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Department of Electronics & Communication

Chief editor : Dr. Lakshmanan M (Prof. and Head, ECE Dept)
Faculty Editor : Mr. Shivam Gupta (Asst. Professor)
Student Editor : Shiven Pandey
Somica Pathak

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 team work in core engineering, academia and research organizations through professional development and lifelong learning.

ARTICLE: 1 SMART SOIL MONITORING SYSTEM FOR SMART AGRICULTURE

Smart Soil Monitoring System for Smart Agriculture: Accurate and timely information is crucial to optimize resources. Sensors determine clay, organic matter, moisture, and nutrients of soil. Sensors at various locations are connected using different technologies. Its data will be automatically reported to the cloud without any internet connection. Sensors broadcast data to local base stations (LBS) at different ranges of distances using WiFi, LoWAN, LoRa, Bluetooth etc. and then to the central base station (CBS) which is far away. Modulation, coding techniques and Line of Sight keep the signal intact. Data from CBS goes to the cloud for analysis, visualization and trend analysis. This helps farmers get frequent and real-time data without the actual need for physical presence. It reduces manpower, water usage and other costs of agriculture and has a positive environmental impact. Integration with other data like weather forecasts gives more precise information. Convergence of technologies, sensors, cloud, automation etc. without human interaction, contributes to IoT.

Long Range Wide Area Networks (LoRaWAN): LoRa is a low-power wireless radio network protocol that support long-range (up to 40km in rural areas and up to 3 km in urban areas) communication between the sensors in the field and base station, low-cost, energy-efficient for IoT and has been integrated into proven solutions for a number of important vertical markets, including smart agriculture. This protocol operates on unlicensed ISM frequencies worldwide. It reduces power consumption and improves the battery lifetime of connected sensors by more than 10 years. LoRa Technology as given in Fig, has a proven track record of enabling efficiencies which reduce environmental impact, maximize yield and minimize expenses. LoRa-based smart agriculture use cases have demonstrated significant and impactful improvements.

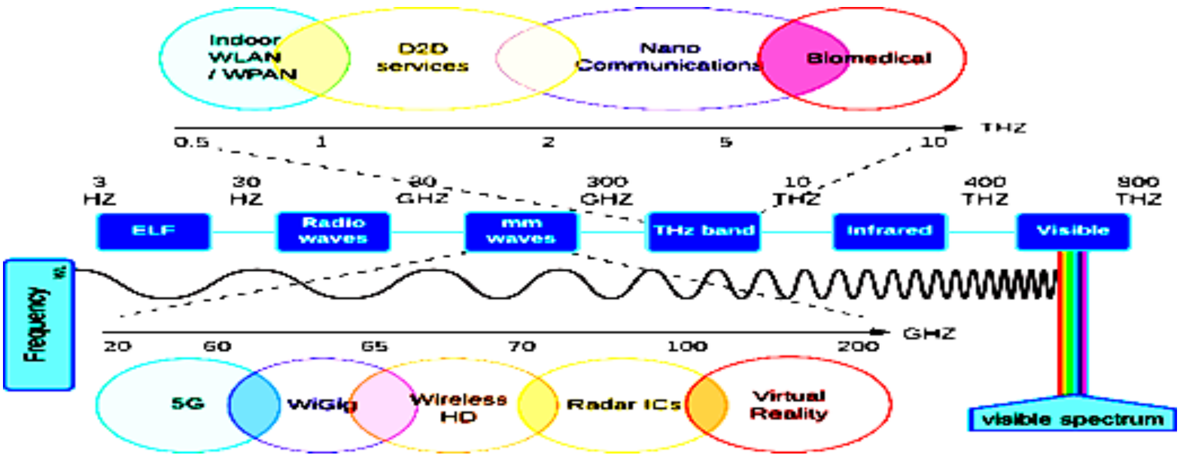
Fig. LoRaWAN Based Smart Soil Monitoring

Ms. Rekha Rani

Asst. Prof./ECE/GCET

ARTICLE: 2 THE APPLICATION FOR 6G AND BIOMEDICAL TECHNOLOGY

According to Edholm's law, the demand for data rates doubles every 18 months and reaches Tbps in the next few years. Sub6GHz/mm 5G technologies could not provide huge bandwidth so the demands for data rate in Tbps we required THz bandwidth whichfulfills the above requirements. The terahertz frequency band is applicable for state-of-the-art connections because the requirement for higher data rates anytime anywhere isto be increased in the near future with an increase in the number of mobile-connected devices which will be the never-ending as shown in Fig. 1. As of now, research inmillimetres-wave technology is reaching commercial deployments and still motivated by the inadequate bandwidth, therefore the terahertz (THz) band is envisioned as theimminent frontier for communication. Wireless communication demands better channel capacity with a high data rate in the modern era. To fulfil these demands, the MIMO-communication systems with THz range are required for high data speed in Tera-bit/sec (Tbps). In addition, it provides very high throughput per device (from multipleGbps to several Tera-bps) including per area efficiency (bps/km2). It is also predicted that the world monthly traffic in smartphones will be about 40 Peta-bytes in 2021. Graphene-based pattern diversity MIMO antenna is designed with good diversity performance from 1.76 THz to 1.87 THz and for Terahertz short-range communication, agraphene-based MIMO antenna is also designed for reconfigurable application. THz (400GHz) high-speed folded reflect-array antenna is required for high-density wireless communication and this is also useful to THz time-domain spectrometry to determine EM properties of dielectric materials. For long and short-distance communication, imaging, and screening of weapons an Elliptical-shaped microstrip ultra-wideband antenna with omnidirectional radiation pattern is designed with a 12 dB peak realized gain. With the increasing demand for high bandwidth &speed, a plasmonic nano reconfigurable UM-MIMO antenna with beamforming capabilities is proposed which leverages the properties of nano-materials and meta-materials.



Dr. Gaurav Saxena
Assoc. Prof./ECE/GCET

ARTICLE: 3 METAMATERIAL ABSORBER AND ITS APPLICATION IN RADAR CROSS SECTION REDUCTION

Metamaterial Absorbers(MA) are artificial composite structures which are generally composed of periodic arrays of metallic patches on the top and ground metal surface separated by a dielectric substrate. The concept is that the incident plane wave electrically excites the top surface of MA, whereas the dielectric substrate is excited by the magnetic field of the incident wave forming a circulating flow of surface current. The electromagnetic fieldsmanipulate the effective material properties of the MA structure, such that the effective permittivity and effective permeability of the MA structure become equal to each other at certain frequencies. So that the effective impedance of MA matches closely with the free space impedance, the reflection and transmission of wave are minimized and absorption is maximized for the MA structure. MA is of critical importance due to its wide range of applications, such as radar cross-section reduction and stealth technology. A novel ultra-thin MA is developed and its application is used in the reduction of RCS of patch antenna while preserving the antenna performance simultaneously. In a metamaterial perfect absorber (MPA) is proposed to reduce the in-band RCS and preserve the radiation characteristics for the guide wave slot array antennas.

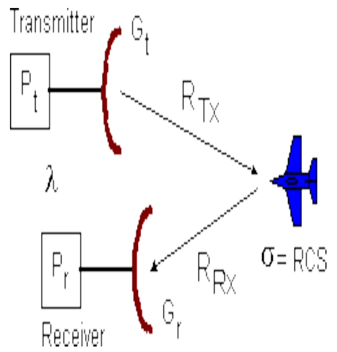


Fig 1 RCS measurement

The surface current distributions of the array antennas are analysed and the MPA is only loaded on the weak current area by the three layers of MPA for RCS reduction. Meanwhile, a novel design method is presented to reduce the RCS of ridged waveguide slot antenna array with MA. The MA consists of a metallic pattern and solid metal on the sides of a dielectricslab covering the PEC ground plane.

Dr. Ankit Sharma
Assoc. Prof./ECE/ GCET

ARTICLE: 4 WIRELESS SENSOR NETWORK DESIGN

Wireless Sensor Networks (WSNs) have grown in recent years and have become an essential part of various applications such as military surveillance, environment monitoring, and medicine. Despite great potential in various applications still successful installation of WSN is a demanding task. For the sake of simplification of WSNs design and abstract from low-level details, high-level approaches are proposed.

WSNs have a large number of nodes which are densely deployed and wirelessly communicated to send and receive environmental information. Every node consists of one or more sensors, a processor, a power supply. Due to complexity, the development of WSNs is a difficult task. Because of this reason, many researchers are going on WSN Design.

For simplicity WSN design approaches are classified as

1. Low-level-based approaches
   - Node-level abstraction approaches
   - Group-level abstraction approaches
   - Network-level abstraction approaches
2. High-level-based approaches
   - Component-based approaches
     - i. High-level SDL Models(HL-SDL)
     - ii. Intense language
     - iii. SensorML
     - iv. UM-RTCOM
     - v. MathWorks Modeling approaches
     - vi. SystemC
     - vii. Middleware
   - Model-driven engineering-based approaches
     - i. MDE-based approaches (MARTE)
     - ii. Design pattern-based approaches

Here WSN modelling techniques and programming methodologies for WSN development are classified into two categories according to the abstraction level of their design. First low-level techniques for WSN and programming models.

The second dealt with high-level-based approaches consisting of component-based modelling techniques and MDE-based approaches specifically which used UML and MARTE standards and pattern-based concepts. The development of WSN can be investigated at different abstraction levels.

Shachee Mishra

2000970310154
Student /ECE/GCET

ARTICLE: 5 Advanced IC Packaging

Advanced packaging is a general grouping of a variety of distinct techniques, including 2.5D, 3D-IC, fan-out wafer-level packaging and system-in-package.

While putting multiple chips in a package has been around for decades, the driver for advanced packaging is directly correlated with Moore's Law. Wires are shrinking along with transistors, and the amount of distance that a signal needs to travel from one end of a chip over skinny wires is increasing at each node.
Moreover, depending on the package, there are fewer physical effects to contend with and components developed at different process nodes can be mixed.

These approaches are now in use across a wide range of products, but initial concerns about cost and time to market continue to slow adoption. That is changing. EDA companies have introduced new tools and flows to automate advanced packaging, and both foundries and OSATs are refining the processes to make it more predictable and less expensive. That is getting a boost by the rising cost of scaling transistors beyond 28nm, as well.

Tushar Vaish
2000970310174
Student /ECE/GCET

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