

Week 1 (June 23-28, 2025)

1) Unmanned Aerial Vehicles - A Technological Perspective

Department	Aerospace Engineering
Eligibility	Senior UG (3rd & 4th Year) from Aerospace, Mechanical, Physics
Prerequisite	None
Course Overview	In the last two to three decades, Unmanned Aerial Vehicles (UAVs) have established themselves as important technological tools for many military and civilian applications. These include; aerial attacks, aerial package delivery, crop monitoring and spraying, surveillance in outdoor and indoor spaces, assistance in disaster relief efforts as part of overall search and rescue missions, aerial photography/videography of public and private gatherings including sporting events, etc. This has also led to the evolution of an ecosystem that includes government agencies, large, medium, and small industries, including startups, that are currently engaged in the design, development, and deployment of different types of UAVs. The proposed course aims to expose students to the various technological inputs that contribute to the design, development and deployment of UAVs and aims to prepare them for taking up further studies / challenges in this critical field of aerospace engineering

2) Application of Biostatistics in Medical Research and Health Care

Department	Biosciences and Bioengineering
Eligibility	Only PG and PhDs. Students from any engineering/medicine department engaged in biomedical/clinical research
Prerequisite	Knowledge of mathematics at 10+2 level
Course Overview	Proposed course would cover how biostatistics help answer pressing research questions in medicine, biology, and public health. This would cover various diverse examples from healthcare sector to emphasize how biostatistics principles/tools are deeply involved in the design, analysis, and interpretation of data for research in public health and medicine.

3) Continuous Process Intensification: Flow, Electro and Mechano Organic Chemistry

Department	Chemistry
Eligibility	UG Students from Chemistry, Chemical Engineering, Materials Science, Nanomaterials
Prerequisite	Basic understanding of chemistry and passion for chemical/materials manufacturing
Course Overview	Continuous process intensification is the future of chemicals and materials manufacturing. It provides sustainable, economical and safe alternative to batch production which has been in practice for last 200 years. Continuous process enables synthetic processes which are reproducible, small and modular footprints, allow on demand production, chemistry in new space. In fact, these processes allow one to carry out synthesis without chemicals (Electro organic synthesis) and also without solvents (Mechano chemistry). Therefore, it is important for everyone working in the domain of chemical and materials synthesis to learn and art and science of continuous process intensification.

4) Strategic Multi-agent Artificial Intelligence

Department	Computer Science and Engineering
Eligibility	UG Students from Computer Science, Mathematics, Operations Research, Electrical Engineering, Economics
Prerequisite	formal mathematical reasoning, a fair amount of probability theory, basic calculus! experience in programming will be useful.
Course Overview	This course explores Algorithmic Mechanism Design, the reverse engineering of Game Theory, focusing on strategic interactions among multiple self-interested agents. The course starts with desired social objectives—such as efficiency, fairness, and stability—and examines whether they can be achieved through algorithmic methods. It also addresses algorithmic challenges in designing such mechanisms efficiently or approximating them when exact solutions are impossible. To ensure a solid foundation, the course begins with game theory fundamentals before delving into mechanism design. Key areas discussed will include auctions, fair division, and stable matching, with applications to sponsored search advertisements, resource allocation, crowdsourcing, and internet-based trade. This course will be valuable for students across Computer Science, Economics, Mathematics, Operations Research, Management Science, and Electrical Engineering, equipping them with essential tools to model, analyse, and design strategic interactions in multi-agent environments.

5) High-frequency Magnetics for Power Electronics

Department	Electrical Engineering
Eligibility	Senior UG (3rd & 4th Year) from Electrical Engineering
Prerequisite	None
Course Overview	<p>Modern power electronic converters, driven by wide-bandgap semiconductor switches, operate at increasingly higher switching frequencies, potentially enabling compact converters with smaller magnetic components. However, leveraging these benefits requires a deep understanding of high-frequency magnetics, loss mechanisms, and parasitic effects. This course will cover both the fundamental and advanced aspects of high-frequency magnetics. A tentative schedule is as follows: Day 1: Explanation of fundamental loss mechanisms in high-frequency windings (skin, proximity effects) and cores (hysteresis, eddy currents) and principles behind the origin of leakage and magnetizing inductance, capacitance, etc., leading to magnetic equivalent circuits. Day 2: Analytical formulations like Dowell's equations, aiding in designing low-loss windings (foil, Litz wire). Day 3: State-of-the-art empirical core loss models, including Steinmetz-derived formulations. Day 4: 2D FEA simulations for estimation of losses and magnetic circuit parameter values. Day 5: Overview of advanced technologies such as planar and integrated magnetics, magnetic cooling.</p>

6) Financial Derivatives Pricing

Department	Mathematics
Eligibility	Senior UG (3rd & 4th Year) with mathematical background
Prerequisite	Linear Algebra, Real Analysis or a good level of Calculus, and Probability.
Course Overview	<p>This course provides a mathematically rigorous introduction to the pricing of financial derivatives, focusing on risk-neutral valuation, the binomial model, and the Black-Scholes framework. Participants will learn fundamental concepts of derivatives markets, arbitrage pricing, and stochastic models used in financial engineering. The course balances theoretical foundations with practical applications, including computational techniques for pricing options. By the end of the course, participants will have a strong understanding of core pricing models and the ability to apply them in various financial contexts.</p>

7) Foundations of Mechatronics: Hands-on

Department	Mechanical Engineering
Eligibility	Senior UG (3rd & 4th Year), PG & PhD from All engineering and technology branches permitted
Prerequisite	background in binary, hexadecimal number representation and arithmetic, basic C programming, basic electricity,
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.

8) Introduction to Observational Astrophysics

Department	Physics
Eligibility	UG students from Any science or engineering departments
Prerequisite	Knowledge of 1st year physics, basic calculus, familiarity with computers
Course Overview	<p>This course provides a comprehensive introduction to observational astronomy for undergraduate and graduate students. The course delivers a structured curriculum covering fundamental astronomical concepts including life cycle of stars, stellar classification, transient and variable astronomical phenomena, as well as technical concepts of coordinate systems, photometry, optical telescopes, cameras. The five-day program consists of daily three-hour lectures supplemented by one-hour hands-on tutorials designed to reinforce theoretical concepts through practical application. Participants will gain proficiency in essential astronomical techniques including observations, image processing, and photometric analysis.</p> <p>A notable component of the course includes scheduled sessions utilizing the GROWTH-India Telescope, providing students with exposure to robotic telescope operations within a controlled educational environment. This practical experience enables students to apply classroom knowledge to actual observational procedures.</p>