sustainable, high-performance mobility solutions and handle challenges within electrification, automation, simulation and the reliability of vehicles. It will meet the automobile industry's demand for engineers who have skills in subjects like hybrid powertrains, mechatronics, functional safety, and optimisation.

Overall, this is a unique program in the country in the field of Mobility Engineering as it covers not only Electric Vehicles, but also Hybrid Vehicles, Autonomous systems and Advanced Driver Assistance System (ADAS) technologies.

Department of Mathematics, IISc

The PhD program -- The Department of Mathematics offers excellent opportunities for research in both pure and applied mathematics to its PhD students. They may choose from a wide variety of topics: Algebra and Number Theory, Analysis, Differential equations and Numerical analysis, Discrete mathematics, Geometry and Topology, Probability and its applications. The students after completing the PhD program, depending on their choice of the research area, are well prepared for a variety of jobs both in the industry and in academic institutions all over the world.

The Integrated PhD program -- The Department of Mathematics, through its Integrated Ph.D. programme, offers exciting opportunities to talented students holding a Bachelor's degree for acquiring a rigorous and modern education in mathematics, and for pursuing research in both pure and applied mathematics. Thus, at the end of this program, the students are well prepared for a variety of jobs both in the industry and in academic.

Programme: B.Tech in Mathematics and Computing

The BTech program in Mathematics and Computing is aimed at producing leaders who will be at the forefront of research, development, and innovation in futuristic disciplines and next generation technologies that require deep use of mathematics, computer science, and data science.

- Immense value to be unlocked by providing a strong foundation in Mathematics, Computation and Data Science at the UG level.
- Significant impact in both academia and industry.
- Interdisciplinary program by leveraging the unmatched expertise available across the institute.
- Opportunities for various specializations and diverse projects.

Outcomes of the Interdisciplinary PhD Program in Cyber Physical Systems

About the PhD program

The Robert Bosch Centre for Cyber Physical Systems at IISc runs a PhD program in Cyber Physical Systems. Research in this area encompasses sensor & actuator technology, Signal processing & Communication, Modeling & Analytics, Control & Optimization Algorithms, and associated Systems engineering. Research in this area is naturally inter-disciplinary and involves foundational expertise from various other departments. Expected Outcomes for the PhD students

Skills Training Outcomes

Appendix B lists a broad list of courses from which the students take between 12 to 21 credits as part of their Research Training Program. Students get exposed to a mix of theoretical as well as practical courses. The expected outcome at the end of the course program is that the students acquire the necessary theoretical tools (from one or more of Signal Processing, Communications, Machine Learning, Modeling, Controls, Applied Mathematics, Applied Statistics) as well a practical tool (programming, simulations, electronics) to undertake their research in Cyber Physical Systems.

Research Training Outcomes

The research problems in this program will be inter-disciplinary in character. Hence the students will get expertise in understanding, formulating, and solving new and cutting-edge problems at the intersection of electrical sciences with other engineering sciences.

Research Outcomes

The research program will address problems of societal and industrial interests in themes like Autonomous Navigation, Smart Transportation Systems, Swarm Robotics, Self-Learning Robotics etc. New knowledge will be produced and disseminated in high quality, peer reviewed publications, technical reports, and PhD theses.

Capacity Outcomes

We expect to produce about 10 PhD students a year and these will take up both academic as well as industrial R&D Positions after they graduate.

Materials Engineering

Programme: PhD in Materials Engineering

The PhD programme of the Department of Materials Engineering trains students to become independent researchers in various subfields of materials engineering. Students in this program perform in-depth studies (experimental, computational, and / or theoretical) of diffusion phenomena, phase transformations, stress and electric field effects in materials and mechanical behaviour, primary and secondary processing of materials, as well as of novel materials such as biomaterials, organic photovoltaics, ferroelectrics and multiferroics, and polymer nanocomposites. The students acquire deep knowledge and strong expertise to enable them to pursue careers in scientific and industrial R&D laboratories, as well as in academic institutions.

Programme: MTech (Research) in Materials Engineering

The MTech (Research) programme of the Department of Materials Engineering trains students in advanced topics in materials engineering. After finishing the coursework component, they are also trained in research (experimental, computational, and / or theoretical) in diffusion phenomena, phase transformations, stress and electric field effects in materials and mechanical behaviour, primary and secondary processing of materials, as well as in synthesis and properties novel materials such as biomaterials, organic photovoltaics, ferroelectrics and multiferroics, and polymer nanocomposites. The students acquire advanced knowledge and training to pursue careers in scientific and industrial R&D laboratories; many also go on to pursue a PhD in leading institutions in India and abroad.

Programme: MTech in Materials Engineering

The MTech programme of the Department of Materials Engineering trains students in advanced topics in materials engineering. After finishing 32 credits of courses, they also undertake a research project (experimental, computational, and / or theoretical) in diffusion phenomena, phase transformations, stress and electric field effects in materials and mechanical behaviour, primary and secondary processing of materials, as well as in synthesis and properties novel materials such as biomaterials, organic photovoltaics, ferroelectrics and multiferroics, and polymer nanocomposites. The students acquire advanced knowledge and training to pursue careers in scientific and industrial R&D laboratories; many also go on to pursue a PhD in leading institutions in India and abroad.

Physics

Programme: Integrated PhD in Physics

The integrated PhD programme of the Department of Physics at the Indian Institute of Science aims to attract students with a bachelor's degree into a research career in physics. Starting with a two-year course work in fundamental and advanced areas of physics, students complete a research project equivalent to a master's degree by research before embarking on a PhD thesis problem supervised by a faculty member with expertise in the relevant area. The thesis work can be experimental or theoretical in nature with a specialisation in astrophysics, condensed matter physics, soft matter physics, biophysics, or atomic physics. During the programme, students build a strong foundation in the fundamental principles ofphysics as well as acquire mastery over specific domain areas which enables them to carry out state-of-the-art research. After completion of this programme, the students are awarded the PhD degree in addition to a master's degree and are well trained to pursue teaching and research careers in academia or industry.

Programme: PhD in Physics

The PhD programme of the Department of Physics at the Indian Institute of Science aims to attract students with a master's degree into aresearch career in physics. Students admitted to this program complete a set of advanced courses in their area of interest before embarking on a PhD thesis problem supervised by a faculty member with expertise in the relevant area. The thesis work can be experimental or theoretical in nature with a specialisation in astrophysics, condensed matter physics, soft matter physics, biophysics, or atomic physics. During the course of the programme, students acquire mastery over specific domain areas which enables them to carry out state-of-the-art research. After completion of this programme, the students are awarded the PhD degree and are well trained to pursue teaching and research careers in academia or industry.

Centre for Nano science and Engineering

M. Tech. Degree:

Starting from 2014, CeNSE has initiated a two-year MTech degree program in Nano Science and Engineering. The course work prepares the students by providing training in interdisciplinary areas such as Solid-state physics, Nanomaterials, Nanoelectronics, MEMS and NEMS, Nanophotonics, Biosensors, Micro/Nano fluidics, with hands-on experiments on Nanofabrication and Nano Characterization techniques. The project constitutes a substantial portion of the MTech program and excellent performance in the project is essential to achieve a good academic record in the program as well as to secure a promising career in industry or academia. In addition, the MTech program is also unique in its emphasis of entrepreneurship and social impact of technology in its curriculum.

M. Tech. Degree (Semiconductor Technology):

CeNSE is launching M. Tech in Semiconductor Technology from the Academic year 2023-24 (Aug'23) with optional minors in the thematic areas of Nanoelectronics, Nano-bio, Photonics, Micro-systems & Packaging, Quantum Technology (in collaboration with Indian Quantum Science Initiative) and Materials (in collaboration with Department of Materials Engineering). The objective is to cater to the fast-growing semiconductor ecosystem in the country in particular and in the world in general while retaining the multi-disciplinary flavor of the erstwhile M. Tech program in Nano Science & Engineering. The program is designed be attractive to students from multiple streams & backgrounds while at the same time aligning with the current industrial relevance of semiconductor technology vis-a-vis the demand for skilled workforce and cutting-edge R&D in semiconductor technology.

Ph. D. Degree (NE stream):

CeNSE offers Ph. D. degree program in the area of nano-science and engineering. The program involves rigorous course work followed by thesis research in various fields, including nanomaterials and nanostructures, electronics, nanofluidics, nanophotonics, nanobiotechnology, plasmonics, sensor systems and computational modeling. The PhD program leverages the world-class nano-fabrication and nano-characterization facilities available in CeNSE to aid the execution of cutting-edge research projects. The PhD program aims to provide highly trained manpower in the area of nano-science and engineering with a particular focus on manpower capable of leading device development efforts in the area of nano-electronics, photonics, MEMS/NEMS and related areas. Students graduating under this Ph. D. program are expected to play a leadership role in nanotechnology research in academia as well as industries.

Ph. D. Degree (Interdisciplinary Program, NA stream):

In addition to the regular PhD program described above, CeNSE offers another Ph. D. degree program which is interdisciplinary by its very design. A student admitted under this program must mandatorily have two advisors from two different departments at IISc. The admission into this program is offered against a specified research project proposed by the two advisors. The goal of this program is to provide a stronger focus on the interface between nanotechnology and other disciplines such as energy research and biotechnology. Students successfully completing a research thesis under this program are expected to possess deep domain knowledge in two complementary fields and lead research activities in academia as well as industries at the interface of nanotechnology and its application domains.

Division of Chemical Sciences

M. Sc Chemical Sciences

The MSc. Chemical Sciences programme is a programme designed to prepare students for advanced chemistry research and practice. A bachelor's degree in chemistry or similar with mathematics as a subject at the bachelor’s level is required to enter the programme. The programme emphasizes curricular learning as well as research. MSc. Chemical Sciences students are expected to be placed in national and international research programmes in academia and industry.

Division of Biological Sciences

M. Sc Life Sciences

The M.Sc. program is a two-year degree program that includes 2 semesters of coursework and 2 semesters of laboratory-based project work. The student enrolled in the program specialize in one of the 5 sub-areas, viz., biochemistry and biophysics; Cell and Developmental Biology; Infectious Diseases; Ecology and Evolution; and Neurosciences and Behaviour based on their interest. The course structure includes hardcore courses that all students take irrespective of their specializations, such as scientific ethics, Opportunities and approaches, Biostatistics, introductory lab courses in cell and molecular biology, and Genetics and Ecology. The softcore pool includes courses based on their specialization, of which many are specifically designed from the MSc program, and others are taken from existing courses in the division. The electives are selected by students based on their specialization. Students are encouraged to take up summer internships. They carry out a 1-year project work in one of the labs in the division in year 2 toward their project work. It is anticipated that the graduating cohort from this program will either pursue further studies (PhD) in India or abroad or take up jobs in the life sciences sector.

Course outcomes
Indian Institute of Science, Bengaluru.

AE 203 Aug 3:0; Fluid dynamics

AE 211 Aug 3:0; Mathematical Methods for Aerospace Engineers

AE 218 Jan 3:0; Computational Gas Dynamics

AE 230 Jan 3:0; Aeroelasticity

AE 252 Aug 3:0; Analysis And Design of Composite Structures

AE 259 Aug 3:0; Navigation, Guidance and Control

AE 262 Jan 3:0; Guidance Theory and Applications

AE 264 Jan 3:0; Vibrations

AE 271 Aug 2:0; Flight Vehicle Design

AE 274 Jan 3:0; Topics in Neural computation

AE 282 Jan 3:0; Unmanned Aerial Vehicles

AE210 Jan 3:0; Gas Dynamics

AE221 Aug 3:0; Flight Vehicle Structures

AE235 Jan 3:0; Non-Destructive Testing & Evaluation (NDT & E)

AE245 Aug 3:0; Mechanics and Thermodynamics of Propulsion

AE247 Jan 3:0; Aircraft Engines

AE250 Aug 3:0; Advanced combustion

AE276 Jan 1:2; Experimental Techniques

AE316 Jan 3:0; Hydrodynamic Stability

AE317 Aug/Jan 3:0; Aeroacoustics

AE364 Jan 3:0; Micromechanics of composites

AI 299o Aug 0:27; MTech Dissertation Project

AS 209 Jan 3:0; Mathematical Methods in Climate Science

AS 215 Aug 3:0; Environmental Fluid Dynamics

AS 308 Jan 2:1; Ocean Modeling

AS202 Jan 3:0; Geophysical Fluid Dynamics

AS203 Aug 3:0; Atmospheric Thermodynamics

AS204 Aug 3:0; Radiation and climate

AS205 Aug 2:1; Ocean Dynamics

AS208 Jan 3:0; Satellite Meteorology

AS211 Jan 2:1; Observational Techniques

AS212 Aug 3:0; Introduction to Atmospheric Dynamics

AS216 Aug Term - 3 Credits; Introduction to the Climate System

BC 203 Aug - Dec 3:0; General Biochemistry

BC 205/RD 210 Jan 2:0; Fundamentals of Physiology and Medicine

BC 210 Jan - April 3:0; Molecular Basis of Ageing and Regeneration

BC_201 Aug 2:0; CELL BIOLOGY

BC206 Aug 2:0; Essentials in Immunology

BC207 Jan 2:0; PROTEOMICS IN PRACTICE

BE 207 Jan 3:0; Mathematical Methods for Bioengineers

BE 212 Jan 1:0; Research communication

BE 213 Aug 2:0; Fundamental of Bio-Engineering - I

BE 214 Aug 2:0; Fundamental of Bio-Engineering – II

BE 216 Jan 3:0; Dynamical Systems Biology

BE 218 Jan 3:1; Computational Epidemiology

BE 219 Aug 2:0; Essentials of Research and Innovation

BE 221 Aug 3:0; Introduction to Data Science for Bioengineers

BE 222 Aug 3:0; Stem Cell Technology

BE 223 Aug 2:0; Space Biology and Bioengineering

BE 226 Aug 2:0; Synthetic Biology and Genetic Engineering

BE206 Aug 3:0; Biology for Engineers

BE208 Jan 3:0; Fundamentals of Bioengineering

BE209 Aug 1:0; Digital Epidemiology

CCE Jan 3:00; Neural Networks for Signal Processing

CD 225 Jan 0:4; Physical and Analytical Chemistry Laboratory

CD204 Aug 3; Chemistry of Materials

CD212 Aug 3:0; Inorganic Chemistry-Main Group and Coordination Chemistry

CD213 Aug 3:0; Organic Chemistry – Structure and Reactivity

CD214 Aug 3:0; Basic Mathematics

CD223 Jan 3:0; Organic Synthesis

CD224 Jan 2:1; Computers in Chemistry

CD301 Jan 3:0; Advanced NMR Spectroscopy

CE 201 Aug 3:0; Basic Geomechanics

CE 202A Aug 3:0; Integrated Investigation of Dams

CE 203A Aug 3:1; Hydrologic Safety Evaluation of Dams

CE 205A Aug 3:0; Transportation Logistics

CE 206A Aug 3:0; Mathematical methods for machine learning

CE 207 JAN 3:0; Geo-environmental Engineering

CE 208 Jan 3:0; Ground Improvement and Geosynthetics

CE 222 Jan 3:0; Fundamentals of Soil Behaviour

CE 223 Aug 3:0; Hydro-climatology

CE 238 Jan 3:0; Structural Masonry

CE 248 JAN 3:0; Regionalization In Hydrology And Water Resources Engineering

CE 285 Jan 3:0; Disaster Management for Dams

CE 295 Jan 3:0; Earth Retaining Structures and Earthen Dams

CE2015 Aug 3:0; An Introduction to Finite Elements

CE203 AUG 3:0; Surface Water Hydrology

CE204 Aug 3:0; Solid Mechanics

CE206 Jan 3:0; Earth and Earth Retaining Structures

CE210 Jan 3:0; Structural Dynamics

CE213 Jan 3:0; Systems Techniques in Water Resources & Environmental Engineering

CE215 Jan 3:0; Stochastic Hydrology

CE219 Aug 3:0; Soil Dynamics

CE220 Aug 3:0; Design of Sub-structures

CE221 Aug 3:0; Earthquake Geotechnical Engineering

CE227 Jan 3:0; Engineering Seismology

CE235 Jan 3:0; Optimization Methods

CE240 Jan 3:0; Uncertainty Modeling and Analysis

CE241 Aug 3:0; Advanced Structural Dynamics

CE242 Aug 3:0; Fire structural engineering

CE243 Aug 3:0; Bridge Engineering

CE246 Aug 3:0; Urban Hydrology

CE247 Aug 3:0; Remote Sensing and GIS in Water Resources and Environmental Engineering

CE263 Aug 3:0; Modelling Transport and Traffic

CE267 Jan 3:0; Transportation Statistics and Micro-Simulation

CE272 Jan 3:0; Traffic Network Equilibrium

CH 207 Jan 1:0; Applied probability and design of experiments

CH 242 Aug 3:0; Special Topics in Theoretical Biology

CH 244 Aug 3:0; Treatment of drinking water

CH 250 Aug 3:0; Laminar flows

CH 251 Aug 3:1; Machine Learning for Materials and Molecules

CH201 Aug 3:0; Chemical Engineering Mathematics

CH202 Aug 3:0; Numerical Methods

CH203 Aug 3:0; Transport Processes

CH204 Aug 3:0; Thermodynamics

CH205 Jan 3:0; Chemical Reaction Engineering

CH206 Aug 1:0; Seminar Course

CH235 Aug 3:0; Modelling in Chemical Engineering

CH236 Jan 3:0; Statistical Thermodynamics

CH245 Jan 3:0; Interfacial and Colloidal Phenomena

CH247 Jan 3:0; Introduction to molecular simulations

CH248 Aug 3:0; Molecular Systems Biology

CP 214 Aug 2:1; Foundations of Robotics

CP 230 Jan 2:1; Motion Planning for Autonomous Systems

CP 232 Aug 2:1; Swarm Robotic System

CP 242 Jan 2:1; Human Robot Interaction

CP 260 Jan 2:1; Robotic Perception

CP 275 Aug 1:2; Formal Analysis and Control of Autonomous Systems

CP 280 Jan 1:2; Mathematical Techniques for Robotics and Automation

CP 282 Aug 0:26; Field Robotics

CP 299 Aug 3:1; MTech Project

CP 312 Oct 2:1; Robot dynamics and control

CP 315 Jan 2:1; Robot Learning and Control

CP 316 Jan 2:1; Real-time Embedded Systems

CP 318 Aug 0:3; Data Science for Smart City Applications

CY 215 Aug 0:14; Advanced Laboratory - 1

CY 225 Aug 3:0; Spectroscopic Methods for Structure Determination

CY 226 Aug 0:3; Advanced Laboratory - II

CY 303 Aug 3:0; Inorganic Chemistry-2: Organometallic Chemistry

DA 218o Aug 3:1; Probabilistic Machine Learning: Theory and Applications

DB201 Aug 2:0; Mathematics and Statistics for Biologists

DB202 Aug 2:0; General Biology

DB204/RD201 Aug 2:0; Genetics

DS 200 JAN 0:1; Research Methods

DS 201 Aug 2:0; BioInformatics

DS 202 Aug 2:1; Algorithmic Foundations of Big Data Biology

DS 222 Aug 3:1; Machine Learning with Large Datasets

DS 260 JAN 3:0; Medical Imaging

DS 261 Aug 3:1; Artificial Intelligence for Medical Image Analysis

DS 265o Aug 3:1; Deep Learning for Visual Analytics

DS 269 Jan 2:1; Computational Methods for Reacting Flows

DS 284 Aug 2:1; Numerical Linear Algebra

DS 285 Aug 3:1; Tensor Computations for Data Science

DS 290 Aug 3:0; Modelling and Simulation

DS 291 Jan 3:1; Finite elements: Theory and Algorithms

DS 294 Jan 3:0; Data Analysis and Visualization

DS 298 Aug 3:1; Random Variates in Computation

DS 391 Jan 3:0; Data Assimilation to Dynamical Systems

DS 397 JAN 3:1; Topics in Embedded Computing

DS221 Aug 3:0; Introduction to Scalable Systems

DS-255 Jan 3:1; System Virtualization

DS256 Jan 3:1; Scalable Systems for Data Science

DS265 Jan 3:1; Deep Learning for Computer Vision

DS295 Jan 3:1; Parallel Programming

DS301 Aug 2:0; Bioinformatics

E0 202 Jan 3:1; Automated Software Engineering with Machine Learning

E0 204 Jan 2:1; Neuromorphic Analog VLSI design

E0 212 Jan 3:0; Graph Algorithms

E0 213 Jan 3:0; Quantum Safe Cryptography

E0 214 Aug 3:0; Applied Linear Algebra and Optimization

E0 215 Aug 3:1; Algorithms Under Uncertainty

E0 220 Aug 3:1; Graph Theory

E0 228 Aug 3:1; Combinatorics

E0 231 Jan 3:1; Algorithmic Algebra

E0 232 Aug-Dec 3:1; Probability and Statistics

E0 238 Jan 3:1; Artificial Intelligence

E0 249 Jan 3:1; Approximation Algorithms

E0 251 Aug 3:1; Data Structures and Algorithms

E0 254 Aug-Dec 3:1; Network and Distributed Systems Security

E0 259 Aug 3:1; Data Analytics

E0 261 Aug 3:1; Database Management Systems

E0 264 Jan-April 3:1; Distributed Computing Systems

E0 265 Jan 3:1; Convex Optimization and Applications

E0 267 Aug 3:1; Soft Computing

E0 270 Jan 3:1; Machine Learning

E0 272 Jan 3:1; Formal Methods in Software Engineering

E0 284 Aug 2:1; Digital VLSI Circuits

E0 294 Aug 3:1; Systems for Machine Learning

E0 299 Aug 3:1; Computational Linear Algebra

E0 307 Aug 3:1; Program Synthesis meets Machine Learning

E0 311 Jan 3:1; Topics in Combinatorics

E0 316 Aug 3:1; Interacting Particle Systems

E0 338 Aug 3:1; Topics in Security and Privacy

E0 361 Jan 3:1; Topics in Database Systems

E0 399 Aug 1:2; Research in Computer Science

E0210 Aug 3:1; Principles of Programming

E0230 Aug 3:1; Computational Methods of Optimisation

E0243 Aug 3:1; Computer Architecture

E0246 Jan 3:1; Real Time Systems

E0247 Aug 3:1; Sensor Networks

E0255 Jan 3:1; Compiler Design

E0256 Aug 3:1; Theory and Practice of Computer Systems Security

E0271 AUG 3:1; Computer Graphics

E0304 Jan 3:1; Computational Cognitive Neuroscience

E0-334 Aug 3:1; Deep Learning for Natural Language Processing

E0343 Jan 3:1; Topics in Computer Architecture

E0358 Aug 3:1; Advanced Techniques in Programming and Compilation for Parallel Architectures

E1 213 Jan 3:1; Pattern Recognition and Neural Networks

E1 241 Aug 3:0; Dynamics of linear systems

E1 242 Jan 3:0; Nonlinear systems and control

E1 243 Jan 2:1; Digital Controller Design

E1 246 Jan 3:1; Natural Language Understanding

E1 246 Oct 3:0; Topics in Networked and Distributed Control

E1 248 Aug 3:0; Sliding mode control and its applications

E1 251 Aug 3:0; Linear and Nonlinear Optimization

E1 254 Jan 3:1; Game Theory

E1 260 Aug 3:1; Optimization for Machine Learning and Data Science

E1 277 Aug 3:1; Reinforcement Learning

E1 277 Jan-April 3:1; Reinforcement Learning

E1222 Aug 3:0; Stochastic Models and Applications

E1244 Jan 3:0; Detection and Estimation Theory

E1251 Aug 3:0; Linear and Nonlinear optimization

E1262 Jan 3:0; Selected Topics in Markov Chains and Optimization

E2 202 Aug 3:0; Random Processes

E2 204 Jan 3:0; Stochastic Processes and Queueing Theory

E2 205 Aug 3:0; Error-Control Codes

E2 210 Aug 3:0; Quantum Error-Correcting Codes

E2 213 Jan 3:0; Information-Theoretic Security

E2 214 Jan 3:0; Finite-State Channels

E2 224 Jan 3:1; Advanced Topics in Networking

E2 232 Aug 2:1; TCP/IP Networking

E2 270 Aug 3:0; Quantum Information Theory

E2201 Aug 3:0; Information theory

E2-202 Aug 3:0; Random Processes

E2203 Jan 3:0; Wireless Communications

E2206 Jan 3:0; Information and Communication Complexity

E2-221 Aug 3:0; Communication Networks

E2-241 Jan 3:0; Wireless Networks

E2-242 Jan 3:0; Multiuser Detection

E2-251 Aug 3:0; Commnication Systems Design

E244 JAN 3:1; Computational Geometry and Topology

E3 220 Aug 3:0; Foundations of Nanoelectronic Devices

E3 231 Jan 2:1; Digital System Design with FPGAs

E3 245 Aug 2:1; Processor System Design

E3 262 AUG 2:1; ELECTRONICS SYSTEMS PACKAGING

E3 273 Aug 2:1; Microcontroller and its Applications

E3 274 Aug 3:0; Power Semiconductor Devices and Physics

E3 277 Jan 2:1; Introduction to Integrated Circuit (IC) Design

E3 280 Jan 3:0; Carrier transport in nanoscale devices

E3 280o Aug 3:1; Semiconductor devices for nanoelectronics

E3 282 Aug 3:0; Basics of Semiconductor Devices and Technology

E3 300 Aug 3:0; Topics in Reinforcement Learning

E3 301 Jan 3:0; Special topics in Nanoelectronics

E3 303 Jan 3:0; Stochastic Dynamics and Stochastic Control with applications to Machine Learning

E3 343 Aug 1:2; Discrete Control and Estimation

E3225 Jan 3:0; Art of Compact Modeling

E3-257 Jan 2:1; Embedded System Design

E3258 Jan 2:1; Design For Internet Of Things

E4 234 Aug 3:0; Advanced Power Systems Analysis

E4 237 Jan/Aug 2:1; Selected Topics in Integrated Power Systems

E4 238 Jan 3:0; Advanced Power System Protection

E4221 Aug 2:1; DSP and AI Techniques in Power System Protection

E4231 Aug 3:0; Power system dynamics and control

E4233 Jan 3:0; Computer Control of Power Systems

E5 212 Jan 3:0; Computational Methods in Electrostatics

E5 213 Jan 3:0; EHV/UHV Power Transmission Engineering

E5 215 Aug 2:1; Pulsed Power Engineering

E5201 Aug 2:1; Production, Measurement and Application of high voltage

E5206 Jan 3:0; High Voltage Power Apparatus

E5209 Jan 3:0; Overvoltages in Power Systems

E5-232 May-June 2:1; Advances in Electric Power Transmission

E6 205 Aug 2:1; Design of Electric Motors

E6 222 Jan 2:1; Design of photovoltaic systems

E6 225 Aug 3:1; Advanced Power Electronics

E6 226 Aug 3:0; Switched Reluctance Machines and Drives

E6 227 Aug 3:0; Power Electronics Design

E6-202 Aug 2:1; Design of Power Converters

E6212 JAN 3:0; DESIGN AND CONTROL OF POWER CONVERTERS AND DRIVES

E6221 Jan 3:1; Switched Mode Power Conversion

E6224 Aug 3:0; Topics in Power Electronics and Distributed Generation

E7 211 Jan 3:0; Photonic Integrated Circuits

E7 214 Jan 3:0; Optoelectronic Devices

E7-221 Aug 2:1; Fiber-Optic Communication

E8 201 Aug 3:0; Electromagnetism

E8241 Jan 2:1; Radio Frequency Integrated Circuits & Systems

E8262 Jan 3:0; CAD for High Speed Chip-Package-Systems

E9 201 Aug 3:0; Digital Signal Processing

E9 206 Aug 3:0; Digital Video: Perception and Algorithms

E9 211 Aug 3:0; Adaptive Signal Processing

E9 213 Jan 3:0; Time-Frequency Analysis

E9 231 Jan 3:0; MIMO Signal Processing

E9 241 Aug 2:1; Digital Image Processing

E9 243 JAN 3:0; Computer Aided Tomographic Imaging

E9 246 Jan 3:1; Advanced Image Processing

E9 261 Jan 3:1; Speech Information Processing

E9-202 Aug 3:0; Advanced DSP: Non-linear Filters

E9205 AUG 3:1; MACHINE LEARNING FOR SIGNAL PROCESSING

E9-221 Jan 3:0; Signal Quantization & Compression

E9251 Jan 3:0; Signal processing for data recording channels

E9252 Jan 3:0; Mathematical methods and techniques in signal processing

E9282 Jan 2:1; Neural Signal Processing

E9291 Aug 2:1; DSP System Design

E9292 Jan 2:1; Real Time Signal processing with DSP

EC 204 Jan 2:1; Evolutionary Biology

EC 205 Aug 2:0; Multi-omics approaches for Biologists

EC 206 Aug 2:1; Evolutionary Genetics

EC 306 Jan 2:1; Advance Ecological Statistics

EC201 Jan 2:1; Theoretical and Mathematical Ecology

EC203 Jan 2:0; Ecology: Principles and Applications

EC301 Aug 2:1; Animal Behaviour: Mechanisms and Evolution

EC302 Aug 2:1; Plant-Animal Interactions (Ecology, Behaviour and Evolution)

EC303 and PH303 Aug 2:1; Spatial dynamic in biology

EC305 Aug 2:1; Quantitative Ecology: Research Design and Statistical Inference

EE304 Jan 3:1; Computational Cognitive Neuroscience

ER 201 Aug 3:0; Renewable Energy Technologies

ES 202 Aug 3:0; Geodynamics

ES204 Aug 3:0; Origin and evolution of the Earth

ES205 Aug 3:0; Mathematics for Geophysicists

ES212 Jan 3:0; Fluid dynamics of planetary interiors

ES213 Jan 3:0; Isotope geochemistry

ET 299 Aug 0:31; MTech EPD Dissertation Project

HE215 Aug 3:0; Nuclear and Particle Physics

HE316 Jan 3:0; Advanced Mathematical methods in Physics

HE384 Jan 3:0; Quantum Computation

HE391 Aug 3:0; Relativistic Quantum Mechanics /Quantum Mechanics III

HE395 Aug 3:0; Quantum Field Theory I

HE396 Jan 3:0; Quantum Field Theory II

HE398 Jan 3:0; General Relativity

IN 212 Jan 3:0; Advanced Nano/Micro Systems

IN 223 Jan 3:0; Advanced Signal Processing

IN214 Jan 3:0; Semiconductor Devices and Circuits

IN224 Jan 3:0; Nanoscience and Device fabrication

IN227 Jan 3:0; Control System Design

IN232 Aug 3:0; Concepts in Solid State Physics

IN244 AUG 2:1; Optical Metrology

IN267 Aug 3:0; Fundamentals of Fluorescence Microscopy

IN268 JAN 2:1; Microfluidic Devices & Applications

IN302 Aug 3:0; Classical and Quantum Optics

IP 214 AUG 2:1; CRYSTALLOGRAPHY FOR CHEMISTS

IP 322 Jan 3:0; Polymer Chemistry

IP 327 Aug 3:0; Chemical Dynamics

IP311 Aug 3:0; Bio and Medicinal Inorganic Chemistry

IP323 Jan 3:0; Topics in Basic and Applied Electrochemistry

LS 103 Aug 1:0; Opportunities and Extensions in Life Sciences - Pa

LS 203 Aug 3:0; Microbiology, Virology and Immunology

LS 204 Aug 3:0; Biochemistry and Biophysics

LS 205 Aug 3:0; Ecology and Evolution

LS 206 Aug 3:0; Developmental Biology and Genetics

LS 207 Aug 3:0; Fundamentals of Molecular Biology

LS 208 Aug 2:0; Physiology and Neurobiology

LS 209 Aug 0:2; Laboratory course in Molecular Techniques

LS 210 Aug 0:2; Laboratory course in Genetics and Ecology

MA 200 Aug 3:1; Multivariable Calculus

MA 220 Aug 3:0; Representation Theory of finite groups

MA 222 Jan 3:1; Measure and integration

MA 223 Aug 3:0; Functional Analysis

MA 229 Jan 3:0; Calculus on Manifolds

MA 235 Jan 3:0; Introduction to hyperbolic manifolds

MA 262 Aug 3:0; Introduction to Stochastic Processes

MA 315 Jan 3:00; Lie Algebras and their Representations

MA 327 Aug 3:0; Topics in Analysis

MA 338 Aug 3:0; Differentiable manifolds and Lie groups

MA 339 Jan 3:0; Geometric Analysis

MA 343 Jan 3:0; Complex Analytical Techniques in Operator Theory

MA 348 Aug 3:0; Topics in function theoretic operator Theory

MA 355 Jan 3:0; Topics in geometric topology: geometric structures

MA 367 Jan 3:0; Topics in Gaussian processes

MA 375 Aug 3:0; Algebraic graph theory

MA 384 Jan 3:0; Mathematical Physics

MA 388 Aug 3:0; Topics in Non-linear Functional Analysis

MA 393 Jan 3:0; Topics in random discrete structures

MA219 Aug 3:1; Linear Algebra

MA221 Aug 3:0; Analysis I

MA232 Aug 3:0; Introduction to Algebraic Topology

MA318 Jan 3:0; Combinatorics

MA319 Jan 3:0; Algebraic Combinatorics

MA361 Aug 3:0; Probability Theory

MA386 Jan 3:0; Coxeter Groups

MB 211 Jan 3:1; Multiscale Theory and Simulations of Biomolecular Systems

MB 215 Aug 2:0; Neuronal Ion Transport in Health and Disease

MB 222 Aug 3:0; Electron microscopy and 3D image processing for Life sciences

MB 315 Jan 2:0; Relaxation Theory and Applications to Solution State Biomolecular NMR Spectroscopy

MB201 Aug 2:0; Introduction to Biophysical Chemistry

MB204 Aug 3:0; Molecular Spectroscopy and its Biological Applications

MB206 Aug 3:0; Conformational and structural aspects of biopolymers

MB207 Jan 2:0; DNA-Protein interaction, Regulation of gene expression, Nanobiology

MB209 Aug 3:1; Molecular and Cellular Neurophysiology

MB210 Jan 2:0; Peptides and Drug-Design

MB212 Jan 2:0; Electron microscopy and 3D image processing for Life sciences

MB303 Jan 3:0; Elements of Structural Biology

MB305 Jan 3:0; Biomolecular NMR Spectroscopy

MC 203 Jan 3:0; Essentials in Microbiology

MC 210/RD 206 Jan 2; Molecular Oncology

MC 211 / BC 210 Jan-April 2:0; Molecular basis of Ageing and Regeneration

MC 216 Aug 1:0; Biological Safety: Principles and practices

MC202 Jan 2:0; Eukaryotic Developmental Genetics

MC203 Aug 3:0; Essentials in Microbiology

MC206 Aug 2:0; RNA Biology

MC208 Aug 3:0; Principles of Genetic Engineering

MC212 Aug 2:0; ADVANCES IN CELL BIOLOGY

ME 202 Aug 3:0; Micro-hydrodynamics

ME 224 Aug 3:0; Mechanical Vibrations

ME 226 Aug 3:0; Applied Dynamics I

ME 259 Aug 3:0; Nonlinear Finite Element Methods

ME 273 Jan 3:0; Solid and Fluid Phenomena at small scales

ME 280 Oct 3:0; Fundamentals of Nanoscale Conduction heat transport

ME 281 Jan 3:0; Thermodynamics of crystalline solids

ME 282 Jan 3:0; Computational Heat Transfer and Fluid Flow

ME 284 and ER-201 Jan and Aug 3:0; Advanced Internal Combustion Engines and Renewable Energy

ME 287 Jan-April 3:0; Refrigeration Engineering

ME 288 Jan-April 3:0; Air Conditioning Engineering

ME 289 Aug-Dec 3:0; Principles of Solar Thermal Engineering

ME 292 Aug 3:0; Contact and Impact Mechanics

ME228 Aug 3:0; Materials and Structure Property Correlations

ME237 Jan 3:0; Mechanics of Microsystems

ME240 Aug 3:0; Dynamics and Control of Mechanical Systems

ME242 Aug - Dec 2018 3:0; Solid Mechanics

ME243 Aug 3:0; Continuum mechanics

ME244 Jan 3:0; Experimental Methods in Microfluidics

ME246 Jan 3:0; Introduction to Robotics

ME249 Jan 3; Fundamentals of acoustics

ME250 Aug 3:0; Structural Acoustics

ME253 Jan 3:0; Vibrations of Plates and Shells

ME255 Aug 3:0; Principles of Tribology

ME256 Jan 3:0; Variational Methods and Structural Optimization

ME257 Jan 3:0; Finite Element Method

ME260 Aug 3:0; Topology Optimization

ME271 Aug-Dec 3:0; Thermodynamics

ME283 Aug 3:0; Two Phase Flow and Boiling Heat Transfer

ME284 Jan 3; Applied Combustion

ME285 Aug 3:0; Turbomachine Theory

ME293 Jan-18 3:0; Fracture Mechanics

MG 212 Aug-Dec 2:1; Behavioral Science

MG 219 Aug 3:0; Introductory Probability Theory

MG 220 Aug 3:0; Introductory Statistics

MG 222 Aug 3:0; Regression and Time Series Analysis

MG 225 Aug 3:0; Decision Models

MG 265 Aug 3:0; Data Mining

MG 286 Jan 3:0; PROJECT MANAGEMENT

MG 298 Aug 2:1; ENTREPRENEURSHIP FOR TECHNOLOGY STARTUPS

MG201 Aug-Dec 3:0; Managerial Economics

MG202 Aug-Dec 3:0; Macroeconomics

MG221 Aug 2:1; Applied Probability and Statistics

MG258 Jan 3:0; Financial Instruments and Risk Management Strategies

MG281 Jan 3:0; Management of Technology for Sustainability

MR 203 Aug -Dec 2017 3:0; Introduction to Biomaterials

MR301 Aug 3:0; Quantum Mechanical Principles in Materials

MR306 Aug 3:0; Electron Microscopy in Materials Characterization

MR308 Jan 3:0; Computational Modeling of Materials

MT 202 Aug 3:0; Materials Thermodynamics and Kinetics

MT 211 Aug 3:0; Magnetism, Magnetic Materials, and Devices

MT 217 Aug 3:0; Computational Mathematics for Materials Engineers

MT 240 Jan 3:0; Principles of Electrochemistry and Corrosion

MT 256 Jan 3:0; Fracture

MT 260 Aug 3:0; Polymer Science and Engineering – I

MT 261 Jan 3:0; Organic Electronics

MT 309 Aug 3:0; Introduction to Manufacturing Science

MT203 Aug 3:0; Materials Design and Selection

MT206 Aug 3:0; Texture and Grain boundary engineering

MT208 Aug 3:0; Diffusion in Solids

MT209 Aug 3:0; Defects in materials

MT213 Jan 3:0; Electronic Properties of Materials

MT220 Jan 3:0; Microstructural Design and Development of Engineering Materials

MT225 Jan 3:0; Elevated Temperature Deformation and Fracture

MT241 Aug 3:0; Structure and Characterization of Materials

MT245 Aug 3:0; Transport Processes in Process Metallurgy

MT248 Jan 3:0; MODELLING AND COMPUTATIONAL METHODS IN METALLURGY

MT271 Jan 3:0; Introduction to Biomaterials Science and Engineering

NE 240 Aug 3:0; Materials design principles for electronic, electromechanical and optical funct

NE 261 Aug 3:0; Piezoelectric MEMS: Theory, Design and Application

NE 281 Aug 3:0; Statistical and probabilistic data analysis techniques

NE 315 Jan 3:0; Semiconductor devices for RF and microwave Electronics

NE-200 Jan 2:0; Technical Writing in English

NE202 Jan and Aug 0:1; Micro and Nano Fabrication Lab

NE203 Aug 3:0; Advanced Micro and Nano fabrication technology and process

NE205 Aug 3:0; Semiconductor Devices and IC Technology

NE-215 Aug 3:0; Applied Solid State Physics

NE222 Aug 3:0; MEMS: Modeling, Design, and Implementation

NE231 Aug 3:0; Microfluidics

NE310 AUG 3:0; Photonics technology: Materials and Devices

NE312 Aug 3:0; Nonlinear and Ultrafast Photonics

NE313 Jan 3:0; Lasers: Principles and Systems

NS 212 Aug 2:1; Neural Signal Processing

NS201 Aug 3:0; Fundamentals of Systems and Cognitive Neuroscience

NS202 Aug 3:0; Fundamentals of Molecular and Cellular Neuroscience

NS301 Jan 3:0; Topics in Systems and Cognitive Neuroscience

NS302 Jan 3:0; Topics in Molecular and Cellular Neuroscience

OC301 Aug 3:0; Organic Synthesis -II

OC302 Aug 3:0; Asymmetric Catalysis: From Fundamentals to Frontiers

OC303 Aug 3:0; Carbohydrate Chemistry

OC303 Jan 3; Physical Methods of Structure Elucidation

PD 230 Aug 3:0; Haptic Systems Design

PD205 Aug 2:1; Materials, Manufacturing and Design

PD232 Aug 2:1; Human Computer Interaction

PD233 Aug 2:1; Design of Biomedical Devices and Systems

PD234 Jan 2:1; Intelligent User Interface

PH 208 Jan 3:0; Condensed Matter Physics-I

PH 379 Aug 3:0; Discrete Photonics and Quantum Analogies

PH201 Aug 3:0; Classical Mechanics

PH202 Jan 3:0; Statistical Mechanics

PH204 Jan 3:0; Quantum Mechanics II

PH205 Aug 3:0; Mathematical Methods of Physics

PH206 Jan 3:0; Electromagnetic Theory

PH212 Jan 3; Experimental methods in condensed matter physics

PH213 Aug 0:4; Advanced experiments in condensed matter physics

PH215 Aug 3:0; Nuclear and Particle Physics

PH320 Aug 3:0; Condensed matter Physics II

PH322 Jan 3:0; Molecular Simulation

PH325 Aug 3:0; Advanced Statistical Physics

PH335 Jan 3:0; Statistical Mechanics of Time-dependent Phenomena

PH350 Jan 3:0; Physics of Soft Condensed Matter

PH351 Aug 3:0; Crystal Growth, thin films and Characterisation

PH352 Jan 3:0; Semiconductor Physics and Technology

PH354 Jan 3:0; Computational Physics

PH359 Jan 3:0; Physics of Nanoscale Systems

PH364 Jan 3:0; Topological Phases of Matter

PH396 Jan 3:0; Quantum Field Theory II

PS 301 Aug 3:0; S&T policy

PS 303 Aug 2:0; Communicating science to nonexperts

QT 202 Jan 3:0; Introduction to Quantum Measurement

QT 204 Jan 3:0; Introduction to Materials for Quantum Technologies

QT 306 Jan 3:0; Advanced Quantum Computation and Information

QT 312 Jan 1:2; Advanced Quantum Technology Lab

RD 209 / BC 210 / MC 211 Jan 3:0; Molecular Basis of Ageing and Regeneration

RD 210 Jan 2:0; Fundamentals of Physiology and Medicine

SS 209 Aug 3:0; Electrochemical Systems

SS202 Aug 3:0; Introduction to Quantum Chemistry

SS304 Aug 3:0; Solar Energy and Materials

ST 201 Jan 3:0; Thermochemical and biological energy recovery from biomass

ST 202: Aug 3:0; Energy Systems and Sustainability

ST 204 Aug 1:1; Sustainable Energy and Environment lab

ST 207 Jan 3:0; Alternate Fuels for Reciprocating Engines

ST 217 Jan 3:1; Field Hydrology, River Engineering and Basin Studies

ST 218 Aug 3:0; Sustainable wastewater management

ST 219 Aug 3:0; Separation Technologies for Sustainable Industrial processes

ST 222 Jan 3:0; Basic Concepts of Planning and Design of Hydro-Mechanical Components in Dam

ST 223 Aug 3:0; Green Catalysis in Chemical Industries

ST213 Jan 3:0; Turbomachines in Renewable Energy

ST214 Aug 3:0; Mathematical Analysis of Experimental Data

UB 204 Jan 2:0; Introductory Physiology

UB205 Jan 2:0; Introductory Physiology

UB208 Jan 2:0; Basic Molecular Biology

UB301L Aug 0:2; Experiments in Microbiology and Ecology

UC101 Aug 2:1; Principles of Physical Chemistry

UC202 Jan 2:0; Thermodynamics and Electrochemistry

UC205 Jan 2:0; Basic Organic Reactions

UC206 Aug 2:1; Basic Organic Chemistry

UC207 Jan 2:1; Instrumental Methods of Chemical Analysis

UE 102 Jan 2:1; Electronics and Electrical Engineering

UE204 Jan 3:0; Elements of Solid Mechanics

UES 206 Jan 1:2; Experimental Methods in Environmental Chemistry

UES 302 Aug 2:0; Design Principles in Environmental Engineering

UES 310 Aug 1:2; Experimental Methods in Solid Waste Management

UES204 Jan 3:0; Fundamentals of Climate Science

UG206L Jan 0:2; Experiments in Biochemistry and Physiology

UH 203 Jan 1:0; Mapping India with the Folk Arts

UM 302 Aug 2:1; Material Processing

UM101 Aug 3:0; Analysis and Linear Algebra

UM201 Aug 3:0; Probability and Statistics

UMT202 Jan 2:1; Structure of Materials

UMT205 Jan 3:0; Mechanical Behavior of Materials

UMT310 Jan 2:1; Introduction to Materials Manufacturing

UMT311 Aug 0:1; Functional Materials Laboratory

UP 101 Aug 2:1; Introductory Mechanics

UP201 Aug 2:1; Introductory Physics III

WR 202 Aug 3:0; Geodetic signal processing

AE 203 Aug 3:0

Fluid dynamics

Department: Aerospace Engineering

Course Outcomes:

Thorough grounding in fluid mechanics preparatory for Aerodynamics and with a deep appreciation of kinematics and vorticity based concepts with appropriate mathematical rigour

AE 211 Aug 3:0

Mathematical Methods for Aerospace Engineers

Department: Aerospace Engineering

Course Outcomes:

Recognize and identify the nature of the mathematical problems that are commonly encountered in aerospace engineering; choose and apply appropriate mathematical methods and tools to solve such problems.

AE 218 Jan 3:0

Computational Gas Dynamics

Department: Aerospace Engineering

Course Outcomes:

The students would learn the basic discretization methods for the partial differential equations of Gas Dynamics, together with the modern and latest CFD algorithms for simulating compressible fluid flows.

AE 230 Jan 3:0

Aeroelasticity

Department: Aerospace Engineering

Course Outcomes:

After completing this course, the student should be able to understand and identify the nature of the aeroelastic problems encountered in flight vehicles and choose the appropriate methods and tools to estimate and solve specific aeroelastic problems.

AE 252 Aug 3:0

Analysis And Design of Composite Structures

Department: Aerospace Engineering

Course Outcomes:

The students get a through introduction to Composite Materials, different types of Fibers and matrices, properties of composites, Applications of composite materials and Micromechanics of Composites. The course also introduces about the theory of Lamina and failure theories. In continuation, theory of Laminates, Analysis of lamina and Laminates and failure predictions are covered. In addition to this, Beam theory and plate theory are taught and the analysis of beams and plates will be covered. Finally the course covers the design aspect the laminates with respect to the ply orientations, stacking sequence, number of plies, thickness of laminate based on different loading conditions.

AE 259 Aug 3:0

Navigation, Guidance and Control

Department: Aerospace Engineering

Course Outcomes:

The students get a thorough introduction to classical control theory, including analysis and design. The concepts are applied to aircraft autopilot design emphasizing the relevance of the topics discussed in the class. The course also introduces modern control theory which can be useful in taking advanced courses offered in the controls stream. The course also provides a detailed introduction to radar theory and applications, navigation principles and guidance laws.

AE 262 Jan 3:0

Guidance Theory and Applications

Department: Aerospace Engineering

Course Outcomes:

The students are expected to thoroughly grasp the following;1.Understanding of relative engagement geometry and central concepts in interception and avoidance;2.Classical guidance theory: Its development and analysis;3.Optimal control theory and its application to aerospace engineering;4.Trajectory simulations using MATLAB;5.Recent advances in aerospace guidance and the research perspective.

भारतीय विज्ञान संस्थान

AE 264 Jan 3:0

Vibrations

Department: Aerospace Engineering

Course Outcomes:

This course is an introduction to the theory and principles of vibration analysis in mechanical systems. Principles from analytical dynamics are introduced so that one can model and analyze vibration problems. Numerical methods of solution of vibrating problems are emphasized. The issues that are of concern in this study include the modeling and analysis of vibration, and their analytical and numerical solution. After completing this course, the student should be able to model, derive the equations of motion, solve these equations analytically or numerically, and analyze the response of a vibrating system.

AE 271 Aug 2:0

Flight Vehicle Design

Department: Aerospace Engineering

Course Outcomes:

After taking the course the student would;1.Design and fabricate the UAVs from scratch;2.Experience in building different types of UAVs and payload associated with it;3.Have insight in selecting the avionics (Motors, SC, servos) for the UAVs;4.Thorough knowledge in manufacturing field (CNC machining and laser cutting);5.Hands on experience in composite manufacturing techniques;6.Design, fabrication and flying of seed dropping UAVs, which has good societal impact.

AE 274 Jan 3:0

Topics in Neural computation

Department: Aerospace Engineering

Course Outcomes:

The students learn the basics of supervised machine learning in the first part of the course. This part of the course gives students comprehensive exposure to traditional machine-learning algorithms Multi-layer perceptron, radial basis function network, and recurrent neural networks. The course also teaches several unsupervised learning techniques for clustering and dimensionality reduction. A rigorous introduction to spiking neural networks and their learning algorithms is also included in the course. The course also covers metacognitive learning and its application, deep learning and advanced online learning algorithms. In the end, students also do a project in which they explore the applications of the algorithms taught in the course.

AE 282 Jan 3:0

Unmanned Aerial Vehicles

Department: Aerospace Engineering

Course Outcomes:

The course outcomes include;1.A thorough understanding of aircraft flight dynamics;2.A rigorous training in MATLAB based high fidelity modelling and simulation;3.An understanding of the synergy between various aircraft subsystems.

AE210 Jan 3:0

Gas Dynamics

Department: Aerospace Engineering

Course Outcomes:

Understand differences between compressible and incompressible flows. Understand driving forces and consequences and obtain quantitative estimates in duct flows. Know effects of shocks and expansions. Be able to calculate changes to flows across shocks/expansions.

AE221 Aug 3:0

Flight Vehicle Structures

Department: Aerospace Engineering

Course Outcomes:

From this course, the students would learn various theories and principles of analyzing vehicle structural components, method of calculating structural loads due to aerodynamics and various principles by which the structures are designed. The students would develop theoretical problem-solving skills and skills to apply such understanding into structural design practices in aerospace industries.

AE235 Jan 3:0

Non-Destructive Testing & Evaluation (NDT & E)

Department: Aerospace Engineering

Course Outcomes:

Students will learn about different types of defects and damage in Engineering materials and structures, effect of those on the mechanical behaviour of the materials, how to evaluate the integrity of structural components. Choice of right techniques for different applications. Evaluation of safety & Reliabiltty of metallic as well as composite structural components.

भारतीय विज्ञान संस्थान

AE245 Aug 3:0

Mechanics and Thermodynamics of Propulsion

Department: Aerospace Engineering

Course Outcomes:

Strong grasp in fundamentals of Air Breathing Aero Engines: overall cycle analysis as well as component based analysis

AE247 Jan 3:0

Aircraft Engines

Department: Aerospace Engineering

Course Outcomes:

After the completion of course, the student could able to;1.Describe the thermodynamic flow process inside different aircraft engines;2.Carry out performance analysis of different types of aircraft engine;3.Can provide estimation of specific thrust, specific impulse, isentropic efficiencies of major engine components, etc;4.Can able to distinguish and describe engine flow across various engine components;5.Can actively participate in aircraft engine design;6.Can understand the complications associated with the aircraft engine technology

AE250 Aug 3:0

Advanced combustion

Department: Aerospace Engineering

Course Outcomes:

The course involves take home assignments constructed around the open source CANTERA tool which will train students to perform the sort of analysis routinely used in industry to support design and developments of combustion systems. This course would be useful to anyone looking for a career in research or in industry around combustion and related topics.

AE276 Jan 1:2

Experimental Techniques

Department: Aerospace Engineering

Course Outcomes:

The students are expected to learn the art and science of carrying out experimental research. At the end of the course a student should be able to design and carry out an experiment on his/her own. This is an important skill which anybody wanting to do experimental research is expected to possess.

AE316 Jan 3:0

Hydrodynamic Stability

Department: Aerospace Engineering

Course Outcomes:

During the course, students would learn the fundamental theory behind hydrodynamic stability along with a selection of the latest concepts. At the end of this course, they would obtain hands-on experience in developing the necessary theory to analyse a new flow problem. Further, they would know how to solve such problems using applied mathematics concepts or, instead, numerically via developing a series of codes for hydrodynamic stability problems during the coursework.

AE317 Aug/Jan 3:0

Aeroacoustics

Department: Aerospace Engineering

Course Outcomes:

Students would learn the fundamentals of acoustics and aeroacoustics theory during this course. A serious student should be able to extend such concepts to practical applications. Further, students are given significant exposure to computational aeroacoustics with an emphasis to the unique challenges that this particular application of CFD entails which should prepare them well for developing advanced codes in this area.

AE364 Jan 3:0

Micromechanics of composites

Department: Aerospace Engineering

Course Outcomes:

Concepts of homogenization, representative volume element, effective properties of a heterogeneous medium

AI 299o Aug 0:27

MTech Dissertation Project

Department: Artificial Intelligence Stream

Course Outcomes:

The dissertation projects allow the students to apply their leanings in various domains, e.g., embedded systems, communication networks, VLSI, processor design, power electronics etc towards developing electronic systems. These systems encompass IoT, healthcare, neuromorphic computing, power systems etc. The projects undergo various phases, e.g., study phase, design phase and engineering phase before their final demonstration.

भारतीय विज्ञान संस्थान

AS 209 Jan 3:0

Mathematical Methods in Climate Science

Department: Centre for Atmospheric and Oceanic Sciences

Course Outcomes:

The desirable outcome is that students learn when and how to apply different apporaches in probability and statistics, and time-frequency analysis, to atmosphere-ocean datasets (both observed and model simulations). At the end of the course, they also should be able to grasp more advanced techniques available for observational analysis.

AS 215 Aug 3:0

Environmental Fluid Dynamics

Department: Centre for Atmospheric and Oceanic Sciences

Course Outcomes:

Explore the science behind natural air and water flows on Earth and their impact on environmental quality. This course offers insights into atmospheric and oceanic fluid systems, essential for students in Physics, Engineering, or marine and climate sciences. It helps to understand the interplay between fluid dynamics and environmental changes.

AS 308 Jan 2:1

Ocean Modeling

Department: Centre for Atmospheric and Oceanic Sciences

Course Outcomes:

The students are taught the governing equations, their simplification for different types of ocean models and numerical methods for solving them. Hands on training is given in running problems using selected ocean models. The course equips the student to carry out development or application of ocean models.

भारतीय विज्ञान संस्थान

AS202 Jan 3:0

Geophysical Fluid Dynamics

Department: Centre for Atmospheric and Oceanic Sciences

Course Outcomes:

A firm grasp of the basic waves supported by rotating and stratified fluids. Basic notions of quasigeostrophic theory. The role of conservation laws in fluid dynamics.

AS203 Aug 3:0

Atmospheric Thermodynamics

Department: Centre for Atmospheric and Oceanic Sciences

Course Outcomes:

Understanding of the atmospheric processes relating tropical convection and cloud formation.

AS204 Aug 3:0

Radiation and climate

Department: Centre for Atmospheric and Oceanic Sciences

Course Outcomes:

Students will learn the relative importance of greenhouse effect, ice, aerosols, and clouds on earth's climate

भारतीय विज्ञान संस्थान

AS205 Aug 2:1

Ocean Dynamics

Department: Centre for Atmospheric and Oceanic Sciences

Course Outcomes:

An understanding of the basic properties of oceans, their distribution and annual cycle;Processes controlling the evolution of sea surface temperature,mixed layer dynamics,thermocline structure; Understanding of the basin-wide circulation of the Atlantic and Pacific Oceans;Monsoon driven circulation of the Indian Ocean;Basic equations, approximations, scale analysis and simple analytical solutions of the equations governing ocean circulation;Classical theories of ocean circulation their simplicity and short-comings.

AS208 Jan 3:0

Satellite Meteorology

Department: Centre for Atmospheric and Oceanic Sciences

Course Outcomes:

students will learn inversion techniques to convert radiance data from satellites to physical quantities like temperature, humidity, and rainfall

AS211 Jan 2:1

Observational Techniques

Department: Centre for Atmospheric and Oceanic Sciences

Course Outcomes:

Get an appreciation of how weather and climate data are collected and disseminated.

AS212 Aug 3:0

Introduction to Atmospheric Dynamics

Department: Centre for Atmospheric and Oceanic Sciences

Course Outcomes:

The basic equations in atmospheric dynamics. Fundamental balances on a rotating planet. Vorticity and its evolution. Common synoptic systems on Earth. The general circulation of the Earth's atmosphere.

AS216 Aug Term - 3 Credits

Introduction to the Climate System

Department: Centre for Atmospheric and Oceanic Sciences

Course Outcomes:

Solid understanding of the Angular momentum, water, energy, entropy and carbon budget in the climate system.

BC 203 Aug - Dec 3:0

General Biochemistry

Department: Biochemistry

Course Outcomes:

The students upon successful completion of course will have good understanding of Biomolecules;(DNA/RNA/PROTEIN/LIPIDS). They would also have been exposed to latest advancements with regard to synthesis and turnover of these biomolecules.

BC 205/RD 210 Jan 2:0

Fundamentals of Physiology and Medicine

Department: Biochemistry and MRDG

Course Outcomes:

Students will be introduced to Clinical medicine. They will get an exposure to basic embryology, physiology and associated human pathologies. They will also learn the principal treatment modalities.

BC 210 Jan - April 3:0

Molecular Basis of Ageing and Regeneration

Department: Biochemistry

Course Outcomes:

Students will attain;1.Understanding of how ageing occurs and what is the evolutionary significance of ageing;2.Understand the mechanistic basis of regeneration and the evolutionary significance of it.

BC_201 Aug 2:0

CELL BIOLOGY

Department: Biochemistry

Course Outcomes:

Students develop important basic understanding about cellular processes including cell cycle, signaling, trafficking and organellar dynamics. A significant emphasis is laid on experimental approaches used and thereby an appreciation for experimental background behind discoveries is also developed by the students.

भारतीय विज्ञान संस्थान

BC206 Aug 2:0

Essentials in Immunology

Department: Biochemistry

Course Outcomes:

Students would understand basic concepts in the working of human immunological system, at the molecular level.

भारतीय विज्ञान संस्थान

BC207 Jan 2:0

PROTEOMICS IN PRACTICE

Department: Biochemistry

Course Outcomes:

Students develop both theoretical and experimental knowledge about large scale protein analysis which is a part of big data science. Each student is given hands-on training for 2D gel electrophoresis, sample preparation and mass spectrometry-derived proteomic data analysis. They also learn data analysis using databases and search engines such as Mascot and Protein Pilot through e-workshops as a part of this course.

BE 207 Jan 3:0

Mathematical Methods for Bioengineers

Department: Bioengineering

Course Outcomes:

At the end of the course, students will be;1.well-versed with mathematical and statistical concepts of importance to bioengineers;2.have acquired facility with numerical tools for solving mathematical problems in bioengineering

BE 212 Jan 1:0

Research communication

Department: Bioengineering

Course Outcomes:

The course aims to introduce student researchers to research communication and the tools required to communicate their research effectively. By the end of the course, students will have a deeper appreciation of the structure of a research paper and the process of writing it, meaning of peer-review, making a research poster and writing a grant proposal and research statement, ethics of communicating research, and writing clearly and concisely.

BE 213 Aug 2:0

Fundamental of Bio-Engineering - I

Department: Bioengineering

Course Outcomes:

Students develop understanding of the most common techniques for the detection of nucleic acids, proteins, and small molecules. In addition, they are exposed to microfluidic platforms that are used to conduct such techniques to develop portable biosensors. They also develop an appreciation of how systems-level properties emerge from the nonlinear dynamics of underlying biochemical networks.

BE 214 Aug 2:0

Fundamental of Bio-Engineering – II

Department: Bioengineering

Course Outcomes:

This course covers the essentials of biomaterials and cell mechanics. Students learn concepts of biocompatibility, protein adsorption and host response to biomaterials. In addition, polymers (synthesis and properties), metals, and ceramics for biomaterial use are also covered. The second part of the course will teach students how to think about cells as a machine. Viscoelasticity of cells and tissues, cytoskeleton, contractility, and cell movement are covered. Students will also be able to describe how molecular motors function, and how cells of our body coordinate with each other to carry out physiological functions.

BE 216 Jan 3:0

Dynamical Systems Biology

Department: Bioengineering

Course Outcomes:

Students will be able to formulate relevant mathematical models for various biological systems, and simulate them. They will also be able to appreciate how systems-level properties emerge from the nonlinear dynamics of biochemical networks, understand the underlying design principles of various biochemical networks, and use mathematical models to predict their dynamical behaviour.

BE 218 Jan 3:1

Computational Epidemiology

Department: Bioengineering

Course Outcomes:

This is a 3:1 course. After taking this course, the student would become familiar with the concepts and methods of epidemiology in the context of the digital era of today. Statistical analysis methods, Cyber Physical Systems (CPS) approach to outbreak analysis, network models for communicable diseases, computational methodologies for studying various kinds of interventions (therapeutic, non-pharmaceutical, and immunisation) will become familiar. The student will gain hands-on experience by working on a series of computational assignments related to the topics in the course. Some exposure to precision medicine will also be provided.

BE 219 Aug 2:0

Essentials of Research and Innovation

Department: Bioengineering

Course Outcomes:

The course introduces students to the methodologies of research, ethical practices, technical communication of research findings, and intellectual property associated with research. The students will learn the following: logic and reasoning, framing of research question and hypothesis, concepts of technical writing, effective communication of research findings, research ethics, intellectual property, and an introduction to commercialization of research findings.

भारतीय विज्ञान संस्थान

BE 221 Aug 3:0

Introduction to Data Science for Bioengineers

Department: Bioengineering

Course Outcomes:

Students will be introduced to the basic concepts and tools of statistical and machine learning. Students will learn to apply the right hypothesis testing tools to different forms of data, analyse medical and biological data using supervised learning techniques, and utilize unsupervised learning on large data.

BE 222 Aug 3:0

Stem Cell Technology

Department: Bioengineering

Course Outcomes:

Students will know the different types of stem cells and their unique properties. They will describe 2D/3D methods to regulate stem cell differentiation and stem cell-based models in the context of regenerative medicines. Students will think about different ways of using stem cells for clinical applications. Also, they will understand the bioethical issues associated with stem cells.

BE 223 Aug 2:0

Space Biology and Bioengineering

Department: Bioengineering

Course Outcomes:

Students were introduced to basic concepts, current state-of-art and future prospects in the area of space biology and biotechnology. Students were introduced to current bioreactor design for space applications and also given practical demonstrations on the same. Payload design and important results from various space agencies were also introduced.

BE 226 Aug 2:0

Synthetic Biology and Genetic Engineering

Department: Bioengineering

Course Outcomes:

Students are taught theoretical and practical aspects of genetic engineering, recombinant DNA technology, and synthetic biology. They are taught about aspects that are to be considered for generating synthetic circuits, proteins, and controlled expression systems. Emphasis is given to learning from examples of various synthetic biology projects. The lectures include aspects of chemical modification of proteins using unnatural amino acids.

BE206 Aug 3:0

Biology for Engineers

Department: Bioengineering

Course Outcomes:

Upon completion of the course, students will be able to;1.Understand various chemical interactions between molecules in biological systems and the idea of pH;2.Describe the structure and function of various biological molecules;3.Explain basic concepts in enzyme kinetics, function and modes of inhibition;4.Compute association and dissociation constants during protein interactions;5.Discuss different aspects of molecular biology including DNA replication, transcription and RNA translation;6.Demonstrate an understanding of Mendelian laws of inheritance;7.Describe cellular architecture and utilize these concepts to design a synthetic organelle or cell mimic;8.Understand fundamental concepts in tissue architecture and physiology;9.Analyze basic biological laboratory experiments performed by others and critique literature.

BE208 Jan 3:0

Fundamentals of Bioengineering

Department: Bioengineering

Course Outcomes:

Upon completion of the course, students will be able to;1.Describe concepts in polymer science and engineering;2.Understand the mechanics of materials and analyze stress strain relationships;3.Discuss fundamental principles in biomaterials and explain the Vroman effect;4.Write diffusion equations and describe basic transport phenomena in solids and liquids;5.Explain concepts in bioprocess engineering including reactor design, product separation and purification techniques;6.Design polymeric scaffolds for growing cells;7.Describe concepts in stem cell biology and their use in tissue engineering utilize;8.Understand fundamental ideas in computational and systems biology;9.Assess and critique bioengineering literature

BE209 Aug 1:0

Digital Epidemiology

Department: Bioengineering

Course Outcomes:

After taking this course, the student would become familiar with the concepts and methods of epidemiology in the context of the digital era of today. Statistical analysis methods, Cyber Physical Systems (CPS) approach to outbreak analysis and network models for communicable diseases will become familiar. Some exposure to precision medicine will also be provided.

CCE Jan 3:00

Neural Networks for Signal Processing

Department: Electronic Systems Engg.

Course Outcomes:

Students will get a firm foundation towards neural networks and advance their research by building upon known things at a foundational level. It is useful for translational work for practicing engineers/scientists.

CD 225 Jan 0:4

Physical and Analytical Chemistry Laboratory

Department: Integrated Ph.D. Chemical Sciences

Course Outcomes:

The students learn various physical chemistry principles, various types of chemical titrations, measurements techniques related various spectroscopic techniques, X-ray diffraction, thermal methods, electrochemical methods.

CD204 Aug 3

Chemistry of Materials

Department: SSCU

Course Outcomes:

Better understanding of the chemistry behind many compounds, that have been of use as materials in devices. The fundamental understanding of the many structures would help the students to better tune their skills in modifying the properties, if they desire to work in this area.

CD212 Aug 3:0

Inorganic Chemistry-Main Group and Coordination Chemistry

Department: Inorganic and Physical Chemistry

Course Outcomes:

The students will learn the chemistry of different elements belonging to the periodic table.

CD213 Aug 3:0

Organic Chemistry – Structure and Reactivity

Department: Organic Chemistry

Course Outcomes:

The students will learn a great deal of physical chemistry principles as applied to organic chemistry. This would enable them to devise experiments to understand new reactions mechanistically.

CD214 Aug 3:0

Basic Mathematics

Department: Integrated Ph.D in Chemistry

Course Outcomes:

The students learn the basic mathematical tools required for analyzing their research data.

CD223 Jan 3:0

Organic Synthesis

Department: Organic Chemistry

Course Outcomes:

The student shall gain a sound understanding of the basics of organic synthesis, methodology development and multi-step synthesis.

CD224 Jan 2:1

Computers in Chemistry

Department: IPC

Course Outcomes:

The key objective of this course is to impress upon all the course students, especially experimental and theoretical chemists alike, that being able to code, even a little bit, is very useful. Although the numerical techniques discussed are largely available in standard data processing and plotting packages like Origin or Matlab or Mathematica, it is important to know at a basic level what these packages actually do. This would help them understand what to make of the output data from the packages. Knowing to code would help them extract and process or organize data from instruments or other code efficiently, thereby becoming a useful tool in their everyday research.

CD301 Jan 3:0

Advanced NMR Spectroscopy

Department: NMR Research Centre

Course Outcomes:

Prepares the students to be self reliant in dealing many structure and conformational problems encountered in chemistry and biology.

CE 201 Aug 3:0

Basic Geomechanics

Department: Civil Engineering

Course Outcomes:

A thorough understanding of the fundamentals of geomechanics, with a strong theoretical underpinning of mechanics.

CE 202A Aug 3:0

Integrated Investigation of Dams

Department: Civil Engineering

Course Outcomes:

The students get a thorough Basics of different subsurface investigation methods through theory Class. This was followed by hands-on training in Laboratory and Field testing of Subsurface problems and mapping of subsurface features. Most advanced techniques of invasive methods of penetration tests and non-invasive tests seismic, electrical and electromagnetic methods are learned by students. So, that these concepts can be applied to investigate existing dams and condition assessment of the dam structure. The course also teaches all modern testing methods and the interpretation of data with case studies. The course involved a mini project, where students must demonstrate their learning by carrying out the experiment, collecting data, and interpreting results.

CE 203A Aug 3:1

Hydrologic Safety Evaluation of Dams

Department: Civil Engineering

Course Outcomes:

The students get an overview of the significance of hydrologic safety evaluation of dams and modeling uncertainty in hydro-meteorological processes. They learn about various approaches/models to arrive at estimates of extreme rainfall, probable maximum precipitation, and the corresponding flood hydrographs for the design and risk assessment of dams and other major hydraulic structures and flood protection works in river basins. The course also covers regional frequency analysis options, which could be explored for predicting floods at ungauged/sparsely gauged locations.

CE 205A Aug 3:0

Transportation Logistics

Department: Civil Engineering

Course Outcomes:

The students learn classic problems in logistics such as routing (last-mile logistics) and scheduling (vehicle/crew) and efficient solution techniques that scale well. Most models discussed exposes students to tools from integer programming/combinatorial optimization. Students also implement their algorithms on benchmark data sets from literature and from other open datasets.

भारतीय विज्ञान संस्थान

CE 206A Aug 3:0

Mathematical methods for machine learning

Department: Civil Engineering

Course Outcomes:

The course aims to explain the role of subjects of matrix algebra, probability theory, statistics, and optimization in developing various machine learning algorithms. The students get introduced to supervised, unsupervised, and reinforcement learning algorithms with emphasis on understanding the probabilistic basis of these algorithms. The students gain an appreciation of the important role of underlying physics in developing machine learning algorithms while dealing with mechanical systems (such as data originating from buildings, bridges, vehicles, and machines) which are engineered by applying laws of physics.

भारतीय विज्ञान संस्थान

CE 207 JAN 3:0

Geo-environmental Engineering

Department: Civil Engineering

Course Outcomes:

Understanding geo-environmental challenges and corresponding design such as landfill designs, contaminant transport, barrier design, climate change effects

CE 208 Jan 3:0

Ground Improvement and Geosynthetics

Department: Civil Engineering

Course Outcomes:

Student will learn about various ground improvement techniques available, how to design them and implement them in field along with various case studies where ground failures were resolved using these techniques and also many case studies that involved ground improvement in large scale with details of engineering design aspects.

CE 222 Jan 3:0

Fundamentals of Soil Behaviour

Department: Civil Engineering

Course Outcomes:

Students learn about soil mineralogy, type and formation of soils, mechanical response of soils to changes in physico-chemical environment

CE 223 Aug 3:0

Hydro-climatology

Department: Civil Engineering

Course Outcomes:

Students receive a general background on hydroclimate processes. They learn the difference between long-term climate simulations and short-range forecasting. Several forecasting models are discussed in class. Students learn how to issue sub-seasonal to seasonal forecasts of streamflow based on climate information. Finally, various performance measures related to deterministic to probabilistic forecasts are also taught.

CE 238 Jan 3:0

Structural Masonry

Department: Civil Engineering

Course Outcomes:

Masonry behaviour; Design Principles; Design of real time masonry structures

CE 248 JAN 3:0

Regionalization In Hydrology And Water Resources Engineering

Department: Civil Engineering

Course Outcomes:

Students would learn about various regionalization approaches which facilitate estimation of hydrometeorological variables, hydrological processes and environmental extreme events (floods, rain storms, droughts) in real world scenario where data are often sparse or unavailable.

CE 285 Jan 3:0

Disaster Management for Dams

Department: Civil Engineering

Course Outcomes:

The students get an overview of different failure modes of various types of dams, apart from methods for assessment of dam breach consequences and emergency action plan preparation. The course introduces various criteria/frameworks used globally (including India) for dam hazard potential classification, and methods for hydrologic and hydraulic routing of dam breach outflow for flood risk assessment. Students further learn about Remote Sensing and Geographic Information Systems (GIS) applications for emergency preparedness and flood mapping.

CE 295 Jan 3:0

Earth Retaining Structures and Earthen Dams

Department: Civil Engineering

Course Outcomes:

Students in this course learn how to (i) determine the earth pressures on various types of earth retaining walls; (ii) design different types of earth retaining walls, bracing system for excavation and sheet pile walls; (iii) determine the stability of earth and rock fills dams under different critical conditions; and (iv) determine the pore pressure in soils under different drainage and seepage conditions.

CE2015 Aug 3:0

An Introduction to Finite Elements

Department: Civil Engineering

Course Outcomes:

The essence of weak formulations and its advantages over direct solutions of strong forms in numerical implementation; how does the notion of piecewise implementation useful in solving solid mechanics problems with complex geometry; how to interpret convergence of numerical solutions

CE203 AUG 3:0

Surface Water Hydrology

Department: Civil Engineering

Course Outcomes:

Students would learn about procedures for analysis of various hydrometeorological and hydrological processes in river basins, and environmental extremes (floods).

CE204 Aug 3:0

Solid Mechanics

Department: Civil Engineering

Course Outcomes:

Rigorous introduction to the principles of solid mechanics, and the ability to apply these principles to solve problems in a wide variety of applications.

CE206 Jan 3:0

Earth and Earth Retaining Structures

Department: Civil Engineering

Course Outcomes:

The students is trained for (i) determining earth pressures on retaining structures, (ii) computing stability of slopes and earthen dams in the presence of ground water seepage and earthquake forces, and (iii) design of braced excavation for deep cuts and excavation in ground.

CE210 Jan 3:0

Structural Dynamics

Department: Civil Engineering

Course Outcomes:

1.To learn how to formulate and solve the equations of motion governing linear dynamical systems subjected to periodic and aperiodic excitations;2.To understand the notions of frequency and time domain analyses, discrete and continuous systems, generalized coordinates, normal modes and orthogonality properties, and uncoupling of equations of motion;3.To learn how to model structural dynamic behavior of structures subjected to wind, earthquake and moving loads;4.To introduce approximate methods for free and forced vibration analysis of linear systems;5.To witness laboratory demonstration of various dynamical phenomena such as resonance, normal modes, vibration under dynamic support motions, seismic wave amplification, sloshing in liquid storage tanks, vibration absorption and isolation and rocking of rigid objects;6.To witness the working of a multi-axes earthquake simulator.

CE213 Jan 3:0

Systems Techniques in Water Resources & Environmental Engineering

Department: Civil Engineering

Course Outcomes:

1.Learning Deterministic optimization techniques such as Linear Programming, Dynamic Programming, Optimization using Calculus;2.Learning Stochastic Optimization techniques such Stochastic Dynamic Programming, Chance Constrained Liner Programming;3.Application of above system techniques in the files of Water Resources and Environmental Engg such as reservoir sizing, planning and operation, river water quality management, water supply systems, irrigation management.

CE215 Jan 3:0

Stochastic Hydrology

Department: Civil Engineering

Course Outcomes:

Students would be equipped with methodologies of addressing uncertainties in hydrologic systems and one step ahead forecasting.

भारतीय विज्ञान संस्थान

CE219 Aug 3:0

Soil Dynamics

Department: Civil Engineering

Course Outcomes:

The student usually learns as to how to;(i) design foundations and isolation systems subjected to different kinds of vibrations;(ii) determine dynamic properties of soils by using laboratory and non-destructive field tests, and; (iii) assess the liquefaction potential of a given site.

CE220 Aug 3:0

Design of Sub-structures

Department: Civil Engineering

Course Outcomes:

Evaluation of bearing capacity from field and laboratory testing, designing of shallow and deep foundations for various loading conditions.

CE221 Aug 3:0

Earthquake Geotechnical Engineering

Department: Civil Engineering

Course Outcomes:

After the completion of course, students will learn about all the engineering aspects of earthquakes and ground response and they would be able to analyse and quantify earthquake hazard in terms of ground amplifications, deformations and liquefaction and would be able to design earthquake resistant structures.

CE227 Jan 3:0

Engineering Seismology

Department: Civil Engineering

Course Outcomes:

Understanding all facts of earthquake hazards, will be able to quantify different earthquake hazards and its effects (e.g. site effects, liquefaction, landslides etc) using different methods, which facilitate in planning new structures/project and retrofit old buildings and infrastructures.

CE235 Jan 3:0

Optimization Methods

Department: Civil Engineering

Course Outcomes:

Student will understand how to formulate an engineering optimization problem and thereafter select appropriate tools needed to solve the problem.

भारतीय विज्ञान संस्थान

CE240 Jan 3:0

Uncertainty Modeling and Analysis

Department: Civil Engineering

Course Outcomes:

1.Ability to model various uncertain parameters in a natural or engineering system, specially in a probabilistic way;2.Propagating this uncertainty via various computational methods to predict the output quantity of interest;3.Ability to write efficient computer programs related to probabilistic methods.

CE241 Aug 3:0

Advanced Structural Dynamics

Department: Civil Engineering

Course Outcomes:

Felicity with FE modelling of vibrating structures;An understanding of role of uncertainties in loads (such as earthquake, wind, moving loads, and road roughness);Introduction to modern concepts in structural health monitoring.

CE242 Aug 3:0

Fire structural engineering

Department: Civil Engineering

Course Outcomes:

How to model fire as a load;How to analyse structures under fire loads by incorporating variation of material properties with respect to temperature, geometric and material non-linearities.

CE243 Aug 3:0

Bridge Engineering

Department: Civil Engineering

Course Outcomes:

Concepts of Bridge design and ability of students to understand force flow and design bridges.

CE246 Aug 3:0

Urban Hydrology

Department: Civil Engineering

Course Outcomes:

The students would be prepared to analyse urban stormwater systems, urban precipitation and stormwater runoff. They would also learn quantification of impacts of climate change on short duration high intensity rainfall in urban areas. Case studies of several cities in India are dealt with, in the seminars presented by the students, and thus they get an exsposure to a variety of urban flooding problems. An exposure to the entire urban water cycle is also provided.

CE247 Aug 3:0

Remote Sensing and GIS in Water Resources and Environmental Engineering

Department: Civil Engineering

Course Outcomes:

1.Learning about satellite remote sensing, GIS, DEM and GPS;2.Learning about digital image processing for image rectification, enhancement and information extraction;3.Application of RS, GIS, DEM and GPS is various domains including rainfall-runoff modelling, Snow mechanics, Watershed management, Irrigation management, soil moisture estimation, Drought and Flood monitoring, Environment and ecology.

CE263 Aug 3:0

Modelling Transport and Traffic

Department: Civil Engineering

Course Outcomes:

The students will learn to use various quantitative methods (in modeling, simulation, and optimization) to solve problems of urban transportation systems both with respect to planning and operations. The students will be equipped with adequate know how to plan various transport improvements in a given urban area.

CE267 Jan 3:0

Transportation Statistics and Micro-Simulation

Department: Civil Engineering

Course Outcomes:

The students will learn to use various data science approaches for understanding and analyzing transportation data, measuring reliability of transportation system, doing impact studies, before-and-after improvement studies, assessing the performance of transportation system etc.

CE272 Jan 3:0

Traffic Network Equilibrium

Department: Civil Engineering

Course Outcomes:

Students will learn to formulate multi-agent systems using a game theoretic approach and will devise algorithms and implement them to find the equilibrium solutions to these problems

CH 207 Jan 1:0

Applied probability and design of experiments

Department: Chemical Engineering

Course Outcomes:

Students will be able to construct point and interval estimates for the population mean and interval estimates for the population variance for single samples, test hypotheses about a single sample and the difference in the means of two samples, learn about P-values, use linear regression to fit data and construct confidence intervals for the slope and the intercept, and perform analysis of variance for single factor and multiple factor experiments.

CH 242 Aug 3:0

Special Topics in Theoretical Biology

Department: Chemical Engineering

Course Outcomes:

At the end of the course, students will have;1.developed an appreciation of the power of theoretical techniques in investigating biological phenomena;2.gained an understanding of selected classic and current topics in theoretical biology;3.acquired hands-on experience in the application of theoretical techniques to biological problems

CH 244 Aug 3:0

Treatment of drinking water

Department: Chemical Engineering

Course Outcomes:

Students will learn about the availability and distribution of water, different methods of treating water to make it potable, and mathematical models for some of the processes

CH 250 Aug 3:0

Laminar flows

Department: Chemical Engineering

Course Outcomes:

The student learns advanced techniques in fluid mechanics relevant for laminar flows at both low and high Reynolds numbers. This includes the solution of the Laplace equations and lubrication analysis for low Reynolds number flows, potential flows in two and three dimensions and boundary layer analysis for high Reynolds number flows. In addition, vorticity dynamics and an elementary introduction to turbulence is also provided.

भारतीय विज्ञान संस्थान

CH 251 Aug 3:1

Machine Learning for Materials and Molecules

Department: Chemical Engineering

Course Outcomes:

Students are introduced to data science and machine learning (ML) for discovering and designing materials and molecules for sustainable energy, clean water/air, and healthcare. Students learn the theory and applications of regression and classification models, unsupervised learning (clustering and principal component analysis), and supervised learning (decision trees, gradient boosting, and neural networks). Students develop ML models using Python for solving challenging problems in materials informatics.

CH201 Aug 3:0

Chemical Engineering Mathematics

Department: Chemical Engineering

Course Outcomes:

Students completing this course will be equipped to analyze and solve problems arising in a variety of fields in engineering and science that are of the form of algebraic, differential, or integral equations. They will be able to classify ordinary and partial differential equations, and choose the appropriate method of solution. They will be equipped to obtain series solutions of ordinary differential equations, and solve homogeneous and inhomogeneous partial differential equations. They will learn tools of orthogonal decomposition, and use it for numerical quadrature, and the solution of inhomogeneous initial and boundary value problems.

CH202 Aug 3:0

Numerical Methods

Department: Chemical Engineering

Course Outcomes:

1.Using Matlab to execute numerical algorithms;2.Numerical solutions of multivariable nonlinear algebraic equations;3.Data fitting algorithms;4.Finite difference techniques for solving differential equations

CH203 Aug 3:0

Transport Processes

Department: Chemical Engineering

Course Outcomes:

Students should have a comprehensive understanding of how a balance between convection and diffusion in heat/mass and momentum transfer at the microscopic level gives rise to the transport rates at the macroscopic scale, and how these can be calculated using solution procedures such as similarity transforms, separation of variables and boundary layer theory.

CH204 Aug 3:0

Thermodynamics

Department: Chemical Engineering

Course Outcomes:

A student who has successfully completed the course should be able to preform thermodynamic analysis of real-world systems, irrespective of the number of phases or components in the system. The student will gain expertise in computing phase equilibria, as well as modelling thermodynamics of solutions. He/She will also gain an understating of statistical thermodynamics at the introductory level such as the concept of partition functions and its relationship to thermodynamics.

CH205 Jan 3:0

Chemical Reaction Engineering

Department: Chemical Engineering

Course Outcomes:

Identify appropriate reactor networks for a given reacting system;Ability to generate appropriate reaction schemes for a given set of reactants Perform non-ideal reactor analysis;understand elements of catalytic processes;Handle complex design problems using computational tools

CH206 Aug 1:0

Seminar Course

Department: Chemical Engineering

Course Outcomes:

The students will be able to deliver well-organised technical presentations at conferences and other symposia.

CH235 Aug 3:0

Modelling in Chemical Engineering

Department: Chemical Engineering

Course Outcomes:

A student should be able to analyze a complex system at hand, in general area of interest to chemical engineers, identify/hypothesize equilibrium steps, rate processes, driving forces at work, and;coupling/inter-dependence among them, and express this understanding in terms of mathematical relationships by making use of established physical laws. The set of mathematical relationships, complete with initial and boundary conditions, and constitutive and equilibrium relationships, should be solvable to make quantitative predictions to test validity of model, explain existing observations, and make new predictions to either aid in engineering design and control or establish model through experimental corroboration.

भारतीय विज्ञान संस्थान

CH236 Jan 3:0

Statistical Thermodynamics

Department: Chemical Engineering

Course Outcomes:

The student will gain an understanding of the principles of statistical thermodynamics and lays the foundation for studying advances topics in statistical mechanics. A successful completion of the course will enable the student to pursue scientific research in the areas of statistical mechanics, physical chemistry and chemical physics.

भारतीय विज्ञान संस्थान

CH245 Jan 3:0

Interfacial and Colloidal Phenomena

Department: Chemical Engineering

Course Outcomes:

After taking this course, a student should be able to quantitatively understand;1.the constraints on the nature of intermolecular attraction to lead to system size independent intrinsic properties of materials;2.the origin of van der Waals attraction between molecules, and the factors that make it strong/weak;3.how intermolecular forces lead to long range attractive forces between particles, and continuum properties of three phases involved modulate it;4.Double layer formation---distribution of counter-ions and other ions in vicinity of a charged surface in a medium;5.Balance of repulsion between charged surfaces due to osmotic pressure buildup and van der Waals attraction between bodies decides kinetic stability of dispersed phase systems using DLVO theory;6.Hydrophobic effect which imparts surfactant molecules their special character;7.Cause of formation of self-assembled structures such as micelles of various sizes and shapes, bilayers and vesicles, and link it to 2 and 3 component surfactant phase diagrams;8.The molecular origin of interfacial tension through anisotropic pressure tensor, and excess surface energy;9.Laplace pressure jump across curved interfaces leading to jet breakup and capillarity;10.Consequences through Kelvin equation for particle size dependent properties of small fluid and solid structures;11.The angle of contact when three phases meet on a contact line: wetting, non-wetting, and partial wetting behavior;12.Contact angle hysteresis through receding and advancing contact angle;13.And most important, relate all the concepts to day to day observations, manifestations in nature, and in emerging technologies;14.A student should be able to identify how interparticle and surface forces could be playing a role in a new system, isolate them by reasoning and additional experiments, and make progress towards engineering desired control on it.

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CH247 Jan 3:0

Introduction to molecular simulations

Department: Chemical Engineering

Course Outcomes:

The student will learn both basic and advanced molecular simulation techniques. Also upon successful completion, the student will be able to write his/her own code for performing molecular simulations.

CH248 Aug 3:0

Molecular Systems Biology

Department: Chemical Engineering

Course Outcomes:

Students taking this course will be;1.Able to distill and model biomolecular interactions and biological phenomenon as mathematical models and simulate them;2.Explain the various physical modeling approaches for biomolecules, biological pathways, regulation and networks;3.Explain the various methods to measure the relevant molecular and network properties;4.Model biological pathways like transcription networks, signal transduction pathways, and spatio-temporal differentiation programs.

CP 214 Aug 2:1

Foundations of Robotics

Department: Cyber Physical Systems

Course Outcomes:

This course serves as an introductory robotics course for students with little/no background in mechanical systems. With this course, the students build the necessary mathematical framework in which to understand topics such as center of gravity and moment of inertia, friction, statics of rigid bodies, principle of virtual work, kinematics of particles and rigid bodies, impacts, Newtonian and Lagrangian mechanics, rigid body transformations, forward and inverse kinematics, forward and inverse dynamics, state space representations. The course also provides hands-on training in dynamic simulators and computational tools used for robotic platforms.

CP 230 Jan 2:1

Motion Planning for Autonomous Systems

Department: Cyber Physical Systems

Course Outcomes:

The students learned about different search-based planning algorithms such as DFS, BFS, Dijkstra, A* algorithm, and basics of reinforcement learning. They also learned about the criteria for comparing algorithms and their time and space complexity, obstacle representations; planning complexity, various heuristics for A* algorithm; Markov decision processes, value and policy Iteration algorithms, sampling-based planning (RRT & RRT* algorithms), geometric representations; configuration space; topological space concepts; representation of obstacles; collision detection and avoidance in relative velocity space; collision cones and velocity obstacles; Artificial potential fields. The assignments helped to give the students exposure to using these motion planning algorithms to practical and realistic problems from the literature.

CP 232 Aug 2:1

Swarm Robotic System

Department: Cyber Physical Systems

Course Outcomes:

The students get a thorough introduction to modeling aspects of quadrotor unmanned aerial system (UAS) dynamics. They also get a detailed introduction to the control system design commonly implemented on quadrotor UAS platforms. The students are assigned specific projects that involve working with a simulation and experimental testbed comprising of multiple UAS platforms demonstrating different aspects of autonomous navigation, which is used to assess student learning and performance at the end of the course.

CP 242 Jan 2:1

Human Robot Interaction

Department: Cyber Physical Systems

Course Outcomes:

Students were taught basics of perception, cognition, rapid aiming movement and haptics. History of robotics, collaborative robots, social and assistive robotics were covered. Many industrial use cases of robots and human robot interaction were demonstrated. Evaluation was done based on term papers and course projects on HRI.

CP 260 Jan 2:1

Robotic Perception

Department: Cyber Physical Systems

Course Outcomes:

After undergoing this advanced course, the students are able to understand both the fundamental techniques as well as the state of the art approaches to robotic perception. The laboratory component of the course also trains the students in better appreciating the concepts, nuances and challenges, as well as enhances their practical skills in developing software solutions for perception problems.

CP 275 Aug 1:2

Formal Analysis and Control of Autonomous Systems

Department: Cyber Physical Systems

Course Outcomes:

The students get a thorough introduction to modelling, analysis, and control of Cyber-Physical Systems. Students develop an understanding of formally representing complex tasks for physical systems where spatial, temporal, and logical requirements are inevitable. In addition, through the lab component students learned to implement the learned techniques on real robotic platforms via the ROS interface.

CP 280 Jan 1:2

Mathematical Techniques for Robotics and Automation

Department: Cyber Physical Systems

Course Outcomes:

The students develop theoretical and practical understanding of fundamental concepts in linear algebra and probability, with a special emphasis on applications for robotics and autonomous systems. The students will be able to model analytically many of the practical scenarios by appying the theoretical concepts. In addition, the computational exercises gives them a better intuitive feel for the concepts. With this fundamental background, the students will. be able to understand the state of the art approaches and technologies in robotics and autonomous systems.

CP 282 Aug 0:26

Field Robotics

Department: Cyber Physical Systems

Course Outcomes:

Students develop experimental knowledge about robots and drones. The concepts are applied to drone autopilot design emphasizing the relevance of the topics discussed in the class. Each student is given hands-on training for ground robots and a few flight tests. Students understand the middleware for autonomous operations, sensor calibrations and sensor interfaces with actual robots. Also, conduct experiments on the thrust-bench test, attitude control test, and development of simulation environment. Students have completed the course project to demonstrate their experimental skills.

CP 299 Aug 3:1

MTech Project

Department: Cyber Physical Systems

Course Outcomes:

The students get to work on various projects in various domains of robotics and autonomous aspects. The projects span from theoretical aspects, analysis, and practical implementations. The students get the opportunity to work with domain experts, and industry experts to explore various research directions.

भारतीय विज्ञान संस्थान

CP 312 Oct 2:1

Robot dynamics and control

Department: Cyber Physical Systems

Course Outcomes:

This course serves as an introductory robotics course for students with little/no background in mechanical systems. With this course, the students build the necessary mathematical framework in which to understand topics such as center of gravity and moment of inertia, friction, statics of rigid bodies, principle of virtual work, kinematics of particles and rigid bodies, impacts, Newtonian and Lagrangian mechanics, rigid body transformations, forward and inverse kinematics, forward and inverse dynamics, state space representations. The course also provides hands-on training in dynamic simulators and computational tools used for robotic platforms.

CP 315 Jan 2:1

Robot Learning and Control

Department: Cyber Physical Systems

Course Outcomes:

This course serves as an introductory robotics course for students on application of control/learning techniques for robotic systems. With this course, the students build the necessary background to understand topics such as linear and nonlinear control, reinforcement learning based control and deep learning tools for different robotic platforms. The course also provides hands-on training in learning frameworks and computational tools used for robot control.

CP 316 Jan 2:1

Real-time Embedded Systems

Department: Cyber Physical Systems

Course Outcomes:

Implement interrupt-driven systems, overcoming limitations of polling systems. Port real-time operating system and build multitasking applications, addressing mutual exclusion and synchronization issues. Learn Linux kernel architecture, understanding its limitations and approaches to meet real-time requirements. Acquire embedded program.

CP 318 Aug 0:3

Data Science for Smart City Applications

Department: Cyber Physical Systems

Course Outcomes:

This interdisciplinary course will equip students with the ability to analyze, infer, and predict insights from large-scale, real-world data prevalent in city networks, encompassing diverse sources such as GPS vehicular data, IoT sensor data, social media data, and smartphone data. Through case studies and programming workshops, students will apply these techniques to address smart city challenges, including urban environment monitoring, intelligent transportation, smart industry, energy-efficient buildings, healthcare, and social media. Moreover, students will develop an interdisciplinary mindset, enabling them to bridge various domains and address complex problems while upholding ethical data handling practices in the smart city landscape.

भारतीय विज्ञान संस्थान

CY 215 Aug 0:14

Advanced Laboratory - 1

Department: Chemical Science

Course Outcomes:

Course provides comprehensive hands-on training for gaining expertise in synthetic organic chemistry for a career in research, covering natural product extraction, single and multi-step syntheses including Diels-Alder, Wittig, Grignard reactions, solution phase peptide synthetic protocols, etc.; various purification techniques; chromatographic identification & isolation; and spectroscopic characterization of different organic compounds.

CY 225 Aug 3:0

Spectroscopic Methods for Structure Determination

Department: Chemical Science

Course Outcomes:

This course enables the students to understand the basic theory and real-life applications of several spectroscopic methods routinely used for molecular structure determination help. The areas covered are electronic absorption and fluorescence, infra-red, nuclear magnetic resonance spectroscopy and mass spectrometry. Many examples are shown in each of these sub-themes, and finally a combined application of the spectroscopic techniques for structural elucidation is demonstrated. Wherever possible, applications of the spectroscopic methods to solve real-life problems are emphasized. It is expected that at the end of the course the students will be ready to utilize their spectroscopy knowledge to solve practical problems. We expect that this knowledge will provide the appropriate background for working in analytical laboratories.

CY 226 Aug 0:3

Advanced Laboratory - II

Department: Chemical Science

Course Outcomes:

The students obtain thorough exposure to a wide range of physical chemistry experiments, methodologies, and analytical instruments. The assigned experiments provide a hands-on opportunity for the students to appreciate the important physical chemistry principles and their applications in various branches of Chemistry and beyond. The experiments range from various types of titrations, monitoring reactions, and quantitative analysis using conventional chemistry and state-of-the-art analytical instruments.

भारतीय विज्ञान संस्थान

CY 303 Aug 3:0

Inorganic Chemistry-2: Organometallic Chemistry

Department: Chemical Science

Course Outcomes:

Students get introduced to organometallic chemistry. Students learn the 18 electron rule and its applications, reaction types in organometallic chemistry and the detailed chemistry of different classes of organometallic compounds. In addition, the course also covers concepts such as dynamics and certain special types of bonding in organometallic compounds and homogeneous catalysis.

DA 218o Aug 3:1

Probabilistic Machine Learning: Theory and Applications

Department: Data Science & Business Analytics Stream

Course Outcomes:

This course provides probabilistic view of various machine learning techniques. It provides both theoretical and application knowledge to students on Bayesian learning. Upon completing this course, students will attain a comprehensive understanding of advanced statistical tools and Bayesian learning algorithms, equipping them with the knowledge and skills to effectively utilize these techniques. Students will learn to design, implement, and assess Bayesian learning systems, including statistical machine learning components, for the purpose of solving real-world problem. They will develop an appreciation for the suitability of different tools and algorithms in various tasks.

DB201 Aug 2:0

Mathematics and Statistics for Biologists

Department: Integrated PhD

Course Outcomes:

Students are expected to be comfortable with basic mathematical concepts in Calculus, Linear Algebra and Statistics by the end of the course.

DB202 Aug 2:0

General Biology

Department: Centre for Ecological Sciences

Course Outcomes:

Students are exposed to the state-of-the-art in concepts, methodologies, and controversies in the subject matter of the course. They will learn how to think critically about the subject and to critique published material as well as online material available on the internet.

DB204/RD201 Aug 2:0

Genetics

Department: Molecular Reproduction, Development and Genetics

Course Outcomes:

The course aims to make students understand the fundamental principles that govern the dissemination of hereditary information As this understanding is crucial in all subjects in biology, the course provides the necessary foundation. As the discussions are interactive, the students are challenged to come up with answers to critical questions rather than being spoon-fed with information. As the course also discusses classical experiments, the students gain the understanding of the scientific process of discovery. This also helps to sharpen their critical abilities..

DS 200 JAN 0:1

Research Methods

Department: Computational and Data Sciences

Course Outcomes:

It will teach and make students aware of research methods and also develop important soft skills for the students.

DS 201 Aug 2:0

BioInformatics

Department: Computational and Data Sciences

Course Outcomes:

The students get a conceptual understanding of data analysis and its relation to experimental observations. The mathematical basis of the approaches and the deployed algorithms are covered to impress why a given analysis/prediction strategy was taken, and the assumptions therein. The course caters to multidisciplinary backgrounds of the students covering the basics of computer use through Linux, use of alignments and their applications in interpreting DNA, RNA and protein sequences. High throughput techniques involving genome analysis, mass spectrometry. protein structure prediction, protein-protein docking/interaction are some of the other topics covered.

DS 202 Aug 2:1

Algorithmic Foundations of Big Data Biology

Department: Computational and Data Sciences

Course Outcomes:

Students gain a broad overview of computational algorithms and data structures for biological sequence analysis. The course syllabus has a significant concentration on genomics and related problems such as high-throughput pattern matching of biological sequences, data compression algorithms, gene finding, genome assembly and phylogenetics. Hands-on programming assignments were offered to appreciate the complexities of real-world data. Many algorithmic techniques learnt in this course are also applicable to areas beyond biology such as text mining, plagiarism checking, web searching and natural language processing.

DS 222 Aug 3:1

Machine Learning with Large Datasets

Department: Computational and Data Sciences

Course Outcomes:

This course teaches students to develop scalable machine learning techniques, both in standalone and in distributed settings. Students learn about design considerations in this area, available tools and algorithms, and also about open problems. Students also get to learn about developments in the industry through various guest lectures from the industry.

DS 260 JAN 3:0

Medical Imaging

Department: Computational and Data Sciences

Course Outcomes:

Medical Imaging is an interdisciplinary subject that requires understanding of physics, technology, and practice of each medical imaging modality. This course will cover physics and technology part. Homework, presentations, and exams will test your understanding of physics and technology aspects. Project will involve development of a compact solution to current problem/s in medical imaging, such that it will enhance your understanding of challenges related to medical imaging.

DS 261 Aug 3:1

Artificial Intelligence for Medical Image Analysis

Department: Computational and Data Sciences

Course Outcomes:

Through this course students learns deep learning techniques to identify, classify, and quantify patterns in clinical images. It covers applications in neuro, brain, retinal, pulmonary, and other medical domains. The course equips students with skills for automated/fully data-driven image processing, analysis, and knowledge-based prediction in healthcare.

DS 265o Aug 3:1

Deep Learning for Visual Analytics

Department: Artificial Intelligence Stream

Course Outcomes:

Students were introduced to the basics of machine learning and deep learning. Apart from theory, students were given assignments/projects to train deep models for various vision applications including classification, detection, segmentation etc using python. Students also learn some advanced topics such as GANs, Transformers, Diffusion Models, Neural Radiance Fields (NeRF), model robustness etc.

DS 269 Jan 2:1

Computational Methods for Reacting Flows

Department: Computational and Data Sciences

Course Outcomes:

The first part of this course would train students in developing detail chemistry based reacting flow solvers, specifically relevant to combustion processes. Dimensionality reduction concepts coupled with neural networks for parametrising thermo-chemical properties that would significantly lower computational costs will be introduced. The second part of the course focuses on data analysis methods for combustion datasets. Both standard and machine learning based analyses methods are covered. In addition to the theoretical background, the course would involve programming of a one-dimensional solver and hands-on data analysis exercises.

DS 284 Aug 2:1

Numerical Linear Algebra

Department: Computational and Data Sciences

Course Outcomes:

Numerical methods and their analysis for solving different types of linear systems.

भारतीय विज्ञान संस्थान

DS 285 Aug 3:1

Tensor Computations for Data Science

Department: Computational and Data Sciences

Course Outcomes:

1-Students will learn a basic understanding of the theoretical foundations of tensor computation. 2-Students will choose efficient tensor decomposition for solving a specific problem. 3-Students will learn efficient algorithms for tensor operations, including multiplication, decomposition, and inverse of tensors. 4-Students will learn how to implement and use tensor computation in data sciences, including image deblurring, image compression, and solving high dimensional partial differential equations. 5-Students will learn the basic tensor computation in neural networks.

DS 290 Aug 3:0

Modelling and Simulation

Department: Computational and Data Sciences

Course Outcomes:

An algorithmic view of stochastic simulation and analysis of convergences, confidence intervals, modeling of input, statistical interpretation of outputs etc.

DS 291 Jan 3:1

Finite elements: Theory and Algorithms

Department: Computational and Data Sciences

Course Outcomes:

The students will learn the mathematical theory of finite element methods and fully practical finite element algorithms for solving partial differential equations elliptic and parabolic scalar PDES, linear elasticity, Mindlin-Reissner plate problem, Navier-Stokes equations.

DS 294 Jan 3:0

Data Analysis and Visualization

Department: Computational and Data Sciences

Course Outcomes:

At the end of the course, the students should be able to parse a real-world data analysis problem into one or more computational components learned in this course, apply suitable machine learning and/or visualization techniques and analyze the results obtained to enable optimal decision making. This would also act as a first course in data science which would provide necessary pre-requisites and knowledge to explore more specialized and involved topics in machine learning, analytics, statistics etc.

DS 298 Aug 3:1

Random Variates in Computation

Department: Computational and Data Sciences

Course Outcomes:

This course is aimed at introducing graduate students to random variate generation, and statistical methods in computation with continuously varying numbers. Basic sets of operations namely linear algebra, integration of functions, and evaluation of statistical parameters, are addressed in high-dimensions using random sampling where a purely numerical approach may either be unviable or significantly less efficient. The course has three modules: Random variate generation, randomized numerical linear algebra, random sampling and integration/estimation. Students are exposed to the basic concepts, integration of these into optimal algorithms, and their example applications.

भारतीय विज्ञान संस्थान

DS 391 Jan 3:0

Data Assimilation to Dynamical Systems

Department: Computational and Data Sciences

Course Outcomes:

Familiarity with basics of modern data assimilation techniques

DS 397 JAN 3:1

Topics in Embedded Computing

Department: Computational and Data Sciences

Course Outcomes:

1.Many Core Architectures for SoCs;2.Programming massively parallel and runtime reconfigurable systems Programming Models;3.Execution Models

DS221 Aug 3:0

Introduction to Scalable Systems

Department: Computational and Data Sciences

Course Outcomes:

Fundamentals of Parallel programming and architectures. Good knowledge of concurrent data structures, cloud computing fundamentals. And mainly ability to devise and program parallel algorithms.

DS-255 Jan 3:1

System Virtualization

Department: Computational and Data Sciences

Course Outcomes:

Contemporary Cloud data centers are complex distributed system setups involving many technologies to deliver the common goals of cloud computing paradigm. As a result of this course the student gets to understand the conceptual constructs of system virtualization that is extensively used as a building block in many of the cloud datacenters. This course prepares them to understand, architect, use and innovate the distributed systems architectures in such setups.

DS256 Jan 3:1

Scalable Systems for Data Science

Department: Computational and Data Sciences

Course Outcomes:

At the end of the course, students will have learned about the following concepts;1.Types of Big Data, Design goals of Big Data platforms, and where in the systems landscape these platforms fall;2.Distributed programming models for Big Data, including Map Reduce, Stream processing and Graph processing;3.Runtime Systems for Big Data platforms and their optimizations on commodity clusters and Clouds;4.Scaling data Science algorithms and analytics using Big Data platforms.

DS265 Jan 3:1

Deep Learning for Computer Vision

Department: Computational and Data Sciences

Course Outcomes:

1.Thoroughly Understanding the fundamentals of Deep Learning;2.Gaining knowledge of the different modalities of Deep learning currently used;3.Gaining Knowlegde about State-of the art models and Other Important Works in recent years;4.Learning the skills to develop Deep Learning based AI Systems(Use of Multiple packages etc.)

भारतीय विज्ञान संस्थान

DS295 Jan 3:1

Parallel Programming

Department: Computational and Data Sciences

Course Outcomes:

The students would primarily learn to apply advanced optimizations to parallel programs and write efficient parallel codes for scientific applications.

DS301 Aug 2:0

Bioinformatics

Department: Computational and Data Sciences

Course Outcomes:

Ability to understand the biological problem at hand and device appropriate computational/bioinformatic strategies to solve it and interpret the results.

E0 202 Jan 3:1

Automated Software Engineering with Machine Learning

Department: Computer Science and Automation

Course Outcomes:

After completing this course successfully, students can;1.Design and implement simple Android applications;2.Identify concurrency and security issues in Android applications;3.Apply machine/deep learning for analyzing software;4.Understand and use state-of-the-art program analysis tools

E0 204 Jan 2:1

Neuromorphic Analog VLSI design

Department: Electronic Systems Engineering

Course Outcomes:

In this course, students will receive a comprehensive introduction to the fascinating field of neuromorphic sensing, brain-inspired computing, and systems. The curriculum covers large-scale analog computation techniques for sensory and motor processing. Students will delve into the fundamental analog building blocks and gain insights into designing VLSI systems influenced by neurobiological architectures and computational paradigms.

E0 212 Jan 3:0

Graph Algorithms

Department: Computer Science and Automation

Course Outcomes:

One of the key aims of this course is to expose the students with advanced algorithm design paradigms such as iterated improvements, approximation algorithms and study carefully randomness as a powerful source of computations. Graphs are used as the problem domain due to its extensive utility and applications in computer science. The core problems such as network flow, matching, LP etc were all discussed in depth during the course.

E0 213 Jan 3:0

Quantum Safe Cryptography

Department: Computer Science and Automation

Course Outcomes:

The goal of this course is to introduce students to post-quantum cryptography. The students get a broad introduction to cryptography in both symmetric and asymmetric settings that form the backbone of any secure communication system. However, the cryptosystems used to secure currently deployed communication networks are all vulnerable to quantum attacks. The course allows the students to learn about cryptosystems based on lattice, error correcting codes, hash functions, multivariate quadratic polynomials etc. These cryptosystems are all deployed using classical hardware but are expected to be secure even in the presence of quantum computers.

E0 214 Aug 3:0

Applied Linear Algebra and Optimization

Department: Computer Science and Automation

Course Outcomes:

Students learn basic concepts in Linear Algebra and their integration with examples from machine learning. The course also gives a good introduction to basic optimization theory and algorithms for solving a variety of optimization problems. The students develop necessary skills to formulate different problems in data science as optimization problems and design efficient solvers for these problems.

E0 215 Aug 3:1

Algorithms Under Uncertainty

Department: Computer Science and Automation

Course Outcomes:

The course covered algorithms that need to make online decisions under uncertain environments. The algorithm-design techniques covered in the course were quite diverse and spanned several research areas, including competitive analysis, regret minimization, and online convex optimization. The course had a project component that engaged the students to explore active research fronts.

E0 220 Aug 3:1

Graph Theory

Department: Computer Science and Automation

Course Outcomes:

The student gets a thorough familiarity with basics of graph theory and its methods.

E0 228 Aug 3:1

Combinatorics

Department: Computer Science and Automation

Course Outcomes:

Basic notions and techniques of combinatorics. Can be very useful in theoretical computer science. Also for researchers in other aspects of computer science.

E0 231 Jan 3:1

Algorithmic Algebra

Department: Computer Science and Automation

Course Outcomes:

Students will learn basics of computational algebra and Grobner bases techniques.

E0 232 Aug-Dec 3:1

Probability and Statistics

Department: Computer Science and Automation

Course Outcomes:

The students get a good handle on probability theory analytics and some aspects of modelling and simulation.

E0 238 Jan 3:1

Artificial Intelligence

Department: Computer Science and Automation

Course Outcomes:

1.Fundamentals of Artificial Intelligence;2.Learn general problem solving, logic, reasoning;3.Learn different learning techniques;4.Communication using natural language;5.Programming in AI languages;6.Multiple agent systems

E0 249 Jan 3:1

Approximation Algorithms

Department: Computer Science and Automation

Course Outcomes:

The course is intended to equip the students with some fundamental tools for designing and analyzing approximation algorithms.

E0 251 Aug 3:1

Data Structures and Algorithms

Department: Computer Science and Automation

Course Outcomes:

After taking this course, a student would;1)Have a good knowledge of heap, search tree data structures;2)Apply these data structures for solving other problems;3)Have a understanding of various algorithm design techniques;4)Design algorithms for new problems using these techniques;5)Have a high level understanding and exposure to advanced topics in data structures and algorithms;6)Be able to implement the studied data structures and algorithms in a high level programming language

E0 254 Aug-Dec 3:1

Network and Distributed Systems Security

Department: Computer Science and Automation

Course Outcomes:

At the end of the course, a student of the course is expected to know the following;1.Knowledge of the mathematical basis for various one way functions, viz., RSA cryptography, prime number based discrete log, ECC based discrete log, block encryption functions, hash functions, MAC functions, pseudorandom number generators, and how they are designed;2.How these one way functions are used to design a security protocol to meet the security requirements of a distributed system;3.How to identify the security requirements of a distributed systems, and design a security protocol to meet these requirements;4.The student is able to deal with 512 or 1024 bit integers in C++ or Java and is able implement a security protocol in C++ or Java using 512 or 1024 bit integers.

E0 259 Aug 3:1

Data Analytics

Department: ECE and CSA

Course Outcomes:

Students will learn modeling techniques, key statistical principles, data handling techniques, will get hands-on experience with large data sets, and will learn to program in a language like Python.

E0 261 Aug 3:1

Database Management Systems

Department: Computer Science and Automation

Course Outcomes:

The students would be fully conversant with the design principles of the engines and middleware of contemporary database systems, and their interactions with the related computing components, including the hardware, the operating system, and the data network.

भारतीय विज्ञान संस्थान

E0 264 Jan-April 3:1

Distributed Computing Systems

Department: Computer Science and Automation

Course Outcomes:

At the end of the course, a student is expected to know the following;1.Fundamental problems of distributed systems like clock synchronization, remote procedure call, group communication, etc., and techniques for solving these problems;2.Implementation of distributed algorithms solving a specific problem in Distributed Computing Systems

E0 265 Jan 3:1

Convex Optimization and Applications

Department: Electrical Engineering

Course Outcomes:

At the end of the course, the students should be comfortable in framing and solving standard convex optimization problems arising in various scientific and engineering applications.

E0 267 Aug 3:1

Soft Computing

Department: Computer Science and Automation

Course Outcomes:

1.Various soft computing techniques;2.Application in various areas;3.Course will help M.Tech students in their project and research students in their research

E0 270 Jan 3:1

Machine Learning

Department: Computer Science and Automation

Course Outcomes:

Students learn both theory and practical aspects of machine learning models. Towards the end of the course, they also get a flavor of machine learning research by doing course projects.

भारतीय विज्ञान संस्थान

E0 272 Jan 3:1

Formal Methods in Software Engineering

Department: Computer Science and Automation

Course Outcomes:

Students who complete the course will be proficient in the basic techniques and tools for carrying out formal verification of software systems.

E0 284 Aug 2:1

Digital VLSI Circuits

Department: Electronic Systems Engineering

Course Outcomes:

After taking this course;1.Students will be able to design any digital system.;2.Students will learn the basics from simple transistor design to complex digital system.;3.This is a very industry oriented course, students learn;various CAD tools used in the chip design industry;5.The course makes the students highly employable in various IC design companies

E0 294 Aug 3:1

Systems for Machine Learning

Department: Computer Science and Automation

Course Outcomes:

The students got an introduction to the working principle of machine learning (ML) algorithms; mainly convolutional neural networks (CNNs). The course introduced advanced GPUs to execute ML workloads, ML workload characterization, and accelerators. The instructors invited speakers from industry which provided the students a flavour of recent industrial development on ML-centric computer systems. Through the assignments, the students got hands on experience on DNN training with GPUs and theoretical knowledge on designing ML accelerators.

E0 299 Aug 3:1

Computational Linear Algebra

Department: Electrical Engineering

Course Outcomes:

The course imparted a good mix of geometric intuition, theorem proving, and applications to data science. Some algorithmic aspects were discussed without getting into details; coding assignments were given in this regard.

E0 307 Aug 3:1

Program Synthesis meets Machine Learning

Department: Computer Science and Automation

Course Outcomes:

The course introduces the basic techniques in program synthesis like program sketching, programming by examples, and syntax-guided synthesis, as well basics of related machine learning techniques like hidden Markov models and automata learning. It then discusses different works that try to combine these techniques. The students completing the course would have learnt basic synthesis and learning techniques and worked on a course project that combines some of these techniques to solve a small synthesis problem.

E0 311 Jan 3:1

Topics in Combinatorics

Department: Computer Science and Automation

Course Outcomes:

Tools from combinatorics is used in several areas of computer science. This course aims to teach some advanced techniques and topics in combinatorics. In particular, we would like to cover probabilistic method which is not covered in the introductory course `graph theory and combinatorics'. Moreover the course would aim to cover to some extent the linear algebraic methods used in combinatorics. We will also discuss some topics from extremal combinatorics.

E0 316 Aug 3:1

Interacting Particle Systems

Department: Computer Science and Automation

Course Outcomes:

The students get a thorough introduction to Markov processes and their use in the study of Interacting Particle Systems. More specifically, the course first focuses on understanding the convergence of Markov jump processes in the Skorokhod space. Thereafter, it deals with the concept of Markov semigroups and their characterization by means of a transition function. Finally, the course looks at various models of Interacting Particle Systems such as the voter model, contact process, etc., and discusses their asymptotic behaviors.

E0 338 Aug 3:1

Topics in Security and Privacy

Department: Computer Science and Automation

Course Outcomes:

This is a research course in Cryptographic Security and Privacy. By crediting the course a student is expected to acquaint her/him-self with recent advances in the research areas covered in this course.

E0 361 Jan 3:1

Topics in Database Systems

Department: Computer Science and Automation

Course Outcomes:

The students would gain a close understanding of the current research trajectories in the international database community, receive training in reading and critiquing research papers, and gain experience in constructing and delivering effective research presentations.

भारतीय विज्ञान संस्थान

E0 399 Aug 1:2

Research in Computer Science

Department: Computer Science and Automation

Course Outcomes:

This is a course meant for MTech (CSE) students in their summer term. Students are expected to study background material and work on a small research problem related to their proposed MTech project. The aim of the course is the help the students build the necessary skills to do research, as well as to get hands-on experience in a small research problem.

E0210 Aug 3:1

Principles of Programming

Department: Computer Science and Automation

Course Outcomes:

The course project is geared towards building the programming skills required for implementing large software systems.

E0230 Aug 3:1

Computational Methods of Optimisation

Department: Computer Science and Automation

Course Outcomes:

Students completing the course should be able to implement Optimisation algorithms to real life problems. They should be also able to formulate engineering problems as an Optimisation.

E0243 Aug 3:1

Computer Architecture

Department: Computer Science and Automation

Course Outcomes:

Understanding of processor microarchitecture (single and multi-core), memory system design, parallel architecture, accelerator architecture, latest developments and research problems in the area of computer architecture.

भारतीय विज्ञान संस्थान

E0246 Jan 3:1

Real Time Systems

Department: Electrical Engineering

Course Outcomes:

Students should be able to schedule the jobs in RTOS and how to handle allocation of resources.

E0247 Aug 3:1

Sensor Networks

Department: Electrical Engineering

Course Outcomes:

Design the applications using sensors and apply the topics used in the course material

E0255 Jan 3:1

Compiler Design

Department: Computer Science and Automation

Course Outcomes:

The students will understand how advanced optimizations work in a compiler. They will also learn to program optimizations and code generation using the LLVM framework.

E0256 Aug 3:1

Theory and Practice of Computer Systems Security

Department: Computer Science and Automation

Course Outcomes:

Most of the state of the art to start conducting basic research in computer systems security

भारतीय विज्ञान संस्थान

E0271 AUG 3:1

Computer Graphics

Department: Computer Science and Automation

Course Outcomes:

Students will learn mathematical and computational techniques for modeling, representing, and displaying 3D geometric objects. Students will also learn about current research topics in computer graphics and its applications, particularly to geometry processing and visualization. They will get hands on experience working on one such topic by reading relevant research project and working on a mini project.

E0304 Jan 3:1

Computational Cognitive Neuroscience

Department: Computer Science and Automation

Course Outcomes:

There is an emerging need for computational frameworks that permit extracting meaningful information from noisy, high-dimensional brain data. The students will review the state-of-the art in machine learning and dimensionality reduction as well as theoretical and computational models in brain research. The course project will train them to develop and apply computational algorithms to large-scale neuroscience datasets, for example, for decoding cognitive states from brain imaging data.

E0-334 Aug 3:1

Deep Learning for Natural Language Processing

Department: Computer Science and Automation

Course Outcomes:

In this course, students will learn to implement, train and invent neural network models and make these models work on practical problems in Natural Language Processing.

E0343 Jan 3:1

Topics in Computer Architecture

Department: Computer Science and Automation

Course Outcomes:

Understanding advanced topics in Computer Architecture with specific focus on t processor architecture (multi-core architecture), memory system design, accelerators, and high performance architectures

भारतीय विज्ञान संस्थान

E0358 Aug 3:1

Advanced Techniques in Programming and Compilation for Parallel Architectures

Department: Computer Science and Automation

Course Outcomes:

Theoretical and practical understanding of topics in compiler parallelization and optimization for parallel architectures, high-performance domain-specific languages and compilers, and an understanding of the state-of-the-art research in this area.

E1 213 Jan 3:1

Pattern Recognition and Neural Networks

Department: Electrical Engineering

Course Outcomes:

The course equips the students with strong basics in Machine Learning (ML). The students would study different algorithms for learning pattern classifiers and would also explore different datasets to get a feel for ML algorithms. The statistical and/or optimization principles underlying different algorithms would be emphasized and thus the students would pick up the background needed to study more advanced topics in ML. The course would be useful both for students wanting to build a career in industry using ML as well as for students wanting to pursue research in ML.

E1 241 Aug 3:0

Dynamics of linear systems

Department: Electrical Engineering

Course Outcomes:

Students would learn about state space description of systems.

E1 242 Jan 3:0

Nonlinear systems and control

Department: Electrical Engineering

Course Outcomes:

1.The students would learn to use various basic and commonly used tools to analyze nonlinear systems and to design controllers for the same;2.The students would learn formal mathematical (theorem-proof style) analysis in the context of controls.

E1 243 Jan 2:1

Digital Controller Design

Department: Electronic Systems Engineering

Course Outcomes:

To enable an engineer to model, design and implement digital controllers

E1 246 Jan 3:1

Natural Language Understanding

Department: Computer Science and Automation

Course Outcomes:

This course provides a modern and statistical perspective on natural language processing. The course will enable the student to: acquire fundamentals of language technology; understand, implement, and apply state-of-the-art techniques to novel problems involving natural language data; and be able to read and understand current research literature.

E1 246 Oct 3:0

Topics in Networked and Distributed Control

Department: Computer Science and Automation

Course Outcomes:

The course is aimed at students who wish to specialize in the areas of networked control systems that involve an interplay of control, communication and computation. The course covers a breadth of topics, and students select topics to study in more depth through course projects and discussions. Students develop the skills of reading scientific literature and technical presentation.

E1 248 Aug 3:0

Sliding mode control and its applications

Department: Electrical Engineering

Course Outcomes:

Students are introduced to different sliding mode control strategies and learn how to employ various mathematical tools from nonlinear systems to prove stability in the presence of disturbances. As part of the course project, students work on recent research papers and develop concepts to use sliding mode for diverse engineering applications, including robotics, power systems, aerospace, etc. The course also incorporates using MATLAB for control systems simulations through different assignments. This course is highly beneficial for research students.

E1 251 Aug 3:0

Linear and Nonlinear Optimization

Department: Electrical Engineering

Course Outcomes:

Students acquire understanding of underlying theory of numerical optimization together with some knowledge on practical aspects of applying standard numerical optimization algorithms for solving engineering problems. Students attain mathematical maturity for understanding numerical optimization methods used in research articles published in various engineering disciplines.

E1 254 Jan 3:1

Game Theory

Department: Computer Science and Automation

Course Outcomes:

The objective of this course is to provide a foundation of game theory to help students apply game theory to problem solving in a rigorous way;1.At the end of this course, the students can expect to be able to model real-world situations using game theory, analyze the situations using game theoretic concepts, and design correct and robust solutions (mechanisms, algorithms, protocols) that would work for rational and intelligent agents;2.The students will have an opportunity to obtain an exposure to and a serious appreciation of the seminal contributions of celebrities such as von Neumann, John Nash, Lloyd Shapley, Robert Aumann, William Vickrey, Leonid Hurwicz, Eric Maskin, and Roger Myerson;3.After completing the course, the students will be able to make forays into topical areas such as algorithmic game theory, algorithmic mechanism design, computational social choice, auctions and market design, electronic commerce, Internet monetization, social network research, and mechanism design for multiagent systems.;4.Students would be able to pursue inter-disciplinary topics such as cyberphysical systems, intelligent transportation, service science, green supply chains, and human computation systems (such as crowdsourcing networks) by formulating and solving topical problems using the conceptual foundations covered in the course.

E1 260 Aug 3:1

Optimization for Machine Learning and Data Science

Department: Electrical Communication Engineering

Course Outcomes:

The main goal of E1 260 course is cover optimization techniques suitable for problems that frequently appear in the areas of data science, machine learning, communications, and signal processing. This course focusses on the computational, algorithmic, and implementation aspects of such optimization techniques. In particular, we discuss the required mathematical background, theory of convex functions, gradient methods, accelerated gradient methods, proximal gradient descent, mirror descent, sub gradient methods, stochastic gradient descent and variants, Project gradient descent and Frank-Wolfe, alternating direction method of multipliers, nonconvex and submodular optimization.

E1 277 Aug 3:1

Reinforcement Learning

Department: Computer Science and Automation

Course Outcomes:

The emphasis in this course is to teach students the foundations of reinforcement learning which includes mathematical formalisms, data-driven algorithms for stochastic control, theoretical analysis of the algorithms as well as to cover some important applications. A course project is also designed where the students read the state-of-the-art research papers, understand and perform implementations on benchmark environments such as OpenAIGym.

E1 277 Jan-April 3:1

Reinforcement Learning

Department: Computer Science and Automation

Course Outcomes:

The students will get to know modelling and analysis tools and techniques for problems of dynamic decision making under uncertainty. They will know the algorithms they can apply when faced with such problems and the convergence and accuracy guarantees that such algorithms would provide.

भारतीय विज्ञान संस्थान

E1222 Aug 3:0

Stochastic Models and Applications

Department: Electrical Engineering

Course Outcomes:

Students would acquire a rigorous understanding of basic concepts in probability theory. They would learn some important concepts concerning multiple random variables such as Bayes rule for random variables, conditional expectation and its uses etc. They would also learn stochastic processes, including Markov Chains and Poisson Processes. The course would provide the background needed to study topics such as Machine Learning, Adaptive Signal Processing, Estimation Theory etc.

E1244 Jan 3:0

Detection and Estimation Theory

Department: Electrical Communication Engineering

Course Outcomes:

1.Study the qualitative problems of detection and estimation in the framework of statistical inference;2.Gain an understanding of, and develop the ability to design, automated systems for detection and estimation (these are often key subsystems of larger systems in real life);3.Write down hypothesis tests and estimation schemes (e.g., Likelihood ratio tests, Maximum likelihood estimators) for typical problems of interest.

E1251 Aug 3:0

Linear and Nonlinear optimization

Department: Electrical Engineering

Course Outcomes:

Students will have understood the conditions of optimality and their meaning. The students will be able to implement important types of unconstrained optimization algorithms, and essential variants of linear programming methods.

E1262 Jan 3:0

Selected Topics in Markov Chains and Optimization

Department: Electronic Systems Engg.

Course Outcomes:

Students will get a flavor of fairly advanced topics in Markov chains, graph theory, combinatorics and optimization useful to their research, build upon existing theory towards applications. In some cases, research papers are directly discussed.

E2 202 Aug 3:0

Random Processes

Department: Electrical Communication Engineering

Course Outcomes:

Students would have basic understanding of probability theory, random variables, random vectors, and discrete valued random processes.

E2 204 Jan 3:0

Stochastic Processes and Queueing Theory

Department: Electrical Communication Engineering

Course Outcomes:

Students would be able to model complex systems with uncertainty using random processes, and analyze the system performance.

भारतीय विज्ञान संस्थान

E2 205 Aug 3:0

Error-Control Codes

Department: Electrical Communication Engineering

Course Outcomes:

At the end of the course, a student is expected to have a good understanding of the principles underlying the design and implementation of error-correcting codes. The course places an emphasis on code design and implementation, and on decoding algorithms in particular. Specifically, the students are exposed to a variety of code constructions, both classical (algebraic) and modern (graphical). They are also introduced to a wide range of decoding algorithms, from basic linear-algebraic decoders to sophisticated algebraic decoders to modern iterative message-passing decoders.

भारतीय विज्ञान संस्थान

E2 210 Aug 3:0

Quantum Error-Correcting Codes

Department: Electrical Communication Engineering

Course Outcomes:

This course serves as an introduction to the topic of error correction and fault tolerance for quantum computation. The theory of quantum error-correcting codes is developed from the basics, assuming only the postulates of quantum mechanics. No background in quantum mechanics or quantum information processing is assumed. Students learn about quantum noise models, fidelity measures, the theory of quantum stabilizer codes, various constructions of such codes, and finally, fault tolerance in quantum computation. An important aspect of the course is the term project in which students are expected to read, present, and write a report on papers at the forefront of research in this field.

E2 213 Jan 3:0

Information-Theoretic Security

Department: Electrical Communication Engineering

Course Outcomes:

A student taking this course is expected to learn the basic tools and techniques needed to carry out research in information-theoretic security. The student will also understand the practical barriers that prevent this paradigm from becoming a viable alternative to mainstream cryptography.

E2 214 Jan 3:0

Finite-State Channels

Department: Electrical Communication Engineering

Course Outcomes:

The course aims to bring students up to speed on the major directions of ongoing research in this field. Along the way, the student may also pick up the important mathematical paradigm of dynamic programming.

E2 224 Jan 3:1

Advanced Topics in Networking

Department: Electrical Communication Engineering

Course Outcomes:

The students learn about recent advances in Networking research in the areas of Data Center and Software Defined Networks. The content of the course is based on the latest research papers from ACM and IEEE conferences on the topics of Data Center and SDN. This is a hands-on course which helps the students implement some of the concepts on a testbed using Mininet.

E2 232 Aug 2:1

TCP/IP Networking

Department: Electronic Systems Engineering

Course Outcomes:

The course aims to bring students up to speed on the major directions of ongoing research in this field. Along the way, the student may also pick up the important mathematical paradigm of dynamic programming.

भारतीय विज्ञान संस्थान

E2 270 Aug 3:0

Quantum Information Theory

Department: Electronic Systems Engineering

Course Outcomes:

The students get a solid background into the fundamentals of quantum information theory, useful for quantum communications, metrology and computing. The course begins by building the necessary background from classical information theory and quantum tools, homogenizing students from a variety of backgrounds, such as EECS, Physics and Math. From here, the tools for understanding quantum information are built systematically with a solid emphasis on mathematical rigor and physical feel as required.

E2201 Aug 3:0

Information theory

Department: Electrical Communication Engineering

Course Outcomes:

The student is expected to understand the definitions of various measures of information and have a working knowledge of their properties. Furthermore, the student should be able to formalize compression, transmission, and estimation problem in an information theoretic setting. The course will also teach the student how to show the optimality of codes for compression and transmission. Finally, advanced students will develop heuristics for identifying packing and covering problems in many standard information processing scenarios.

E2-202 Aug 3:0

Random Processes

Department: Electrical Communication Engineering

Course Outcomes:

Students learn basic concepts, techniques, and elementary proof methods in Probability and Random Processes.

E2203 Jan 3:0

Wireless Communications

Department: Electrical Communication Engineering

Course Outcomes:

How to model wireless channels? How to design and analyze diversity techniques? Understand cellular system design. Understand MIMO and OFDM techniques.

E2206 Jan 3:0

Information and Communication Complexity

Department: Electrical Communication Engineering

Course Outcomes:

This course is meant for second or third year graduate students who already have encountered communication complexity and information theory in their research. On completion of this course, a student is expected to understand various measures of communication complexity and relation between them. He or she should be able to identify the communication complexity bottlenecks in various theory problems and should develop the art of showing optimality using communication complexity lower bounds. The student should have a good exposure to recent developments in this fundamental field and also to various use-cases.

E2-221 Aug 3:0

Communication Networks

Department: Electrical Communication Engineering

Course Outcomes:

Understanding of the Internet architecture, applications, protocols, and design from an end-to-end and layering perspective and a performance analysis perspective.

E2-241 Jan 3:0

Wireless Networks

Department: Electrical Communication Engineering

Course Outcomes:

Students learn basic principles, concepts, techniques, and methods, for the design and analysis of Wireless Networks.

E2-242 Jan 3:0

Multiuser Detection

Department: Electrical Communication Engineering

Course Outcomes:

The students would learn modeling of various multiuser communication systems as linear vector channels, learn optimum detection, linear and non-linear detection algorithms, and multiuser/MIMO signal detection algorithms based on local search, meta-heuristics, message passing, and Markov Chain Monte Carlo techniques.

E2-251 Aug 3:0

Commnication Systems Design

Department: Electrical Communication Engineering

Course Outcomes:

This course will give exposure and in-depth treatment to modeling or RF impairments in communication systems and use these models for design and performance evaluation of communication systems.

E244 JAN 3:1

Computational Geometry and Topology

Department: Computer Science and Automation

Course Outcomes:

Students taking this course will be introduced to a new class of problems and algorithms that involve the study of geometry and topology. The course will also introduce various algorithmic paradigms and hence help students improve their algorithmic skills. After successful completion of the course, a student will be able to effectively apply the techniques to specific application domains of interest or pursue independent research in this area.

E3 220 Aug 3:0

Foundations of Nanoelectronic Devices

Department: Electrical Communication Engineering

Course Outcomes:

The students would learn the following from this course;(1)Mathematical foundation of quantum mechanics, including bra and ket algebra;(2)Fundamental postulates of quantum mechanics;(3)Uncertainty principle, quantum dynamics, and aspects of time evolution;(4)Application of quantum mechanical principles in formulation of free particle, Hydrogen atom, and Excitons;(5)Description of electrons in solids, and understanding Fermi energy and its difference with chemical potential;(6)Crystal lattice and reciprocal space, Bloch's theorem, electronic structure and its related concepts;(7)Basic concepts of carrier transport in semiconductors;(8)MOSFET device concepts and details of its operations, different quantum mechanical effects including quantization, quantum capacitance, Intra- and Inter-band tunneling;(9)Coupled Poisson-Schrodinger equations and numerical solution;(10)Quantum theory of linear harmonic oscillator, Concepts of lattice vibration and phonons, implication into devices;(11)Quantum theory of angular momentum, Electron spin.

E3 231 Jan 2:1

Digital System Design with FPGAs

Department: Electronic Systems Engineering

Course Outcomes:

At the end of the course, a student; 1.Given a set of specifications for a digital system, will be able to design the system meeting the specifications;2.In particular, given an algorithm, will be able to design the datapath and the controller(s) to implement the functionality;3.Will be able to design datapath using higher level combinational and sequential blocks;4.Will be able to solve the functional and timing problems in the datapath;5.Will be able to resolve various issues related to the controller design;6.Will be able to resolve synchronization issues;7.Will be able to write a VHDL code to implement a particular design/block;8.Will be able to analyze a VHDL code and infer what circuit a synthesis tool might generate out of a code;9.Will know how the VHDL simulation tool simulates the code;10.Will be able to write test benches to automate the verification process;11.Will be able to choose a particular FPGA for a particular application;12.Will be able to use FPGAs in your design, meeting the area and delay constraints and estimate the power consumption;13.Will be able to design and code to exploit the architectural features of FPGA.

E3 245 Aug 2:1

Processor System Design

Department: Electronic Systems Engineering

Course Outcomes:

At the end of the course, a student; 1.Given a set of specifications for a Processor, will be able to design the processor meeting the specifications;2.In particular, given the specification, required Multi-cycle, Single-cycle or pipelined CPU would be designed;3.Will be able to do the deatiled timing analysis and would be able to meet the timing requirements;4.Will be able to resolve data dependences by stalling;5.Will be able to solve data dependences by data forwarding and bypassing;6.Will be able to design the bus interface for the processor;7.Will be able to design peripheral devices compatible to BUS;8.Will be able to design the BUS bridges

भारतीय विज्ञान संस्थान

E3 262 AUG 2:1

ELECTRONICS SYSTEMS PACKAGING

Department: Electronic Systems Engineering

Course Outcomes:

1.Student masters the fundamental knowledge of electronics packaging including package styles or forms, hierarchy and methods of packaging necessary for various environments;2.Provide pathway for further studies in packaging if the student is inclined to do so;3.Provide industry perspective;4.Ability to distinguish between engineering performance and economic considerations to develop; cost-efficient and high performance packaging approaches. Students should be able to predict the reliability of electronic components and structures.

E3 273 Aug 2:1

Microcontroller and its Applications

Department: Electronic Systems Engineering

Course Outcomes:

The students get in depth knowledge of the architecture of latest technology in microcontrollers from 8-bit to 32-bit commercial-of-the-shelf (COTS) like Arduino, Raspberry (Pi RPi-4) with all the possible features that may be available in any microcontrollers. The course deals with engineering applications using microcontrollers. The lectures are reinforced with lab sessions and mini projects. The students can take any prototype from design to implementation in fields such as IoT, Mechatronics etc.

E3 274 Aug 3:0

Power Semiconductor Devices and Physics

Department: Electronic Systems Engineering

Course Outcomes:

Very less power semiconductor device expertise is;available in industry and numerous research options are available. This course will provide insight into physics of power semiconductor devices under extreme operation conditions like high voltage, high current and high temperature which are encountered under typical power electronic environment. The knowledge developed from this, will help in designing power devices with desired specifications.

E3 277 Jan 2:1

Introduction to Integrated Circuit (IC) Design

Department: Electrical Communication Engineering

Course Outcomes:

Students explore fundamental concepts in integrated circuit (IC) design and gain hands-on experience with computer-aided design (CAD) tools. Topics encompass key components like amplifiers, current-mirrors, inverters, and latches, while introducing design principles such as frequency response, feedback, linearity, and noise culminating in the design of an integrated operational amplifier.

E3 280 Jan 3:0

Carrier transport in nanoscale devices

Department: Electrical Communication Engineering

Course Outcomes:

The students would learn the following from this course;(1)Brief overview of basic quantum mechanics, crystal structure and Brillouin zone, electrons in crystalline solids, momentum space, Energy band structure in semiconductors, quantum confinement, semi-classical electroc dynamics in perfect crystal;(2)Concepts of scattering of carriers, Fermi golden rule;(3)Different types of scattering mechanisms including Ionized impurity scattering, various phonon scattering methods, e-e scattering, surface roughness scattering, and scattering for quantum confined carriers;(4)Concept of distribution function, Boltzmann transport equation(BTE), relaxation time approximation;(5)Solution of BTE, numerical solutions, validity of BTE, coupled electrical and thermal transport;(6)Quantum transport - conduction quantization, current flow in a one-level model, different regimes of transport including self-consistent field and Coulomb blockade, current carrying modes in quantum wire and 2D electron gas, ballistic versus non-ballistic transport;(7)Open system versus closed system, concept of level broadening, Formal treatment of open system, coherent transport using Green's function, ballistic current in a two-terminal device.

E3 280o Aug 3:1

Semiconductor devices for nanoelectronics

Department: Electronics & Communication Engg. Stream

Course Outcomes:

The students get a thorough introduction to quantum mechanics. The basic concepts of solid state physics are then discussed. The concepts are then applied to the foundations of nanoelectronic devices. The course also introduces modern nano-devices useful for electronic and opto-electronic devices. The different quantum effects in these devices are discussed in details. Aspects of quantum device simulation are also covered.

E3 282 Aug 3:0

Basics of Semiconductor Devices and Technology

Department: Electronic Systems Engineering

Course Outcomes:

The course will enable students to understand and appreciate the synergy between quantum mechanics and semiconductor materials, which will eventually lead to a general framework of concepts applicable across a variety of semiconductor devices. The students will be able to comprehend the drift and diffusion mode of electrical transport through semiconductor devices. The course will empower students to use quantum mechanics and transport theory to investigate complex and novel electrical devices.

E3 300 Aug 3:0

Topics in Reinforcement Learning

Department: Electrical Communication Engineering

Course Outcomes:

Students get a thorough introduction to reinforcement learning. Course covers the design and analysis of reinforcement learning algorithms. The use of martingale techniques is emphasised while analysing the performance of learning algorithms. Derivations of both lower as well as upper-bounds on the performance of such algorithms are covered.

E3 301 Jan 3:0

Special topics in Nanoelectronics

Department: Electronic Systems Engineering

Course Outcomes:

In the "Special Topics in Nanoelectronics" course, students will delve deep into the world of nanoelectronic materials and devices, with a special focus on constrained dimensions. They'll apply advanced theoretical concepts, particularly from quantum mechanics and condensed matter physics to design nanoelectronic devices and engage in hands-on projects. This course provides a strong foundation for advanced studies and cultivates critical thinking and problem-solving skills, preparing graduates for research and innovation in this rapidly evolving field.

E3 303 Jan 3:0

Stochastic Dynamics and Stochastic Control with applications to Machine Learning

Department: Electrical Communication Engineering

Course Outcomes:

Introduces the students to the topic of stochastic dynamical systems, their optimal control and martingales. The course also derives Hamilton-Jacobi-Bellman equation, and applies it to derive the optimal controls for the class of linear stochastic dynamical systems in which the performance cost is quadratic in the system state and controls. These concepts are then applied in order to analyse the performance of machine learning and reinforcement learning algorithms.

भारतीय विज्ञान संस्थान

E3 343 Aug 1:2

Discrete Control and Estimation

Department: Electronic Systems Engineering

Course Outcomes:

This course is on digital or discrete Controller and estimator design using state space methods. This course will benefit the research students. Most controls courses focus on theoretical aspects with little or no exhortation in implementational challenges. This course will focus on controller implementation in the face of non-idealities, unmodelled dynamics and non-linearities on systems that students will practically build during the course. This course needs considerable R&D time along with lots of lab hours. Hence this course is designed as 1:2 credit 300 level course. The course includes introduction to discrete state space control, circuit averaging, space vector modeling, linearization, discrete full state feedback, state augmentation, discrete full order estimation, discrete reduced order estimation, discrete optimal estimation, discrete LQR, discrete robust control.

E3225 Jan 3:0

Art of Compact Modeling

Department: Electronic Systems Engineering

Course Outcomes:

Compact modeling techniques, Verilog-A, Implementation of compact model in circuit simulator

E3-257 Jan 2:1

Embedded System Design

Department: Electronic Systems Engineering

Course Outcomes:

Students should be able to design and implement fairly complex embedded systems that may use interrupts and have certain real time requirements to meet. Further, they should be able to troubleshoot and debug already deployed systems

E3258 Jan 2:1

Design For Internet Of Things

Department: Electronic Systems Engineering

Course Outcomes:

Able to choose a processor, design a power supply, choose the powering modality, choose the communication protocol, choose communication technology, choose between sensors, ICs and components;In summary ability to build complete (hardware and software) embedded devices.

E4 234 Aug 3:0

Advanced Power Systems Analysis

Department: Electrical Engineering

Course Outcomes:

This course discusses the advanced topics related to power system analysis. Knowledge about these advanced topics will help students in research and professional career.

E4 237 Jan/Aug 2:1

Selected Topics in Integrated Power Systems

Department: Electrical Engineering

Course Outcomes:

Students will learn modelling & control of various advanced control technologies of power grids, like FACTS, HVDC, Renewables, etc. They get ability to design & implement them in basic programming languages like C, C++ & Fortran. Through an individual project they will learn 100% implementation of a IEEE transactions paper by properly identifying the tasks, various implementation stages, gathering concepts, etc.

भारतीय विज्ञान संस्थान

E4 238 Jan 3:0

Advanced Power System Protection

Department: Electrical Engineering

Course Outcomes:

This course mostly use IEEE and CIGRE standards to teach advanced topics of power system protection. As a result, students will be familiar with the industrial practices.

भारतीय विज्ञान संस्थान

E4221 Aug 2:1

DSP and AI Techniques in Power System Protection

Department: Electrical Engineering

Course Outcomes:

Recent trends in the area of power system protection and to learn through lab exercises to implement high speed and and accurate power protection algorithms on DSP hardware. Understanding the use of Artificial Intelligence techniques such as Neural Networks and Fuzzy logic techniques in digital power system protection schemes.

E4231 Aug 3:0

Power system dynamics and control

Department: Electrical Engineering

Course Outcomes:

Students will learn development of various types of models used for synchronous machines, Hydro & steam turbine, governors & excitation systems. Students will get the ability to simulate these models using numerical methods in basic programming languages like C, C++ or Fortran. Get knowledge of Transient & small signal stability assessment methods for large power systems. Will get the knowledge of developing various stability controls for Power Systems. Through the project each student will learn various advances in Power Systems Dynamic modelling & Control by implementing 50% results of a reputed journal paper (IEEE Transactions on Power Systems). This gives the ability of doing literature review, understanding technical paper & ability to get the required concepts & tools for paper implementation. This gives a good research training.

E4233 Jan 3:0

Computer Control of Power Systems

Department: Electrical Engineering

Course Outcomes:

This course is targeted for giving thorough understanding of how an operator does planning, analysis & operation of day to day scenarios in large scale power systems. Students will learn various mathematical techniques, steady state models & control center functions. They get ability to design & implement various control center functionalities in basic programming languages like C, C++ & fortran. Through a group project they will learn 100% implementation of a IEEE transactions paper by properly identifying the tasks, various implementation stages, gathering concepts, exchange of concepts, etc..,

E5 212 Jan 3:0

Computational Methods in Electrostatics

Department: Electrical Engineering

Course Outcomes:

The outcome of the course are;1.Clear understanding on the governing electric fields under various operating contingencies;2.Comprehensive knowledge on the three commonly employed numerical methods for electrical insulation;3.Basic aspects of the computer program development for these methods;4.Practical aspects of field computation and its interpretation/usage

भारतीय विज्ञान संस्थान

E5 213 Jan 3:0

EHV/UHV Power Transmission Engineering

Department: Electrical Engineering

Course Outcomes:

Students would be introduced to the issues in designing power transmission lines operating at EHV/UHV voltages especially about insulation design, corona losses, audible noise , insulation co-ordination, electric field under the lines, issues due to mechanical vibrations of overhead power transmission lines and their mitigation etc.

E5 215 Aug 2:1

Pulsed Power Engineering

Department: Electrical Engineering

Course Outcomes:

This course will train the students to design pulsed power systems for use in various military, atomic energy and industrial applications

E5201 Aug 2:1

Production, Measurement and Application of high voltage

Department: Electrical Engineering

Course Outcomes:

Course outcomes can be itemised as;1.Advanced knowledge in high voltage insulation aspects;2.Expertise in generation and measurement of high voltages;3.Enhanced understanding in air breakdown aspects;4.Enhanced understanding in pollution aspects related to insulators;5.Enhanced understanding in high voltage application for pollution control

E5206 Jan 3:0

High Voltage Power Apparatus

Department: Electrical Engineering

Course Outcomes:

1.Advanced knowledge in high voltage power apparatus;2.enhanced understanding in monitoring and diagnostic aspects of transformer;3.expertise in testing aspects of circuit breaker;4.advanced knowledge in power transformer design, testing, shirt circuit force calculations

E5209 Jan 3:0

Overvoltages in Power Systems

Department: Electrical Engineering

Course Outcomes:

1.time-domain treatment of overvoltage on transmission lines;2.methods to compute it;3.Analyse overvoltage data or phenomenon in systems, networks;4.protection against overvoltage

भारतीय विज्ञान संस्थान

E5-232 May-June 2:1

Advances in Electric Power Transmission

Department: Electrical Engineering

Course Outcomes:

Advanced knowledge in high voltage insulation and transmission engg, Understanding of the SCADA and substation automation etc..

E6 205 Aug 2:1

Design of Electric Motors

Department: Electronic Systems Engineering

Course Outcomes:

Motor design for the electric mobility application is a very important and upcoming area especially in the context of global transition to EVs. The course includes topics like importance of motor design, electric and magnetic loading, concepts of BH curves and material properties, magnetic circuits applied to electrical machines, flux path calculations, design of electrical windings and MMF distribution (DC machine windings: like a lap, wave, ring, commutator etc; AC machine windings), winding design variable speed machines, generalized theory for design of electrical machines (volume, power density, windings, core, standards, power loss, efficiency and etc.), induction motor design, DC machine design, special machines design (Switch Reluctance Machine Design), thermal and insulation design, JMAG electromagnetic FEM analysis of different machines.

E6 222 Jan 2:1

Design of photovoltaic systems

Department: Electronic systems engineering

Course Outcomes:

To enable the student to understand the PV source and how to interface it to real world applications. To enable the student to design such power interfaces.

E6 225 Aug 3:1

Advanced Power Electronics

Department: Electrical Engineering

Course Outcomes:

Prepare students for research

E6 226 Aug 3:0

Switched Reluctance Machines and Drives

Department: Electrical Engineering

Course Outcomes:

Starting with energy stored in magnetic field, reluctance force and reluctance torque, the course attempts to impart a strong understanding of the operating principles of reluctance machines. The students are expected to acquire the capability to model, analyze, design, simulate, characterize and control switched reluctance motors and generators.

E6 227 Aug 3:0

Power Electronics Design

Department: Electrical Engineering

Course Outcomes:

The students are exposed to advanced concepts and challenges in gate driver design, power magnetics design and power converter design. The course enhances design-oriented thinking and pushes students to think beyond textbooks to hone their design skills.

E6-202 Aug 2:1

Design of Power Converters

Department: Electronic systems engineering

Course Outcomes:

To be able to design any power converter circuit for a given set of specifications and to develop a prototype.

E6212 JAN 3:0

DESIGN AND CONTROL OF POWER CONVERTERS AND DRIVES

Department: Electronic systems engineering

Course Outcomes:

MODELING, DESIGN AND CLOSED LOOP CONTROL OF VARIABLE SPEED DRIVES

E6221 Jan 3:1

Switched Mode Power Conversion

Department: Electrical Engineering

Course Outcomes:

The student is expected with both the design and control of dc-dc converters at the end of the course. The laboratory exercises are designed to make the student comfortable with the auxiliary circuits associated with the power electronics converters and also with basic dc-dc converters.

E6224 Aug 3:0

Topics in Power Electronics and Distributed Generation

Department: Electrical Engineering

Course Outcomes:

The student is expected to understand the various challenges behind introducing distributed generation. The student is also expected to become comfortable with the design methods for electronic power converters for optimized industrial requirements.

E7 211 Jan 3:0

Photonic Integrated Circuits

Department: ECE

Course Outcomes:

After the completion of the course, the student will;1.Be able to design and analyze an integrated optic waveguide Understand the working of various photonic components;2.Be able to choose the technology suitable for the intended device. Also he/she will be ready to understand current developments.

भारतीय विज्ञान संस्थान

E7 214 Jan 3:0

Optoelectronic Devices

Department: ECE

Course Outcomes:

(i)understand the basic working mechanism of the devices;(ii) understand the governing equations to be able to perform calculations to characterize the performance of the devices and;(iii) have the practical knowledge and an understanding of the trade-offs when using these devices in their respective applications.

E7-221 Aug 2:1

Fiber-Optic Communication

Department: ECE

Course Outcomes:

Students learn about the various optical sources, detectors and fiber types and their suitability/choice for any application.

E8 201 Aug 3:0

Electromagnetism

Department: ECE

Course Outcomes:

The outcome of the course (as stated by the students) are;1.It generates real interest in this not so well-perceived subject;2.Clear understanding of the basic principles associated with

भारतीय विज्ञान संस्थान

E8241 Jan 2:1

Radio Frequency Integrated Circuits & Systems

Department: ECE

Course Outcomes:

Understand why/how RF circuit design differs from others, Learn to design and analyse RF circuits, Exposure to industry standard tools forRF circuit design, and Learn Vector Network analyzer based measurement of circuit components and antennas.

भारतीय विज्ञान संस्थान

E8262 Jan 3:0

CAD for High Speed Chip-Package-Systems

Department: ECE

Course Outcomes:

Students learn about different electromagnetic and circuit simulation methods

E9 201 Aug 3:0

Digital Signal Processing

Department: Electrical Engineering

Course Outcomes:

1)How one can sample a continuous-time signal to obtain discrete-time signal without loosing any information and reconstruct back the continuous-time signal;2)Various transforms to mathematically analyze discrete-time signals for frequency domain interpretation;3)different discrete-time structures for implementing discrete-time algorithms;4)how computer approximation affects the discrete-time system structure;5)How to sample a discrete-time signal at different rates and conditions on signal for efficient reconstruction;6)design and implementation of different filters that can run on discrete-time signals based on the specification for continuous-time signal.

E9 206 Aug 3:0

Digital Video: Perception and Algorithms

Department: ECE

Course Outcomes:

Students are expected to be able to interpret video processing algorithms from the point of view of their perceptual relevance, know what kind of signal processing models explain processing along the human visual pathway and even try to incorporate such ideas in video processing algorithms such as compression, quality assessment, denoising, saliency, and so on.

E9 211 Aug 3:0

Adaptive Signal Processing

Department: ECE

Course Outcomes:

The students would learn how to use iterative techniques to solve parameter estimation problems. Further, the theoretical guarantees of iterative and recursive methods will be learnt to enable them to choose the appropriate method for signal processing systems. A good understanding of techniques like Kalman Filtering and Recursive Least-Squares techniques will be useful to extend them to machine learning paradigms

E9 213 Jan 3:0

Time-Frequency Analysis

Department: Electrical Engineering

Course Outcomes:

The students would be equipped with the tools and techniques to handle nonstationary signals arising in various real-world contexts.

E9 231 Jan 3:0

MIMO Signal Processing

Department: ECE

Course Outcomes:

At the end of the course, the student will;1.Have deep knowledge about the design and analysis of multiple antenna systems;2.Understand different transmission and reception schemes, their advantages and relative performance;3.Using recent results from random matrix theory, analyze the capacity performance of massive MIMO systems;4.Relate the principles learned to recent standardization activities and 5G

E9 241 Aug 2:1

Digital Image Processing

Department: Electrical Engineering

Course Outcomes:

The students would get a firm foundation in 2-D signal processing and be able to handle real-world image processing problems and develop image processing software.

भारतीय विज्ञान संस्थान

E9 243 JAN 3:0

Computer Aided Tomographic Imaging

Department: Electrical Engineering

Course Outcomes:

After taking this course ...1.The student will learn principles of tomographic imaging with different modalities such as x-ray, PET and SPECT, NMR/MRI , ultra sound and optical with non-diffracting and diffracting energy sources;2.Learn principles of non-invasive medical imaging techniques and non destructive techniques for industrial imaging;3.Understand projections and projection slice theorem;4.various types of data acquisition in tomography - parallel beam, fan-beam and cone-beam as well as circular and helical trajectories of the source and detectors. First to 4th generation of CT;5.Learn transform domain non-iterative 2D and 3D reconstruction techniques for non diffracting radiation sources;6.Understand Fourier inversion technique and Fourier methods of reconstruction techniques;7.Learn the statistical nature of the radiation energy generation, propagation, and detection. The errors and artifacts due to the practical limitations of these processes;8.Exposed to a class of Algebraic Reconstruction Techniques (ART) and its variants;9.Some applications of Tomographic principles in signal processing and image processing.

E9 246 Jan 3:1

Advanced Image Processing

Department: Electrical Engineering

Course Outcomes:

Students are expected to have an understanding of and implement various advanced image processing algorithms and analyze their performance on datasets to make improvements. This is achieved through a series of hands on assignments and projects.

E9 261 Jan 3:1

Speech Information Processing

Department: Electrical Engineering

Course Outcomes:

1) Understanding of human speech communication system; 2) Time varying signals and system for modeling speech; 3)Short-time analysis for speech signal; 4) Various types of parameterizations and representations for speech including homomorphic filtering, cepstrum, pole-zero modeling; 5) Deep learning, choices of cost function, non-linearities, intialization; 6) Convolutional architecture, restricted Boltzmann machine; 7) Applications of various techniques for speech coding, enhancement and recognition.

E9-202 Aug 3:0

Advanced DSP: Non-linear Filters

Department: ECE

Course Outcomes:

This course expands the horizon of signal processing and communication students to non-linear techniques and their optimality, deviating from the predominantly Gaussian.linear analysis of signals and systems; Non-filters are also power efficient and are based on sorting and boolean logic implementations.

E9205 AUG 3:1

MACHINE LEARNING FOR SIGNAL PROCESSING

Department: Electrical Engineering

Course Outcomes:

Students would learn the theory and practice of machine learning methods.

E9-221 Jan 3:0

Signal Quantization & Compression

Department: ECE

Course Outcomes:

Students will gain in depth knowledge of digital representation of signals and information. Performance measures of SQNR, Noise shaping, perceptual masking will be understood. The trade offs between signal models and adaptive schemes will be realized. Offline optimum design Vs online adaptation of signal models and quantization schemes will be appreciated.

E9251 Jan 3:0

Signal processing for data recording channels

Department: Electronic systems engineering

Course Outcomes:

Students will get a firm foundation towards advanced research by building upon known things at a foundational level in physical data storage. This is very useful for advanced research in the field, as well as, translational work for practicing engineers/scientists.

E9252 Jan 3:0

Mathematical methods and techniques in signal processing

Department: Electronic systems engineering

Course Outcomes:

Students will get the foundations into signal theory necessary to pursue advanced research. Masters' level students can use these skills in the industry having a solid analytical background.

E9282 Jan 2:1

Neural Signal Processing

Department: Electrical Engineering

Course Outcomes:

Students are expected to be comfortable in using a variety of signal processing techniques on a wide variety of brain signals by the end of this course.

E9291 Aug 2:1

DSP System Design

Department: Electrical Engineering

Course Outcomes:

Students will have the in depth knowledge of hardware they have used, how to write their programs using fixed and floating point implementations. How to pipeline/parallelize the algorithms on the hardware to have either reduce the power consumption or increase the speed of operation of algorithms.

E9292 Jan 2:1

Real Time Signal processing with DSP

Department: Electrical Engineering

Course Outcomes:

Implement the signal processing algorithms using real time signals and how it can be scheduled based on the clock . The miniproject developed will be in the area of either audio/speech or in image processing

EC 204 Jan 2:1

Evolutionary Biology

Department: Centre for Ecological Science

Course Outcomes:

At the end of this course, we expect the student to have a better understanding of the different evolutionary processes that shape biodiversity. The course also addresses microevolutionary processes using quantitative genetics at the molecular level. In the practical section of the course, the students will learn how to use analytical tools to construct and interpret phylogenetic trees from molecular data and understand the evolutionary diversification of gene/protein families.

EC 205 Aug 2:0

Multi-omics approaches for Biologists

Department: Centre for Ecological Sciences

Course Outcomes:

This course provides an in-depth introduction to "omics" technologies (Genomics, Transcriptomics, Proteomics, and Metabolomics), and how they can be implemented for understanding interesting aspects in various fields of biology, including ecology, evolutionary biology, genetics, and biomedical research. This course consists of lectures, discussions, and hands-on bioinformatic practical sessions.

EC 206 Aug 2:1

Evolutionary Genetics

Department: Ecological Sciences

Course Outcomes:

This course consists of lectures, discussions and hands-on bioinformatics sessions. Practical sessions introduce students to various aspects of data acquisition, processing, and analyses, while theory classes provide in-depth knowledge of the underlying principles.

EC 306 Jan 2:1

Advance Ecological Statistics

Department: Centre for Ecological Sciences

Course Outcomes:

This course introduces advanced topics in ecological statistics, including generalised linear models; tackling zero-inflation; and mixed-effects models. Students are introduced to statistical modelling strategies and best practice in choosing variables and setting up and interpreting models. Students gain hands-on experience in fitting and interpreting statistical models using R/RStudio with ecological data-sets.

EC201 Jan 2:1

Theoretical and Mathematical Ecology

Department: Centre for Ecological Science

Course Outcomes:

At the end of this course, students should develop an ecological intuition that is quantitatively grounded, be able to read and critique mathematical/computational modelling papers, reproduce their results, and possibly even build basic models themselves. PhD students working in biological research are expected learn to think quantitatively and with a theoretical bent on their own research. This course is also expected to inspire many quantitatively trained UG students towards mathematical biology research.

भारतीय विज्ञान संस्थान

EC203 Jan 2:0

Ecology: Principles and Applications

Department: Centre for Ecological Science

Course Outcomes:

Broad introduction to ecology and its relevance to society

भारतीय विज्ञान संस्थान

EC301 Aug 2:1

Animal Behaviour: Mechanisms and Evolution

Department: Centre for Ecological Science

Course Outcomes:

Students gain an understanding of the history of animal behaviour research, physiological basis of behaviour, ecology and evolution of behaviour, as well as are exposed to different approaches to studying the subject. The practical component gives them hands-on training in designing and analysing behavioural experiments, as well as presenting these results.

EC302 Aug 2:1

Plant-Animal Interactions (Ecology, Behaviour and Evolution)

Department: Centre for Ecological Science

Course Outcomes:

Students are exposed to the state-of-the-art in concepts, methodologies, and controversies in the subject matter of the course. They will learn how to think critically about the subject and to critique published material as well as online material available on the internet.

EC303 and PH303 Aug 2:1

Spatial dynamic in biology

Department: Centre for Ecological Science

Course Outcomes:

This will train students to apply ideas from nonequilibrium statistical physics and stochastic processes to Biological systems. The course will also train towards presentation skills as well as research skills via an independent project that students would develop.

EC305 Aug 2:1

Quantitative Ecology: Research Design and Statistical Inference

Department: Centre for Ecological Science

Course Outcomes:

Understanding principles of good study design and statistical inference. Proficiency in using R to test design (e.g., power analyses) and run common statistical techniques used in ecology (e.g., regression, multiple regression, ANOVA, generalised linear models etc)

EE304 Jan 3:1

Computational Cognitive Neuroscience

Department: Computer Science and Automation

Course Outcomes:

There is an emerging need for computational frameworks that permit extracting meaningful information from noisy, high-dimensional brain data. The students will review the state-of-the art in machine learning and dimensionality reduction as well as theoretical and computational models in brain research. The course project will train them to develop and apply computational algorithms to large-scale neuroscience datasets, for example, for decoding cognitive states from brain imaging data.

ER 201 Aug 3:0

Renewable Energy Technologies

Department: interdisciplinary Centre for Energy Research

Course Outcomes:

complete PV from basic device physics to plant working principals

ES 202 Aug 3:0

Geodynamics

Department: Centre for Earthsciences (CEaS)

Course Outcomes:

Get insights about the working of the planet, and an appreciation of its origin, uniqueness. It explains the way the earth's unique environment has evolved as the only known planet in the Universe that sustains life. It provides reasoning as to why the natural calamities occur, as part of the earth's natural evolution and leads to an appreciation of the fact that the long term survival of the human race is contingent on its ability to understand the earth processes and its long-term consequences such as climate change.

ES204 Aug 3:0

Origin and evolution of the Earth

Department: Centre for Earthsciences (CEaS)

Course Outcomes:

For the student with no prior Earth science knowledge: fundamental concepts related to the origin and evolution of our planet; For the student with prior Earth science knowledge: improved understanding of Earth processes, introduction to cosmochemistry

ES205 Aug 3:0

Mathematics for Geophysicists

Department: Centre for Earthsciences (CEaS)

Course Outcomes:

Vector notation and calculus, construction of partial differential equations (PDEs) in vector form that describe geophysical phenomena, elementary fluid mechanics, basic electromagnetism, basic solutions to PDEs, construction of dimensionless parameters and equations, hands-on experience in problem solving through 3 assignments.

ES212 Jan 3:0

Fluid dynamics of planetary interiors

Department: Centre for Earthsciences (CEaS)

Course Outcomes:

Advanced fluid mechanics in stationary and rotating reference frames, principles of rotating convection, magnetohydrodynamics (MHD) of planets, applications of turbulence theories to planetary interiors and atmospheres.

ES213 Jan 3:0

Isotope geochemistry

Department: Centre for Earthsciences (CEaS)

Course Outcomes:

Students will develop a better understanding of the different isotopic-proxies used for addressing wide-ranging Earth science problems. They will also get a better understanding of how these isotope ratio measurements are performed.

ET 299 Aug 0:31

MTech EPD Dissertation Project

Department: Electronic Systems Engineering

Course Outcomes:

To make students experience all the stages and processes involved in conceptualizing, investigating, designing, and manufacturing electronic products. This includes various components like electronic packaging, microfabrication, communication networks, industrial design, thermal design, product design, app design, entrepreneurship, and tech start-up aspects. The project also seeks to enhance and impart industry relevant skills to students.

HE215 Aug 3:0

Nuclear and Particle Physics

Department: Centre for High Energy Physics

Course Outcomes:

The students are introduced to the basic tenants of nuclear physics and particle physics. The students should be well versed by the end of the course by the basic building blocks of nature and the four fundamental interactions.

HE316 Jan 3:0

Advanced Mathematical methods in Physics

Department: Centre for High Energy Physics

Course Outcomes:

The particular course emphasises on the physics applications to group theory; The students understand the properties of finite groups and constructing their; representations. The students are also introduced to lie Algebras and lie groups and their representations, which form one of the important continuous groups with many applications in; physics. They are expected to learn all the techniques; required to derive the representations of SU(N) groups.

HE384 Jan 3:0

Quantum Computation

Department: Centre for High Energy Physics

Course Outcomes:

Students would learn the framework of quantum computation, and how that may be useful for future quantum technologies.

भारतीय विज्ञान संस्थान

HE391 Aug 3:0

Relativistic Quantum Mechanics /Quantum Mechanics III

Department: Centre for High Energy Physics

Course Outcomes:

The course teaches students the first steps in relativistic quantum field theory. The students learn canonical quantisation, Klein Gordon Equation, solutions, Dirac Equation and solutions.

भारतीय विज्ञान संस्थान

HE395 Aug 3:0

Quantum Field Theory I

Department: Centre for High Energy Physics

Course Outcomes:

Students are equipped to start research in particle physics. More material would be taught in QFT-II.

HE396 Jan 3:0

Quantum Field Theory II

Department: Centre for High Energy Physics

Course Outcomes:

Expertise in quantum field theory, which is the key ingredient and tool of high energy physics, both experimental and theoretical. Most of the material is also of key use to condensed matter physicists

HE398 Jan 3:0

General Relativity

Department: Centre for High Energy Physics

Course Outcomes:

Should have a working knowledge of Einstein's general relativity and some modern research areas.

IN 212 Jan 3:0

Advanced Nano/Micro Systems

Department: Instrumentation and Applied Physics

Course Outcomes:

Students learn the phenomenon involved at small scale lengths that provided the information about the working of the systems and all the information related to fabrication. Case by case study is taken to tea h them about various systems.

IN 223 Jan 3:0

Advanced Signal Processing

Department: Instrumentation and Applied Physics

Course Outcomes:

The students were introduced to signal processing, filter design, and transforms (Fourier, Laplace and Z-transforms). The course then delves into multi-rate signal processing concepts and associated transforms like STFT and Wavelets. Emerging concepts in the area of compressive sensing and sparse recovery schemes were covered. The course then briefly elaborates on recent deep learning based approaches and its relationship to signal processing concepts. Lastly, the course also involves individual projects to enable student gain hands-on experience with these signal processing techniques.

IN214 Jan 3:0

Semiconductor Devices and Circuits

Department: Instrumentation and Applied Physics

Course Outcomes:

The course connects circuit performance to material and device behavior. At the end of the course, the students would learn to; 1.)Analyse semiconductor devices (electrostatics and current-voltage characteristics) from fundamental principles; 2.)Understand the implications of material properties and device physics when the device is used in circuits; 3.)Engineer and innovate on device design and even construct new devices intended for special applications in circuits. There is special emphasize placed on this aspect;4.)Learn the fundamentals of analog circuit design (with the example of voltage amplifiers) and observe how device properties and device design impact circuit behaviour (eg. dc and ac response, noise)

IN224 Jan 3:0

Nanoscience and Device fabrication

Department: Instrumentation and Applied Physics

Course Outcomes:

After taking this course a student will be able to understand; 1.Role of quantum mechanics in Nanomaterials; 2.Band structure of nanomaterials; 3.structural, optical, electronic properties of nanomaterials; 4.How to analyse data from characterization techniques like XRD, TEM, Absorption and emission spectroscopy.

IN227 Jan 3:0

Control System Design

Department: Instrumentation and Applied Physics

Course Outcomes:

At the end of the course the student would be able to do the following; (1) The use and significance of the different tools for control system design and analysis such as Nyquist plots,Bode plots, Evans plots (root locus), and Nichols plots; (2) Undertake systematic design of 1-DOF control systems;(3) Employ controllers such as PID and Lead-Lag for control design; (4)Undertake systematic design of 2-DOF control systems; (5)Understand the fundamental limitations associated with control of LTI systems;(6)Understand the special issues associated with non-minimum phase systems and unstable systems

IN232 Aug 3:0

Concepts in Solid State Physics

Department: Instrumentation and Applied Physics

Course Outcomes:

This course will expose students to the basic concepts in solid state physics, along with relevant experimental details. By the end of this course students will be able to appreciate the physics of metals, semiconductors and insulators. Students will also learn to evaluate advanced research articles and effectively communicate scientific ideas via writing and speaking.

IN244 AUG 2:1

Optical Metrology

Department: Instrumentation and Applied Physics

Course Outcomes:

Basics of Optical Instrumentation, Computational Imaging, and Image Analysis/ Demodulation Techniques. Gains hands on experience in setting up the optical systems and making measurements with them. Experience with processing the digital images acquired in optical metrology tools to decode the information about the measurand on MATLAB platform.

IN267 Aug 3:0

Fundamentals of Fluorescence Microscopy

Department: Instrumentation and Applied Physics

Course Outcomes:

Fluorescence based techniques

IN268 JAN 2:1

Microfluidic Devices & Applications

Department: Instrumentation and Applied Physics

Course Outcomes:

Exposure to the design and fabrication techniques of Microfluidic Devices, hands-on experience. Familiarity with various applications of Microfluidics and Lab-on-Chip Technologies and doing a term-project in realizing a specific application.

IN302 Aug 3:0

Classical and Quantum Optics

Department: Instrumentation and Applied Physics

Course Outcomes:

The classical and quantum nature of light.

भारतीय विज्ञान संस्थान

IP 214 AUG 2:1

CRYSTALLOGRAPHY FOR CHEMISTS

Department: Inorganic and Physical Chemistry

Course Outcomes:

TO THE STUDENTS OF CHEMISTRY BACK GROUND AFTER THE COURSE, THEY WILL BE CONFIDENT TO DO THE SINGLE CRYSTAL X-RAY DIFFRACTION STUDIES THEMSELVES

IP 322 Jan 3:0

Polymer Chemistry

Department: Inorganic and Physical Chemistry

Course Outcomes:

Students will come out with; 1.a strong appreciation of all aspects of polymer chemistry; 2.an understanding of how polymers are prepared and where they are used an knowledge of how polymers are characterized; 3.knowledge of all contemporary methods of polymer synthesis; 4.an appreciation of several specialty polymers and their applications

IP 327 Aug 3:0

Chemical Dynamics

Department: Inorganic and Physical Chemistry

Course Outcomes:

The students are introduced to experimental and theoretical aspects of chemical dynamics. Course starts with introduction to scattering and covers, elastic, inelastic and reactive scattering; potential Scattering; Newton diagrams; experiments; physical observables; differential and total cross sections; angular distribution - forward and backward scattering. Students then learn about potential energy surfaces controlling chemical reactions. They learn about how chemical reaction dynamics can be used to infer the potential surface. Transition from macroscopic to microscopic kinetics is introduced. Transition state theory explaining the Arrhenius equation of the thermal rate constants, k(T) and Rice-Ramsperger-Kessel-Marcus (RRKM) theory explaining the microscopic energy dependent rate constants, k(E) are covered in detail.

IP311 Aug 3:0

Bio and Medicinal Inorganic Chemistry

Department: Inorganic and Physical Chemistry

Course Outcomes:

The students would learn about the importance of metal ions in biological systems and how the metal ions mediate various biological functions such as metal-protein interactions, metal-nucleic acid interactions. They would also learn medicinally important metalloproteins, and development of drugs based on metalloproteins inhibition.

भारतीय विज्ञान संस्थान

IP323 Jan 3:0

Topics in Basic and Applied Electrochemistry

Department: Inorganic and Physical Chemistry

Course Outcomes:

The students will be able to analyze the electrochemical data (for example, with respect to mechanisms of redox reactions), design catalysts for electrochemical reactions. Appreciate and know fundamentals of electrochemical phenomena.

LS 103 Aug 1:0

Opportunities and Extensions in Life Sciences - Pa

Department: Life Sciences

Course Outcomes:

This course is designed specifically for M.Sc. Life Sciences students and is a core course for them. The course exposes students to alternate life science study areas beyond academic research. The course introduces them to topics such as BioEntrepreneurship, Intellectual property, science policy, sci-art; science communication and journalism, technology in life sciences, AI-ML In life sciences, healthcare innovation, and several other alternative areas. The topics are covered by established specialists in these areas through lectures and interaction, followed by oral presentations, assignments, and poster presentations by students on one of the topics in these areas. The course aims to empower students to explore other career opportunities in life sciences.

भारतीय विज्ञान संस्थान

LS 203 Aug 3:0

Microbiology, Virology and Immunology

Department: Life Sciences

Course Outcomes:

The students are introduced to the world of invisibles, by looking into the history of the microbe hunters and teaching them the important of Microbes in the making this planet habitable. Students are taught about bacteria as a tool for bioremediation. Most importantly, they are taught about the microbial diversity, and ecosystem which form the basis of signalling, in microbes, intra and inter species communication and finally quorum induced microbial community behaviour. They are also exposed to the mechanisms by which pathogen can cause disease and their intervention strategies.

भारतीय विज्ञान संस्थान

LS 204 Aug 3:0

Biochemistry and Biophysics

Department: Life Sciences

Course Outcomes:

The students got a detailed introduction to the anatomy of biomolecules, what are the factors that govern their shape that lead to their function in cellular systems. Enormous emphasis was laid on detailed understanding of the mechanism of action of lipids, carbohydrates, nucleic acids, enzymes, natural product drugs and proteins. Details were provided on how various spectroscopic tools are used to address biological questions.

भारतीय विज्ञान संस्थान

LS 205 Aug 3:0

Ecology and Evolution

Department: Life Sciences

Course Outcomes:

The students get a thorough introduction to basic ecology and evolution. In lectures, the instructor(s) will cover topics related to history of evolutionary thought, levels and types of selection, systematic, phylogenetics, biodiversity, ecological interactions, functioning of ecosystems and various threats faced by natural and human-modified ecosystems under global change. Through assigned readings, students will develop a broad understanding of how ecology and evolution provide a basis to understand life on earth.

LS 206 Aug 3:0

Developmental Biology and Genetics

Department: Life Sciences

Course Outcomes:

Students studied the fundamentals of genetics including Mandelian genetics, extensions to mandelian genetics, recombination on the chromosome as well as pedigree analysis and personalized genetics with respect to human diseases. They were taught how genetics was studied using multiple model organisms including Drosophila, yeast and plants and the applicability of this subject to human biology. Students were also taught about plant developmental changes in response to various biotic and abiotic stresses. Moreover, epigenetic regulation during early development including early embryogenesis, stem cell specification and germ line inheritance was covered.

LS 207 Aug 3:0

Fundamentals of Molecular Biology

Department: Life Sciences

Course Outcomes:

The course begins with early findings in the area of Molecular Biology and how the DNA double helix model revolutionized this field. Central Dogma and the process involved in transfer of genetic information are taught. The students are also introduced to the concept and mechanisms of gene regulation and genomics.

भारतीय विज्ञान संस्थान

LS 208 Aug 2:0

Physiology and Neurobiology

Department: Life Sciences

Course Outcomes:

Students learn fundamental aspects of human embryology, Cardiovascular system, Respiratory system, Endocrine system, Digestive system, Renal physiology, and Neurobiology. They will also gain basic knowledge of common diseases, disorders, and pathologies associated with these systems along with therapeutic interventions.

LS 209 Aug 0:2

Laboratory course in Molecular Techniques

Department: Life Sciences

Course Outcomes:

This course is designed specifically for M.Sc. Life Sciences students and is a core course for them. The course provides hands-on training to students in fundamental molecular and cell biology techniques, which are core in almost all life sciences laboratories. They execute experiments on DNA, RNA, and protein isolation, analysis and their characterization; cell culture; viability assessment; treatment, and subsequent analysis. The course introduces them to good laboratory practices and how to plan, execute, and record experiments.

LS 210 Aug 0:2

Laboratory course in Genetics and Ecology

Department: Life Sciences

Course Outcomes:

Students had hands-on experience designing and executing experiments in genetics and ecology. These experiments involved field observations, manipulative experiments with live animals and samples, and computer simulations. Some topics in genetics included studying the development, behavior and performing genetic experiments with the model organisms Arabidopsis thaliana, Saccharomyces cerevisiae, Caenorhabditis elegans, Drosophila melanogaster and Danio rerio. In ecology, students learned about ecosystem function, species diversity and distribution patterns, sexual selection, and the evolution of traits and speciation. Emphasis was on study design and the connection between process to pattern.

MA 200 Aug 3:1

Multivariable Calculus

Department: Mathematics

Course Outcomes:

Students learn analysis of multivariable functions, continuity, differentiability; integration of these functions. This course material will serve as foundation for many subsequent courses both in pure and applied areas.

MA 220 Aug 3:0

Representation Theory of finite groups

Department: Mathematics

Course Outcomes:

At the end of the course, a student would; 1) Understand the basics of representation theory of finite groups; 2)have enough knowledge about basic tools of representation theory; 3) be able to use these tools to determine representations of "Good Enough" groups; 4) Know pros and cons of these tools and apply suitably; 5) be able to describing complex representations of symmetric groups and of GL_2(F_q)

MA 222 Jan 3:1

Measure and integration

Department: Mathematics

Course Outcomes:

Lebesgue integral. Lebesgue differentiation.

MA 223 Aug 3:0

Functional Analysis

Department: Mathematics

Course Outcomes:

After this course, a student learns the basics of functional analysis. They learn to treat the vector spaces which have the additional property of being topological spaces. Blending of these two structures brings them an exposure to higher mathematics. Important theorems like the Hahn-Banach theorem are taught here. These theorems stand a student in good stead throughout his mathematical life.

MA 229 Jan 3:0

Calculus on Manifolds

Department: Mathematics

Course Outcomes:

The student having seen basic analysis and linear algebra is expected to learn how these topics play a significant role, first in multi-variate calculus which then naturally leads to calculus on manifolds. The intimate relationship between analysis and geometry should become apparent at the end of this course.

MA 235 Jan 3:0

Introduction to hyperbolic manifolds

Department: Mathematics

Course Outcomes:

The students acquire a thorough introduction to hyperbolic surfaces and 3-manifolds, which played a key role in the development of geometric topology in the preceding few decades. The course covers the basic notions of Riemannian geometry that are relevant to introduce the models of hyperbolic space and its geometry. The students are also introduced to the theory of Fuchsian groups and Kleinian groups, the thick-thin decomposition of hyperbolic manifolds, and fundamentals of 3-manifold topology. The students learn about the ideas behind the proof of the Mostow Rigidity Theorem, which is one of the seminal results in 20th century mathematics.

भारतीय विज्ञान संस्थान

MA 262 Aug 3:0

Introduction to Stochastic Processes

Department: Mathematics

Course Outcomes:

Students are introduced to the theory of discrete and continuous-time Markov Chains focused mainly on deriving the stationary distribution of the chain. Several important examples such as random walks, branching processes, Poisson processes are covered. Simulation of these processes and modern concepts like rates of convergence are also discussed. The course ends with an introduction to Brownian motion and study of its properties.

MA 315 Jan 3:00

Lie Algebras and their Representations

Department: Mathematics

Course Outcomes:

Students would learn the structure theory and representations theory of Lie algebras from this course.

MA 327 Aug 3:0

Topics in Analysis

Department: Mathematics

Course Outcomes:

Some beautiful theorems in analysis. More importantly basic techniques needed to work in analysis.

MA 338 Aug 3:0

Differentiable manifolds and Lie groups

Department: Mathematics

Course Outcomes:

Students taking this course ought to; 1)Know why we care about defining manifolds and what we expect to do with them; 2)Give examples of manifolds; 3)Understand how to construct diffeomorphisms using vector fields; 4)Understand why to care about differential forms and the Stokes theorem and how to prove the latter;5)Know how differential calculus can help with distinguishing different objects (through De Rham cohomology).

भारतीय विज्ञान संस्थान

MA 339 Jan 3:0

Geometric Analysis

Department: Mathematics

Course Outcomes:

After taking this course, a student ought to; 1)Understand what a PDE on a manifold means; 2)Why we care about setting up and studying PDE on manifolds; 3)How one proves existence and uniqueness for linear and some nonlinear PDE; 4)As a part of 3), know about Sobolev spaces and Holder spaces of functions.

MA 343 Jan 3:0

Complex Analytical Techniques in Operator Theory

Department: Mathematics

Course Outcomes:

Students got a thorough introduction to certain classical and modern topics in the theory of operators on Hilbert spaces which enabled them for state-of-the-art research. The topics included Ando dilation, Distinguished varieties, Sharpening of Ando's inequality, The extension property, Holomorphic retracts and description of distinguished varieties through the Berger-Coburn-Lebow Theorem.

MA 348 Aug 3:0

Topics in function theoretic operator Theory

Department: Mathematics

Course Outcomes:

This was a special topics course aimed to equip students to start research. It included Banach algebras – Gelfand theory, L-infinity functional calculus for bounded normal operators, Pick - Nevanlinna and Caratheodory Interpolation problems, Distinguished varieties in the bidisc.

MA 355 Jan 3:0

Topics in geometric topology: geometric structures

Department: Mathematics

Course Outcomes:

The students are introduced to the fundamental results as well as current research in the following areas: geometric structures on surfaces, hyperbolic 3-manifolds, Riemann surfaces and Teichmüller theory. The course focuses on the various interactions between these fields, so the students see how different sub-fields of geometric topology interact. In the course, students also learn to explore open-ended questions and see how writing related computer programs helps in such exploration.

MA 367 Jan 3:0

Topics in Gaussian processes

Department: Mathematics

Course Outcomes:

Fundamental concepts of Gaussian processes. Also about stationary Gaussian processes on the line which are useful in signal processing and filtering theory.

MA 375 Aug 3:0

Algebraic graph theory

Department: Mathematics

Course Outcomes:

The students first get a review of basic concepts of linear algebra and graph theory. This is followed by introducing the concept of matrices related to graphs. Several matrices related to graphs, such as adjacency matrix, incidence matrix, Laplacian matrix, and distance matrix, are introduced along with their many interesting properties. The classical matrix tree theorem is studied. The course also introduced the Perron-Frobnenius theory and the concept of algebraic connectivity.

MA 384 Jan 3:0

Mathematical Physics

Department: Mathematics

Course Outcomes:

The purpose of this course will be to understand and appreciate the symbiotic relationship that exists between mathematics and physics. Topics to be covered can vary but those in this edition include: a brisk introduction to basic notions of differential geometry (manifolds, vector fields, metrics, geodesics, curvature, Lie groups and such), classical mechanics (Hamiltonian and Lagrangian formulations, n-body problems with special emphasis on the n=3 case) and time permitting, an introduction to integrable systems.

MA 388 Aug 3:0

Topics in Non-linear Functional Analysis

Department: Mathematics

Course Outcomes:

The student gets a through introduction to the Critical Point theory of functionals defined on an infinite dimensional Banach Spaces. These theories have been applied to study semi-linear elliptic PDEs which are related to various Astrophysical models. A modern method called Concentration Compactness Principle has been developed to handle the issue of non-compactness in infinite dimensional Banach Spaces. The techniques developed in this course can be used to study Yamabe equation which is related to scaler curvature of a Riemannian Manifold.

MA 393 Jan 3:0

Topics in random discrete structures

Department: Mathematics

Course Outcomes:

Real trees, the Brownian continuum random tree, phase transition in random graphs, scaling limits of discrete combinatorial structures, random maps, the Brownian map and its geometry.

MA219 Aug 3:1

Linear Algebra

Department: Mathematics

Course Outcomes:

Solving linear equations, working with matrices, in particular eigenvalues and eigenvectors, and applying the techniques to real life problems like graph theory, computer science, electronics and applied mathematics. Spectral theorems, prevalent in many branches of mathematics.

MA221 Aug 3:0

Analysis I

Department: Mathematics

Course Outcomes:

Proficiency in (a) dealing with functions of one and several variables, including integration and differentiation of the same, (b) A working knowledge of metric spaces and continuous functions defined on the same, (c) on a broader level, a rigorous mindset towards problem solving, including linear reasoning.

MA232 Aug 3:0

Introduction to Algebraic Topology

Department: Mathematics

Course Outcomes:

The students learnt;1.techniques to compute the fundamental group of topological spaces, and the proof that it is a topological invariant; 2.acquired an understanding of covering spaces and the correspondence with subgroups of the fundamental group; 3.learnt how to compute simplicial homology groups of a simplicial complex.

MA318 Jan 3:0

Combinatorics

Department: Mathematics

Course Outcomes:

How to approach problems in combinatorics

MA319 Jan 3:0

Algebraic Combinatorics

Department: Mathematics

Course Outcomes:

Learn basis of algebraic combinatorics

MA361 Aug 3:0

Probability Theory

Department: Mathematics

Course Outcomes:

Students will be able to understand advanced probability models and be able to analyse and develop such models.

MA386 Jan 3:0

Coxeter Groups

Department: Mathematics

Course Outcomes:

Learn basis of the theory of Coxeter groups

MB 211 Jan 3:1

Multiscale Theory and Simulations of Biomolecular Systems

Department: Molecular Biophsyics Unit

Course Outcomes:

Advance methods in molecular modeling

MB 215 Aug 2:0

Neuronal Ion Transport in Health and Disease

Department: Molecular Biophysics Unit

Course Outcomes:

Students learn about the structure and functioning of different neuronal ion channels and their contribution to the neuronal plasticity mechanisms. Gain an understanding of the current techniques employed to study the physiological and pathophysiological aspects of neuronal ion channels and transporters. Knowledge of the involvement and alteration of various ion channel functions in neurobiological disorders.

MB 222 Aug 3:0

Electron microscopy and 3D image processing for Life sciences

Department: Molecular Biophysics Unit

Course Outcomes:

Students learn the details about electron microscopes, cryo-electron microscopes, and image formation by electrons. Additionally, this course covers the basic concepts of Fourier analysis, phase contrast, electron scattering, Contrast Transfer Function, and point spread function, which assist them in studying the TEM/Cryo-EM data processing. We also cover the basic concepts of K-Mean clustering, Maximum Likelihood, and Bayesian statistics, which are required for image reconstruction. Students also learn the steps in cryoEM structure determination workflow and principles behind reconstructing a 3D structure from 2D cryo-EM images. Cryo-EM methods applicable to studying cellular structures are also introduced and principles discussed with case study examples, such as cryo-electron tomography, correlative light and electron microscopy (cryo-CLEM) and cryo-focused ion beam milling (cryo-FIB-SEM). Students are exposed and learn how different biological samples at different size scales, from proteins to cells, can be imaged and reconstructed using electron microscopy. Additionally, couple of demonstration classes are organized to correlate the theory with practical, where students learn sample preparation, microscope handling, and data collection. These demonstration classes will benefit the students for the next advanced course, where students will get exposure to hands on training for TEM/cryo-EM and image processing.

भारतीय विज्ञान संस्थान

MB 315 Jan 2:0

Relaxation Theory and Applications to Solution State Biomolecular NMR Spectroscopy

Department: Molecular Biophysics Unit

Course Outcomes:

This course will introduce students to the methodology for studying protein dynamics using NMR relaxation measurements and enable them to simulate and interpret data from such experiments. Students will be introduced to Redfield theory and will analyse T1 relaxation, T2 relaxation, cross-relaxation and relaxation interference in homonuclear and heteronuclear two-spin IS systems within the context of Redfield theory to understand fast dynamics in biomolecules. A substantial part of the course will also be allocated to the theory and application of recent methods for characterizing slow biomolecular dynamics such as CEST/DEST, relaxation dispersion, magnetization exchange and paramagnetic relaxation enhancement.

भारतीय विज्ञान संस्थान

MB201 Aug 2:0

Introduction to Biophysical Chemistry

Department: Molecular Biophsyics Unit

Course Outcomes:

Students will study applications of equilibrium thermodynamics to biological systems and obtain a molecular level understanding of non-covalent interactions important for determining macromolecular conformation; They will also become familiar with various methodologies for determining binding constants and hydrodynamic methods for estimating macromolecular size and shape.

MB204 Aug 3:0

Molecular Spectroscopy and its Biological Applications

Department: Molecular Biophsyics Unit

Course Outcomes:

Learn to interpret spectroscopic data for structural analysis.

MB206 Aug 3:0

Conformational and structural aspects of biopolymers

Department: Molecular Biophsyics Unit

Course Outcomes:

A student of this course is expected to have learnt about 3-D aspects of molecules in general and in particular, peptides, proteins and nucleic acids.

MB207 Jan 2:0

DNA-Protein interaction, Regulation of gene expression, Nanobiology

Department: Molecular Biophsyics Unit

Course Outcomes:

Students taking this course will be; 1.Able to describe and explain the parameters that control biomolecular interactions and recognition esp. in the context of gene regulation;2.Explain how single molecule methods are used to understand such molecular interactions at the nanoscale; 3.Design and apply such studies to problems of board scientific interest that involve molecular interactions

MB209 Aug 3:1

Molecular and Cellular Neurophysiology

Department: Molecular Biophsyics Unit

Course Outcomes:

The students would get a broad introduction to cellular and molecular neurophysiology. Whereas the first part of the course deals with the quantitative details of neuronal passive properties, action potential generation, synaptic transmission using simple experimental systems, the second part of the course delves into details of mammalian neuronal physiology with a specific focus on neuronal and synaptic plasticity during learning

MB210 Jan 2:0

Peptides and Drug-Design

Department: Molecular Biophsyics Unit

Course Outcomes:

The students would learn the structure and conformation of natural and unnatural amino acid containing peptides, the methods for their combinatorial and parallel synthesis, the reagents for efficient amide bond coupling. They learn how to design a bioactive sequence from a given protein or hormonal peptide sequence, they learn about strategies for macrocyclization and conformational restriction that are important for the lead development in drug discovery. They learn about strategies to enhance the cellular permeability of peptides, along with the strategies to enhance their metabolic stability. Finally they learn about the various peptide bond isosteres that are used in drug discovery, which have forwarded peptide leads into clinic.

भारतीय विज्ञान संस्थान

MB212 Jan 2:0

Electron microscopy and 3D image processing for Life sciences

Department: Molecular Biophsyics Unit

Course Outcomes:

Cryo-electron microscopy and the image processing is an emerging technology; This course will clear the idea about image formation, Fourier analysis, Contrast Transfer Function, Point Spread Function and Electromagnetic applications in biology and medicine. Also, this course will help to understand the common line methods, particle symmetry, Projection Theorem, K-means clustering algorithm. Researchers (Ph.D. student and postdoctoral researchers) will learn how to handle the electron microscope, what is the basic principle and how we can use this instrument for our research purposes. They will also learn the data processing, data collection, data analysis, model building and molecular docking.

MB303 Jan 3:0

Elements of Structural Biology

Department: Molecular Biophsyics Unit

Course Outcomes:

Introduction to structural biology

भारतीय विज्ञान संस्थान

MB305 Jan 3:0

Biomolecular NMR Spectroscopy

Department: Molecular Biophsyics Unit

Course Outcomes:

The student will learn the basic theory of NMR spectroscopy. Furthermore, they will learn the theoretical and practical aspects of NMR data acquisition and the details of analysis of Pulsed NMR methodology. The course is intended to train students to become independent users of the NMR instruments.

MC 203 Jan 3:0

Essentials in Microbiology

Department: Microbiology and Cell Biology

Course Outcomes:

As detailed in the syllabus, basic as well as advanced learning exposure in field of Microbiology

MC 210/RD 206 Jan 2

Molecular Oncology

Department: Microbiology and Cell Biology; Molecular Reproduction, Development and Genetics

Course Outcomes:

The student ill have a better understanding of mechanism behind cancer development and progression, cancer diagnosis and treatment, genetic and epigenetic basis of cancer development

भारतीय विज्ञान संस्थान

MC 211 / BC 210 Jan-April 2:0

Molecular basis of Ageing and Regeneration

Department: Microbiology and Cell Biology; Molecular Reproduction, Development and Genetics

Course Outcomes:

Learn about mechanism of Ageing and Regeneration

MC 216 Aug 1:0

Biological Safety: Principles and practices

Department: Microbiology and Cell Biology

Course Outcomes:

The students get a basic and advanced understanding of biosafety principles applied in microbiological, cell biology, and animal experiments. The course is comprised of several laboratory based examples of accidents happened due to lack of application and adherence of biosafety practices. In addition, the students learn the working principle of biosafety cabinets, autoclaves, chemical hoods, necropsy chambers, BSL2-, BSL3, and BSL4 laboratories. The course also introduces how biological hazards can be avoided by applying advanced safety guidelines.

MC202 Jan 2:0

Eukaryotic Developmental Genetics

Department: Microbiology and Cell Biology; Molecular Reproduction, Development and Genetics

Course Outcomes:

After successful completion of this course, students will have better understanding in genetic principles,

MC203 Aug 3:0

Essentials in Microbiology

Department: Microbiology and Cell Biology; Molecular Reproduction, Development and Genetics

Course Outcomes:

The students learns to understand and appreciate the basic mechanism of biological processes
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भारतीय विज्ञान संस्थान

MC206 Aug 2:0

RNA Biology

Department: Microbiology and Cell Biology; Molecular Reproduction, Development and Genetics

Course Outcomes:

Basic knowledge of RNA and update with advanced concepts in RNA Biology, which will help students in understanding the regulation of gene expression at different levels. Students working in the area of RNA Biology will be specifically benefited with this comprehensive course contents.

MC208 Aug 3:0

Principles of Genetic Engineering

Department: Microbiology and Cell Biology; Molecular Reproduction, Development and Genetics

Course Outcomes:

undergrad and postgraduate students

MC212 Aug 2:0

ADVANCES IN CELL BIOLOGY

Department: Microbiology and Cell Biology; Molecular Reproduction, Development and Genetics

Course Outcomes:

Students will learn current knowledge on cell biology including basic techniques

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ME 202 Aug 3:0

Micro-hydrodynamics

Department: Mechanical Engineering

Course Outcomes:

Students learn how to (1) formulate and investigate microscale flows, (2) use non-dimensionalization and scaling analysis to simplify microscale flow problems and come up with simplified mathematical models, and (3) use advanced mathematical tools such as perturbation methods to find analytical solutions to microscale flow problems.

ME 224 Aug 3:0

Mechanical Vibrations

Department: Mechanical Engineering

Course Outcomes:

The student gets a detailed introduction to the analysis of linear multi-degree-of-freedom dynamical systems. The course also introduces the student to the application of these analytical methods to nonlinear dynamical systems, which can be very useful in taking advanced courses offered in the areas of dynamical and control systems theory, system identification and machine learning. In particular, after taking this course, the students will be able to: (1) Analyze and derive the governing equations of motion of systems used in a variety of applications including automotive and aerospace structures and mechanisms, microelectromechanical systems, biomedical devices, and consumer products. (2) Understand and appreciate the analytical approaches used to derive exact (and/or approximate) solutions of large multidimensional linear and nonlinear dynamical systems. (3) Understand the connections that exist between the analytical approaches considered above and the numerical approaches required for solving (identification of) complex, data-driven systems.

भारतीय विज्ञान संस्थान

ME 226 Aug 3:0

Applied Dynamics I

Department: Mechanical Engineering

Course Outcomes:

At the end of the course the student will be able to: 1. Start with a sketch or verbal description of any 2D mechanism and write equations of motion (EoM) using Newton-Euler with minimal coordinates, or with Lagrange Eqs, or using Maximal coordinates and DAEs (Differential Algebraic Equations); Solve the EoM numerically and animate the solutions (system response); Apply various checks (conservation laws, comparison between methods, limiting cases) to assure the validity of the results; 2. Have facility with various skills; solving ODEs with events, root finding, optimization, symbolic derivation of EoM, animation; 3. Have facility with dyads; Have some intuition for 3D rotations, including representation using dyads, matrices, and axis-angle; Be able to animate 3D motion of a rigid object.

भारतीय विज्ञान संस्थान

ME 259 Aug 3:0

Nonlinear Finite Element Methods

Department: Mechanical Engineering

Course Outcomes:

Nonlinear finite element procedures are extensively used by structural engineers to design components for applications where large deformations or material nonlinearities are encountered. Also, manufacturing engineers require knowledge of these procedures to design dies and fixtures for various forming processes like sheet metal forming, rolling and extrusion. This course will provide the necessary fundamentals to students to undertake these tasks. In addition to exposure to algorithmic aspects, the course will provide the student with hands-on experience in implementing them in finite element codes and debugging them through carefully designed example problems. Thus, the student will acquire the skill to implement the algorithms via user-defined subroutines in general purpose finite element codes like ANSYS and ABAQUS. Moreover, a quick but thorough exposure will be given to Continuum Mechanics concepts which are crucial to understanding nonlinear finite element procedures.

ME 273 Jan 3:0

Solid and Fluid Phenomena at small scales

Department: Mechanical Engineering

Course Outcomes:

Broader perspective of mechanical behaviour of materials especially at small scales

ME 280 Oct 3:0

Fundamentals of Nanoscale Conduction heat transport

Department: Mechanical Engineering

Course Outcomes:

Students are introduced to basics of classical and quantum mechanics, statistical thermodynamics, crystal lattices, phonons and their properties: dispersions, group velocities and heat capacity, kinetic theory, Boltzmann transport equation, phonon scattering and thermal conductivity of semiconductors. Students get exposed to calculating phonon properties with python through assignments and in-class exercises.

ME 281 Jan 3:0

Thermodynamics of crystalline solids

Department: Mechanical Engineering

Course Outcomes:

Students are introduced to basics of classical and statistical thermodynamics, classical and quantum mechanics, crystal lattices, phonons and their contributions to Gibbs and Helmholtz crystal free energies, phonon self-energies and line-shapes, and anharmonic phonon renormalization. Students get exposed to calculating phonon properties with python through assignments and in-class exercises.

ME 282 Jan 3:0

Computational Heat Transfer and Fluid Flow

Department: Mechanical Engineering

Course Outcomes:

Through this course students learn about discretization methodologies that go into complex large scale fluid flow simulations. They also gain knowledge of important concepts such as consistency and convergence including stability of the discrete systems that are obtained from approximation of governing equations.

ME 284 and ER-201 Jan and Aug 3:0

Advanced Internal Combustion Engines and Renewable Energy

Department: CCE, ICER

Course Outcomes:

Fundamentals of the subject contents to advanced level topics.

भारतीय विज्ञान संस्थान

ME 287 Jan-April 3:0

Refrigeration Engineering

Department: Mechanical Engineering

Course Outcomes:

Refrigeration field is the most important applied energy and a major energy consuming sector. The students will come to know both the older technologies and the newer developments in the face of ozone depletion and global warming problems.

ME 288 Jan-April 3:0

Air Conditioning Engineering

Department: Mechanical Engineering

Course Outcomes:

Upon completion of this course, students will have a solid background in all (i.e. fundamental and applied) aspects of air conditioning. The knowledge gained will be useful in their further studies or to become an independent consultant on air conditioning.

ME 289 Aug-Dec 3:0

Principles of Solar Thermal Engineering

Department: Mechanical Engineering

Course Outcomes:

The students will have solid foundation in the fundamentals. With the knowledge gained in this course, they will be able to go through any advanced literature and understand.

ME 292 Aug 3:0

Contact and Impact Mechanics

Department: Mechanical Engineering

Course Outcomes:

This course provides students with a comprehensive understanding of contact and impact mechanics, including frictionless and adhesive contact, atomic-level forces, and 1-D elastic body impact mechanics. Students also learn how to apply these principles to scanning probe microscopy, nanoindentation, and dynamic testing techniques. This knowledge and hands-on experience equip students for advanced research and real-world applications.

ME228 Aug 3:0

Materials and Structure Property Correlations

Department: Mechanical Engineering

Course Outcomes:

The students understand how to control the properties of materials and the genesis of the property of materials including metals, ceramics and polymers.

ME237 Jan 3:0

Mechanics of Microsystems

Department: Mechanical Engineering and CeNSE as NE 211

Course Outcomes:

After taking this course, the students would; 1)become familiar with the field of microelectromechanical systems (MEMS); 2)be able to analyze MEMS components and devices using reduced-order (lumped) models; 3)be able to model and simulate multi-physics phenomena found in MEMS and other systems; 4)appreciate how to think about a MEMS device at the systems level; 5)become comfortable with using MEMS simulation software; 6)gain experience in designing MEMS devices

ME240 Aug 3:0

Dynamics and Control of Mechanical Systems

Department: Mechanical Engineering

Course Outcomes:

The students will learn concept of degree of freedom and generalised coordinates of a rigid body and; multi-body system, how to specify orientation of a rigid body using Euler angles and other representations, obtain linear and angular velocities of rigid multi-body systems, analyse kinematics of rigid multi-body systems, learn about the Lagrangian and Newton-Euler formulation to derive equations of motion and solve them numerically, perform linearization of the equations of motion to analyse small motions. The students will be exposed to classical control techniques using root locus and bode plots and to modern state space methods. They will be introduced to the concepts of stability, controllability and observability in linear control systems.

भारतीय विज्ञान संस्थान

ME242 Aug - Dec 2018 3:0

Solid Mechanics

Department: Mechanical Engineering

Course Outcomes:

Understanding concepts in Solid Mechanics like stress, strain, equilibrium and constitutive equations is essential for a design engineer. This course will expose the student to advanced concepts in Solid Mechanics and Elasticity theory building on elementary Strength of materials which is taught in undergraduate programs. Emphasis will be placed on tensor character of stress, strain and governing field equations after a thorough introduction to tensor algebra and calculus. Important concepts such as Uniqueness of solutions, St.Venant principle, Minimum potential energy theorem will discussed. The student will learn about solution of elasticity problems using not only stress function / potential function methods but also using energy methods. The limitations of plane elasticity assumptions (plane strain and plane stress) will be emphasized. At the end of the course, the student is expected to have a thorough knowledge of Solid Mechanics and should be able to apply it for strength / stiffness based design of engineering components. Also, he /she would acquire adequate background to take more advanced courses such as Fracture Mechanics, Impact Mechanics and Contact Mechanics.

ME243 Aug 3:0

Continuum mechanics

Department: Mechanical Engineering

Course Outcomes:

Students learn a unified treatment of all materials that can be treated as continua including balance laws that are common to all continua, and constitutive laws and the constraints that they should satisfy.

ME244 Jan 3:0

Experimental Methods in Microfluidics

Department: Mechanical Engineering

Course Outcomes:

1.The class is an elective, aimed at providing exposure to topics that are not usually covered in classes on fluid mechanics, and solid mechanics; 2.The material to be covered and assessment procedure will particularly benefit students engaged in research projects related to the content of the course. This includes problems related to microfluidics, biomechanics, and lab-on-chip devices.

ME246 Jan 3:0

Introduction to Robotics

Department: Mechanical Engineering

Course Outcomes:

The students will; a)learn how to model a robot and its components; b)learn how to derive and solve forward and inverse kinematics of serial and parallel manipulators; c)learn how to obtain equations of motion of a serial and parallel robot; d)different control techniques (linear and nonlinear) used to control the motion of a robot; e)be exposed to advanced topics such as flexible robots, mobile robots etc.

भारतीय विज्ञान संस्थान

ME249 Jan 3

Fundamentals of acoustics

Department: Mechanical Engineering

Course Outcomes:

1)The student will learn how to pose an engineering problem that involves sound propagation. This will be in the form of an integral equation that can be solved either analytically or numerically;2)The student will understand the physics of sound propagation outdoors and in enclosed spaces; 3)The student will learn how to solve a hyperbolic pde with initial conditions and boundary conditions; 4)The student will get an exposure to Green Functions that are fundamental to pdes; 5)He will get exposed to deep concepts like, integral equations, Sommerfeld radiation condition, sound structure interaction.

ME250 Aug 3:0

Structural Acoustics

Department: Mechanical Engineering

Course Outcomes:

The student will; 1)know how to pose and sound structure interaction problem; 2)understand how sound and structure coupled waves behave. How fluid affects the structure and vice versa; 3)get know most commonly used analytical methods to deal with the mathematics.

ME253 Jan 3:0

Vibrations of Plates and Shells

Department: Mechanical Engineering

Course Outcomes:

The student will learn about; 1)infinitesimal displacements in curvilinear coordinates. He/she will learn about nonlinear strains and how to linearize them; 2)about a general set of equations of motion for vibrating continuous systems; 3)Modeshapes and resonances; 4)how to compute the forced response for any type of forcing; 5)the receptance method.

ME255 Aug 3:0

Principles of Tribology

Department: Mechanical Engineering

Course Outcomes:

An appreciation of the Tribological concepts as an application of Physics, chemistry and mechanics.

ME256 Jan 3:0

Variational Methods and Structural Optimization

Department: Mechanical Engineering

Course Outcomes:

After taking this course, a student would; 1)Understand the difference between ordinary calculus and calculus of variations as well as functions and functionals;2)Get a quick grasp of the terminology of function spaces, energy spaces in particular; 3)Be able to take the first variation of a functional; 4)Write down necessary conditions of functionals involving multiple functions; multiple derivatives of a function; one, two, or three independent variables on which the functions depend; 5)Understand how to write the boundary conditions, including variable end conditions and transversality conditions; 6)Appreciate energy and variational methods in mechanics as well as the interconnection between force-balance (differential equation), weak form (principle of virtual work and D' Lambert principle), and energy principles (minimum potential energy and Hamilton's principle) in mechanics; 7)Be able to think about the inverse problem of writing the minimization principle from the differential equation; 8)Gain a thorough understanding of Karush-Kuhn-Tucker (KKT) conditions for constrained minimization problems and the concept of Lagrange multipliers and their various interpretations; 9)Be able to analytically obtain the necessary conditions for optimizing a bar of variable cross-section profile for different objective functions and constraints; 10)Be able to the same for beams, plates, 2D and 3D continuous structures; 11)Understand the sensitivity analysis in structural optimization; 12)Be able to implement the numerical optimization algorithm to obtain optimized geometry of bars, beams, plates, 2D continua, 2D and 3D trusses, 2D and 3D frames and grillages; 13)Be able to consider transient and multiphysics problems in structural optimization; 14)Become familiar with Optimization Toolbox in Matlab; 15)Be able to formulate optimization problems in the framework of calculus of variations and then convert into the discretized form as a finite-variable continuous optimization.

ME257 Jan 3:0

Finite Element Method

Department: Mechanical Engineering

Course Outcomes:

The students will not only learn how to use the finite element method, but also how to formulate and code a finite element method for any given set of partial differential equations. Thus, the finite element method is developed as a tool for the numerical solution of partial differential equations, and not confined only to structural mechanics applications the way it is typically taught.

ME260 Aug 3:0

Topology Optimization

Department: Mechanical Engineering

Course Outcomes:

After taking this course, the student would; 1.Be able to formulate and implement topology optimization of structures and compliant mechanisms; 2.Be able to write sensitivity (gradients) for cost functionals with respect to design variables and shape-changing parameters; 3.Be able to appreciate the connection between homogenization theory and topology optimization Become familiar with numerical methods used in topology optimization; 4.Be conversant with the contemporary literature in the field of topology optimization

ME271 Aug-Dec 3:0

Thermodynamics

Department: Mechanical Engineering

Course Outcomes:

At the end of the course the student would have strong hold on the fundamentals concepts of thermodynamics. The student would be able to apply the laws the thermodynamics to a host of engineering problems involving work and heat interactions. The student would be equipped with fundamental tools to help analyze complex systems with advanced tools such as Exergy and Availability. The course would also lay the foundation to advanced courses such as Convective Heat Transfer, Radiation and Conduction and Transport Phenomena.

ME283 Aug 3:0

Two Phase Flow and Boiling Heat Transfer

Department: Mechanical Engineering

Course Outcomes:

Methods of analysis of two phase flows with and without phase change.

ME284 Jan 3

Applied Combustion

Department: Mechanical Engineering

Course Outcomes:

The students will obtain an understanding of the physics of basic and advanced combustion phenomena. They will be equipped with the basic tools of analyzing such phenomena. They will also be exposed to industrial applications of combustion, specifically with respect to applications in energy conversion and propulsion; Finally, they will obtain an understanding of the working and design of combustion devices.

भारतीय विज्ञान संस्थान

ME285 Aug 3:0

Turbomachine Theory

Department: Mechanical Engineering

Course Outcomes:

The course gives exposure to the basic principles of axial and radial turbomachines, and ways to analyze and understand the flow within them.

ME293 Jan-18 3:0

Fracture Mechanics

Department: Mechanical Engineering

Course Outcomes:

Fracture Mechanics is important both from the perspective of material development and design of engineering components. While conventional design for strength, stiffness or fatigue life make use of elementary concepts based on Strength of Materials and Theory of Elasticity, these may give erroneous estimates of load bearing capacity or life of a structural component due to presence of flaws. In this course, the student will learn about mechanics of crack tip fields and appropriate fracture characterizing parameters like stress intensity factor and J integral or nonlinear energy release rate and how to compute them using various methods. Special emphasis will be given to experimental methods for determining the fracture toughness (for example, ASTM standard procedure for JIC testing). Failure of structures by fatigue crack growth is another important topic which the student will learn in this course. Various empirical fatigue crack growth laws, role of stress ratio, overload cycle, etc., will be discussed. An engineering approach to elastic-plastic fracture mechanics which makes use of a handbook style approach to evaluate important fracture characterizing parameters like J and CMOD will be described. At the end of the course, the student should be able to apply the concepts that he/she has learnt to design of structural components taking into account presence of flaws, nature of loading and constitutive behavior of the material. Also, he / she should be able to conduct experiments in the laboratory following standard test procedures to determine the fracture toughness of materials.

MG 212 Aug-Dec 2:1

Behavioral Science

Department: Management Studies

Course Outcomes:

Individual effectiveness and developing better understanding of others

भारतीय विज्ञान संस्थान

MG 219 Aug 3:0

Introductory Probability Theory

Department: Management Studies

Course Outcomes:

Learning basic probability calculation using combinatorics & probability laws, and probability distributions of discrete & continuous random variables & random vectors and their moment & quantile based summary measures. Being able to model real life uncertain scenarios using standard discrete and continuous probability models like Binomial, Hypergeometric, Geometric, Negative Binomial, Poisson, Uniform, Normal, Exponential, Gamma and Weibull distributions, and learning visualization, computations and simulations involving these distributions using R.

MG 220 Aug 3:0

Introductory Statistics

Department: Management Studies

Course Outcomes:

Learning fundamentals of frequentist mathematical statistics involving Estimation and Hypotheses Testing. Estimation: Uniformly Minimum Variance Unbiased Estimation and Method of Moments and Maximum Likelihood. Hypothesis Testing: Uniformly Most Powerful Unbiased Tests, Likelihood Ratio Tests, p-values. Learning applications in solving one and two sample problems for Mean, Variance and Proportions using both parametric and non-parametric methods and their implementations in R.

MG 222 Aug 3:0

Regression and Time Series Analysis

Department: Management Studies

Course Outcomes:

Learning how to model a quantitative dependent variable in terms of several quantitative and categorical independent variables using a linear model for the purpose of understanding association, decision making and prediction. Learning univariate time series modeling using Auto Regressive Integrated Moving Average Models and their Seasonal versions for the purpose of understanding the evolution of a time series and forecasting. Implementation of the methods in R so that students can actually solve real life problems using the learnt methods.

MG 225 Aug 3:0

Decision Models

Department: Management Studies

Course Outcomes:

After taking this course a student should be able to; 1.Build a discrete event simulation model in simply and perform statistical analysis to compare the outputs; 2.Perform steady state and transient simulation output analysis; 3.Understand the notion of pareto optimality; 4.Develop method for estimating the efficient frontier; 5.Build ANN and SVM models for classification problems; 6.Develop DEA models for study the relative efficiencies of DMU's

MG 265 Aug 3:0

Data Mining

Department: Management Studies

Course Outcomes:

After taking this course a student should be able to; 1.Write non-trivial programs in Python; 2.Work on a hadoop system and work with MapReduce framework; 3.Perform market basket analysis using Apriori and FP tree; 4.Perform clustering analysis; 5.Understand the advantages and limitations of some of the popular clustering methods; 6.Build a decision tree for classification; 7.Work with BayesNet; 8.Use PCA for data summarisation

भारतीय विज्ञान संस्थान

MG 286 Jan 3:0

PROJECT MANAGEMENT

Department: Management Studies

Course Outcomes:

The course aims at the following learning targets; 1.To understand the concepts of project definition, life cycle, and systems approach; 2.To develop competency in project scooping, work definition, and work breakdown structure(WBS); 3.To handle the complex tasks of time estimation and project scheduling, including PERT and CPM; 4.To develop competencies in project costing, budgeting, and financial appraisal; 5. To gain exposure to project control and management, using standard tools of cost and schedule variance analysis; 6.To appreciate the elements of risk and quality in hi-tech projects; 7.To learn project management by aâ‚¬cepracticeaâ‚¬â€¢, through the medium of aâ‚¬restudy projectsâ‚¬; and; 8.To appreciate and understand the use of computers in project management, especially at tool like MS Project.

भारतीय विज्ञान संस्थान

MG 298 Aug 2:1

ENTREPRENEURSHIP FOR TECHNOLOGY STARTUPS

Department: Management Studies

Course Outcomes:

This course on Entrepreneurship provides you the opportunity to develop your business plan, as well as to read and evaluate many business plans, synopses, and cases. At the end of the course, you should have a â€oegoodâ€• understanding of how to start a company, and some of the issues that arise in the entrepreneurial process.\r\n\r\nAs this is a â€oelaboratoryâ€• course, we will minimize the â€oelecture pedagogyâ€• of teaching. Instead, we will opt for a judicious combination of case teaching and guest lectures, augmented with some experiential learning. Some of the guest lecturers may come from outside Bangalore, and all of them will be sparing their valuable time for enhancing your learning ability. Hence, we will expect you to be well prepared and intellectually aggressive to maximize the benefits for all. Preparation and hands-on practice is essential for you to get as much as possible from this course (apart from a good grade!). So, please read the assigned portions and case(s), before you come to class. Also, ensure that you make all your submissions of assignments (please see next Section) on time, as per the given schedule.\r\n\r\n

MG201 Aug-Dec 3:0

Managerial Economics

Department: Management Studies

Course Outcomes:

A fair understanding of micro behaviour of consumers and firms in different market structures.

MG202 Aug-Dec 3:0

Macroeconomics

Department: Management Studies

Course Outcomes:

A student would be able to appreciate the macroeconomic developments and its implications fairly well, at the end of the course.

भारतीय विज्ञान संस्थान

MG221 Aug 2:1

Applied Probability and Statistics

Department: Management Studies

Course Outcomes:

1.Acquiring a basic knowledge of Probability Theory, useful for modeling uncertain phenomena, and required for understanding the logic of Statistical Methods and Machine Learning; 2.Learning the general methods of frequentist estimation and hypothesis testing; 3.Learning standard statistical methods useful for everyday routine elementary applications.

MG258 Jan 3:0

Financial Instruments and Risk Management Strategies

Department: Materials Research Centre

Course Outcomes:

The course is designed to help students appreciate the various aspects of financial markets, need for their existence, and risk management for financial derivatives. The course lays the foundation for more advanced topics in Quantitative finance.

MG281 Jan 3:0

Management of Technology for Sustainability

Department: Materials Research Centre

Course Outcomes:

1.Better understanding of the whole issue of "Sustainability" and its critical relevance for future managers and professionals; 2.Need for an integrated approach in evaluating performances of business, organisations and individuals by taking into account both the positive and negative impact on economic, social and environmental systems; 3.Rethinking on depending "profit" alone as business performance to "triple bottom-line; 4.Methods to synthesize multi-dimensional, hierarchical and quasi-quantitative information.

MR 203 Aug -Dec 2017 3:0

Introduction to Biomaterials

Department: Materials Research Centre

Course Outcomes:

Extra lectures by neurosurgeons and prosthodontist by clinicians excite the students into the clinical relevance of the biomaterials.

भारतीय विज्ञान संस्थान

MR301 Aug 3:0

Quantum Mechanical Principles in Materials

Department: Materials Research Centre

Course Outcomes:

The appeal of this course goes beyond the divisions as the students attending this course are from both sciences as well as engineering backgrounds. It is also very popular among the senior undergraduate students.

भारतीय विज्ञान संस्थान

MR306 Aug 3:0

Electron Microscopy in Materials Characterization

Department: Materials Research Centre

Course Outcomes:

Fundamental understanding of principles of operation of SEM, TEM and interpretation of images and diffraction patterns. This course will be a prerequisite for undergoing hands-on training on TEM at AFMM.

MR308 Jan 3:0

Computational Modeling of Materials

Department: Materials Research Centre

Course Outcomes:

Students who have taken the previous course have immensely benefited from this course, there have been many other students, who, without any prerequisite knowledge of quantum mechanics, statistical mechanics etc. have grasped the underlying concepts and have successfully applied the learning from this course to their research work.

MT 202 Aug 3:0

Materials Thermodynamics and Kinetics

Department: Materials Engineering

Course Outcomes:

1.Knowledge of various thermodynamic quantities and their inter-relationships; 2.Thermodynamic origins of phase diagrams, reaction equilibrium constant, equilibrium defects, curvature effects, etc; 3.Solution to the diffusion equation in simple systems; their implications; 4.Understanding of diffusion mechanisms, and the origin of temperature dependence of diffusion coefficient

MT 211 Aug 3:0

Magnetism, Magnetic Materials, and Devices

Department: Materials Engineering

Course Outcomes:

This course has been a part of our institute's curriculum for the past two years. Through this course, students gain a comprehensive understanding of the fundamentals of magnetism and the properties of magnetic materials. Emphasis is placed on real-world applications, particularly in the design and development of magnetic devices. Furthermore, it paves the way for students interested in pursuing advanced topics within the magnetic materials domain, ensuring they are well-equipped to navigate the complexities of the field.

भारतीय विज्ञान संस्थान

MT 217 Aug 3:0

Computational Mathematics for Materials Engineers

Department: Materials Engineering

Course Outcomes:

Students are taught the mathematical basics of solving ordinary and partial differential equations, vector calculus, and transformation (e.g., Fourier) methods. In parallel, students obtain hands-on training on implementing all the mathematical solutions that they have learnt through the course via python-based notebooks, so that their computational skills are enhanced. Students should be able to use the python and computing skills developed in this course as part of other courses, research, and/or training within materials science.

MT 240 Jan 3:0

Principles of Electrochemistry and Corrosion

Department: Materials Engineering

Course Outcomes:

Students are introduced to the thermodynamic, kinetic, and mass transport aspects of electrochemical systems, such as batteries, supercapacitors, and fuel cells. Students get an overview of the various experimental and computational techniques available for measuring and modelling electrochemical systems. Subsequently, students explore the electrochemical principles governing corrosion, types and mechanisms of corrosion, and methods available to mitigate corrosion.

MT 256 Jan 3:0

Fracture

Department: Materials Engineering

Course Outcomes:

Understanding of the factors that govern failure in systems ranging from structural metals to functional materials, knowledge of external factors that affect reliability and how to anticipate and quantify them, methods of measuring toughness quantitatively with 3 demonstrations in the laboratory that cover contact loading, adhesion and plane strain fracture toughness

MT 260 Aug 3:0

Polymer Science and Engineering – I

Department: Materials Engineering

Course Outcomes:

Basics of polymers to physical chemistry of polymers, structure property relationship and processing techniques.

MT 261 Jan 3:0

Organic Electronics

Department: Materials Engineering

Course Outcomes:

Fundamental understanding of organic electronics and appreciate importance of structure property relationship of molecules in devices like OPV, OLED, sensors and transistors.

MT 309 Aug 3:0

Introduction to Manufacturing Science

Department: Materials Engineering

Course Outcomes:

The course bridges the gap between theory and practice in the broad domain of "Materials processing & Manufacturing". The students get a thorough introduction to various casting, welding, metal forming as well as powder metallurgy processes. Moreover, the course offers students both theoretical and experimental knowledge to understand the mechanism of solidification, mechanics of metal working, insight of weld metallurgy and weld mechanics as well as mechanics of solid-state sintering of metal as well as ceramic powders.

MT203 Aug 3:0

Materials Design and Selection

Department: Materials Engineering

Course Outcomes:

Encourage a combination of simple hands-on experiments and software, both individually and in groups, to develop a broad sense of various properties of materials. Recognise need to, and develop procedures to, compromise when there are conflicting objectives in design. Include awareness of ecological and sustainability issues.

MT206 Aug 3:0

Texture and Grain boundary engineering

Department: Materials Engineering

Course Outcomes:

1.Acquaintance with crystallography of polycrystals; 2.Knowledge of texture representation and analysis; 3.Understanding of texture measurement procedures and modelling; 4.Knowledge of textures developed in different types of materials; 5.Application of existing knowledge to tailor texture in new materials; 6.Familiarization of application of texture to industrial problems; 7.Idea of grain boundary structure and its implication in engineering properties

MT208 Aug 3:0

Diffusion in Solids

Department: Materials Engineering

Course Outcomes:

Diffusion-controlled phase transformation and microstructural evolution in inhomogeneous material systems

MT209 Aug 3:0

Defects in materials

Department: Materials Engineering

Course Outcomes:

Thermodynamics and kinetics of crystal defects, and their central role on properites of materials

भारतीय विज्ञान संस्थान

MT213 Jan 3:0

Electronic Properties of Materials

Department: Materials Engineering

Course Outcomes:

It is an introductory course to mostly students who did not have much exposure to semiconductor physics before. So it starts with Classical Drude model, and ends with complex devices. At the end of this course students have a flavor of electronic properties, they start to understand that many physical properties of material are based on their electronic structure. They understand band structures and electronic transport mechanisms of a wide range of materialand with the exposure to many functional devices, such as LEDs, photovoltaics, transistors, supercapacitors, magnetoelectrics their academic / research interest broadens into a wider subject space.

MT220 Jan 3:0

Microstructural Design and Development of Engineering Materials

Department: Materials Engineering

Course Outcomes:

1.An appreciation for the importance of microstructure on properties of structural materials; 2.An overview of the various schemes available to control microstructure; 3.A survey of engineerign materials and the role of microstructure.

MT225 Jan 3:0

Elevated Temperature Deformation and Fracture

Department: Materials Engineering

Course Outcomes:

Encouraging a healthy skeptical approach to examining existing theories, models and experiments. Develop skills in evaluating critically experimental data and different potential mechanisms. Utilize fundamental understanding to assess results on new materials.

MT241 Aug 3:0

Structure and Characterization of Materials

Department: Materials Engineering

Course Outcomes:

Students will learn about fundamentals of crystallography, describe structures from symmetry viewpoint, formal description of point defects and its importance in influencing properties, interpretation of x-ray powder diffraction pattern to obtain structural and microstructural information, essentials about SEM and TEM.

MT245 Aug 3:0

Transport Processes in Process Metallurgy

Department: Materials Engineering

Course Outcomes:

Student would be able to understand the basic transport processes which are occurring in the daily life in their respective disciplines and would be able to explain the complex phenomena up to some extent.

भारतीय विज्ञान संस्थान

MT248 Jan 3:0

MODELLING AND COMPUTATIONAL METHODS IN METALLURGY

Department: Materials Engineering

Course Outcomes:

This course will provide a sound knowledge of relevant tools that are necessary to build physical and mathematical models to describe the complex physical phenomena pertaining to real world and simulate their behaviour at laboratory and pilot scale. After completing this course one should be able to apply the knowledge gained in this subject to many other complex engineering systems/processes.

MT271 Jan 3:0

Introduction to Biomaterials Science and Engineering

Department: Materials Engineering

Course Outcomes:

Learn the basic concepts in the use of materials for biomedical applications and the principles of biological response to materials

भारतीय विज्ञान संस्थान

NE 240 Aug 3:0

Materials design principles for electronic, electromechanical and optical funct

Department: Nanoscience and Engineering

Course Outcomes:

By the end of the course, the students understand and appreciate generalized frameworks of understanding material properties through symmetry, thermodynamics (stat-mech) and kinetics. This provides a basic training for them to think about materials design for a desired property. Frequency response of properties, the relations between dissipative and fluctuative properties arising out of causality will also be take-home messages. In addition, the students learn general experimental techniques and design to measure various properties, including various spectroscopic tools.

NE 261 Aug 3:0

Piezoelectric MEMS: Theory, Design and Application

Department: Nanoscience and Engineering

Course Outcomes:

The course covers theory and design of acoustics-based Microelectromechanical (MEMS) devices that work on piezoelectric transduction. The students have assignments which include analytical calculations, FEM, device layout, and also measurement familiarization. The concepts of material design, structural engineering and electrical domain analysis are covered with respect to Piezoelectric MEMS applications. Transducers and systems such as resonators, oscillator, filters, inertial measurement units, etc. are covered in detail in this course.

भारतीय विज्ञान संस्थान

NE 281 Aug 3:0

Statistical and probabilistic data analysis techniques

Department: Nanoscience and Engineering

Course Outcomes:

The student will get exposure to the foundational concepts in statistics and probability from an applied perspective suitable for experimentalists. The student will be able to apply stochastic models to aid data analysis, for instance, techniques for parameter estimation and hypothesis testing with experimental data. Noise analysis of experimental systems is also introduced in this course. In addition, students will be able to use Matlab programming environment to perform these calculations and modeling.

NE 315 Jan 3:0

Semiconductor devices for RF and microwave Electronics

Department: Nanoscience and Engineering

Course Outcomes:

The students are exposed to the basics of semiconductor devices used in microwave electronics. Various types of transistors including III-V, III-nitride, bipolar and silicon LDMOS devices used in RF electronics are covered including a flavor for where/how those are used in real-world RF domain. The course also gives a basic introduction to microwave concepts such as Transmission lines, Smith Chart, waveguides, impedance matching - from the device point of view.

NE-200 Jan 2:0

Technical Writing in English

Department: Center for nano Science and Engineering

Course Outcomes:

Students are expected to be be able to write good sentences, draft abstracts, manuscripts, and thesis chapters after going through the course.

NE202 Jan and Aug 0:1

Micro and Nano Fabrication Lab

Department: Center for nano Science and Engineering

Course Outcomes:

Course outcomes; At the end of the course, the student should have hands-on experience and familiarity in using micro and nano fabrication process tools. The student should be able to independently develop process flow to fabricate a device and identify suitable unit process.

NE203 Aug 3:0

Advanced Micro and Nano fabrication technology and process

Department: Center for nano Science and Engineering

Course Outcomes:

A thorough understanding of the various unit-processes in micro/nano fabrication. Focus is on fundamental understanding but practical details are also covered.

NE205 Aug 3:0

Semiconductor Devices and IC Technology

Department: Center for nano Science and Engineering

Course Outcomes:

Students would learn fundamentals as well as advanced concepts in semiconductors and semiconductor devices.

NE-215 Aug 3:0

Applied Solid State Physics

Department: Center for nano Science and Engineering

Course Outcomes:

Basics of the following: quantum mechanics and relevance to solid state science and esp. to nanoscience; crystal structures and defects; electrical, thermal, and magnetic properties of solids; semiconductors and dielectrics

NE222 Aug 3:0

MEMS: Modeling, Design, and Implementation

Department: Center for nano Science and Engineering

Course Outcomes:

Understanding of MEMS technology

NE231 Aug 3:0

Microfluidics

Department: Center for nano Science and Engineering

Course Outcomes:

1.Understanding of MEMS technology; 2.Multiphysics modelling of MEMS devices; 3.Design of MEMS devices and simulation of response Understanding of issues in MEMS implementation

भारतीय विज्ञान संस्थान

NE310 AUG 3:0

Photonics technology: Materials and Devices

Department: Center for nano Science and Engineering

Course Outcomes:

A student; 1.should have gained knowledge of properties of light in dielectric and free space. should be able to understand optical wave propagation in dielectric medium; 2.should be able to design photonic devices to manipulate properties of light using waveguides. should be able to interpret wave propagation dynamics in complex medium; 3.should be able to design optical functions such as, light coupling, wavelength filtering, power splitting, polarisation rotation, light generation and detection; 4.should be able to identify suitable material and fabrication process to realise photonic functionalities on-chip.

NE312 Aug 3:0

Nonlinear and Ultrafast Photonics

Department: Center for nano Science and Engineering

Course Outcomes:

1.Strong working knowledge in applied nonlinear photonics; 2.Ability to design practical systems based on nonlinear optics such as harmonic generators, parametric amplifiers, difference frequency generation, Raman and Brillouin effects, Modelocked Lasers

NE313 Jan 3:0

Lasers: Principles and Systems

Department: Center for nano Science and Engineering

Course Outcomes:

1.Extensive Practical Knowledge in Laser Systems; 2.Ability to analyze laser phenomena and apply it to variety of situtations; 3.Ability to design and build different laser systems such as Fiber Lasers, Solid State Lasers, Optical communication amplifiers, pulsed lasers

NS 212 Aug 2:1

Neural Signal Processing

Department: Neuroscience

Course Outcomes:

Students get introduced to different types of brain signals and learn popular techniques that are used for their analysis and interpretation. Matlab-based assignments allow students to use these techniques on real data. Finally, students write a grant proposal where they first propose a problem and develop techniques to solve it.

NS201 Aug 3:0

Fundamentals of Systems and Cognitive Neuroscience

Department: Center for nano Science and Engineering

Course Outcomes:

After taking the course, a student should have a basic knowledge of brain function, understand the neural basis of sensory, motor, attention and space.

NS202 Aug 3:0

Fundamentals of Molecular and Cellular Neuroscience

Department: Centre for Neuroscience (CNS)

Course Outcomes:

Students will get a fundamental understanding of nervous system structure, development, neurotransmitter systems, synaptic plasticity, learning and memory.

NS301 Jan 3:0

Topics in Systems and Cognitive Neuroscience

Department: Centre for Neuroscience (CNS)

Course Outcomes:

After taking this course, students should be in a position to critically read and evaluate papers in cognitive and systems neuroscience. They should also be able to write grants on these topics.

NS302 Jan 3:0

Topics in Molecular and Cellular Neuroscience

Department: Centre for Neuroscience (CNS)

Course Outcomes:

At the end of the course the students will have deeper understanding on a wide area of research in neuroscience. They will be taught to critically read a scientific paper, assess the technical soundness and the conclusions drawn from the experiments. This will enable them to formulate hypotheses based on scientific data and design experiments to test them.

OC301 Aug 3:0

Organic Synthesis -II

Department: Centre for Neuroscience (CNS)

Course Outcomes:

After the completion of the course, the students would learn the application of retrosythetic analysis in organic synhtesis. The special emphasis on bio-active natural products synthesis gives them an idea of planning, design, understanding the mechanistic impliations and execution of synthetic organic chemistry which is pivotal in organic chemistry. After the completion of the course the students would able to theoretically devises strategies for the synthesis of simple to complex organic molecules synthesis.

OC302 Aug 3:0

Asymmetric Catalysis: From Fundamentals to Frontiers

Department: Organic Chemistry (OC)

Course Outcomes:

Students are expected to learn the basics of asymmetric synthesis and catalysis such as various types of catalysis, modes of asymmetric induction, stereochemical models etc. Contemporary literature is covered so that students completing this course would be in a position to take up research projects in this area of organic synthesis.

OC303 Aug 3:0

Carbohydrate Chemistry

Department: Organic Chemistry (OC)

Course Outcomes:

By gong through the course, the student will gain an understanding of immense chemistry constituting carbohydrates. Chemistry of carbohydrates is not taught in most of academic environments in the country at large, even when carbohydrates are ever pervasive in all walks chemistry, materials development and biologically driven technological advancements. The course aims to provide a sound understanding of the fundamentals of the chemistry of carbohydrates, that will enable the student to carry forward.

OC303 Jan 3

Physical Methods of Structure Elucidation

Department: Organic Chemistry (OC)

Course Outcomes:

Students understand the basic principles of spectroscopy and able to solve structural problems, particularly Organic Molecules.

PD 230 Aug 3:0

Haptic Systems Design

Department: Product Design and Manufacturing

Course Outcomes:

The students are introduced to fundamentals of haptics, its applications and challenges associated with developing high fidelity haptic systems. In that process they learn: Neurophysiology and psychophysics related to somatosensory and motor systems, Sensory substitution, Skin, muscle and mechanoreceptor biomechanics, Lumped parameter modeling of dynamic electro-mechanical systems, Selection of sensors and actuators for haptic system design, Impedance and admittance control, Kinematic and dynamic analysis of manipulators.

PD205 Aug 2:1

Materials, Manufacturing and Design

Department: Centre for Product Design and Manufacturing

Course Outcomes:

The students are introduced to the concept of sustainability, the process of design based on boundary conditions, selection of materials for the given properties, reliability, failure analysis. At the end of the course they should be in a position to choose the right material for a given application.

PD232 Aug 2:1

Human Computer Interaction

Department: Centre for Product Design and Manufacturing

Course Outcomes:

1.Basic guidelines to design good interface; 2.Idea of user modelling and interface personalization; 3.A usability evaluation tool to develop inclusive interfaces; 4.Conducting usability evaluation and reporting results; 5.Knowledge about novel interaction technologies; 6.Knowledge about HCI issues in developing countries and in automotive and aviation environments; 7.Basic know-how about writing international standards; 8.A HCI research paper co-authored by students as course project

भारतीय विज्ञान संस्थान

PD233 Aug 2:1

Design of Biomedical Devices and Systems

Department: Centre for Product Design and Manufacturing

Course Outcomes:

1.Awareness about medical device classification, regulatory requirements, and principals of bioethics. A risk-based approach to medical device design and design control; 2.Working principals of various of medical technologies; 3.Role of design innovations in the advancement of medical technology. Working in teams and with clinical collaborators.

PD234 Jan 2:1

Intelligent User Interface

Department: Centre for Product Design and Manufacturing

Course Outcomes:

1.Using AI to develop intelligent interface and interaction; 2.Idea of user modelling and interface personalization; 3.Exposure to state-of-the-art eye gaze, hand, head and finger movement and EEG trackers; 4.Developing new input modalities tracking eye gaze, hand, finger, head movement of users; 5.Hands on training on Expert System and Machine Learning toolbox; 6.Conducting usability evaluation and reporting results

PH 208 Jan 3:0

Condensed Matter Physics-I

Department: Physics

Course Outcomes:

These course will help the students to learn about the basics of solid state physics.

भारतीय विज्ञान संस्थान

PH 379 Aug 3:0

Discrete Photonics and Quantum Analogies

Department: Physics

Course Outcomes:

Students develop analytical and numerical tools for exploring intriguing transport phenomena in periodic photonic networks. Examples include photonic band engineering, optical Bloch oscillations, dynamic localization, topologically protected edge transport, Kerr nonlinearity and the formation of discrete solitons. They also learn quantum analogies and experimental implementation of such novel phenomena.

PH201 Aug 3:0

Classical Mechanics

Department: Physics, Centre for High Energy Physics

Course Outcomes:

1.The student would learn Lagrangian and Hamiltonian formalisms which are; 2. essential to understand modern developments in physics, like quantum mechanics, field theory, condensed matter physics, particle physics, etc.

PH202 Jan 3:0

Statistical Mechanics

Department: Physics

Course Outcomes:

Students learn how to evaluate macroscopic thermal properties of matter (specific heat, magnetic susceptibility, etc) from microscopic dynamics. The course begins with first using classical dynamics and then using quantum dynamics as the microscopic principles. The notion of an ensemble is introduced to the students for the first time.

PH204 Jan 3:0

Quantum Mechanics II

Department: Physics

Course Outcomes:

Students are fully trained to take up research work in the fields of condensed matter physics and astrophysics

PH205 Aug 3:0

Mathematical Methods of Physics

Department: Physics

Course Outcomes:

Students receive an all round introduction to this fundamental course and can build on the deliverables from this course to attack problems in condensed matter physics, elementary particle physics and astrophysics theory, and also apply this if they become experimentalists

PH206 Jan 3:0

Electromagnetic Theory

Department: Physics

Course Outcomes:

UG+Integrated Ph.D.

PH212 Jan 3

Experimental methods in condensed matter physics

Department: Physics

Course Outcomes:

skills in experimental methods

PH213 Aug 0:4

Advanced experiments in condensed matter physics

Department: Physics

Course Outcomes:

hands on training on diverse experimental tools and data analysis that an experimental condensed matter physicist requires.

PH215 Aug 3:0

Nuclear and Particle Physics

Department: CHEP

Course Outcomes:

Students are fully furnished with knowledge of Nuclear and Particle physics, at the level of CSIR and UGC Net exam pre-requisites

PH320 Aug 3:0

Condensed matter Physics II

Department: Physics

Course Outcomes:

The student will learn the basics techniques to deal with interacting quantum systems, e.g. mean field theory, second quantized operators. Also transport and linear response theories that connect between theory and experimental observations are taught. It introduces theoretical framework such as BCS theory of superconductivity.

PH322 Jan 3:0

Molecular Simulation

Department: Physics

Course Outcomes:

Writing basic MD and MC code. Understand advanced sampling, Able to get started with the research in this area

PH325 Aug 3:0

Advanced Statistical Physics

Department: Physics

Course Outcomes:

Students would get a good grasp of modern statistical mechanics of interacting, classical and quantum systems and learn the techniques mentioned in the syllabus. A good grasp of this subject is essential to understand recent developments in large parts of condensed-matter science.

PH335 Jan 3:0

Statistical Mechanics of Time-dependent Phenomena

Department: Physics

Course Outcomes:

Ideally: the ability to formulate, from general principles, the dynamical equations describing the large-scale, long-time behaviour of fluctuations in a wide range of ordered and disordered many-particle systems including fluids, liquid crystals, crystalline solids, and magnets, at thermal equilibrium and possibly with extensions to a variety of out-of-equilibrium situations.

PH350 Jan 3:0

Physics of Soft Condensed Matter

Department: Physics

Course Outcomes:

he course gives the basic principles and application of soft matter physics towards understanding properties and phenomena occurring in materials like polymers, colloids, surfactants etc. General principles of understanding structure, dynamics as well as flow and mechanical properties of these materials would also be covered.

PH351 Aug 3:0

Crystal Growth, thin films and Characterisation

Department: Physics

Course Outcomes:

The student will learn about the crystal growth mechanisms and techniques. Various thin films deposition techniques and thin film characterisation techniques are also covered in the course.

भारतीय विज्ञान संस्थान

PH352 Jan 3:0

Semiconductor Physics and Technology

Department: Physics

Course Outcomes:

After the course, a student must be able to; (1)Understand the difference between metals, semiconductors and insulators; (2)Calculate the band structure using a simple tight-binding model; (3)Estimate the number of carriers at a given temperature for a semiconductor; (4)Understand the importance of doping to change carrier density; (5)Understand the importance of different scattering mechanisms that limit mobility; (6)Understand the difference between direct and indirect semiconductors; (7)Relate the optical absorption to the band structure; (8)Calculate non-equilibrium densities for different carrier lifetimes; (9)Understand the band diagram and depletion layer in PN junctions; (10)Understand the fundamental operation of a bipolar transistor

PH354 Jan 3:0

Computational Physics

Department: Physics

Course Outcomes:

Learn basic programming and applying it to physics problems.

PH359 Jan 3:0

Physics of Nanoscale Systems

Department: Physics

Course Outcomes:

Electronic and optical properties of low-dimensional materials.

PH364 Jan 3:0

Topological Phases of Matter

Department: Physics

Course Outcomes:

The students would be exposed to the basic physics of topological phases of mater and their implications in transport properties of condensed matter systems. They are also expected to gain an understanding of the current level of research, both experimental and theoretical, in topological systems.

PH396 Jan 3:0

Quantum Field Theory II

Department: CHEP

Course Outcomes:

End product is students who are ready to carry out research in particle physics and field theory

PS 301 Aug 3:0

S&T policy

Department: Society and Policy

Course Outcomes:

The course discusses S&T related policies in India and explores specific policy components for its implications on society and development. The students explore dynamics of policy formulation and policy process through policy domains like monetary/fiscal, energy and environment, and IP/technology/innovation. The students learn about various policy designs through case studies and specific policy analysis. At the end of the course the students develop a policy brief with the focus on understanding structural design.

PS 303 Aug 2:0

Communicating science to nonexperts

Department: Society and Policy

Course Outcomes:

Students will be able to realize the jargon in the description of their research, learn how to pitch their research in an engaging and exciting manner, and consider various need of a large and diverse interdisciplinary audience when discussing their research. The course has extensive in-class communication/improvisation exercises.

QT 202 Jan 3:0

Introduction to Quantum Measurement

Department: Instrumentation and Applied Physics_QT

Course Outcomes:

The students get a thorough theoretical understanding of the role of measurements in quantum theory, as well as the intricacies of designing specific measurements for specific quantities. The course teaches the student the various types of measurements and the ways to calculate their back-action on the system being measured. The course specialises in teaching the student the techniques to control, manipulate and characterise a single quantum system. The course equips the student with the physics of light-matter interaction which, in turn, helps design measurement protocols for quantum systems.

QT 204 Jan 3:0

Introduction to Materials for Quantum Technologies

Department: Instrumentation and Applied Physics_QT

Course Outcomes:

This is an introductory course aimed at familiarizing the students to the basics of materials that are widely used in various quantum technologies. The course starts with a brief introduction to solid state physics, followed by electron-phonon interactions, electron transport and modeling in nanoscopic devices. Quantum devices and low dimensional materials are then introduced followed by concepts of topology. The course also delves into correlations and disorder effects in materials.

QT 306 Jan 3:0

Advanced Quantum Computation and Information

Department: Instrumentation and Applied Physics_QT

Course Outcomes:

The students were introduced to a variety of quantum algorithms and techniques of quantum error correction. Then the physical implementation of the software formulation on various hardware platforms was discussed, spanning NMR systems, superconducting quantum processors, ion-trap and neutral atom quantum processors as well as measurement-based photonic computing systems. All these topics covered uptodate developments in the subject.

QT 312 Jan 1:2

Advanced Quantum Technology Lab

Department: Instrumentation and Applied Physics_QT

Course Outcomes:

This lab course teaches the students to get hands-on experience in microwave and RF electronics, measurement techniques employed in actual research labs working in quantum technologies, numerical simulations of open quantum systems. The student is trained to come up with the experiment methodology too, as no manual is provided for the experiments – from a problem statement, each student prepares a proposal for the experimental methodology. This gives the students training in planning experiments, and considering all the aspects of conducting them successfully.

RD 209 / BC 210 / MC 211 Jan 3:0

Molecular Basis of Ageing and Regeneration

Department: MRDG, MCB, BC

Course Outcomes:

Basic mechanisms underlying ageing in animals and interventions to slow aging and improve health span.

भारतीय विज्ञान संस्थान

RD 210 Jan 2:0

Fundamentals of Physiology and Medicine

Department: Biochemistry, Molecular Reproduction, Development and Genetics

Course Outcomes:

At the end of the course, the students will acquire an understanding of the integration between different cells, tissues and organs that results in physiological homeostasis and how it is lost in disease. On a practical level, the course will help students get acquainted with studying results like stained tissue sections, X rays etc.

SS 209 Aug 3:0

Electrochemical Systems

Department: Solid State and Structural Chemistry

Course Outcomes:

The students are introduced to the basics of electrochemistry including the various polarization losses such as ohmic, kinetic and mass transfer polarization. The course then covers electrochemical measurement techniques broadly classified as potential controlled and current controlled techniques. The last portion of the course is dedicated to covering the application of electrochemical concepts to Fuel cells, Li-ion batteries and supercapacitors. Students also perform a small lab project or a topical presentation. By the end of the course, students tend to be comfortable with graduate level electrochemistry necessary for starting research in this area.

SS202 Aug 3:0

Introduction to Quantum Chemistry

Department: Solid State and Structural Chemistry Unit

Course Outcomes:

How quantum mechanics determines molecular shape; how molecular properties are computed

SS304 Aug 3:0

Solar Energy and Materials

Department: Solid State and Structural Chemistry Unit

Course Outcomes:

After taking this course the students would learn; 1.Basics concepts of p-n junction, Light management in Solar Cells, Shockley–Queisser limit or detailed balance limit; 2.electron Transfer Theory, Emerging light harvesting materials; 3.Basics of Dye Sensitized Solar Cells, Organic Solar Cells, Perovskite Solar Cells.

भारतीय विज्ञान संस्थान

ST 201 Jan 3:0

Thermochemical and biological energy recovery from biomass

Department: Centre for Sustainable Technologies

Course Outcomes:

This course in particular exposes the students towards addressing the energy conversion process for biomass for various outputs. The background acquired in this course will be a starting point for further research in the energy technologies or even bio-fuel programs.

ST 202: Aug 3:0

Energy Systems and Sustainability

Department: Centre for Sustainable Technologies

Course Outcomes:

1.The course provides an insight into various energy conversion technologies with emphasis on addressing the overall mass and energy balance. Efficiency of the conversion processes and comparison with various technologies; 2.Using low carbon energy, creating scenarios using techno-economic studies which could intervene into the policy decisions.

ST 204 Aug 1:1

Sustainable Energy and Environment lab

Department: Centre for Sustainable Technologies

Course Outcomes:

1.Through this course, students entering CST will get an exposure to various areas of research conducted at the centre which is interdisciplinary by nature; 2.The range of areas and the experimental methodology provides the student an opportunity to have hands on experience in conducting experiments and analyse the data. They would also experiencing how to represent the data.

ST 207 Jan 3:0

Alternate Fuels for Reciprocating Engines

Department: Centre for Sustainable Technologies

Course Outcomes:

Major take away from this course is in arriving at empirical relationships towards arriving at power and efficiency of a standard diesel/gasoline engine on alternate gaseous and liquid fuels.

ST 217 Jan 3:1

Field Hydrology, River Engineering and Basin Studies

Department: Centre for Sustainable Technologies

Course Outcomes:

Sensitizing students about the journey of water starting from precipitation, its penetration to soil and ground to its movement to valleys and creation of river flows, focus on base reservoirs to ensure summer flows when rains leave, objective of creating permanence in river flows, flood analysis, field visits and physical model experimental studies, using software models for hydrology and river analysis, socio-economics of people in basins for whom river is the lifeline.

ST 218 Aug 3:0

Sustainable wastewater management

Department: Sustainable Technologies

Course Outcomes:

This course provides its participants knowledge on the fundamentals and practices in wastewater management in both urban and rural contexts – encompassing Wastewater origin, composition & hazards; Conventional activated sludge process; Other/newer biological treatment methods; Water recycling & nutrient recovery; Alternative sanitation approaches. In addition to understanding the fundamentals of different treatment options for wastewater, the participants will learn to see wastewater as a resource and appreciate sustainable practices.

ST 219 Aug 3:0

Separation Technologies for Sustainable Industrial processes

Department: Sustainable Technologies

Course Outcomes:

At the end of this course, the student should be able to select potential separation technologies for a given separation application, and perform a basic design analysis of these technologies. Subsequently, they should select the optimal technology for the application based on a thermo-economic and ecological impact analysis of the candidate technologies.

ST 222 Jan 3:0

Basic Concepts of Planning and Design of Hydro-Mechanical Components in Dam

Department: Sustainable Technologies

Course Outcomes:

Developing the sense of reductionist approach of arresting river flow by building dams, the dangers to biodiversity, fish migration and sediment blockade, impact of structure of dams, gates and supporting structures, decision model of dam removal, case studies of impact of floods on hydro mechanical equipment, alternatives to large dams and associated human tragedy, revolutionary designs for low head dams and associated hydro mechanical equipment.

ST 223 Aug 3:0

Green Catalysis in Chemical Industries

Department: Sustainable Technologies

Course Outcomes:

Students have acquired a comprehensive knowledge of catalytic chemistry and reaction engineering, enabling them to grasp the difficulties of modern catalytic pollution mitigation and emerging "green" catalytic processes. They advanced a deep understanding of various catalysts and catalytic reactions, as well as complex surface-catalyzed reaction mechanisms. Students are also skilled in recognizing the structural and functional properties of heterogeneous catalysis, along with characterization techniques. Moreover, they gained the ability to critically analyze and compare different chemical and industrial processes based on sustainability parameters.

ST213 Jan 3:0

Turbomachines in Renewable Energy

Department: Centre for Sustainable Technologies

Course Outcomes:

1.Origin of blade shape of different turbomachines operating with incompressible and compressible flows; 2.Design under conditions of variability in input fluid and output load; 3.Specialized design of water pumps; 4.Renewable energy dynamics in both tur

ST214 Aug 3:0

Mathematical Analysis of Experimental Data

Department: Centre for Sustainable Technologies

Course Outcomes:

At the end of the course, the student is expected to learn; 1) Dimensional analysis leading to functionalities; uncertainty analysis and curve fitting; 2) Simplified understanding of complex probability theories; 3)Design of experiments, replication, randomization and blocking; 4)ANOVA and screening experiments; 5)First hand learning in applying the tools and skills learnt in the class room onto experimental test rigs in planning, design collection and analysis of data.

UB 204 Jan 2:0

Introductory Physiology

Department: MCBL

Course Outcomes:

Learn about mammalian Physiology

भारतीय विज्ञान संस्थान

UB205 Jan 2:0

Introductory Physiology

Department: Old Physics Building

Course Outcomes:

1.Students are expected to learn concept of homeostasis with some examples. Students will be exposed to the vast area of endocrinology and its importance in body homeostasis; 2.Plant biology- synthesis of various of plant compounds and their importance in the treatment of diseases

UB208 Jan 2:0

Basic Molecular Biology

Department: Molecular Reproduction, Development and Genetics

Course Outcomes:

The course is expected to present a broader picture of living systems by integrating the reductionistic concepts of molecular biology with holistic concepts such as evolution. As the discussions are interactive, students are encouraged to develop a critical approach and enhance their analytical abilities.

UB301L Aug 0:2

Experiments in Microbiology and Ecology

Department: CES and MCB

Course Outcomes:

Students will learn key techniques in Microbiology. In the Ecology module, students will learn how to frame questions and hypotheses, as well as how to design experiments. There will be one weekend field trip to a National Park, where students conduct an independent research project. Students also independently create one nature documentary.

UC101 Aug 2:1

Principles of Physical Chemistry

Department: Undergraduate

Course Outcomes:

After finishing this course, students would be able to apply quantum concepts in physical chemistry problems, make qualitative conclusions for several experiments, understand better the analytical methods in chemistry like spectroscopy, NMR, etc.

UC202 Jan 2:0

Thermodynamics and Electrochemistry

Department: SSCU / Undergraduate Chemistry

Course Outcomes:

Thermodynamics and its applications to prediction of reaction outcomes, spontaneity etc.

UC205 Jan 2:0

Basic Organic Reactions

Department: Undergraduate

Course Outcomes:

1.As the title reflects, this is a basic organic chemistry course and compulsory for the Chemistry major UG students. Students successfully completing this course are expected to learn through this course the basic concepts of organic chemistry such as electronic structure and reaction mechanism; 2.All major reactions of alkenes, alkynes and carbonyls are taught through this course. In addition, preliminary aspects of pericyclic reactions and organometallics are also covered.

भारतीय विज्ञान संस्थान

UC206 Aug 2:1

Basic Organic Chemistry

Department: Organic Chemistry

Course Outcomes:

1.The course is the first organic chemistry course in the undergraduate program of the institute in which the students learn about the usefulness of organic chemistry in diverse areas and everyday life ranging from natural products, drugs and pharmaceuticals, dyes and pigments, detergents, food and beverages, essential oils and fragrance, polymers to electronic materials and also in knowing the molecules of all living systems and understanding the basic biological processes at molecular level; 2.They are taught why chirality and stereochemistry are important in understanding the basic biological processes, drug-receptor interactions etc. This is intended to help the students to understand the three dimensionality of organic and biomolecules and their significance. Lectures on conformations of cyclic and acyclic systems apprise them about the conformations of peptides/proteins, biomolecules like DNA and RNA.

UC207 Jan 2:1

Instrumental Methods of Chemical Analysis

Department: Undergraduate Program in Chemical Sciences

Course Outcomes:

The students get an idea of the different analytical tools required for carrying out research in Chemistry and Materials.

भारतीय विज्ञान संस्थान

UE 102 Jan 2:1

Electronics and Electrical Engineering

Department: Undergraduate

Course Outcomes:

1.Students get a basic understanding of analog electronics, digital electronics and microcontrollers. They carry out experiments using diodes, transistors, operational amplifiers, combinational and sequential circuits, and state machines; 2.In microcontrollers, they write programs to light up an LED, read a temperature sensor and develop programs for a PID controller.

UE204 Jan 3:0

Elements of Solid Mechanics

Department: Undergraduate

Course Outcomes:

1.How to model behaviour of simple structural elements like bars, shafts, beams, pressurised cylindrical and spherical vessels; 2.Extension of this understanding to study simple trusses and frames; 3.Gain an understanding of stress, strain, material constitutivity, equations of equilibrium and compatibility, and energy principles; 4.Felicity to formulate and numerically solve simple engineering problems.

UES 206 Jan 1:2

Experimental Methods in Environmental Chemistry

Department: Undergraduate

Course Outcomes:

Teaches the student about the geochemical and anthropogenic causes that cause water pollution, permissible limits of common pollutants in drinking water and provides hands on experimental practice to determine the pollutant concentrations in water samples

भारतीय विज्ञान संस्थान

UES 302 Aug 2:0

Design Principles in Environmental Engineering

Department: Undergraduate

Course Outcomes:

1.Acquire general knowledge and understanding of the principles upon which environmental engineering is based, including general engineering, mathematical and scientific computations as well the physical, chemical, and biological science; 2.Appreciate the need for multidisciplinary approaches to engineering solutions to environmental problems, and the cross-media (air, water, earth) nature of environmental problems; 3.Gain basic knowledge and skills to identify solutions to environmental engineering and understand current issues and the context in which environmental engineering is practiced; 4.Appreciate and value the environmental engineering and professional ethics.

UES 310 Aug 1:2

Experimental Methods in Solid Waste Management

Department: Undergraduate

Course Outcomes:

Students learn standard methods to characterize hazardous chemical wastes, how inorganic pollutants react with soils, how pollutants are transported through soils and how to minimize release of pollutants from solid waste

भारतीय विज्ञान संस्थान

UES204 Jan 3:0

Fundamentals of Climate Science

Department: Undergraduate

Course Outcomes:

Students learn the basic thermodynamic processes of the atmosphere like formation mechanism of fog and clouds. The static stability of the atmosphere is taught to understand the state of the climate. Radiative transfers in the atmosphere gives fundamentals of energy balance at the top of the atmosphere, and at the surface of the earth, and thus provides a conceptual background for understanding the climate variations of the earth including global warming. The general circulation basics provide the mean circulation pattern and energy exchange between north and south through atmospheric winds and ocean currents. These are relevant to understanding climate change scenario with differential heating across latitudes. Finally, the carbon cycle concepts are introduced to enable students understand the carbon budget of the earth.

UG206L Jan 0:2

Experiments in Biochemistry and Physiology

Department: Undergraduate

Course Outcomes:

Students are expected to become well versed with the basic techniques and understand the principles of each technique to be able to carry out research projects in laboratories thereon.

UH 203 Jan 1:0

Mapping India with the Folk Arts

Department: Undergraduate Programme

Course Outcomes:

Understand India through the living art of common people; come to this understanding by probing into the folk art and appreciating them; understand how art and science can come together.

UM 302 Aug 2:1

Material Processing

Department: Materials Engineering for UG

Course Outcomes:

Students will appreciate polymer processing techniques used for various articles.

UM101 Aug 3:0

Analysis and Linear Algebra

Department: IISc Undergraduate CORE programme

Course Outcomes:

A student taking this course would; 1)Be introduced to the rigorous meaning of convergence and its relevance to one-variable Calculus, and also glimpse how the rigorous definitions are extendable to other scenarios; 2)Acquire a conceptual understanding -- as distinct from a mere ability to compute, which is the emphasis in high-school -- of such concepts as infinite series, limits, continuity, and integration; 3)Appreciate the reasons underlying the relationship between integration and differentiation, and thereby be able to apply this insight to mathematical models in the natural sciences that rely on Calculus; 4)Be introduced to the concepts of vector spaces and linear transformations in their abstract generality; 5)Gain some insight on how the language of vector spaces and linear transformations underlies problems ranging from solving linear algebraic equations to the theory and solution of differential equations; 6)Gain some understanding on the importance of formulating clear definitions and how to do so; gain experience in deductive reasoning; and learn to deduce from the general theory presented in the lectures procedures for solving specific problems.

UM201 Aug 3:0

Probability and Statistics

Department: Undergraduate

Course Outcomes:

Basic notion of probability and statistical methods.

UMT202 Jan 2:1

Structure of Materials

Department: Undergraduate

Course Outcomes:

Basic understanding of structure, microstructure and property correlation in materials

UMT205 Jan 3:0

Mechanical Behavior of Materials

Department: Undergraduate

Course Outcomes:

An understanding of loads and stresses experienced by structures, how they fail, and how to select materials based on their behavior for different structural applications.

UMT310 Jan 2:1

Introduction to Materials Manufacturing

Department: UG-Materials

Course Outcomes:

They will learn different types of manufacturing processes for metals and polymers, including practical experience of lab scale manufacturing of different materials.

UMT311 Aug 0:1

Functional Materials Laboratory

Department: Materials Engineering

Course Outcomes:

The students receive an exposure to a large range of functional properties, starting from precise resistance measurement to Seebeck coefficient determination, determination of piezoelectric constant, hall-effect measurements, Curie temperature determination of a ferromagnet, figure of merit of a solar cell, exposure to UV-visible spectroscopy for band gap determination and exposure to electrochemistry in terms of capacity and Coulombic efficiency of supercapacitor and Li-ion batteries.

भारतीय विज्ञान संस्थान

UP 101 Aug 2:1

Introductory Mechanics

Department: Physics, Undergraduate Programme

Course Outcomes:

Basic concepts in mechanics and their applications in solving problems and explaining observable phenomena as seen in laboratory experiments.

UP201 Aug 2:1

Introductory Physics III

Department: Physics

Course Outcomes:

The aim of the course is to survey topics that are usually covered under the title "modern physics". Topics selected include thermal physics, special theory of relativity, introductory quantum physics, molecular/solid state physics, nuclear/particle physics, and cosmology. These topics will be treated in a way so as to give a flavor of open problems and challenges in physics to a newcomer.

भारतीय विज्ञान संस्थान

WR 202 Aug 3:0

Geodetic signal processing

Department: Water Research

Course Outcomes:

Students were introduced to the contemporary developments in Geodesy. They learnt the theoretical foundation and developed scripts to attempt solving some of the research problems in Earth Science using satellite data. They wrote codes for orbit determination and predicted position of either ISS or Starlink satellites. They were also taught fundamentals of signal processing often used in Geodesy. They also learnt advanced signal processing techniques such as, regression techniques, Kalman filter, Bayesian inference, and time-series decomposition. They were acquainted with satellite gravimetry, GNSS, and altimetry. They developed codes to process GRACE data and use it for solving one of the research problems of high importance, such as last year they estimate Evapotranspiration from Geodetic data.