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)

Description: 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)

Description: 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.

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.

Interdisciplinary programmes

Programme: Interdisciplinary PhD in BioSystems Science and Engineering

The interdisciplinary PhD programme of the Centre for Biosystems Science and Engineering (BSSE) 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: 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 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

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.

Nano science

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.

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.

Course outcomes
Indian Institute of Science, Bengaluru.

Search this list with the course number (e.g., ME256 or ME 256)

E0 249 Jan 3:01; Approximation Algorithms

AE 203 Aug 3:00; Fluid dynamics

AE 211 Aug 3:00; Mathematical Methods for Aerospace Engineers

AE 230 Jan 3:00; Aeroelasticity

AE 259 Aug 3:00; Navigation, Guidance and Control

AE 262 Jan 3:00; Guidance Theory and Applications

AE 271 Aug 2:00; Flight Vehicle Design

AE 282 Jan 3:00; Unmanned Aerial Vehicles

AE 218 Jan 3:00; Computational Gas Dynamics

AE203 Aug 3:00; Fluid Dynamics

AE210 Jan 3:00; Gas Dynamics

AE221 Aug 3:00; Flight Vehicle Structures

AE235 Jan 3:00; Non-Destructive Testing & Evaluation (NDT & E)

AE245 Aug 3:00; Mechanics and Thermodynamics of Propulsion

AE247 Jan 3:00; Aircraft Engines

AE250 Aug 3:00; Advanced combustion

AE276 Jan. 1:02; Experimental Techniques

AE316 Jan 3:00; Hydrodynamic Stability

AE317 Aug/Jan 3:00; Aeroacoustics

AE364 Jan 3:00; Micromechanics of composites

AS 209 January 3:00; Mathematical Methods in Climate Science

AS202 Jan 3:00; Geophysical Fluid Dynamics

AS203 August 3:00; Atmospheric Thermodynamics

AS204 August 3:00; Radiation and climate

AS205 Aug. 2:01; Ocean Dynamics

AS208 Jan 3:00; Satellite Meteorology

AS211 January 2:01; Observational Techniques

AS212 August 3:00; Introduction to Atmospheric Dynamics

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

BC 203 August - December 3:00; General Biochemistry

BC 205 / RD 210 Jan 2:00; Fundamentals of Physiology and Medicine

BC 210 January - April 3:00; Molecular Basis of Ageing aanf Regeneration

BC203 Aug 3; General Biochemistry

BC206 August 2:00; Essentials in Immunology

BC207 Jan 2:00; PROTEOMICS IN PRACTICE

BC_201 Aug 2:00; CELL BIOLOGY

BE 207 Jan 3:00; Mathematical Methods for Bioengineers

BE206 August 3:00; Biology for Engineers

BE208 January 3:00; Fundamentals of Bioengineering

BE209 Aug. 1:00; Digital Epidemiology

CCE Jan 3:00 Neural Networks for Signal Processing

CD 225 January 0:04; Physical and Analytical Chemistry Laboratory

CD204 Aug 3; Chemistry of Materials

CD212 Aug 3:00; Inorganic Chemistry-Main Group and Coordination Chemistry

CD213 August 3:00; Organic Chemistry – Structure and Reactivity

CD214 Aug. 3:00; Basic Mathematics

CD223 Jan. 3:00; Organic Synthesis

CD224 Jan 2:01; Computers in Chemistry

CD301 Jan 3:00; Advanced NMR Spectroscopy

CE 201 Aug 3:00; Basic Geomechanics

CE 207 JAN 3:00; Geo-environmental Engineering

CE 208 Jan 3:00; Ground Improvement and Geosynthetics

CE 222 Jan 3:00; Fundamentals of Soil Behaviour

CE 238 Jan. 3:00; Structural Masonry

CE 248 JAN 3:00; REGIONALIZATION IN HYDROLOGY AND WATER RESOURCES ENGINEERING

CE2015 Aug. 3:00; An Introduction to Finite Elements

CE203 AUG 3:00; SURFACE WATER HYDROLOGY

CE204 August 3:00; Solid Mechanics

CE206 Jan. 3:00; Earth and Earth Retaining Structures

CE210 January 3:00; Structural Dynamics

CE213 Jan 3:00; Systems Techniques in Water Resources & Environmental Engineering

CE215 Jan 3:00; Stochastic Hydrology

CE219 Aug. 3:00; Soil Dynamics

CE220 Aug 3:00; Design of Sub-structures

CE221 Aug 3:00; Earthquake Geotechnical Engineering

CE227 Jan 3:00; Engineering Seismology

CE235 January 3:00; Optimization Methods

CE240 January 3:00; Uncertainty Modeling and Analysis

CE241 August 3:00; Advanced Structural Dynamics

CE242 August 3:00; Fire structural engineering

CE243 August 3:00; Bridge Engineering

CE246 Aug 3:00; Urban Hydrology

CE247 Aug 3:00; Remote Sensing and GIS in Water Resources and Environmental Engineering

CE263 Aug. 3:00; Modelling Transport and Traffic

CE267 Jan. 3:00; Transportation Statistics and Micro-Simulation

CE272 Jan 3:00; Traffic Network Equilibrium

CH 207 Jan 1:00; Applied probability and design of experiments

CH 242 Aug 3:00; Special Topics in Theoretical Biology

CH 244 August 3:00; Treatment of drinking water

CH201 August 3:00; Chemical Engineering Mathematics

CH202 Aug 3:00; Numerical Methods

CH203 Aug 3:00; Transport Processes

CH204 Aug 3:00; Thermodynamics

CH205 Jan 3:00; Chemical Reaction Engineering

CH206 Aug 1:00; Seminar Course

CH235 Aug 3:00; Modelling in Chemical Engineering

CH236 Jan 3:00; Statistical Thermodynamics

CH245 Jan 3:00; Interfacial and Colloidal Phenomena

CH247 Jan 3:00; Introduction to molecular simulations

CH248 Aug 3:00; Molecular Systems Biology

DB201 Aug 2:00; Mathematics and Statistics for Biologists

DB202 Aug 2:00; General Biology

DB204/RD201 Aug. 2:00; Genetics

DS 200 JAN 0:01; Research Methods

DS 222 Aug 3:01; Machine Learning with Large Datasets

DS 260 JAN 3:00; Medical Imaging

DS 284 Aug. 2:01; Numerical Linear Algebra

DS 290 Aug 3:00; Modelling and Simulation

DS 291 Jan 3:01; Finite elements: Theory and Algorithms

DS 294 Jan. 3:00; Data Analysis and Visualization

DS 391 Jan 3:00; Data Assimilation to Dynamical Systems

DS 397 JAN 3:01; Topics in Embedded Computing

DS-255 Jan 3:01; System Virtualization

DS221 August 3:00; Introduction to Scalable Systems

DS256 Jan 3:01; Scalable Systems for Data Science

DS265 Jan 3;1; Deep Learning for Computer Vision

DS295 Jan 3:01; Parallel Programming

DS301 Aug 2:00; Bioinformatics

E0 202 Jan 3:01; Automated Software Engineering with Machine Learning

E0 220 Aug 3:01; Graph Theory

E0 228 Aug 3:01; Combinatorics

E0 231 Jan 3:01; Algorithmic Algebra

E0 232 August-December 3:01; Probability and Statistics

E0 238 Jan 3:01; Artificial Intelligence

E0 251 Aug 3:01; Data Structures and Algorithms

E0 254 August-December 3:01; Network and Distributed Systems Security

E0 259 Aug 3:01; Data Analytics

E0 261 August 3:01; Database Management Systems

E0 264 January-April 3:01; Distributed Computing Systems

E0 265 Jan 3:01; Convex Optimization and Applications

E0 267 Aug 3:01; Soft Computing

E0 270 Jan 3:01; Machine Learning

E0 272 Jan 3:01; Formal Methods in Software Engineering

E0 284 Aug 2:01; Digital VLSI Circuits

E0 311 Jan 3:01; Topics in Combinatorics

E0 338 August 3:01; Topics in Security and Privacy

E0 361 January 3:01; Topics in Database Systems

E0-334 Aug 3:01; Deep Learning for Natural Language Processing

E0210 Aug 3:01; Principles of Programming

E0230 Aug 3:01; Computational Methods of Optimisation

E0243 Aug. 3:01; Computer Architecture

E0246 Jan 3:01; Real Time Systems

E0247 Aug 3:01; Sensor Networks

E0255 Jan 3:01; Compiler Design

E0256 Aug 3:01; Theory and Practice of Computer Systems Security

E0271 AUG 3:01; Computer Graphics

E0304 Jan 3:01; Computational Cognitive Neuroscience

E0343 Jan. 3:01; Topics in Computer Architecture

E0358 Aug 3:01; Advanced Techniques in Programming and Compilation for Parallel Architectures

E1 213 Jan 3:01; Pattern Recognition and Neural Networks

E1 241 Aug 3:00; Dynamics of linear systems

E1 241 Aug 3:00; Dynamics of linear systems

E1 242 Jan 3:00; Nonlinear systems and control

E1 243 Jan 2:01; Digital Controller Design

E1 246 Jan 3:01; Natural Language Understanding

E1 254 January 3:01; Game Theory

E1 277 January-April 3:01; Reinforcement Learning

E1222 Aug. 3:00; Stochastic Models and Applications

E1244 Jan 3:00; Detection and Estimation Theory

E1251 Aug 3:00; Linear and Nonlinear optimization

E1262 Jan 2015, 2016, 2017 3:00; Selected Topics in Markov Chains and Optimization

E2 202 Aug 3:00; Random Processes

E2 204 Jan 3:00; Stochastic Processes and Queueing Theory

E2 205 Aug. 3:00; Error-Control Codes

E2 213 Jan. 3:00; Information-Theoretic Security

E2 214 Jan. 3:00; Finite-State Channels

E2 214 Jan. 3:00; Finite-State Channels

E2 214 Jan. 3:00; Finite-State Channels

E2 214 Jan. 3:00; Finite-State Channels

E2 214 Jan. 3:00; Finite-State Channels

E2 232 August 2:01; TCP/IP Networking

E2-202 Aug. 3:00; Random Processes

E2-221 Aug. 3:00; Communication Networks

E2-241 Jan. 3:00; Wireless Networks

E2-242 Jan. 3:00; Multiuser Detection

E2-251 Aug. 3:00; Commnication Systems Design

E2201 Aug 3:00; Information theory

E2203 Jan. 3:00; Wireless Communications

E2206 Jan 3:00; Information and Communication Complexity

E244 JAN 3:01; Computational Geometry and Topology

E3 220 August 3:00; Foundations of Nanoelectronic Devices

E3 231 January 2:01; Digital System Design with FPGAs

E3 245 August 2:01; Processor System Design

E3 262 AUG 2:01; ELECTRONICS SYSTEMS PACKAGING

E3 274 Aug. 3:00; Power Semiconductor Devices and Physics

E3 280 January 3:00; Carrier transport in nanoscale devices

E3 282 Aug 3:00; Basics of Semiconductor Devices and Technology

E3-257 Jan 2:01; Embedded System Design

E3225 January 3:00; Art of Compact Modeling

E3258 Jan 2:01; Design For Internet Of Things

E4 234 Aug 3:00; Advanced Power Systems Analysis

E4 237 Jan/Aug 2:01; Selected Topics in Integrated Power Systems

E4 238 Jan 3:00; Advanced Power System Protection

E4221 August 2:01; DSP and AI Techniques in Power System Protection

E4231 Aug 3:00; Power system dynamics and control

E4233 Jan 3:00; Computer Control of Power Systems

E5 212 Jan 3:00; Computational Methods in Electrostatics

E5 213 Jan 3:00; EHV/UHV Power Transmission Engineering

E5 215 Aug. 2;1; Pulsed Power Engineering

E5-232 May-June 2:01; Advances in Electric Power Transmission

E5201 August 2:01; Production, Measurement and Application of high voltage

E5206 Jan 3:00; High Voltage Power Apparatus

E5209 Jan 3:00; Overvoltages in Power Systems

E6 222 Jan 2:01; Design of photovoltaic systems

E6 225 Aug 3:01; Advanced Power Electronics

E6-202 Aug 2:01; Design of Power Converters

E6212 JAN 3:00; DESIGN AND CONTROL OF POWER CONVERTERS AND DRIVES

E6221 Jan 3:01; Switched Mode Power Conversion

E6224 Aug 3:00; Topics in Power Electronics and Distributed Generation

E7 211 Jan 3:00; Photonic Integrated Circuits

E7 214 Jan 3:00; Optoelectronic Devices

E7-221 Aug 2:01; Fiber-Optic Communication

E8 201 August 3:00; Electromagnetism

E8241 Jan 2:01; Radio Frequency Integrated Circuits & Systems

E8262 Jan 3:00; CAD for High Speed Chip-Package-Systems

E9 201 Aug. 3:00; Digital Signal Processing

E9 206 Aug. 3:00; Digital Video: Perception and Algorithms

E9 211 Aug 3:00; Adaptive Signal Processing

E9 213 January 3:00; Time-Frequency Analysis

E9 231 Jan. 3:00; MIMO Signal Processing

E9 241 August 2:01; Digital Image Processing

E9 243 JAN 3:00; Computer Aided Tomographic Imaging

E9 246 Jan 3:01; Advanced Image Processing

E9 261 Jan. 3:01; Speech Information Processing

E9-202 Aug 3:00; Advanced DSP: Non-linear Filters

E9-221 Jan 3:00; Signal Quantization & Compression

E9205 AUG 3:01; MACHINE LEARNING FOR SIGNAL PROCESSING

E9251 Bi-annually, Typically Jan. 3:00; Signal processing for data recording channels

E9252 Mainly Aug until now, sometimes Jan 3:00; Mathematical methods and techniques in signal processing

E9282 Jan 2:01; Neural Signal Processing

E9291 Aug 2:01; DSP System Design

E9292 Jan 2:01; Real Time Signal processing with DSP

EC 204 Jan 2:01; Evolutionary Biology

Ec201 Jan 2:01; Theoretical and Mathematical Ecology

EC203 Jan 2:00; Ecology: Principles and Applications

EC301 August 2:01; Animal Behaviour: Mechanisms and Evolution

EC302 Aug 2:01; Plant-Animal Interactions (Ecology, Behaviour and Evolution)

EC303 and PH303 Aug 2:01; Spatial dynamic in biology

EC305 Aug 2:01; Quantitative Ecology: Research Design and Statistical Inference

EE304 Jan 3:01; Computational Cognitive Neuroscience

ER 201 August 3:00; Renewable Energy Technologies

ES 202 August 3:00; Geodynamics

ES204 Aug 3:00; Origin and evolution of the Earth

ES205 Aug 3:00; Mathematics for Geophysicists

ES212 Jan 3:00; Fluid dynamics of planetary interiors

ES213 Jan 3:00; Isotope geochemistry

HE215 Aug 3:00; Nuclear and Particle Physics

HE316 JAN 3:00; Group theory and applications in physics

HE316 Jan 3:00; Advanced Mathematical methods in Physics

HE384 Jan. 3:00; Quantum Computation

HE391 Aug 3:00; Relativistic Quantum Mechanics /Quantum Mechanics III

HE395 August 3:00; Quantum Field Theory I

HE396 Jan. 2018 3:00; Quantum Field Theory II

HE396 Jan 3:00; Gauge Field Theories / Quantum Field Theory II

HE398 Jan 3:00; General Relativity

IN 212 January 3:00; Advanced Nano/Micro Systems

IN214 Jan 3:00; Semiconductor Devices and Circuits

IN224 Jan 3:00; Nanoscience and Device fabrication

IN227 Jan. 3:00; Control System Design

IN232 Aug 3:00; Concepts in Solid State Physics

IN244 AUG 2:01; Optical Metrology

IN267 Aug 3:00; Fundamentals of Fluorescence Microscopy

IN268 JAN 2:01; Microfluidic Devices & Applications

IN302 Aug 3:00; Classical and Quantum Optics

IP 214 AUG 2;1; CRYSTALLOGRAPHY FOR CHEMISTS

IP 322 January 3:00; Polymer Chemistry

IP311 Aug. 3:00; Bio and Medicinal Inorganic Chemistry

IP323 January 3:00; Topics in Basic and Applied Electrochemistry

MA 200 August 2017- December 2017 3:01; Multivariable Calculus

MA 200 Aug 3:01; Multivariable Calculus

MA 220 Aug. 3:00; Representation Theory of finite groups

MA 222 Jan 3:01; Measure and integration

MA 223 August 3:00; Functional Analysis

MA 223 August 3:00; Functional Analysis

MA 229 Jan 3:00; Calculus on Manifolds

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

MA 327 Aug 3:00; Topics in Analysis

MA 338 Aug. 3:00; Differentiable manifolds and Lie groups

MA 339 Jan 3:00; Geometric Analysis

MA 339 Jan 3:00; Geometric Analysis

MA 367 Jan 3:00; Topics in Gaussian processes

MA219 Aug. 3:01; Linear Algebra

MA221 Aug. 3:00; Analysis I

MA232 Aug. 3:00; Introduction to Algebraic Topology

MA318 Jan 3:00; Combinatorics

MA319 Jan 3:00; Algebraic Combinatorics

MA361 Aug 3:00; Probability Theory

MA386 Jan 3:00; Coxeter Groups

MB 211 Jan 3:01; Multiscale Theory and Simulations of Biomolecular Systems

MB201 Aug 2:00; Introduction to Biophysical Chemistry

MB204 Aug 3:00; Molecular Spectroscopy and its Biological Applications

MB206 August 3:00; Conformational and structural aspects of biopolymers

MB207 Jan 2:00; DNA-Protein Interaction

MB207 Jan 2:00; DNA-Protein interaction, Regulation of gene expression, Nanobiology

MB209 Aug. 3:01; Molecular and Cellular Neurophysiology

MB210 Jan 2:00; Peptides and Drug-Design

MB212 January 2:00; Electron microscopy and 3D image processing for Life sciences

MB303 Jan 3:00; Elements of Structural Biology

MB305 Jan 3:00; Biomolecular NMR Spectroscopy

MC 203 Jan 3:00; Essentials in Microbiology

MC 210/RD 206 Jan 2; Molecular Oncology

MC 211 / BC 210 January-April 2:00; Molecular basis of Ageing and Regeneration

MC202 Jan. 2:00; Eukaryotic Developmental Genetics

MC203 Aug 3:00; Essentials in Microbiology

MC206 Aug 2:00; RNA Biology

MC208 Aug 3:00; Principles of Genetic Engineering

MC212 Aug 2:00; ADVANCES IN CELL BIOLOGY

MC212 Aug. 2:00; Advances in Cell Biology

ME 259 August 3:00; Nonlinear Finite Element Methods

ME 273 Jan 3:00; Solid and Fluid Phenomena at small scales

ME 282 Jan 3:00; Computational Heat Transfer and Fluid Flow

ME 284 and ER-201 Jan and Aug 3:00; Advanced Internal Combustion Engines and Renewable Energy

ME 287 January-April 3:00; Refrigeration Engineering

ME 288 January-April 3:00; Air Conditioning Engineering

ME 289 August-December 3:00; Principles of Solar Thermal Engineering

ME228 Aug 3:00; Materials and Structure Property Correlations

ME237 Jan. 3:00; Mechanics of Microsystems

ME240 August 3:00; Dynamics and Control of Mechanical Systems

ME242 August - December 2018 3:00; Solid Mechanics

ME243 August 3:00; Continuum mechanics

ME244 January 3:00; Experimental Methods in Microfluidics

ME246 Jan 3:00; Introduction to Robotics

ME249 Jan. 3; Fundamentals of acoustics

ME250 Aug. 3:00; Structural Acoustics

ME253 Jan. 3:00; Vibrations of Plates and Shells

ME255 Aug 3:00; Principles of Tribology

ME256 Jan. 3:00; Variational Methods and Structural Optimization

ME257 Jan 3:00; Finite Element Method

ME260 Aug. 3:00; Topology Optimization

ME271 Aug-Dec 3:00; Thermodynamics

ME283 Aug 3:00; Two Phase Flow and Boiling Heat Transfer

ME284 January 3; Applied Combustion

ME285 Aug 3:00; Turbomachine Theory

ME293 Jan-18 3:00; Fracture Mechanics

MG 212 Aug-Dec 2:01; Behavioral Science

MG 225 Aug 3:00; Decision Models

MG 265 Aug 3:00; Data Mining

MG 286 Jan 3:00; PROJECT MANAGEMENT

MG 298 Aug 2:01; ENTREPRENEURSHIP FOR TECHNOLOGY STARTUPS

MG201 August-December 3:00; Managerial Economics

MG202 August-December 3:00; Macroeconomics

MG221 Aug 2:01; Applied Probability and Statistics

MG258 Jan 3:00; Financial Instruments and Risk Management Strategies

MG281 Jan 3:00; Management of Technology for Sustainability

MR 203 Aug. -Dec. 2017 3:00; Introduction to Biomaterials

MR301 Aug 3:00; Quantum Mechanical Principles in Materials

MR306 August 3:00; Electron Microscopy in Materials Characterization

MR308 Jan 3:00; Computational Modeling of Materials

MT 202 August 3:00; Materials Thermodynamics and Kinetics

MT 256 January 3:00; Fracture

MT 260 August 3:00; Polymer Science and Engineering – I

MT 261 January 3:00; Organic Electronics

MT203 Aug 3:00; Materials Design and Selection

MT206 August 3:00; Texture and Grain boundary engineering

MT208 Aug. 3:00; Diffusion in Solids

MT209 Aug 3:00; Defects in materials

MT213 January 3:00; Electronic Properties of Materials

MT220 Jan 3:00; Microstructural Design and Development of Engineering Materials

MT225 Jan 3:00; Elevated Temperature Deformation and Fracture

MT241 Aug 3:00; Structure and Characterization of Materials

MT245 August 3:00; Transport Processes in Process Metallurgy

MT248 Jan 3:00; MODELLING AND COMPUTATIONAL METHODS IN METALLURGY

MT271 Jan 3:00; Introduction to Biomaterials Science and Engineering

NE-200 Jan. 2:00; Technical Writing in English

NE-215 Aug. 3:00; Applied Solid State Physics

NE202 Jan and Aug 0:01; Micro and Nano Fabrication Lab

NE203 Aug 3:00; Advanced Micro and Nano fabrication technology and process

NE205 Aug 3:00; Semiconductor Devices and IC Technology

NE222 Aug. 3:00; MEMS: Modeling, Design, and Implementation

NE231 August 3:00; Microfluidics

NE310 AUG 3:00; Photonics technology: Materials and Devices

NE312 Aug 3:00; Nonlinear and Ultrafast Photonics

NE313 Jan 3:00; Lasers: Principles and Systems

NS201 Aug 3:00; Fundamentals of Systems and Cognitive Neuroscience

NS202 Aug. 3:00; Fundamentals of Molecular and Cellular Neuroscience

NS301 Jan 3:00; Topics in Systems and Cognitive Neuroscience

NS302 Jan. 3:00; Topics in Molecular and Cellular Neuroscience

OC301 Aug 3:00; Organic Synthesis -II

OC302 August 3:00; Asymmetric Catalysis: From Fundamentals to Frontiers

OC303 Jan 3; Physical Methods of Structure Elucidation

OC303 Aug. 3:00; Carbohydrate Chemistry

PD205 Aug 2:01; Materials, Manufacturing and Design

PD232 Aug 2:01; Human Computer Interaction

PD233 Aug 2:01; Design of Biomedical Devices and Systems

PD234 Jan 2:01; Intelligent User Interface

PH 208 Jan 3:00; Condensed Matter Physics-I

PH201 Aug 3:00; Classical Mechanics

PH202 Jan 3:00; Statistical Mechanics

PH204 Jan 3:00; Quantum Mechanics II

PH204 January 3:00; Quantum Mechanics II

PH205 August 3:00; Mathematical Methods of Physics

PH206 January 3:00; Electromagnetic Theory

PH212 Jan 3; Experimental methods in condensed matter physics

PH213 Aug 0:04; Advanced experiments in condensed matter physics

PH215 August 3:00; Nuclear and Particle Physics

PH320 Aug 3:00; Condensed matter Physics II

PH322 Jan 3:00; Molecular Simulation

PH325 August 3:00; Advanced Statistical Physics

PH335 Jan 3:00; Statistical Mechanics of Time-dependent Phenomena

PH350 Jan 3:00; Physics of Soft Condensed Matter

PH351 Aug 3:00; Crystal Growth, thin films and Characterisation

PH352 Jan 3:00; Semiconductor Physics and Technology

PH354 Jan. 3:00; Computational Physics

PH359 Jan 3:00; Physics of Nanoscale Systems

PH364 Jan 3:00; Topological Phases of Matter

PH396 January 3:00; Quantum Field Theory II

RD 209 / BC 210 / MC 211 Jan 3:00; Molecular Basis of Ageing and Regeneration

RD 210 January 2:00; Fundamentals of Physiology and Medicine

SS202 Aug 3:00; Introduction to Quantum Chemistry

SS304 August 3:00; Solar Energy and Materials

ST 201 Jan 3:00; Thermochemical and biological energy recovery from biomass

ST 204 Aug 1:01; Sustainable Energy and Environment lab

ST 207 Jan 3:00; Alternate Fuels for Reciprocating Engines

ST 202: August 3:00; Energy Systems and Sustainability

ST213 Jan 3:00; Turbomachines in Renewable Energy

ST214 Aug 3:00; Mathematical Analysis of Experimental Data

UB 204 Jan 2:00; Introductory Physiology

UB205 Jan 2:00; Introductory Physiology

UB208 Jan. 2:00; Basic Molecular Biology

UB301L Aug 0:02; Experiments in Microbiology and Ecology

UC101 August 2:01; Principles of Physical Chemistry

UC202 January 2:00; Thermodynamics and Electrochemistry

UC205 January 2:00; Basic Organic Reactions

UC206 August 2:01; Basic Organic Chemistry

UC207 Jan. 2:01; Instrumental Methods of Chemical Analysis

UE 102 Jan 2:01; Electronics and Electrical Engineering

UE204 Jan 3:00; Elements of Solid Mechanics

UES 206 Jan 1:02; Experimental Methods in Environmental Chemistry

UES 302 Aug 2:00; Design Principles in Environmental Engineering

UES 310 Aug 1:02; Experimental Methods in Solid Waste Management

UES204 Jan 3:00; Fundamentals of Climate Science

UG206L Jan 0:02; Experiments in Biochemistry and Physiology

UM 302 Aug 2:01; Material Processing

UM101 Aug. 3:00; Analysis and Linear Algebra

UM101 Aug 3:00; Analysis I

UM201 Aug 3:00; Probability and Statistics

UMT202 Jan 2:01; Structure of Materials

UMT205 Jan 3:00; Mechanical Behavior of Materials

UMT310 Jan. 2:01; Introduction to Materials Manufacturing

UMT311 Aug 0:01; Functional Materials Laboratory

UP 101 Aug 2:01; Introductory Mechanics

UP201 Aug 2:01; Introductory Physics III

UP203 Jan 2:01; Intermediate Electromagnetism and the Quantum Physics of Radiation

E0 249 Jan 3:01

Approximation Algorithms

Department: CSA

Course outcomes:

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

approximation algorithms.

AE 203 Fluid dynamics August December 3

Fluid dynamics

Department: Aerospace

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 3:00

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 230 Jan 3:00

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 259 Aug 3:00

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 3:00

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.

AE 271 1st week of August to 3rd week of Dec (2:1)

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 282 Jan 3:00

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.

AE-218 Jan 3:00

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.

AE203 AUG 3:00

Fluid Dynamics

Department: AE

Course outcomes:

Know foundational concepts for analysing fluid dynamics. Learn to perform integral analyses and overall balances from conservation laws and differential equations analyses for fields. Understand modeling approximations such as inviscid, incompressible, turbulent for different types of flows.

AE210 Jan 3:00

Gas Dynamics

Department: AE

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.

AE210 Jan 3:00

Gasdynamics

Department: Aerospace Engineering

Course outcomes:

1) Understand that flow energetics and kinematics are closely coupled in gasdynamic phenomena.

2) Appreciate the critical role played by sound waves and the importance of acoustic speed.

3) Understand the role of Mach number in describing compressible flow phenomena.

4) Understand the differences in flow phenomena at subsonic and supersonic velocities.

5) Learn analytical tools using control volume methods to address gasdynamic problems of engineering interest.

6) Two important concepts - flow choking and directional nature of supersonic flows will be addressed.

7) Generation of supersonic flows using convergent-divergent nozzles and their operation will be understood.

8) Students will understand how to factor effects of friction and heat addition to gasdynamic flow, typical in aerospace engines.

9) Students will learn about modeling shock waves and their interactions, shock-expansion theory - a useful theory to determine aerodynamic loads on aerospace vehicles in supersonic flow.

10) The partial differential equations of gasdynamics will be elaborated.

11) Students will learn simplified technique useful in practical engineering design - small perturbation theory.

12) Method of characteristics is a useful technique to design supersonic nozzles and students will design a supersonic nozzle using this numerical tool.

13) Students will be exposed to the theories of measurement and testing techniques such as shock tunnels and wind tunnels, pitot measurements to name a few.

14) Students will learn the essentials of hypersonic flows.

AE221 Aug 3:00

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 3:00

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.

AE245 Aug 3:00

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 3:00

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 3:00

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. 1:02

Experimental Techniques

Department: Aerospace

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 3:00

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 3:00

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 3:00

Micromechanics of composites

Department: Department of Aerospace Engineering

Course outcomes:

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

AS 209 January 3:00

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.

AS202 Jan 3:00

Geophysical Fluid Dynamics

Department: CAOS

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 August 3:00

Atmospheric Thermodynamics

Department: Centre for Atmospheric and Oceanic Sciences

Course outcomes:

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

AS204 August 3:00

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

AS205 Aug. 2:01

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 3:00

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 January 2:01
Observational Techniques

Department: CAOS

Course outcomes:

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

AS212 August 3:00

Introduction to Atmospheric Dynamics

Department: CAOS

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 August Term - 3 Credits

Introduction to the Climate System

Department: CAOS

Course outcomes:

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

system.

BC 203 August - December 3:00

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 2:00

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 January - April 3:00

Molecular Basis of Ageing aanf 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.

BC203 Aug 3

General Biochemistry

Department: Biochemistry

Course outcomes:

Students gain knowledge in the broad subject areas of Biochemistry that will help them with their research.

BC206 August 2:00

Essentials in Immunology

Department: Biochemistry

Course outcomes:

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

level.

BC207 Jan 2:00

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.

BC_201 Aug 2:00

CELL BIOLOGY

Department: BIOCHEMISTRY

Course outcomes:

Students develop important basic understanding about cellular processes including cell cycle, signalling,

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.

BE 207 Jan 3:00

Mathematical Methods for Bioengineers

Department: BioSystems Science and Engineering

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

BE206 August 3:00

Biology for Engineers

Department: Centre for BioSystems Science and Engineering

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 January 3:00

Fundamentals of Bioengineering

Department: Centre for BioSystems Science and Engineering

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. 1:00

Digital Epidemiology

Department: BioSystems Science and Engineering

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 Neural Networks for Signal Processing-I Jan-17 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 January 0:04

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, electrocemical 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 3:00

Inorganic Chemistry-Main Group and Coordination Chemistry

Department: Department of Inorganic and Physical Chemistry

Course outcomes:

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

CD213 August 3:00

Organic Chemistry – Structure and Reactivity

Department: Department of 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. 3:00

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. 3:00

Organic Synthesis

Department: Department of 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 2:01

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 3:00

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 3:00

Basic Geomechanics

Department: Civil Engineering

Course outcomes:

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

mechanics.

CE 207 JAN 3:00

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 3:00

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 3:00

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 238 Jan. 3:00

Structural Masonry

Department: Civil Enginerng

Course outcomes:

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

CE 248 JAN 3:00

GIONALIZATION IN HYDROLOGY AND WATER RESOURCES ENGINEERI

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.

CE2015 Aug. 3:00

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 3:00

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 August 3:00

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. 3:00

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 January 3:00
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 3:00

Systems Techniques in Water Resources & Environmental Engineering

Department: Civil Engineering

Course outcomes:

* Learning Deterministic optimization techniques such as Linear Programming, Dynamic Programming, Optimization using Calculus.

* Learning Stochastic Optimization techniques such Stochastic Dynamic Programming, Chance Constrained Liner Programming.

* 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 3:00

Stochastic Hydrology

Department: Civil Engineering

Course outcomes:

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

CE219 Aug. 3:00

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 3:00

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 3:00

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 3:00

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 January 3:00

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.

CE240 January 3:00

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 August 3:00

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 August 3:00

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 August 3:00

Bridge Engineering

Department: Civil Engineering

Course outcomes:

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

CE246 Aug 3:00

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 3:00

Remote Sensing and GIS in Water Resources and Environmental Engineering

Department: Civil Engineering

Course outcomes:

* Learning about satellite remote sensing, GIS, DEM and GPS

* Learning about digital image processing for image rectification, enhancement and information extraction.

* 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. 3:00

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. 3:00

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 3:00

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 1:00

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 3:00

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 August 3:00

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

CH201 August 3:00

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 3:00

Numerical Methods

Department: Chemical Engineering

Course outcomes:

- Using Matlab to execute numerical algorithms

- Numerical solutions of multivariable nonlinear algebraic equations

- Data fitting algorithms

- Finite difference techniques for solving differential equations

CH203 Aug 3:00

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 3:00

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 3:00

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 1:00

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 3:00

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.

CH236 Jan 3:00

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.

CH245 Jan 3:00

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.

CH247 Jan 3:00

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 3:00

Molecular Systems Biology

Department: Chemical Engineering

Course outcomes:

Students taking this course will be:

Able to distill and model biomolecular interactions and biological phenomenon as mathematical models and simulate them.

Explain the various physical modeling approaches for biomolecules, biological pathways, regulation and networks.

Explain the various methods to measure the relevant molecular and network properties.

Model biological pathways like transcription networks, signal transduction pathways, and spatio-temporal differentiation programs.

DB201 Aug 2:00

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 2:00

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. 2:00

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 0:01

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 222 Aug 3:01

Machine Learning with Large Datasets

Department: CDS

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 3:00

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 284 Aug. 2:01

Numerical Linear Algebra

Department: Computational and Data Sciences (CDS)

Course outcomes:

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

DS 290 Aug 3:00

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 3:01

Finite elements: Theory and Algorithms

Department: Department of 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. 3:00

Data Analysis and Visualization

Department: Department of Computational and Data Sciences (CDS)

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 391 Jan 3:00

Data Assimilation to Dynamical Systems

Department: Computational and Data Sciences

Course outcomes:

Familiarity with basics of modern data assimilation techniques

DS 397 JAN 3:01

Topics in Embedded Computing

Department: Computational and Data Sciences

Course outcomes:

Many Core Architectures for SoCs

Programming massively parallel and runtime reconfigurable systems

Programming Models

Execution Models

DS-255 Jan 3:01

System Virtualization

Department: CDS

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.

DS221 August 3:00

Introduction to Scalable Systems

Department: CDS

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.

DS256 Jan 3:01

Scalable Systems for Data Science

Department: Department of 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: CDS

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.)

DS295 Jan 3:01

Parallel Programming

Department: CDS

Course outcomes:

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

DS301 Aug 2:00

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 3:01

Automated Software Engineering with Machine Learning

Department: CSA

Course outcomes:

After completing this course successfully, students can:

* Design and implement simple Android applications

* Identify concurrency and security issues in Android applications

* Apply machine/deep learning for analyzing software

* Understand and use state-of-the-art program analysis tools

E0 220 Aug 3:01

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 3:01

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 3:01

Algorithmic Algebra

Department: Computer Science and Automation

Course outcomes:

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

E0 232 August-December 3:01

Probability and Syayistics

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 3:01

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 251 Aug 3:01

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 August-December 3:01
Network and Distributed Systems Security

Department: Department of 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 3:01

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 August 3:01

Database Management Systems

Department: CSA

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.

E0 264 January-April 3:01

Distributed Computing Systems

Department: Department of 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 3:01

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 3:01

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 3:01

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.

E0 272 Jan 3:01

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 2:01

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.

The course makes the students highly employable in various IC design companies.

E0 311 Jan 3:01

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 338 August 3:01

Topics in Security and Privacy

Department: CSA

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 January 3:01
Topics in Database Systems

Department: CSA

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.

E0-334 Aug 3:01

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.

E0210 Aug 3:01

Principles of Programming

Department: CSA

Course outcomes:

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

software systems.

E0230 Aug 3:01

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. 3:01

Computer Architecture

Department: CSA

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.

E0246 Jan 3:01

Real Time Systems

Department: Department of Electrical Engineering

Course outcomes:

Students should be able to schedule the jobs in RTOS

and how to handle allocation of resources.

E0247 Aug 3:01

Sensor Networks

Department: Department of Electrical Engineering

Course outcomes:

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

E0255 Jan 3:01

Compiler Design

Department: CSA

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 3:01

Theory and Practice of Computer Systems Security

Department: CSA

Course outcomes:

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

E0271 AUG 3:01

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 3:01

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.

E0343 Jan. 3:01

Topics in Computer Architecture

Department: CSA

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

E0358 Aug 3:01

Advanced Techniques in Programming and Compilation for Parallel Architectures

Department: CSA

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 3:01

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 3:00

Dynamics of linear systems

Department: EE

Course outcomes:

- Students would learn about state space description of systems.

- Students would learn fundamental concepts in linear systems and

  controls such as stability, controllability and observability.

- Students would learn formal mathematical (theorem-

E1 241 Aug 3:00

Dynamics of linear systems

Department: EE

Course outcomes:

- Students would learn about state space description of systems.

- Students would learn fundamental concepts in linear systems and

 controls such as stability, controllability and observability.

- Students would learn formal mathematical (theorem-proo

E1 242 Jan 3:00

Nonlinear systems and control

Department: EE

Course outcomes:

- The students would learn to use various basic and commonly used tools to analyze nonlinear systems and to design controllers for the same.

- The students would learn formal mathematical (theorem-proof style) analysis in the context of controls.

- The

E1 243 Jan 2:01

Digital Controller Design

Department: Electronic Systems Engineering

Course outcomes:

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

E1 246 Jan 3:01

Natural Language Understanding

Department: CSA

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 254 January 3:01
Game Theory

Department: CSA (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.

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.

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.

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.

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 277 January-April 3:01
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.

E1222 Aug. 3:00

Stochastic Models and Applications

Department: EE

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 3:00

Detection and Estimation Theory

Department: ECE

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 3:00

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 2015, 2016, 2017 3:00

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 3:00

Random Processes

Department: ECE

Course outcomes:

Students would have basic understanding of probability theory, random variables, random vectors, and

discrete valued random processes.

E2 204 Jan 3:00

Stochastic Processes and Queueing Theory

Department: ECE

Course outcomes:

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

system performance.

E2 205 Aug. 3:00

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.

E2213 Jan. 3:00

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. 3:00

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 214 Jan. 3:00

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 basic ideas involved in dynamic programming.

E2 214 Jan. 3:00

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 basic ideas involved in dynamic programming.

E2 214 Jan. 3:00

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 on finite-state channels, and to provide the mathematical tools and techniques needed to carry out research in this field. In particular, students are exposed to the fundamental mathematical technique of dynamic programming.

E2 214 Jan. 3:00

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 on finite-state channels, and to provide the mathematical tools and techniques needed to carry out research in this field. In particular, students are exposed to the fundamental mathematical technique of dynamic programming.

E2 232 August 2:01
TCP/IP Networking

Department: Department of Electronic Systems Engineering

Course outcomes:

Students acquire detailed understanding of how TCP/IP networks operate.

Discussions of concepts and notions in class and a variety of lab exercises enable students to grasp the

essentials, and prepare them to solve practical networking problems.

E2-202 Aug. 3:00

Random Processes

Department: Electrical Communication Engineering

Course outcomes:

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

Processes.

E2-221 Aug. 3:00

Communication Networks

Department: Department of ECE

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. 3:00

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. 3:00

Multiuser Detection

Department: Department of ECE

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. 3:00

Communication Systems

Department: Department of ECE

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.

E2201 Aug 3:00

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.

E2203 Jan. 3:00

Wireless Communications

Department: ECE

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 3:00

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.

E244 JAN 3:01

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 August 3:00

Foundations of Nanoelectronic Devices

Department: Electrical Communication Engineering (ECE)

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 January 2:01
Digital System Design with FPGAs

Department: Department of 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 August 2:01

Processor System Design

Department: Department of 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

E3 262 AUG 2:01

ELECTRONICS SYSTEMS PACKAGING

Department: Electronic Systems Engineering (ESE)

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 274 Aug. 3:00

Power Semiconductor Devices and Physics

Department: DESE

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 280 January 3:00

Carrier transport in nanoscale devices

Department: Electrical Communication Engineering (ECE)

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 282 Aug 3:00

Basics of Semiconductor Devices and Technology

Department: Department of 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.

E3-257 Jan 2:01

Embedded System Design

Department: Dept of 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

E3225 January 3:00

Art of Compact Modeling

Department: Electronic System Engineering

Course outcomes:

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

E3258 Jan 2:01

Design For Internet Of Things

Department: DESE

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.

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 2:01

Selected Topics in Integrated Power Systems

Department: Department of 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.

E4 238 Jan 3:00

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.

E4221 August 2:01

DSP and AI Techniques in Power System Protection

Department: Electrical Engineering Department

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 3:00

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 3:00

Computer Control of Power Systems

Department: Department of 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..,

E5212 Jan 3:00

Computational Methods in Electrostatics

Department: EE

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

E5213 Jan 3:00

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 Engg.

Course outcomes:

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

and industrial applications

E5-232 May-June 2:01

Advances in Electric Power Transmission

Department: Electrical Engg

Course outcomes:

Advanced knowledge in high voltage insulation and transmission engg,

Understanding of the SCADA and substation automation etc..

E5201 August 2:01

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 3:00

High Voltage Power Apparatus

Department: Electrical Engineering

Course outcomes:

* Advanced knowledge in high voltage power apparatus

* enhanced understanding in monitoring and diagnostic aspects of transformer

* expertise in testing aspects of circuit breakers

* advanced knowledge in power transformer design, testing, shirt circuit force calculations

E5209 Jan 3:00

Overvoltages in Power Systems

Department: Electrical Engineering

Course outcomes:

* time-domain treatment of overvoltage on transmission lines

* methods to compute it

* analyse overvoltage data or phenomenon in systems, networks

* protection against overvoltage

E6 222 Jan 2:01

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 3:01

Advanced Power Electronics

Department: Electrical Engineering

Course outcomes:

Prepare students for research

E6-202 Aug 2:01

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 3:00

DESIGN AND CONTROL OF POWER CONVERTERS AND DRIVES

Department: DESE

Course outcomes:

MODELING, DESIGN AND CLOSED LOOP CONTROL OF VARIABLE SPEED DRIVES

E6221 Jan 3:01
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 3:00

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 3:00

Photonic Integrated Circuits

Department: ECE Dept

Course outcomes:

After the completion of the course, the student will,

Be able to design and analyze an integrated optic waveguide

Understand the working of various photonic components

Be able to choose the technology suitable for the intended device.

Also he/she will be ready to understand current developments.

E7 214 Jan 3:00

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 2:01

Fiber-Optic Communication

Department: ECE

Course outcomes:

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

E8 201 August 3:00

Electromagentism

Department: EE

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   electromagnetic field theory

3. Comprehend the framework of the governing laws and their applicability

   to the electrical engineering problems

4. Able to solve standard problems through acquires basic mathematical skills

E8241 Jan 2:01

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.

E8262 Jan 3:00

CAD for High Speed Chip-Package-Systems

Department: ECE

Course outcomes:

Students learn about different electromagnetic and circuit simulation methods

E9 201 Aug. 3:00

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. 3:00

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 3:00

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 January 3:00

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. 3:00

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 August 2:01

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.

E9 243 JAN 3:00

Computer Aided Tom ographic 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 3:01

Advanced Image Processing

Department: EE

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. 3:01

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 3:00

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.

E9-221 Jan 3:00

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.

E9205 AUG 3:01

MACHINE LEARNING FOR SIGNAL PROCESSING

Department: ELECTRICAL ENGINEERING

Course outcomes:

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

E9251 Bi-annually, Typically Jan. 3:00

Signal processing for data recording channels

Department: Electronic Systems Engg.

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 Mainly Aug until now, sometimes Jan 3:00

Mathematical methods and techniques in signal processing

Department: Electronic Systems Engg.

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 2:01

Neural Signal Processing

Department: EE

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 2:01

DSP System Design

Department: Department of 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 2:01

Real TIme Signal processing with DSP

Department: Department of 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 2:01

Evolutionary Biology

Department: Centre for Ecological Sciences

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.

Ec201 Jan 2:01

Theoretical and Mathematical Ecology

Department: Centre for Ecological Sciences

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.

EC203 Jan 2:00

Ecology: Principles and Applications

Department: CES

Course outcomes:

Broad introduction to ecology and its relevance to society

EC301 August 2:01

Animal Behaviour: Mechanisms and Evolution

Department: Centre for Ecological Sciences

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 2:01

Plant-Animal Interactions (Ecology, Behaviour and Evolution)

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."

EC303 and PH303 Aug 2:01

Spatial dynamic in biology

Department: Centre for Ecological Sciences and Physics

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 2:01

Quantitative Ecology: Research Design and Statistical Inference

Department: Centre for Ecological Sciences

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)

Ee123 jan 3:00

Sample course

Department: Ese

Course outcomes:

Design

EE304 Jan 3:01

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 August 3:00

Renewable Energy Technologies

Department: interdisciplinary Centre for Energy Research

Course outcomes:

complete PV from basic device physics to plant working principals

ES 202 August 3:00

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 3:00

Origin and evolution of the Earth

Department: Centre for Earth Science

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 3:00

Mathematics for Geophysicists

Department: Centre for Earth Sciences

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 3:00

Fluid dynamics of planetary interiors

Department: Centre for Earth Sciences

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 3:00

Isotope geochemistry

Department: Centre for Earth Science

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.

HE215 Aug 3:00

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 3:00

Group theory and applications in physics

Department: Centre for High Energy Physics

Course outcomes:

Knowledge of group theory as is necessary for the study of relativistic particle physics

HE316 Jan 3:00

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. 3:00

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.

HE391 Aug 3:00

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.

HE395 August 3:00

Quantum Field Theory I

Department: CHEP

Course outcomes:

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

HE396 Jan. 2018 3:00

Quantum Field Theory II

Department: CHEP

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.

HE396 Jan 3:00

Gauge Field Theories / Quantum Field Theory II

Department: Centre for High Energy Physics

Course outcomes:

The main outcome of the course is that the student can now understand

the main concepts behind non-abelian gauge theories and renormalisation.

These two topics are very important to understand further advanced topics

in quantum field theory.

HE398 Jan 3:00

General Relativity

Department: Centre for High Energy Physics, Physics

Course outcomes:

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

IN 212 January 3:00

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.

IN214 Jan (was offered in Aug till 2016) 3:00

Semiconductor Devices and Circuits

Department: Instrumentation and Applied Physics

Course outcomes:

The concepts and analysis of semiconductor device physics.

Methods to develop novel semiconductor devices.

Impact of device physics on circuit design.

IN214 Jan 3:00

Semiconductor Devices and Circuits

Department: Department of 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)

IN214 Jan 3:00

Semiconductor Devices and Circuits

Department: Department of 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 3:00

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. 3:00

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 3:00

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 2:01

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 3:00

Fundamentals of Fluorescence Microscopy

Department: IAP

Course outcomes:

Fluorescence based techniques

IN268 JAN 2:01

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 3:00

Classical and Quantum Optics

Department: IAP

Course outcomes:

The classical and quantum nature of light.

IP 214 AUG 2;1

CRYSTALLOGRAPHY FOR CHEMISTS

Department: I P C

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 January 3:00

Polymer Chemistry

Department: Inorganic and Physical Chemistry

Course outcomes:

Students will come out with:

a strong appreciation of all aspects of polymer chemistry

an understanding of how polymers are prepared and where they are used

an knowledge of how polymers are characterized

knowledge of all contemporary methods of polymer synthesis

an appreciation of several specialty polymers and their applications

IP311 Aug. 3:00

Bio and Medicinal Inorganic Chemistry

Department: Department of 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.

IP323 January 3:00

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.

MA 200 August 2017- December 2017 3:01

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 200 Aug 3:01

Multivariable Calculus

Department: Mathematics

Course outcomes:

Students develop knowledge in the real analysis of multivariable functions. Differentiation, Integration and some results in integral calculus.

MA 220 Aug. 3:00

Representation Theory of finite groups

Department: Mathematics

Course outcomes:

At the end of the course, a student would

a) Understand the basics of representation theory of finite groups

b) have enough knowledge about basic tools of representation theory

c) be able to use these tools to determine representations of "Good Enough" groups

d) Know pros and cons of these tools and apply suitably

e) be able to describing complex representations of symmetric groups and of $GL_2(F_q)$

MA 222 Jan 3:01

Measure and integration

Department: Mathematics

Course outcomes:

Lebesgue integral. Lebesgue differentiation.

MA 223 August 3:00

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 223 August 3:00

Functional Analysis

Department: Mathematics

Course outcomes:

The students will learn everything written in the Syllabus.

MA 229 Jan 3:00

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 315   Jan. 3:00

Lie Algebras and their Representations

Department: Department of Mathematics

Course outcomes:

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

MA 327 Aug 3:00

Topics in Analysis

Department: Mathematics

Course outcomes:

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

MA 338 Aug. 3:00

Differentiable manifolds and Lie groups

Department: Mathematics

Course outcomes:

Students taking this course ought to

a) Know why we care about defining manifolds and what we expect to do with them.

b) Give examples of manifolds.

c) Understand how to construct diffeomorphisms using vector fields.

d) Understand why to care about differential forms and the Stokes theorem and how to prove the latter.

e) Know how differential calculus can help with distinguishing different objects (through De Rham cohomology).

MA 339 Jan 3:00

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 339 Jan 3:00

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 367 Jan 3:00

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.

MA219 Aug. 3:01

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. 3:00

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. 3:00

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 3:00

Combinatorics

Department: Mathematics

Course outcomes:

How to approach problems in combinatorics

MA319 Jan 3:00

Algebraic Combinatorics

Department: Mathematics

Course outcomes:

Learn basis of algebraic combinatorics

MA361 Aug 3:00

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 3:00

Coxeter Groups

Department: Mathematics

Course outcomes:

Learn basis of the theory of Coxeter groups

MB 211 Jan 3:01

Multiscale Theory and Simulations of Biomolecular Systems

Department: Molecular Biophsyics Unit

Course outcomes:

Advance methods in molecular modeling

MB201 Aug 2:00

Introduction to Biophysical Chemistry

Department: Molecular Biophysics

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 3:00

Molecular Spectroscopy and its Biological Applications

Department: Molecular Biophysics Unit

Course outcomes:

Learn to interpret spectroscopic data for structural analysis.

MB206 August 3:00

Conformational and structural aspects of biopolymers

Department: Molecular Biophysics Unit (MBU)

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 2:00

DNA-Protein Interaction

Department: MBU

Course outcomes:

They will have exposure to structural basis of Gene expression

MB207 Jan 2:00

DNA-Protein interaction, Regulation of gene expression, Nanobiology

Department: Molecular Biophysics Unit

Course outcomes:

Students taking this course will be:

Able to describe and explain the parameters that control biomolecular interactions and recognition esp. in the context of gene regulation.

Explain how single molecule methods are used to understand such molecular interactions at the nanoscale

Design and apply such studies to problems of board scientific interest that involve molecular interactions

MB209 Aug. 3:01

Molecular and Cellular Neurophysiology

Department: Molecular Biophysics 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 2:00

Peptides and Drug-Design

Department: Molecular Biophysics 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.

MB212 January 2:00

Electron microscopy and 3D image processing for Life sciences

Department: Molecular Biophysics 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 3:00

Elements of Structural Biology

Department: Molecular Biophysics Unit

Course outcomes:

Introduction to structural biology

MB305 Jan 3:00

Biomolecular NMR Spectroscopy

Department: Molecular Biophysics 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 3:00

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

MC 211 / BC 210 January-April 2:00

Molecular basis of Ageing and Regeneration

Department: MCBL

Course outcomes:

Learn about mechanism of Ageing and Regeneration

MC202 Jan. 2:00

Eukaryotic Developmental Genetics

Department: MCB, MRDG

Course outcomes:

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

MC203 Aug 3:00

Essentials in Microbiology

Department: Microbiology and Cell Biology

Course outcomes:

The students learns to understand and appreciate the basic mechanism of biological processes .

MC206 August-December 2:00

RNA Biology

Department: Microbiology and Cell Biology

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 3:00

Principles of Genetic Engineering

Department: Microbiology and Cell Biology

Course outcomes:

Theoretical and practical knowledge to use recombinant DNA techniques in research.

MC212 Aug 2:00

ADVANCES IN CELL BIOLOGY

Department: Microbiology and Cell Biology

Course outcomes:

undergrad and postgraduate students

MC212 Aug. 2:00

Advances in Cell Biology

Department: Microbiology and Cell Biology

Course outcomes:

Students will learn current knowledge on cell biology including basic techniques

ME 259 August 3:00
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 3:00

Solid and Fluid Phenomena at small scales

Department: Department of Mechanical Engineering

Course outcomes:

Broader perspective of mechanical behaviour of materials especially at small scales.

ME 282 Jan 3:00

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 3:00

Advanced Internal Combustion Engines and Renewable Energy

Department: CCE, ICER

Course outcomes:

Fundamentals of the subject contents to advanced level topics.

ME 287 January-April 3:00

Refrigeration Engineering

Department: Department of Mechanical Engineering, IISc, Bangalore-560012

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 January-April 3:00

Air Conditioning Engineering

Department: Department of Mechanical Engineering, IISc, Bangalore-560012

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 August-December 3:00

Principles of Solar Thermal Engineering

Department: Department of Mechanical Engineering, IISc, Bangalore-560012

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.

ME228 Aug 3:00

Materials and Structure Property Correlations

Department: Mechanical

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. 3:00

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 August 3:00

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.

ME242 August - December 2018 3:00
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 August 3:00

Continuum mechanics

Department: Mechanical

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 January 3:00

Experimental Methods in Microfluidics

Department: Mechanical

Course outcomes:

The class is an elective, aimed at providing exposure to topics that are not usually covered in classes on fluid mechanics, and solid mechanics.

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 3:00

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.

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. 3:00

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. 3:00

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 3:00

Principles of Tribology

Department: Department of Mechancial Engineering

Course outcomes:

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

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 3:00

Finite Element Method

Department: Mechanical

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. 3:00
Topology Optimization

Department: Mechanical Engineering

Course outcomes:

After taking this course, the student would...

Be able to formulate and implement topology optimization of structures and compliant mechanisms

Be able to write sensitivity (gradients) for cost functionals with respect to design variables and shape-changing

parameters

Be able to appreciate the connection between homogenization theory and topology optimization

Become familiar with numerical methods used in topology optimization

Be conversant with the contemporary literature in the field of topology optimization

ME271 Aug-Dec 3:00

Thermodynamics

Department: Mechanical

Course outcomes:

Basic Concepts, Advanced Topics in Thermodynamics, Strengthening of Fundamentals.

ME271 August-December 3:00
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.

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ME283 Aug 3:00

Two Phase Flow and Boiling Heat Transfer

Department: Mechanical Engineering

Course outcomes:

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

ME283 Aug 3:00

Two Phase Flow and Boiling Heat Transfer

Department: Mechanical Engineering

Course outcomes:

Students would learn methods of analysis of two phase flows with and without phase change.

ME284 January 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.

ME285 Aug 3:00

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 3:00
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.

ME293 Jan-18 3:00
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 2:01

Behavioral Science

Department: MS

Course outcomes:

Individual effectiveness and developing better understanding of others

MG 225 Aug 3:00

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 August 3:00

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

MG 286 JAN 3:00

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‚¬cepracticeâ‚¬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.

MG 298 AUG 2:01

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€œgoodâ€• 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€œlaboratoryâ€• course, we will minimize the â€œlecture 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 August-December 3:00

Managerial Economics

Department: Management Studies

Course outcomes:

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

MG202 August-December 3:00

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.

MG221 Aug 2:01

Applied Probability and

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 3:00

Financial Instruments and Risk Management Strategies

Department: Management Studies

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 3:00

Management of Technology for Sustainability

Department: Department of Management Studies

Course outcomes:

Better understanding of the whole issue of "Sustainability" and its critical relevance for future managers and professionals.

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.

Rethinking on depending "profit" alone as business performance to "triple bottom-line"

Methods to synthesize multi-dimensional, hierarchical and quasi-quantitative information.

MR 203 Aug. -Dec. 2017 3:00

Introduction to Biomaterials

Department: MRC

Course outcomes:

Extra lectures by neurosurgeons and prosthodontist by clinicians excite the students into the clinical

relevance of the biomaterials.

MR301 Aug 3:00

Quantum Mechanical Principles in Materials

Department: MRC

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.

MR306 August 3:00

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 3:00

Computational Modeling of Materials

Department: MRC

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 August 3:00

Materials Thermodynamics and Kinetics

Department: Department of Materials Engineering

Course outcomes:

Knowledge of various thermodynamic quantities and their inter-relationships

Thermodynamic origins of phase diagrams, reaction equilibrium constant, equilibrium defects, curvature effects, etc.

Solution to the diffusion equation in simple systems; their implications

Understanding of diffusion mechanisms, and the origin of temperature dependence of diffusion coefficient

MT 256 January 3:00

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 August 3:00

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 January 3:00
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.

MT203 Aug 3:00

Materials Design and Selection

Department: Materials Engg

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 August 3:00

Texture and Grain boundary engineering

Department: Department of 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. 3:00

Diffusion in Solids

Department: Materials Engineering

Course outcomes:

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

MT209 Aug 3:00

Defects in materials

Department: Materials Engineering

Course outcomes:

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

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 3:00

Microstructural Design and Development of Engineering Materials

Department: Materials Engineering

Course outcomes:

- An appreciation for the importance of microstructure on properties of structural materials.

- An overview of the various schemes available to control microstructure

- A survey of engineerign materials and the role of microstructure.

MT225 Jan 3:00

Elevated Temperature Deformation and Fracture

Department: Materials Engg

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 3:00

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 August 3

Transport Processes in Process Metallurgy

Department: Department of 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.

MT248 Jan 3

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 3:00

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

NE-200 Jan. 2

Techical Writing in English

Department: CeNSE

Course outcomes:

Students are expected to be be able to write good sentences, draft abstracts, manuscripts, and thesis chapters

after going through the course.

NE-215 Aug. 3
Applied Solid State Physics

Department: CeNSE

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

NE202 Jan and Aug 0:01
Micro and Nano Fabricaiton Lab

Department: Center for nano Science and Engineering

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 3:00

Advanced Micro and Nano fabrication technology and process

Department: Centre 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 3:00

Semiconductor Devices and IC Technology

Department: CeNSE

Course outcomes:

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

NE222 Aug. 3:00

MEMS: Modeling, Design, and Implementation

Department: CeNSE

Course outcomes:

Understanding of MEMS technology

Multiphysics modelling of MEMS devices

Design of MEMS devices and simulation of response

Understanding of issues in MEMS implementation

NE231 August 3:00

Microfluidics

Department: Centre for Nano Science and Engineering

Course outcomes:

Students will learn to design various microfluidic devices required for tackling real life applications.

NE310 AUG 3:00

Photonics technology: Materials and Devices

Department: Center for nano Science and Engineering

Course outcomes:

A student,

should have gained knowledge of properties of light in dielectric and free space.

should be able to understand optical wave propagation in dielectric medium.

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.

should be able to design optical functions such as, light coupling, wavelength filtering, power splitting,

polarisation rotation, light generation and detection.

should be able to identify suitable material and fabrication process to realise photonic functionalities on-chip.

NE312 Aug 3:00

Nonlinear and Ultrafast Photonics

Department: Centre for Nano Science and Engineering

Course outcomes:

Strong working knowledge in applied nonlinear photonics

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 3:00

Lasers: Principles and Systems

Department: Centre for Nano Science and Engineering

Course outcomes:

Extensive Practical Knowledge in Laser Systems

Ability to analyze laser phenomena and apply it to variety of situtations

Ability to design and build different laser systems such as Fiber Lasers, Solid State Lasers, Optical

communication amplifiers, pulsed lasers

NS201 Aug 3:00

Fundamentals of Systems and Cognitive Neuroscience

Department: CNS

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. 3:00

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 3:00

Topics in Systems and Cognitive Neuroscience

Department: 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. 3:00

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 3:00

Organic Synthesis -II

Department: Organic Chemistry

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 August 3:00

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 Jan 3

Physical Methods of Structure Elucidation

Department: Organic Chemistry

Course outcomes:

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

Organic Molecules.

OC303 Aug. 3:00

Carbohydrate Chemistry

Department: Department of Organic Chemistry

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.

PD205 Aug 2:01

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 2:01

Human Computer Interaction

Department: CPDM

Course outcomes:

· Basic guidelines to design good interface

· Idea of user modelling and interface personalization

· A usability evaluation tool to develop inclusive interfaces

· Conducting usability evaluation and reporting results

· Knowledge about novel interaction technologies

· Knowledge about HCI issues in developing countries and in automotive and aviation environments

· Basic know-how about writing international standards

· A HCI research paper co-authored by students as course project

PD233 Aug 2:01

Design of BioMedical Devices and Systems

Department: CPDM

Course outcomes:

Awareness about medical device classification, regulatory requirements, and principals of bioethics.

A risk-based approach to medical device design and design control.

Working principals of various of medical technologies.

Role of design innovations in the advancement of medical technology.

Working in teams and with clinical collaborators.

Intelligent User Interface

Department: CPDM

Course outcomes:

· Using AI to develop intelligent interface and interaction

· Idea of user modelling and interface personalization

· Exposure to state-of-the-art eye gaze, hand, head and finger movement and EEG trackers

· Developing new input modalities tracking eye gaze, hand, finger, head movement of users

· Hands on training on Expert System and Machine Learning toolbox

· Conducting usability evaluation and reporting results

PH 208 Jan 3:00

Condensed Matter Physics-I

Department: Physics

Course outcomes:

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

PH201 Aug 3:00

Classical Mechanics

Department: Department of Physics, Centre for High Energy Physics

Course outcomes:

The student would learn Lagrangian and Hamiltonian formalisms which are

essential to understand modern developments in physics, like quantum mechanics, field theory, condensed

matter physics, particle physics, etc.

PH202 Jan 3:00

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 3:00

Quantum Mechanics II

Department: course offered by CHEP and Physics

Course outcomes:

various approximation methods used in QM, scattering theory as well as a brief introduction to relativistic

quantum mechanics

PH204 January 3:00

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 August 3:00

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 January 3:00

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 0:04

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 August 3:00

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 3:00

Consensed 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 3:00

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 August 3:00

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 3:00

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 3:00

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 3:00

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.

PH352 Jan 3:00

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. 3:00

Computational Physics

Department: Physics

Course outcomes:

Learn basic programming and applying it to physics problems.

PH359 Jan 3:00

Physics of Nanoscale Systems

Department: Physics

Course outcomes:

Electronic and optical properties of low-dimensional materials.

PH364 Jan 3:00

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 January 3:00

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

RD 209 / BC 210 / MC 211 Jan 3:00

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.

RD 210 January 2:00

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.

SS202 Aug 3:00

Introduction to Quantum Chemistry

Department: SSCU

Course outcomes:

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

SS304 August 3:00

Solar Energy and Materials

Department: Solid State and Structural Chemistry Unit (SSCU)

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.

ST 201   Jan 3:00

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 204 Aug 1:01

Sustainable Energy and Environment lab

Department: Centre for Sustainable Technologies

Course outcomes:

Through this course, students entering CST will get an exposure to various areas of research conducted at the centre which is interdisciplinary by nature.

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 3:00

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-202:   August 3:00

Energy Systems and Sustainability

Department: Centre for Sustainable Technologies

Course outcomes:

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.

Using low carbon energy, creating scenarios using techno-economic studies which could intervene into the policy decisions.

ST213 Jan 3:00

Turbomachines in Renewable Energy

Department: Centre for Sustainable Technologies

Course outcomes:

- Origin of blade shape of different turbomachines operating with incompressible and compressible flows.

- Design under conditions of variability in input fluid and output load

- Specialized design of water pumps

- Renewable energy dynamics in both tur

ST214 Aug 3:00

Mathematical Analysis of Experimental Data

Department: Center 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 JANUARY 2:00

Introductory Physiology

Department: MCBL

Course outcomes:

Learn about mammalian Physiology

UB205 January to April 2:00

Introductory Physiology

Department: Old Physics Building

Course outcomes:

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.

Plant biology- synthesis of various of plant compounds and their importance in the treatment of diseases

UB208 Jan. 2:00

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 0:02

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 August 2:01

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 January 2:00

Thermodynamics and Electrochemistry

Department: SSCU / Undergraduate Chemistry

Course outcomes:

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

UC205 January 2:00

Basic Organic Reactions

Department: Undergraduate

Course outcomes:

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.

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.

UC206 August 2:01

Basic Organic Chemistry

Department: Organic Chemistry

Course outcomes:

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.

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. 2:01

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.

UE 102 Jan 2:01

Electronics and Electrical Engineering

Department: UG

Course outcomes:

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.

In microcontrollers, they write programs to light up an LED, read a temperature sensor and develop programs for a PID controller.

UE204 January 3:00

Elements of Solid Mechanics

Department: UG

Course outcomes:

How to model behaviour of simple structural elements like bars, shafts, beams, pressurised cylindrical and spherical vessels.

Extension of this understanding to study simple trusses and frames.

Gain an understanding of stress, strain, material constitutivity, equations of equilibrium and compatibility, and energy principles.

Felicity to formulate and numerically solve simple engineering problems.

UES 206 Jan 1:02

Experimental Methods in Environmental Chemistry

Department: UG Program

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

UES 302 Aug 2:00

Design Principles in Environmental Engineering

Department: Undergraduate

Course outcomes:

• 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.

• Appreciate the need for multidisciplinary approaches to engineering solutions to environmental problems, and the cross-media (air, water, earth) nature of environmental problems.

• Gain basic knowledge and skills to identify solutions to environmental engineering and understand current issues and the context in which environmental engineering is practiced.

• Appreciate and value the environmental engineering and professional ethics.

UES 310 August 1:02

Experimental Methods in Solid Waste Management

Department: UG Program

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

UES204 January 3:00

Fundamentals of Climate Science

Department: UG

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 January 0:02

Experiments in Biochemistry and Physiology

Department: Undergraduate Program

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.

UM 302 August 2:01

Material Processing

Department: Materials Engineering for UG

Course outcomes:

Students will appreciate polymer processing techniques used for various articles.

UM101 Aug. 3:00
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.

UM101 Aug 3:00

Analysis I

Department: Undergraduate

Course outcomes:

Introduction to analysis

UM201 August 3:00

Probability and Statistics

Department: UG

Course outcomes:

Basic notion of probability and statistical methods.

UMT202 January 2:01

Structure of Materials

Department: UG

Course outcomes:

Basic understanding of structure, microstructure and property correlation in materials

UMT205 Jan 3:00

Mechanical Behavior of Materials

Department: UG Materials program

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. 2:01

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 August 0:01
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.

UP 101 August 2:01

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 2:01

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.

UP203 Jan 2:01

Intermediate Electromagnetism and the Quantum Physics of Radiation

Department: Physics or Undergraduate Sciences

Course outcomes:

The students are expected to understand propagation of light or electromagnetic waves under different limiting

regimes.