



**GALGOTIAS COLLEGE
OF ENGINEERING & TECHNOLOGY**

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**Department of
Electronics & Communication**

Chief Editor: Dr. Lakshmanan M (Prof. and Head, ECE Dept)

Faculty Editor: Mr. Hitesh Kumar (Asst. Professor)

**Student Editor: Ashish Kumar Singh
Atyant Jain**

About ECE Department

The Department of ECE offers B.Tech and M.Tech courses in Electronics and Communication Engineering from Dr. A.P.J. Abdul Kalam Technical University, (formerly Uttar Pradesh Technical University / Gautam Buddh Technical University) Lucknow. Electronics & Communication Engineering deals with the electronic devices, circuits, communication equipment's like transmitter, receiver, 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-art infrastructure and computing facilities to students and faculty. The faculty members are actively involved in different domains of research with special focus in 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 a regular hardware and software labs as well as the state-of-art research labs in microwave and antennas, where faculty and students are working on funding projects and offering consultancy services. Some of the available softwares in 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 to 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 with shoulder with the institution, it is constantly aiming towards reaching greater heights to serve the needs of the 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

- P01 Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- P02 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.
- P03 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.
- P04 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.
- P05 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.
- P06 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.
- P07 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.
- P08 Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- P09 Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- P010 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.
- P011 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.
- P012 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:

- PS01:** Design and develop models for analog & digital electronic circuits and systems.
- PS02:** 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 life-long learning.

ARTICLE: 1 SIXTH SENSE TECHNOLOGY

SIXTH SENSE TECHNOLOGY: Technology is the process by which humans modify nature to meet their needs and wants. Increase in the needs leads to the increase in the technology and vice versa. Because every impossible of the past has become possible in the present and day by day the proof has been stronger. It's the beginning of a new era of technology where engineering will reach new milestones. Just like in the science fiction movies where display of the computer screen appears on walls, commands are given by gestures, the smart digital environment which talks to us to do our work and so on, there are such devices like Alexa, Google mini are revolutionary steps and many more will be possible very soon. You imagine it and sixth sense technology will make it possible. Isn't it futuristic? Now it's time for sci-fi movie directors to think ahead because the technology shown in their fiction movies soon will become household stuff. The Sixth Sense also known as 'A Clairvoyance (Extrasensory) Perception' has emerged as 'The Sixth Sense Technology' in the past few years.

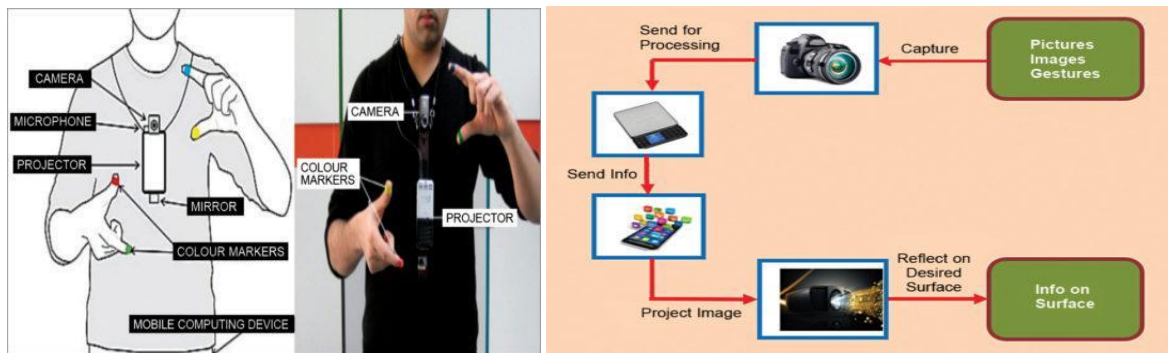


FIG 1 Pranav Mistry with sixth sense Technology FIG 2 Working of six Sense Technology

The first person to make a device based on this concept was Steve Mann. He developed a wearable computing device in the 1990s when he was a student at Media Lab. He implemented the concept through the means of a neck-worn projector accompanied by a camera system. The concept was further developed by Pranav Mistry, a research associate and PhD candidate at Massachusetts Institute of Technology, who is currently head of Think Tank team and vice president of research at Samsung Research America. The device consists of components like a camera, a mirror and a projector connected wirelessly to a Bluetooth smart phone that can slip comfortably into one's pocket. The camera recognizes individuals, images, pictures, gestures one makes with their hands with the help of the coloured markers. The data caught by the camera is then analysed by a software program and tracks down the location of the markers with the help of single vision technique. This software recognizes 3 kinds of gestures: - Multi-touch, freehand and iconic. Information is then processed by the smartphone after which the downward-facing projector projects the output image on to the mirror which in turn reflects image on to the desired surface. Thus, digital information is freed from its confines and placed in the physical world.

The fabulous 6th sense technology is a blend of many exquisite technologies. The thing which makes it magnificent is the marvellous integration of all those technologies and presents it into a single portable and economical product. It associates technologies like hand gesture recognition, image capturing, processing, and manipulation, etc.

[Ajay Shakti Mishra](#)
[19GCEBEC128](#)
[Student /ECE/GCET](#)

ARTICLE: 2 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 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 central base station (CBS) which is far away. Modulation, coding techniques and Line of Sight keeps signal intact. Data from CBS goes to cloud for analysis, visualization and trend analysis. This helps farmers to get frequent and real time data without actual need of physical presence. It reduces manpower, water usage and other costs of agriculture and has 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 (upto 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 over worldwide. It reduce the 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.



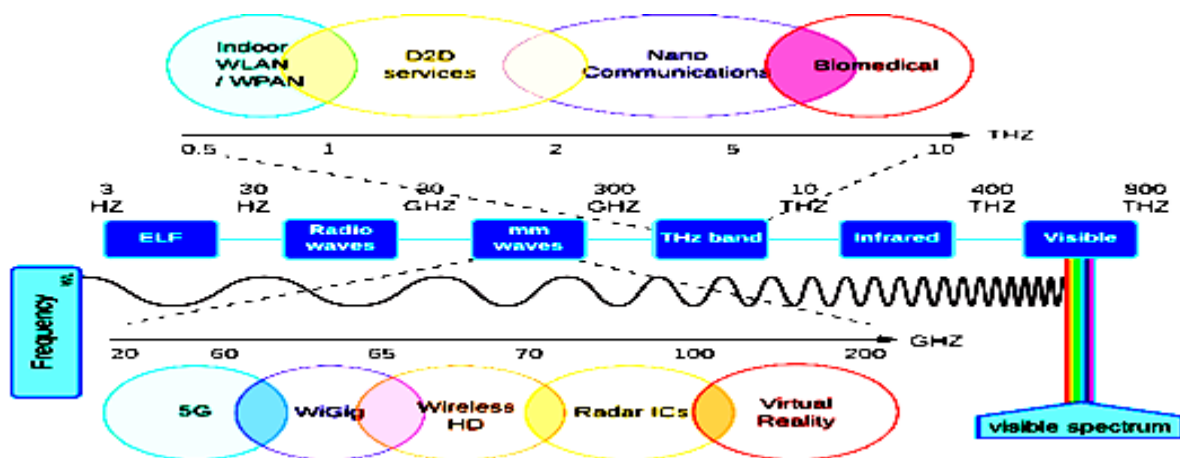
Fig. LoRaWAN Based Smart Soil Monitoring

[Ms. Rekha Rani](#)

[Asst. Prof./ECE/GCET](#)

ARTICLE: 3 THz APPLICATION FOR 6G AND BIO MEDICAL TECHNOLOGY

According to Edholm's law, the demand for data rates is doubled every 18 months and reached in 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 which fulfills the above requirements. Terahertz frequency band is being applicable for state-of-art-communications because the requirement for higher data rates anytime, anywhere is to 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 in millimetres-wave technology is reaching commercial deployments and still motivated by the inadequate bandwidth, therefore the terahertz (THz) band is envisioned as the imminent frontier for communication. Wireless communication is demanded better channel capacity with a high data rate in the modern era. To full-fill these demands, the MIMO-communication systems with THz range are required for high data speed in Tera-bit/sec (Tbps). In addition, it is providing very high throughput per device (from multiple Gbps 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, a graphene-based MIMO antenna is also designed for reconfigurable application. THz (400 GHz) 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 12 dB peak realized gain. The increasing demand for high bandwidth & speed, a plasmonic nano reconfigurable UM-MIMO antenna with beamforming capabilities is proposed which leverage the properties of nano-materials and meta-materials.



[Dr. Gaurav Saxena](#)
[Assoc. Prof./ECE/GCET](#)

ARTICLE: 4 METAMATERIAL ABSORBER AND ITS APPLICATION IN RADAR CROSS SECTION REDUCTION

Metamaterial Absorbers(MA) are artificial composite structures which are generally composed of periodic array of metallic patch on the top and ground metal surface separated by dielectric substrate. The concept is that the incident plane wave electrically excites top surface of MA, whereas the dielectric substrate is excited by the magnetic field of incident wave forming a circulating flow of surface current. The electromagnetic fields manipulate 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, thus the reflection and transmission of wave are minimized and absorption is maximized for the MA structure. MA is of critical importance due to their wide range of applications relating to 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.

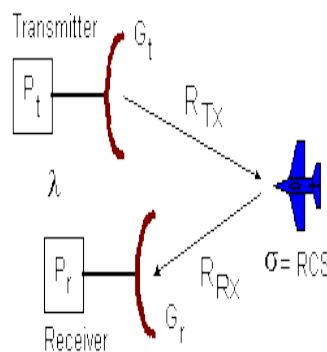


Fig 1 RCS measurement

The surface current distributions of the array antennas is analysed and the MPA is only loaded on the weak current area by the three layers 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 metallic pattern and solid metal on sides of a dielectric slab cover the PEC ground plane.

[Mr. Ankit Sharma](#)
[Asst. Prof./ECE/ GCET](#)

ARTICLE: 5 WHY QUANTUM COMPUTING ?

"Quantum Mechanics: Real black magic calculus."

-Sir Albert Einstein

As we know that classical computers are based on the classical law of Physics so they are good at simulating the problems based on classical world but if you will try to simulate the quantum mechanical models or models based on 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 jobs. 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 numbers of the order 10^{50} called p and q which is unknown to you and I multiply them and give it to you as a number N ($N=p*q$) and I ask you to find the numbers p and q . As they were the prime numbers so they will be unique and one number will be less than \sqrt{N} and 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 for executing a for loop 10^8 times, so it will take 100 sec for 10^{10} iterations and you have to go all the way up to 10^{50} which will cost more than **The Age of The Universe! ($100*10^{40}$ secs)**. We just need a real quantum device which can run these algorithms and people are really trying very hard to make effective quantum devices. You might ask why do we need to do the factor of such a large number? Actually, this factorization problem is assumed to be a Non solvable problem so many big companies like Amazon, Google have their encryption technique based on this problem.

[Abhishek Upadhyay](#)

[1900970310014](#)

[Student /ECE/GCET](#)

ARTICLE: 6 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 specially, 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 gauge the performance of his antenna system in real environments.

[Dr.. Madan Kumar Sharma](#)
[Assoc. Prof./ECE/GCET](#)

ARTICLE: 7 CAMERA PILL TECHNOLOGY SET TO EASE CANCER DIAGNOSIS

Colonoscopies can be an uncomfortable procedure for patients who may already be worried about what the results may find. The process involves probing the large intestine with a tiny fiber optic camera, known as an endoscope, embedded in a 4ft long, flexible tube. As well as colon cancer, colonoscopies can be used to detect and diagnose a whole host of diseases, including irritable bowel syndrome (IBS) and Crohn's disease. The procedure itself is not only uncomfortable and expensive, it can also be ineffective at spotting smaller tumors – leading to misdiagnosis. Around 750,000 incomplete colonoscopies occur each year in the US alone, which means patients often have to undergo an additional procedure, such as an X-ray or CT scan, in order to complete the colorectal examination – incurring extra costs and risks in the process. "Pill Cam Colon 2 is the only minimally invasive tool that offers direct visualization of the colon at low risk and high accuracy," says Gregory Default, VP of global market development for capsule endoscopy at Given Imaging. "It doesn't require sedation, which means patients can carry on with their normal day, and recovery is immediate. "There is no internal memory or internal processing capability within the capsule itself. Instead, data is transmitted in real time via the RF transmitter and on-board antenna to a data recorder worn by the patient either on a shoulder strap or a belt. When the Pullam is closed, two magnetic strips on the lid activate a MEMS switch to keep it in the off state. The device only activates when the lid is opened. "There were definitely performance problems with the first product," says Garner. "One of the things we learned from our trial was that the capsule behaves very differently in the colon than it does in the small bowel. The diameter of the colon is about twice the size and the peristaltic movements are different. In the small bowel, you have steady peristaltic movements that help propel the pill through it steadily, whereas in the colon you may have two or three peristaltic waves per day. This meant that the capsule would literally park in a section of the colon for a period of time and then, after a large peristaltic wave, move and then park again very quickly, meaning it would miss some markers along the way.



It was only through the use of specially developed medication and the adjustable frame rate of the imagers that this could be overcome. We have a very active R&D department," he says. "We're interested to see if we can combine sensors with imagers to detect different elements in the GI tract. We also want to explore the potential for a sensor that can detect the presence of blood, and a capsule that can identify things like PH levels and temperature, as well as capture images. With further development, we believe it could even be possible to make the Pill Cam maneuverable through the use of magnetics. A lot of science fiction prototypes show smart pills with robotic arms coming out of them that can take samples and deliver drugs. These are areas we continue to look into to understand all the challenges involved. However, it will be some time yet before this kind of thing is possible." Looking at how far the technology has come in just 10 years; it will be interesting to see how it evolves over the next decade and what new vistas of the human body it will open up to our vision and understanding.

[Ms. Ranjana Kumari](#)
[Asst. Prof./ECE/GCET](#)

ARTICLE: 8 INTERNET OF THINGS: THINGS GETTING SMART

We have traveled a journey in which we have seen the first computer invented by Charlesabbage to the first computer on Earth which can an impossible equation in minutes. And every day we are witnessing things a few years back which are unthinkable. In all these, our ears are witnessing a three word 'IOT' what that means yeah everyone knows.... like everyone is surrounded by a minimum of 2-3 devices which can be controlled remotely. like we can control our laptop through phones or we can just say hey Alexa!! Play my favorite song or Ok google what the news? I know no teenager will ever say what the news they will say what's the feed. So how all these things are happening like we have to just roll our fingertips and it happened all these things are happening by the coordination and interaction of devices with very smart software's and also, yes you are doing help just shouting at Alexa play my favorite music, shut down the lights, please make the fans off so much of work right? But it is now part of our life and like it, an estimate that around 10-12 billion devices will get connected to it our cloud by 2030. everything will be so approachable without doing anything driverless car, driverless metro, everything will get smart but this smartness is making us dumb, don't?

[Shashank Shukla](#)

[1900970310014](#)

[Student /ECE/GCET](#)

ARTICLE: 9 WHAT IS ARTIFICIAL INTELLIGENCE (AI)

Artificial intelligence (AI) refers to the simulation of human intelligence in machines that are programmed to think like humans and mimic their actions. The term may also be applied to any machine that exhibits traits associated with a human mind such as learning and problem-solving. The ideal characteristic of artificial intelligence is its ability to rationalize and take actions that have the best chance of achieving a specific goal.

Understanding Artificial Intelligence:

When most people hear the term artificial intelligence, the first thing they usually think of is robots. That's because big-budget films and novels weave stories about human-like machines that wreak havoc on Earth. But nothing could be further from the truth. Artificial intelligence is based on the principle that human intelligence can be defined in a way that a machine can easily mimic it and execute tasks, from the simplest to those that are even more complex. The goals of artificial intelligence include learning, reasoning, and perception.

Applications of Artificial Intelligence:

- The applications for artificial intelligence are endless. The technology can be applied to many different sectors and industries. AI is being tested and used in the healthcare industry for dosing drugs and different treatment in patients, and for surgical procedures in the operating room.
- Other examples of machines with artificial intelligence include computers that play chess and self-driving cars. Each of these machines must weigh the consequences of any action they take, as each action will impact the end result. In chess, the end result is winning the game. For self-driving cars, the computer system must account for all external data and compute it to act in a way that prevents a collision.
- Artificial intelligence also has applications in the financial industry, where it is used to detect and flag activity in banking and finance such as unusual debit card usage and large account deposits—all of which help a bank's fraud department.
- Applications for AI are also being used to help streamline and make trading easier. This is done by making supply, demand, and pricing of securities easier to estimate.

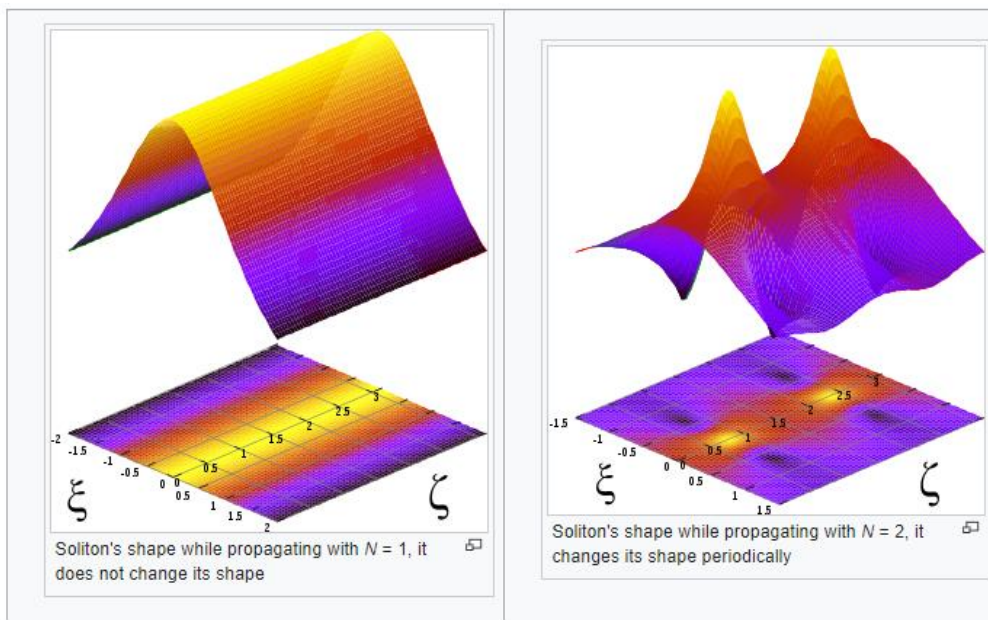
[Mr. Shahid Eqbal](#)
[Asst. Prof./ECE/GCET](#)

ARTICLE: 10 SOLUTION IN OPTICS

Solitons are localized wave entities that can propagate in nonlinear media while maintaining a constant shape. They ubiquitously occur in many branches of physics including hydrodynamics, plasma physics, nonlinear optics and Bose–Einstein condensates. In optics, an optical wavepacket (a pulse or a beam) has a natural tendency to spread as it propagates in a medium, either due to chromatic dispersion or as a result of spatial diffraction.

Most often, when this natural broadening is eliminated through a nonlinear process, a stable self-localized wavepacket forms. Such a self-trapped wave packet, whether in time or space or both, is known as an optical soliton. Optical spatial solitons are self-trapped optical beams that propagate in a nonlinear medium without diffraction, i.e. their beam diameter remains invariant during propagation. Intuitively, a spatial soliton represents an exact balance between diffraction and nonlinearly induced self-lensing or self-focusing effects. It can also be viewed as an optical beam that induces a waveguide that, in turn, guides itself throughout propagation as if it were confined in an optical fiber.

The exact compensation occurs when the pulse shape is that of a fundamental soliton, ($N=1$). The pulse remains chirpless, due to the exact compensation that occurs between the SPM-induced and GVD-induced frequency modulations.



[Dr. R. L Yadav](#)
[Assoc. Prof./ECE/GCET](#)

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