GALGOTIAS COLLEGE
OF ENGINEERING & TECHNOLOGY

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Department of
Electronics & Communication

About ECE Department

The Department of ECE offers B.Tech Electronics and Communication Engineering courses from Dr. A.P.J. Abdul Kalam Technical University, (formerly Uttar Pradesh Technical University/Gautam Buddh Technical University) Lucknow. Electronics & Communication Engineering deals with electronic devices, circuits, and communication equipment like transmitters, receivers, and integrated circuits (IC). Microprocessors, satellite communication, microwave engineering, antenna and wave propagation. The department aims to impart high-quality education in ECE and conduct top-notch research in ECE-related fields.

The department provides state-of-the-art infrastructure and computing facilities to students and faculty. The faculty members are actively involved in different domains of research with a special focus on four thrust areas:

1. Wireless Communication and Networks
2. Microwave and Antennas,
3. VLSI Design
4. Communication Systems
5. Signal and Image Processing.

The department has regular hardware and software labs as well as state-of-the-art research labs in microwave and antennas, where faculty and students are working on funding projects and offering consultancy services. Some of the available software in the ECE department are MATLAB, HFSS, ns-2, ns-3, Riverbed Academic edition, OrCAD PSPICE, eSim, SCILAB, OR-Tools, Expeyes, etc. The Department follows a well-proven pedagogy of sharing knowledge with the young and vibrant minds of the college. As we are affiliated with AKTU University, Lucknow, the curriculum and subjects are prescribed by AKTU University. In addition to instruction in core ECE subjects, we also teach elective subjects in advanced topics such as Voice over Internet Protocol, Filter Design, Digital Image Processing, Digital System Design using VHDL, Speech Processing, Advance Digital Design using Verilog, Microcontroller for Embedded Systems, etc. The department imparts world-class training and research besides promoting active industry-institute collaboration by identifying current trends and taking part in sponsored research projects and consultancy services. The department also has a worldwide reach with its vibrant alumni network. Working shoulder by shoulder-with the institution, it is constantly aiming towards reaching greater heights to serve the needs of society and meet the aspirations of the student community.

Vision of Institute

To be a leading educational institution recognized for excellence in engineering education and research producing globally competent and socially responsible technocrats.

Mission of Institute

IM1: To provide state-of-the-art infrastructural facilities that support achieving academic excellence.

IM2: To provide a work environment that is conducive for professional growth of faculty and staff.

IM3: To collaborate with industry for achieving excellence in research, consultancy and entrepreneurship development.

Vision of Department

To be recognized as a center of excellence in Electronics and Communication Engineering for the quality and global education, interdisciplinary research and innovation, to produce committed graduates who can apply knowledge and skills for the benefit of society.

Mission of Department

DM1: To provide quality education by providing state of the art facility and solutions for global challenges.

DM2: To provide a framework for promoting the industry-institution collaboration and empower the students in interdisciplinary research.

DM3: To transform students into socially responsible, ethical and technically proficient engineers with innovative skills and usage of modern tools.

DM4: To make the students corporate ready with spirit and necessary interpersonal skills.

Program Outcomes

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, review 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 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 and 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.

Program Specific Outcomes

By the completion of Electronics & Communication Engineering program the student will be able to:

PSO1: Design and develop models for analog & digital electronic circuits and systems.
PSO2: Design, develop and test electronic and communication systems for applications with real Time constraints.

Program Educational Objectives

PEO 1	Graduates will excel in their career by acquiring knowledge in the field of Electronics and Communication Engineering with the usage of modern tools and emerging technologies.
PEO 2	Graduates will have the capability to analyze real life problems of the society and produce innovative solutions.
PEO 3	Graduates exhibit professionalism, ethical attitude, communication skills and teamwork in core engineering, academia and research organizations through professional development and lifelong learning.

ARTICLE: 1 DATA - THE NEW GOLD

Yes, you read it right, "DATA IS THE NEW GOLD", this piece of writing talks about a thing, which has become the most precious thing in the world so much so that it is as exquisite as some of the most valuable resources in our world. Over the years, gold, oil etc. have been regarded as the most valuable assets of this world but now it has all been replaced by a new entity called DATA. The arrival of computers, and machines and the subsequent rise and advancement of the internet have fabricated a human dependence on technology. The top titans of Silicon Valley like Microsoft, Google etc. know more about our day-to-day interaction with devices than we ever will. This industry is collecting gigantic amounts of data from millions of users every day.

Data is a very general term, it can be anything related to information about something, like for example the name of a person or his or her address can be regarded as data. So basically data is a set of characters that has been rendered into a form that is efficient for movement, processing and communication. Data can be as small as one bit or as large as millions of terabytes. In the computing world, data has massive importance and usage. So much so that a new derivative has branched out from data known as BIG DATA due to its massive utilization by companies all over the world. Big DATA is data in the form of a petabyte range or even larger than that. It has gained a lot of prominence over time and is used by huge multinationals for giving out good products. People all over the world are using products made by Silicon Valley, for example use of Google maps. People use Google Maps for navigation and knowingly or unknowingly share their current location data with the company. Then a combination of data from other users is used to create specific traffic patterns which suggest which route is faster and which one is slower. This inter-combination of data enables Google Maps to function efficiently. Along with this, YouTube is another example of the versatile use of data, where the user's video preferences are based upon the search history, trending videos, location etc. This also helps in boosting advertising which is a major source of income for these companies, as data helps anticipate user behaviour and targets customers involved with the respective product. Data availability and accessibility have massively transformed mankind's interaction with technology. Smartwatches would not have existed without the availability of data related to a user's behaviour, location parameters etc. We wouldn't be able to make weather predictions, stock-market performance analysis etc. without the use of data. Data conceptualisation, processing and visualisation are the most proficient ways to convey an anecdote and give out facts in a way that encapsulates mankind's curiosity.

ABHINAV VERMA
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ARTICLE: 2 Microwave Photonics

After the invention of the laser, some visionaries thought about future high-speed communication in the 1960s and saw photonics as a possible alternative to microwaves. For terrestrial telecommunication, it was not clear to the researcher as to which one of these two technologies would prevail. However, it was very much clear at the time; that the two technologies were complementary to one another in many aspects.

So, it was not surprising that these two technologies would overlap and combine to form an interdisciplinary subject called "microwave photonics". Over the years microwave photonics gained technical maturity and evolved significantly. Microwave photonics combines technologies that are developed for both optical parts of the spectrum and microwave. From a historical point of view, it is seen that an ample number of examples of simple optical communications have been present since ancient times. These depended on the vision of humans to notice signals, such as the semaphore visual telegraph codes generated by Chappe's optical telegraph created during the French Revolution. Optical communication was suppressed by the subsequent appearance of the electrical telegraph almost a century later. Transatlantic telegraph cable was first commercially and successfully installed in 1866. Before the publication by Kao and Hockham, it would take another century to use optical communication techniques.

In the 19th century, in addition to the telegraph, research on wireless communication had also begun, despite the invention of the photophone (a telecommunications device that allows transmission of speech on a beam of light) by Alexander Graham Bell and Charles Sumner Tainter in 1880. It was the first demonstration of open space communication linkage, in which the light beam's intensity modulation was done at the transmitter, and the modulated light was converted in the RF domain at the receiver end. This technique was employed for telephone transmission.

Eventually, radio techniques for wireless transmission prevailed over optical techniques, and this domination continued ever since. Chandra Bose in the 1890s recognized the advantage of higher frequencies and invented the mm-wave transmission. During the 2nd World War, researchers started working in the microwave domain and invented the radar. In satellite communications and radar systems, vacuum tubes were an important component of microwave electronics. Now, CMOS technology dominates over microwave circuits. Complex and compact circuits required for satellite navigation receivers and mobile communications are possible because of microwave monolithic integrated circuits development.

In the beginning, researchers working in the microwave photonics field were only focused on defence applications. But recently this field has been expanded beyond defence applications, including medical imaging, wireless communication, satellite communication, cellular, optical signal processing, cable television and distributed antenna systems. All these applications require large bandwidth, high speed and increasing value of dynamic range. Simultaneously, low-power and lightweight devices are also required.

Mr. Hitesh Gupta
Asst. Prof./ECE/GCET

ARTICLE: 3 Internet of Things

The term IoT might have been coined but technological advancements are trying to fast catch up with what viewers have been promised by sci-fi movies for a while. A potential concept that has gained massive traction and can assist in bringing about enhancements in varied aspects of life using programmed machine intelligence and adaptive learning capability is the Internet of Things (IoT) a couple of decades ago, but interest in endeavouring fields with similar goals have been around for a while.

IoT is about interconnecting devices of the physical world within the prevailing internet infrastructure using assorted sensors to manipulate existing robust functioning and extrapolating ways to improve throughput while shortening response time, without human-to-machine or machine-to-machine interactions. Many leading entrepreneurs believe that with IoT, the physical world is becoming one big information system and it can fundamentally change the way businesses function.

It works by assigning an IPv6 address to all the components of the real-world (primarily electronic real world (primarily electronic components). In an attempt to broaden the horizons of the concept of IoT, the capacity of IP addresses has been increased enormously. The functioning is then monitored using ubiquitous sensing elements present all over the unit. Sensors send feedback at regular intervals over a secured network to provide real-time functioning of that object while also registering anomalies. These data collected over some time can then be processed to triangulate methods of enhancing performance. An added benefit of this system is that manufacturers can recognize a malfunction in a unit present with a consumer in any part of the city. The particular malfunctioning part can also be meticulously found, and the manufacturer can then fabricate that part beforehand and effectively eliminate delays in maintenance.

 IoT has the potential to bring about advancements in the healthcare sector, construction management and transportation systems and energy efficiency in a manner never seen before. It can also be greatly employed in farming practices to evolve it to the level of precision farming. Data collected over a period can help in determining precise weather conditions for a particular crop to flourish and process this along with the meteorological department's predictions to remotely provide all relevant information. A drone can then be employed to perform the task. Determining the quantity of water supply, manure and other relevant stuff will become more sophisticated, timely and precise.

Shashank Shukla

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ARTICLE: 4 WHY QUANTUM COMPUTING?

"Quantum Mechanics: Real black magic calculus."
-Sir Albert Einstein

As we know classical computers are based on the classical law of Physics so they aregood at simulating problems based on the classical world but if you try to simulate the quantum mechanical models or models based on the General Theory of Relativity or quantum gravity models it becomes nearly impossible for a classical computer to compute them. So, we need computers that are based on quantum Physics to do this kind of job. When our calculations involve large numbers then also, we need quantum computers.

Let me give you an example –Suppose I have two different big prime numbersof the order 10^{50} called p and q which are unknown to you I multiply them and giveyou a number N (N=p*q) and I ask you to find the numbers p and q. As they were the prime numbers they will be unique and one number will be less than $\sqrt{N}$ and the second one will be greater than $\sqrt{N}$. So, if you try to solve this problem on a classical computer then you don't have any other option than the **Brute force search method.**

You have to run a for loop till $\sqrt{N}$ and check whether N is divisible by it or not. But this is just a flaw! Because it costs you 1 sec to execute a for loop 10^8 times, it will take 100 sec for 10^{10} iteration and you have to go all the way up to 10^{50} which will cost more than **TheAge of The Universe! (100*10^{40} secs).** We just need a real quantum device which canrun these algorithms and people are trying very hard to make effective quantum devices. You might ask why we need to do the factor of such a large number. This factorization problem is assumed to be a solvable problem so many big companies like Amazon, Google have their encryption technique based on this problem.

Abhishek Upadhyay
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ARTICLE: 5 MIMO Communication Systems Design and Challenges

Wireless standards are always evolving to be able to provide higher data rates to mobile users to enhance their multimedia experience. According to the famous channel capacity formula, this can be achieved either by increasing the transmitted power to enhance the signal-to-noise ratio (SNR) level or by providing wider bandwidths. Both of these metrics are usually difficult to change because of the regulations on power transmission levels from various wireless terminals to avoid interference with other equipment, and because bandwidth is very expensive to buy in a crowded spectrum allocation. One way to overcome this limit is to use multiple antenna systems at the mobile terminal as well as the base station.

Multiple-input-multiple-output (MIMO) technology has become an integral part of wireless systems nowadays. This technology depends on the use of multiple antenna elements at the mobile terminal as well as the base station. The design of compact printed MIMO antenna systems is a challenging task especially when it is made for small-factor mobile terminals. The introduction of MIMO brought with it several performance metrics and measurement methods to allow the designer to gauge the performance of his antenna system in real environments.

Dr. Madan Kumar Sharma
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