
1) Applied Aeroacoustics,
Department of Aerospace Engineering; Dec 4-8th 2023

Eligibility: UG, PG, PhD

Background: Aerospace/Mechanical/Civil/Chemical Engineering students with strong background in Fluid Mechanics and Engineering Mathematics

Aeroacoustics is the study of flow-generated sound. Examples include the sound of turbulent flow behind a car's side-view mirror that may be heard within the car, the noise made by the turbulent exhaust of a jet engine, the sound generated by a helicopter's rotor in hover, etc. This is somewhat removed from classical acoustics that dealt with sound generated by a vibrating solid surface in otherwise quiescent air (as in musical instruments). In this course, you will receive an introduction to the governing equations of aeroacoustics. In parallel, we will do an exercise in spectral analysis of microphone signals recorded in the far field of a jet, to get a feel for practical aspects. We will then look at the sources of sound, and ways of modelling them. In parallel, we will do study computational aeroacoustics tools that can predict how sound travels from such sources to various observers. Finally, we will look at Lighthill's acoustic analogy for reformulating Navier-Stokes equations to a forced acoustic wave equation, as well as the famous Ffowcs-Williams Hawkins (FWH) method of propagating flow solutions found by computations to distant observers. Our testbench will be the computational solution of a supersonic jet whose sound field we will predict. This will close the loop with the initial spectral analysis of microphone signals that were measured in its experimental counterpart as a validation exercise.

2) Applied Statistical Methods and Data Analysis,
Centre for Technology Alternative for Rural Areas; Dec 11-15th 2023

Eligibility: PG, PhD

Background: BTech/BS/MTech/MS/PhD/MSc

This one-week capsule course, "Applied Statistics and Data Analysis Essentials," is designed to equip students with the fundamental skills necessary for harnessing the power of statistics in various fields, such as engineering, agriculture, social sciences, and medicine.

Course Objectives:

- Evaluate the appropriateness of statistical analyses, results, and inferences to understand research and interpret data in applied settings.
- Select the correct analysis technique for new research, ensuring that the chosen method aligns with the research objectives.
- Interpret the results effectively, providing valuable insights and recommendations.
- Utilize statistical results as part of a larger critical thinking process to make informed decisions.
- Effectively communicate statistical findings in their theses, research papers, and manuscripts.
- Gain hands-on experience in using statistical software, including MINITAB and R, to conduct data analysis.

3) *Becoming' an Entrepreneur: Leveraging Your University & Local Ecosystems*

Desai Sethi School of Entrepreneurship, Dec 4-8th, 2023

Eligibility: UG, PG

Background: All backgrounds are welcome

Entrepreneurship goes beyond the idea of establishing a VC backed scalable startup, to roles like a social innovator or an intrapreneur in a large organization. It is increasingly being understood that the seeds of entrepreneurship must be sown early on, for individuals to harvest its benefits as they move from one destination to another in their respective careers. Countries like India have already embarked on the path of embedding innovation and entrepreneurship programs for school going students, and many economies are investing heavily towards activating undergraduate and post graduate students' entrepreneurial energy through a combination of incubation centres and other entrepreneurship support organizations. Apart from the overall economy benefiting from such movements, a key beneficiary of this trend is the young undergraduate / post-graduate student. Students can now leverage entrepreneurship support systems and resources, even as they continue their undergraduate / post -graduate studies, to learn and activate their entrepreneurial identity. This course would provide relevant inputs in form of practices and decision-making frameworks which young students can understand and adopt in their quest towards building an entrepreneurial identity independent of whether or not they wish to create a new venture during the period of their college education. Having an entrepreneurial identity and related skill sets is known to create opportunities for the individual across domains and across time, apart from the possibility of creating a new venture should the circumstances afford such a possibility.

4) *Climate Change and Climate Solutions,* **IDP Climate Studies; Dec 4-8th 2023**

Eligibility: UG, PG, PhD

Background: Anybody

Climate change affects all aspects of lives and livelihoods, agriculture, water, energy, health, transportation, industries, and national security. This course is a brief introduction to Climate Science, Climate Change and Climate Solutions needed to tackle the Climate Change Risks. Introduction to energy balance, drivers of global warming, consequences and impacts at local scales, and potential future risks are discussed.

5) *Combustion in Automobile and Gas Turbine Engines,* **Department of Mechanical Engineering; Dec 4-8th 2023**

Eligibility: PG

Background: Any students from Mechanical Engg or Energy or Aerospace Engg, having basic knowledge of thermodynamics.

This topic covers basics of Combustion, Thermodynamic-Cycles and combustion related to IC engines, Thermodynamic-Cycle and Combustion in Gas Turbine engines. If time permits emission in IC engines will be covered.

6) Computational Heat Transfer and Fluid Flow,
Department of Aerospace Engineering; Dec 11-15th 2023

Eligibility: PG

Background: Mechanical, Aerospace

In this course the following topics will be covered: Mathematical representation of fluid flow and heat transfer

- Segregation of heat transfer modes
- Derivation of governing equations
- Discretisation method
- Control volume formulation
- Conduction (steady and transient)
 - Application (steady state)
 - Application (transient)

Convection schemes (central, upwind, higher order schemes)

- Application (Advection diffusion equation)

Analysis of laminar boundary layer flow and heat transfer

- External flows – forced flow
- Internal flows – forced flow
- External flows - natural convection

Modelling of turbulent flows

- Modelling approaches
- One-equation models
- Two-equation models
 - Application (Flow over air foil, jet flow modelling)

This course will make significant use of CFD software 'Ansys-Fluent' and gives students a working knowledge of the software for solving few common heat transfer and fluid flow problems. Course participants should have access to either 'Ansys-Fluent' Student version or Academic version, either installed on their laptops/PCs or have access to a machine on which the software is installed.

7) Fluorescence spectroscopy & microscopy: Fundamentals & Applications;
Department of Chemistry; Dec 11-15th 2023

Eligibility: UG, PG, PhD

Background: Any branch of Science and Technology, with an interest in spectroscopy

Fluorescence spectroscopy and microscopy is widely used in academic research as well as in industrial R&D. The areas of application span Chemistry, Physics, Materials Science, Biology and Medicine. Given the diverse background of the users of these techniques, there is often a lack of understanding of the basic process involved, leading to incomplete and sometimes incorrect interpretation of data. This is the issue that the course seeks to address, through lectures as well as hands on sessions, with equipment available in the institute: Steady state spectrophotometers, Time Correlated Single Photon Counting (TCSPC) spectrometer, Femtosecond Optical Gating (FOG), Fluorescence Lifetime Imaging (FLIM) and Fluorescence Correlation Spectroscopy (FCS).

8) *Fundamental Statistics for Risk Analysis of Climate & Geo-Hazards*
Department of Civil Engineering; Dec 4-8th 2023

Eligibility: UG, PG, PhD

Background: Some background of probability and statistics and basic maths/calculus is necessary.

A good understanding of fundamental concepts in statistics is necessary for risk analysis of climate and geo-hazards. Data in this domain vary across space and time. In this course, learners will get an opportunity to learn such fundamental concepts as i) Introduction to data and modelling, representation of climate and geo-hazard data, ii) Introduction to risk and uncertainty assessment, iii) Probabilistic characterization of hazard, iv) Basic concepts of probability, v) Random variables and probability distributions, vi) Statistical parameter estimation and hypothesis testing, with details on Maximum Likelihood method, vii) Parametric and Non-parametric uncertainty in estimation, viii) Extreme Value Analysis, ix) Causal models - linear regression, x) Implementation of concepts discussed in cloud-based (open-source) Python programming environment.

9) *Introduction to Carbon Sequestration,*
Department of Earth Sciences, Dec 4-8th 2023

Eligibility: UG, PG PhD;

Background: Students of any background can join, but kindly note that the course will focus on geological issues. The instructor will cover introductory facts aimed for the beginners.

Storage of CO₂ in geological formation has received global attention across the scientific disciplines. In this course we will introduce this concept for the beginners who have no prior idea on this subject. Several Indian examples will be provided in the lectures. Science, technology, policy etc. will be touched and the thrust will be on geological issues.

10) *Introduction to Mechanobiology,*
Department of Chemical Engineering; Dec 11-15th 2023

Eligibility: PG PhD;

Background: Any stream of biology, Chemical, Mechanical Engg.

The course will cover the following topics:

- Introduction to Mechnobiology, applications and importance in normal and pathological conditions.
- Introduction to Cytoskeletal elements: Structure of actin, microtubule, intermediate filaments.
- Cell membrane: description of bi-layer structure, membrane tension, Laplace's equation.

- Mechanobiology techniques: micropipette aspiration, micro fabrication and micro pillars, microcontact printing, making substrates of different rigidities, atomic force microscopy (AFM), Traction force microscopy (TFM).
- Mechanobiology of Cell migration.
- Mechanism of mechano transduction; ion-channel, stretchy proteins, Tensegrity model and nuclear deformation.
- Clutch model for rigidity sensing.
- Mechanobiology of Diseases

11) Life Cycle Assessment: Introduction and Engineering Applications
Department of Environmental Science & Engineering, Dec 11-15, 2023

Eligibility: UG, PG PhD;

Background: This course can be attended by any student, researcher or anyone who is interested to learn about LCA and does not require any pre-requisite as the course will start from the basics of LCA.

The course shall consist of following modules:

- I. Understanding the Concept of LCA
- II. Understanding of Consequential and Attributional LCA
- III. Understanding of Life Cycle Inventory
- IV. Understanding of Life Cycle Impact Assessment Methods
- V. Getting Started with LCA for Experts (formerly GaBi)
- VI. LCA for Experts Modelling Principles
- VII. Various Case Studies on Engineering Applications

12) No-Code Artificial Intelligence tools for Academic Research,
IDP in Educational Technology; Dec 11-15th 2023

Eligibility: PG, PhD

Background: Anyone doing Research. Computer proficiency preferred. Open for all

At the end of this course, the participants will be able to: a. Know how to perform Systematic Literature Review (SLR) using No Code AI tools for academic research. b. Get an overview of No-Code AI tools for SLR c. Develop a framework for doing SLR using No-Code AI tools.

13) Power Electronics for Electric Vehicle Charging,
Department of Energy Science and Engineering; Dec 4-8th 2023

Eligibility: UG, PG, PhD

Background: Electrical Engineering/ Electronics Engineering/ Energy Engineering

There adoption of electric vehicles (EVs) is increasing globally because of environmental concerns arising from green-house gas emissions. Development of suitable charging infrastructure is one of the major challenges being faced. This course on “Power Electronics for Electric Vehicle Charging” begins with a brief outline on various EV charging techniques including AC vs DC charging, levels-1,2 and 3 of charging, slow and fast charging. Relevant protocols and standards for charging and connectors will also be discussed. Moreover, the

operating principle, modulation, design and analysis of various power converter topologies (for both AC-DC and DC-DC conversion stages) currently being used for EV applications, will be discussed in detail. Some of the front-end power factor (PFC) correction topologies include diode bridge rectifier with boost PFC, interleaved boost PFC converter, bridgeless boost PFC and totem pole PFC circuits, while the battery charging DC-DC converters include phase-shifted full bridge converter, dual active bridge converter and LLC resonant converters. Subsequently, the technology of integrated on-board chargers (IOBC) for different motors including induction motor and permanent magnet- based motor drives will also be dealt with as a part of this course.

14) RF Transistor Devices and Technology: From Materials to Microwave ICs on Gallium Nitride,
Department of Electrical Engineering; Dec 4-8th 2023

Eligibility: UG, PG, PhD

Background: Basic Electron Device Physics Understanding

High-speed and high-power RF transistors are critically important for communication applications, including Satellites, Radars, and 4G/5G/6G applications. The frequency ranges from 1-100 GHz with an RF power output of 2-200 W. Gallium Nitride (GaN) has been identified as the material of choice and found its place in every domain of RF applications. Several technological advances are involved in this technology, which can convert a simple GaN heterostructure to an RF circuit. This course will introduce a step-by-step approach to walk the students through the basic understanding of these devices and explain GaN as a material, device design, device fabrication, device characterization, modeling, IC design with passives, layout, and IC fabrication. At the end of the course, the students will understand the basics of each step and a good knowledge of the ingredients that go into this technology. At the end of the course, the students should be able to chalk out a path to realize an RF circuit of their choice.

15) Waste to Energy - Sustainable Waste management
Department of Energy Science and Engineering; Dec 11-15th 2023

Eligibility: UG, PG, PhD

Background: Any student with Science/Engineering background

'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 thermo-chemical 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 wastes to energy conversion systems.

16) Yoga & Positive Psychology for Managing Self & Organizations,
Shailesh J. Mehta School of Management; Dec 4-8th 2023

Eligibility: UG, PG, PhD

Background: Open for all branches and specialization

Management is commonly understood as getting maximum returns from the available resources to achieve valuable objectives. Management involves managing money, material, machine and men. While first three factors can be managed in objective manner when it comes to managing ‘men’ it is essentially managing ‘minds’. To manage or lead minds of others a manager needs to manage his or her own mind. Managing mind which can also be termed as managing ‘self’ requires systematic reflection on ‘self’. The course is weaved around the methods of strengthening of physical, emotional, intellectual aspects of ‘self’ based on the principles and practices of Yoga and Positive Psychology. This course also entails the insights from the fields of yoga and mindfulness for the development of organizations and institutions.

17) Policymaking in AI and Data,
Ashank Desai Centre for Policy Studies; Dec 4-8th 2023

Eligibility: PG, PhD

Background: Students with background in computational or social sciences with interest in AI, governance, public policy, and political economics

This course is an interdisciplinary introductory course for policymaking around AI and Data. It will bring the student up to scratch with the international landscape of extant policymaking on AI, the frameworks being used, their strengths and weaknesses, as well as make certain they learn the basic concepts, digital and philosophical, of AI, machine learning, and data. The course will also make the student conversant with the basic theory around data policy and governance structures as they exist in India and worldwide, and the ongoing debates on the same. By the end of the 20 hours course, the student would have learnt a basic amount of what AI technologies are and aren't, how data interacts with them, how they influence and are influenced by the human society, and why/how national and international actors design policy around them. Students with a background in technology but wishing to learn the social impact of AI, or conversely with a background in the social sciences wishing to understand the technology of AI, along with students of public policy and related areas will be benefited from this course.