GALGOTIAS COLLEGE
OF ENGINEERING & TECHNOLOGY

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Department of Electronics & Communication

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About ECE Department

Electronics and Communication Engineering witnessed significant growth in India over the past few decades. Electronics and Communication Engineering (ECE) is a specialized branch of engineering that focuses on the design, development, and application of electronic devices, communication systems, and related technologies. It plays a crucial role in shaping modern society by enabling efficient communication, advanced electronic devices, and cutting-edge technology solutions. Graduates with a degree in Electronics and Communication Engineering have a wide range of career opportunities. They can work as Electronics Engineers, Communication Engineers, Embedded System designers, VLSI engineers, Network Engineers, Research Scientists, Consultants, and even pursue higher studies in specialized fields.

Electronics and Communication Engineering at GCET is headed by Dr. Swaminathan Ramamurthy and has 40 faculty members who have received their PG and Ph.D degrees from top-notch universities. The faculty members of this department are consistently doing well in teaching and research. The department offers B.Tech in Electronics and Communication Engineering with 180 intakes. The B.Tech ECE programme attracts the brightest students of the state every year. The placement record of the department has always been impressive. Almost 100% of the students get jobs from the campus placement and many of them are getting it in core companies every year. We encourage the students to do design and research based projects during their B.Tech degree.

The department has state-of-the art laboratories in almost all the areas of Electronics and Communication with modern simulation tools to cater to various specializations and is equipped with facilities for measurement, characterization and synthesis of experimental as well as theoretical results. The department has organized several guest lectures, short-term training programmes, workshops, seminars, symposiums and conferences in the field of Electronics and Communication. The department is actively involved in R&D activities and regularly publishes their research in reputed Journals and Conferences. The research areas include Wireless Communication and Networks, Microwave Engineering, Antenna design, VLSI Design, Signal and Image Processing, Communication Engineering, IoT and Embedded Systems.

Galgotias Electronics Society (GNIX) is a Techno-Cultural society in the department of Electronics and Communication Engineering. The objective of the GNIX society is to spread technical awareness and social responsibility. Student members of GNIX keep organizing various co-curricular and extra-curricular activities like seminars, workshops, guest lectures, and industrial visits etc. for the students of the department.

B. Tech. ECE is accredited by the National Board of Accreditation (NBA).

INITIAL ACCREDITATION-2017, FIRST RE-ACCREDITATION-2020, SECOND RE-ACCREDITATION-2021.

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 QUANTUM CRYPTOGRAPHY

Quantum cryptography is built upon the fundamental principles of the uncertainty principle in quantum physics and serves as a promising solution to address the potential vulnerabilities of current cryptographic methods when faced with future quantum computers. By leveraging the principles of quantum physics, quantum encryption enables the secure transmission of sensitive data, preventing eavesdropping attempts.

The most extensively studied and practically implemented form of quantum cryptography is known as quantum key distribution (QKD). QKD involves sending a secret key through a stream of photons, and users can determine if the key has been compromised by comparing measurements obtained at both ends of the transmission. This ensures that even if a phone call is intercepted by an unauthorized party, they would not be able to observe or decipher the encrypted information without disrupting the photons and altering the measurement results.

On the other hand, post-quantum cryptography also referred to as quantum-proof cryptography, aims to develop encryption methods that remain resistant to algorithms or calculations run on future quantum computers. This is important because today's encryption methods may no longer provide adequate security once quantum computers become a reality.

Currently, QKD has been demonstrated to work effectively; however, its widespread adoption is limited due to significant technological constraints. The process involves using a single-photon laser to transmit a quantum key one photon at a time through a fiber optic cable. This method is slower compared to existing communication technologies and requires a dedicated fiber optic cable between the communicating parties. Furthermore, the distance between the parties also poses challenges, as repeaters used to transmit data over longer distances can disrupt the delicate quantum state necessary for QKD. These limitations impede the widespread implementation of quantum cryptography.

In terms of the differences between classical cryptography and quantum cryptography, classical cryptography relies on the computational difficulty of factoring large numbers and is rooted in mathematical principles. The security of classical cryptography lies in the complexity of mathematical problems, particularly the factorization of large numbers. In contrast, quantum cryptography is a budding technology that relies on the laws of physics and quantum mechanics. It leverages quantum phenomena to establish secure communication between two parties based on the unalterable laws governing quantum mechanics.

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ARTICLE: 2 Embracing the Future: Optical Wireless Communication

Introduction: Optical wireless communication, also known as free-space optical communication (FSO), is an innovative technology that harnesses the power of light to transmit data wirelessly. With its potential for high data transfer rates, enhanced security, and versatile applications, optical wireless communication is poised to shape the future of wireless connectivity.

Speed and Efficiency: Optical wireless communication offers lightning-fast data transfer rates, leveraging the wide bandwidth available in the optical spectrum. With the capacity to achieve data rates ranging from several gigabits to terabits per second, this technology is capable of revolutionizing industries that rely on large data throughput, such as video streaming, virtual reality, and high-performance computing.

Enhanced Security: The inherent security advantages of optical wireless communication make it an attractive option for transmitting sensitive data. Unlike radio-based wireless communication, which can be intercepted or eavesdropped on, light waves used in optical wireless communication are highly directional and challenging to intercept without physically obstructing the transmission path. This makes optical wireless communication more secure, protecting the confidentiality and integrity of transmitted information.

Overcoming Limitations: While optical wireless communication requires a direct line of sight between the transmitter and receiver, ongoing advancements in beam-steering technologies and adaptive optics are expanding its possibilities. These developments enable communication around obstacles and in non-line-of-sight scenarios, allowing for greater flexibility in deployment and usage. Imagine a world where wireless signals can seamlessly reach any location, providing high-speed connectivity without the need for physical infrastructure.

Adapting to Environmental Factors: Optical wireless communication does face challenges related to atmospheric conditions such as fog, rain, or dust particles that can scatter or absorb light signals. However, researchers are actively working on improving signal processing techniques and developing adaptive optical systems to mitigate these obstacles. As a result, the reliability and resilience of optical wireless communication systems continue to improve, making them suitable for deployment in various environments, including urban areas and industrial settings.

Expanding Applications: Optical wireless communication has the potential to transform numerous industries and domains. It can revolutionize wireless internet connectivity, offering high-speed and reliable connections for homes, businesses, and smart cities. Additionally, it can facilitate seamless indoor and outdoor wireless networks, support wireless sensor networks for applications in healthcare, agriculture, and infrastructure monitoring, and enable efficient data centre interconnectivity. Furthermore, optical wireless communication holds promise for satellite communication, inter-satellite links, and underwater communication.

Conclusion: As we look to the future, optical wireless communication stands out as a transformative technology. Its ability to provide high-speed data transfer, enhanced security, and adaptability to different environments positions it as a vital component of the evolving wireless communication landscape. While traditional wireless technologies will continue to coexist, optical wireless communication holds the potential to unlock new possibilities in various sectors, enabling faster and more secure connectivity that propels us into a truly connected world.

Dr. Nitin Garg
Assistant Prof./ECE/GCET

ARTICLE: 3 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 easilymimic 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 dosingdrugs and different treatments in patients and for surgical procedures in the operating room.

• Other examples of machines with artificial intelligence include computers that play chess andself-driving cars. Each of these machines must weigh the consequences of any action they take,as each action will impact the result. In chess, the 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 detectand 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 doneby making the supply, demand, and pricing of securities easier to estimate.

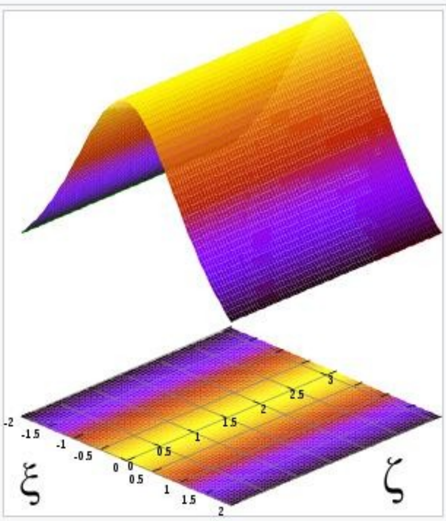
Dr. Shahid Eqbal
Prof./ECE/GCET

ARTICLE: 4 SOLUTION IN OPTICS

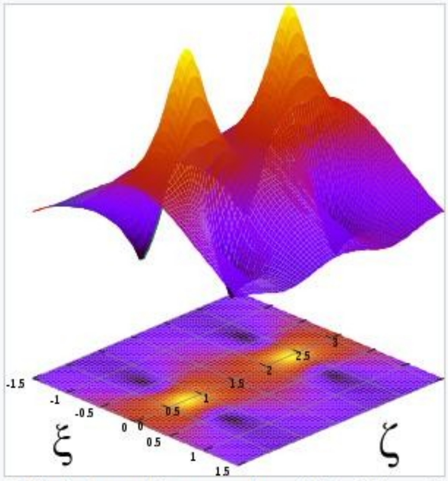
Solitons are localized wave entities that can propagate in nonlinear media while maintaining a constant shape. They ubiquitously occur in many branches of physics including hydrodynamics, plasma physics, nonlinear optics and Bose–Einstein condensates. In optics, an optical wave packet (a pulse or a beam) 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 wave packet 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.



Soliton's shape while propagating with $N = 1$, it does not change its shape



Soliton's shape while propagating with $N = 2$, it changes its shape periodically

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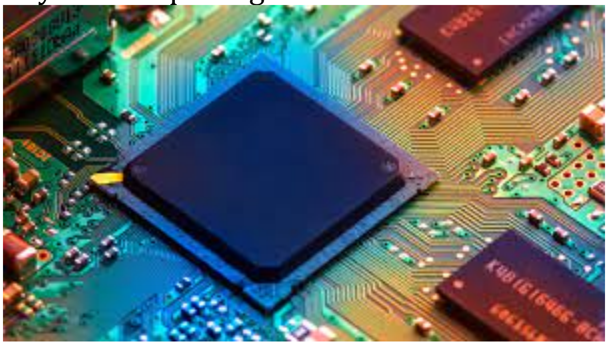
ARTICLE: 5 Advanced IC Packaging

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 them more predictable and less expensive. That is getting a boost from the rising cost of scaling transistors beyond 28nm, as well.

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