

Week 1 (December 8-12, 2025)**Data-Driven Flow Modelling**

Department	Aerospace Engineering
Course Instructor	Professor Aniruddha Sinha
Eligibility	Open to all: UG, PG and PhD
Discipline	Aerospace, Mechanical, Chemical, Civil
Prerequisite	Should have taken a course in Fluid Mechanics, as well as in Engineering Mathematics (including Linear Algebra)
Course Overview	Powered by ever-improving computational resources, Computational Fluid Dynamics (CFD) has become the default tool for understanding and designing fluid flows. However, the huge amounts of data coming out these calculations bedevil the easy grasping of the fundamentals of the flows. It turns out that many flows – even highly turbulent ones – have an innate simple (reduced-order) structure that often affords an intimate, albeit approximate, insight that is difficult to attain directly from CFD data. This course will introduce the student to the tools required to arrive at such reduced-order models using data derived from CFD. Such models allow (a) grasping the essential features of the flow, (b) predicting the flow for 'unseen' parameters and/or times, and (c) flow control. This course allow students to bridge the gap between the simple canonical flows studied in theoretical fluid mechanics and the practical engineering flows computed with CFD.

Microbial Evolution in Health and Biotechnology

Department	Chemical Engineering
Course Instructor	Professor Supreet Saini
Eligibility	Open to all: UG, PG and PhD
Discipline	All branches. Suitable for all who are interested in learning and applying quantitative approaches to problems in health and industry.
Prerequisite	Only a strong interest in learning microbial evolution.
Course Overview	Microbial populations evolve rapidly, driving antibiotic resistance in pathogens, shaping host–microbe interactions, and enabling advances in industrial biotechnology. This one-week course introduces the principles of microbial evolution with a focus on real-world applications. Students will learn how mutations, genetic interactions, and stress environments determine adaptive outcomes, and how evolutionary theory combined with systems biology can help predict and sometimes control microbial change.

Antennas for Next-Gen Wireless Technologies: From Fundamentals to 5G, 6G, and Beyond

Department	Electrical Engineering
Course Instructor	Professor ANIRBAN SARKAR
Eligibility	Open to all: UG, PG and PhD
Discipline	Electronics and Communication, Electrical Engineering, Signal Processing and Communications, Microwaves
Prerequisite	Basic Electromagnetic Theory and Basic UG 1st year Circuit Theory (Not so much needed)
Course Overview	This intensive 5-day course provides a comprehensive understanding of antenna theory, design principles, and applications in modern wireless systems. Beginning with fundamentals of electromagnetic radiation and antenna parameters, the course will gradually cover advanced antenna types and their role in 5G, satellite communication, radar, IoT, and bio-sensing applications. Participants will nicely explore practical aspects of antenna modeling, numerical simulations, and performance evaluation through examples of microstrip, leaky-wave, phased array, and reconfigurable antennas. Special emphasis will be given to emerging trends such as millimeter-wave antennas, AI-driven beam steering, and compact antenna systems for integrated devices. The course, designed for graduate students, researchers, and professionals, blends theory with application-focused case studies, equipping participants with skills to design and analyze antennas for next-generation wireless technologies.

Introduction to Nuclear Engineering and Reactor Physics

Department	Energy Science & Engineering
Course Instructor	Professor Suneet Singh
Eligibility	Senior UG (Third Year and Final Year), PG and PhD
Discipline	Open to all Disciplines
Prerequisite	None
Course Overview	The course “Introduction to Nuclear Engineering and Reactor Physics” provides a strong foundation in the principles and applications of nuclear energy systems. It emphasizes reactor physics, covering neutron interactions, diffusion and transport theory, reactor criticality, kinetics, and control mechanisms. Students study the fission process, various reactor types, moderation techniques, and power generation concepts to understand how design parameters influence reactor behavior and overall performance. Analytical and computational methods are introduced to help learners model neutron behavior in a reactor. By the end of the course, learners gain the ability to analyze and predict reactor statics and dynamics, forming a vital foundation for advanced studies and research in nuclear engineering.

Sustainable Building

Department	Energy Science and Engineering
Course Instructor	Professor Gurubalan Annadurai
Eligibility	Senior UG (Third and Final Year), PG and PhD
Discipline	Students from Mechanical, Electrical, Civil, Architecture, Energy are eligible
Prerequisite	None
Course Overview	The "Sustainable Buildings" course is an interdisciplinary offering that equips participants with the knowledge and skills to design sustainable and energy-efficient buildings. The course aims to enhance a deep understanding of green building principles and sustainable design practices. The course delves into the principles, strategies, and technologies that enable the design of net-zero houses. From passive design techniques that maximise energy efficiency to advanced renewable energy systems such as solar and geothermal, the course will provide a comprehensive understanding of the holistic approach required to achieve net zero status. Through case studies, and simulations, the course will also cover how to integrate sustainable design principles seamlessly into any net-zero projects while meeting the diverse needs of the building.

Waste to Energy

Department	Energy Science & Engineering
Course Instructor	Professor Sandeep Kumar
Eligibility	Open to all: UG, PG and PhD
Discipline	Any Science/Engineering background
Prerequisite	None
Course Overview	‘Waste-to-Energy’ technologies are not only relevant in generating green energy and fuel for various power, transport and industrial/thermal application, but also features as sustainable way in managing the animal, agricultural, industrial and municipal waste towards cleaner environment. The course will discuss about waste categorisation and various waste to energy technologies, including biological, chemical and thermochemical conversion processes, and it’s underlying principles. Course will have (2 + 2) hrs lecture for 5 days and will have interactive lab session and demonstration of few waste to energy conversion systems.

Cognition, Emotion, and Mindfulness

Department	Humanities and Social Science
Course Instructor	Professor Rashmi Gupta
Eligibility	Open to all: UG, PG and PhD
Discipline	Students from any discipline are eligible
Prerequisite	None
Course Overview	Emotion is a fundamental human psychology component that plays a significant role in our lives. Understanding how humans process emotions is important to understanding others' feelings and sensibility. This course applies findings from the interdisciplinary field of neuroscience and the psychological studies of cognition, motivation, and emotion. Basic, complex and social emotions are explored from the perspective of, for example, the subjective experience of emotion, non-conscious processes, and how emotions are interpreted, expressed, or regulated. Affective systems, neural networks, and their relationship to cognitive processes such as attention, learning, memory, and decision-making are addressed. Knowledge of the interaction between cognition and emotion helps create a balanced and harmonious society and is also helpful in technology development and its usage. Given this, it seems only sensible to commit to affect and emotion in human-computer interaction, investigate the underlying principles, study their role, develop methods to quantify them and build applications that use them. In this course, we will also discuss the role of mindfulness meditation in cognitive and emotional processes, which in turn may affect well-being from the scientific lens.

Manufacturing Electric Vehicles

Department	Mechanical Engineering
Course Instructor	Professor Prashant P Date
Eligibility	Open to all: UG, PG and PhD
Discipline	Mechanical, Metallurgical, Electrical, Aerospace
Prerequisite	None
Course Overview	The Course will bring out the different manufacturing technologies for electric Mobility in general. Several conventional technologies need to be made more precise. Tolerances are smaller and this calls for automated production. The major focus will be on manufacture of Batteries (Lithium Ion) and manufacture of motors. The design issues will also be discussed. The third major element is the Chassis. This has to be modified to suit the configuration of the electric vehicle. The course will involve a few short assignments besides the lectures, which will feature developments in EV manufacture.

Nanomanufacturing: Science and Technologies

Department	Mechanical Engineering
Course Instructor	Professor Rakesh Mote
Eligibility	Senior UG (3rd & 4th Year), PG & PhD
Discipline	Mechanical, Materials Science, Electrical, Physics
Prerequisite	None
Course Overview	This course focuses on-hands on activities pertaining to foundations of mechatronics. Students will learn basic constituents of mechatronics system: Sensors, Actuators, Controller and plant. 70% of the course will have laboratory activity where students will learn to sense encoder, to actuate motor, and finally to closed loop control (P, PD) a DC servo motor using a microcontroller (XEP 100). The course would be useful for students interested in robotics, automation, mechatronics, and related areas. Background in digital electronics, and microprocessors could be useful but not required.

Week 2 (December 15-19, 2025)**Coastal-Ocean Resources, Engineering and Management:**

Department	Civil Engineering
Course Instructor	Professor Prof. Gowri Shankar C
Eligibility	Open to all: UG, PG and PhD
Discipline	Open to all Disciplines
Prerequisite	Participants are expected to have full proficiency in English to ensure effective engagement with course materials and discussions.
Course Overview	This interdisciplinary winter school course offers a comprehensive introduction to the principles and practices of coastal-ocean engineering, management and sustainable resource utilization. Designed for students and early-career professionals, the program covers key topics including coastal processes, hazards and their mitigation, ocean resources such as wave/tidal energy/offshore aquaculture, and shore protection measures. Emphasis will be placed on the integration of coastal process-based approaches with environmental and socio-economic considerations for sustainable coastal development. Participants will engage with real-world case studies, lectures from experts, and a detailed exploration on the state of the art open-source numerical models. The course also explores policy frameworks and coastal zone management strategies to address climate change impacts and disaster resilience. By the end of the program, attendees will gain a solid foundation in coastal processes and engineering solutions, preparing them to contribute effectively to research, planning, and decision-making in coastal environments.

Group Testing: An Important Tool for Data Science

Department	Computer Science and Engineering
Course Instructor	Professor Ajit Rajwade
Eligibility	Senior UG (Third Year and Final Year), PG and PhD
Discipline	CSE, EE, Mathematics and Statistics, Operations Research, Data Science
Prerequisite	Exposure to basic algorithms, probability and statistics
Course Overview	Group testing is an area of information theory or data science which involves testing n samples for a defect in an indirect manner: You create $m < n$ pools, where each pool contains a mixture of a random subset of the n samples, and you test the m pools instead of the n individual samples. This helps you save on tests and there are recovery guarantees to obtain the status of the n samples from the results on m pools with good accuracy. Group testing has many applications, including in pooled RT-PCR testing for COVID19. It also has many applications in data science, such as multi-label classification, efficient image classification and near neighbour search.

"Becoming" an Entrepreneur: Leveraging Your University and Local Ecosystems

Department	Desai Sethi School of Entrepreneurship
Course Instructor	Professor Sankalp Pratap
Eligibility	Open to all: UG, PG and PhD
Discipline	Open to all Disciplines
Prerequisite	Should give some credible evidence of interest in entrepreneurship
Course Overview	Economic Development is multidimensional and requires collaboration and contribution from different stakeholders. That said, the present-day scholars of different areas, managers and leaders need to be aware of the development discourse and the political economy associated with it. This course tends to sensitize the future researchers, scholars, leaders and experts of different areas about the meaning and different aspects of development along with the costs as well as the tradeoffs in growth and development in an economy like India. The course also makes them aware about the political economy of development using India as the country in case. Concepts like elite capture, cognitive capture, regulatory capture, rent seeking etc. will be discussed.

Power Electronics: Fundamentals and Practical Design.

Department	Electrical Engineering
Course Instructor	Professor Shiladri Chakraborty
Eligibility	Senior UG (Third Year and Final Year), PG and PhD
Discipline	Electrical Engineering, Electronics & Communication Engineering
Prerequisite	None
Course Overview	Power electronics is one of the key enabling technologies facilitating the efficient conversion and control of electrical power in applications like renewable energy systems, electric vehicles, data centres, etc. This course provides a comprehensive introduction to switched-mode power electronics, focusing on the operation and design of elementary power converter circuits. It begins with a review of key power semiconductor devices and explores the working principles of the half-bridge converters, covering both hard- and soft-switching techniques. Participants will gain a deep understanding of MOSFET datasheets, gate-drive requirements, and various gate-driver circuit topologies. Special emphasis is placed on the effects of parasitic inductances in converter operation and strategies to mitigate voltage ringing through careful gate-drive design, decoupling capacitors, and snubber circuits. The course also highlights best practices in PCB layout to minimize parasitics and enhance electromagnetic performance. By the end of the 5-day course, learners will become familiar with key principles of power electronic circuits and will be equipped with the practical knowledge required to design practical, robust switched-mode power converters.

Continuum Mechanics

Department	Mechanical Engineering
Course Instructor	Professor Amit Singh
Eligibility	Senior UG (Third Year and Final Year), PG and PhD
Discipline	Mechanical, Mathematics, Aerospace, Mechanical, Chemical, Physics, Material Science, Civil, Bioscience
Prerequisite	Basic understanding of algebra and calculus
Course Overview	Mechanics based upon concepts of time, space, matter, force, deformation and energy is the study of the equilibrium or motion of matter. Continuum mechanics is the determination of the internal condition of the continuum material body in response to external forces and energy sources. This course presents an introduction to the classical theory of continuum mechanics. The objective of the course is to make students familiar with vector and tensor algebra, kinematics, balance laws, constitutive relations and applications of continuum mechanics to problems of solids.

Political Economy of Development: Indian Experience

Department	School of Management
Course Instructor	Professor Ashish Singh
Eligibility	Open to all: UG, PG and PhD
Discipline	Open to all Disciplines
Prerequisite	None
Course Overview	Economic Development is multidimensional and requires collaboration and contribution from different stakeholders. That said, the present-day scholars of different areas, managers and leaders need to be aware of the development discourse and the political economy associated with it. This course tends to sensitize the future researchers, scholars, leaders and experts of different areas about the meaning and different aspects of development along with the costs as well as the tradeoffs in growth and development in an economy like India. The course also makes them aware about the political economy of development using India as the country in case. Concepts like elite capture, cognitive capture, regulatory capture, rent seeking etc. will be discussed.