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TECH-ZINE

A Technical Magazine of ECE Dept.

DEPARTMENT OF ELECTRONICS AND
COMMUNICATION ENGINEERING



VARDHAMAN
COLLEGE OF ENGINEERING

www.vardhaman.org

Message from the

PRINCIPAL



Dear Faculty, Staff, and Students,

It gives me great pleasure to announce the release of the July–December 2025 issue of Tech-Zine, the technical magazine of the Department of Electronics and Communication Engineering at Vardhaman College of Engineering.

Tech-Zine continues to serve as a dynamic platform that highlights the technical competence, creativity, and innovative thinking of our students and faculty across diverse domains of Electronics and Communication Engineering. This publication reflects the department’s commitment to academic excellence, research, and the holistic development of budding engineers.

I extend my sincere appreciation to the editorial team, contributors, and all those involved in bringing this edition to fruition. Their dedication, teamwork, and enthusiasm are truly commendable.

I encourage all members of our college community to explore this edition of Tech-Zine and engage with the insightful and inspiring content it offers.

I congratulate the Department of Electronics and Communication Engineering on this achievement and wish them continued success in their academic and professional endeavors.

Dr. J V R Ravindra
Principal & Professor of ECE
Vardhaman College of Engineering



Message from the **HEAD OF THE DEPARTMENT**

It is with great pleasure that I announce the release of the latest edition of the Department Technical Magazine of Electronics and Communication Engineering. This publication stands as a reflection of the dedication, creativity, and technical excellence demonstrated by our students and faculty.

The Department of ECE consistently strives to achieve excellence in academics, research, and industry-oriented learning. This magazine highlights a wide spectrum of achievements, innovative projects, research contributions, and creative expressions that showcase the intellectual vibrancy of our department.

I extend my heartfelt congratulations to the editorial team, contributors, and all those involved in bringing this magazine to fruition. Their commitment, teamwork, and enthusiasm are truly commendable.

I am confident that this magazine will serve as a valuable source of knowledge and inspiration for its readers. Let us continue to nurture innovation, curiosity, and excellence as we push the boundaries of knowledge in the field of Electronics and Communication Engineering.

Dr. S. Rajendar

Professor & Head of Department of ECE

EDITORIAL

FACULTY IN CHARGE



It gives us immense pleasure to present the July–December 2025 Issue of Tech-Zine, the biannual technical e-magazine of the Department of Electronics and Communication Engineering. This edition reflects the collective creativity, technical expertise, and innovative spirit of our students and faculty, who continue to explore and express ideas beyond the classroom.

Tech-Zine serves as more than just a magazine—it is a platform that encourages intellectual curiosity, interdisciplinary thinking, and creative expression. Within these pages, readers will find a diverse blend of technical articles, emerging technology insights, research perspectives, creative writing, and artistic contributions that together showcase the dynamic culture of our department.

We encourage readers to delve into this edition and engage with the ideas presented. Each contribution is a testament to the dedication and enthusiasm of our academic community, highlighting how technology and creativity can converge to inspire meaningful innovation.

We extend our heartfelt gratitude to the editorial team, student contributors, reviewers, and all supporters whose efforts made this publication possible. Their commitment and collaboration have been instrumental in shaping this issue. We hope that Tech-Zine 2025 continues to inspire, inform, and ignite new perspectives in the field of Electronics and Communication Engineering.

Dr. Sunkaraboina Sreenu
Assistant Professor



EDITORIAL

STUDENT EDITOR

“Progress is measured not only by success, but by the perseverance that carries us forward.” This thought reflects the essence of our journey in creating this edition of Tech-Zine. Beyond deadlines and milestones, it was the shared determination, creativity, and continuous learning that gave true meaning to this experience. Every stage of developing this magazine offered opportunities for collaboration, innovation, and personal growth.

It is a privilege to present the latest edition of Tech-Zine, a platform that celebrates the intellectual curiosity and technical excellence of our college community. This magazine brings together diverse ideas and viewpoints, offering students and faculty a space to express innovation that extends beyond conventional boundaries.

Within these pages, readers will discover a vibrant blend of content—insightful technical articles, research perspectives, expressive artwork, compelling photography, and creative literary contributions. Together, these elements form a mosaic of ideas that encourage exploration, critical thinking, and imagination. I express my sincere gratitude to Dr. S. Sreenu Sir for his constant support and guidance throughout this journey.

As we move forward in our pursuit of technological innovation, let us continue to value the process of learning and creation. It is through collective effort and shared passion that meaningful progress is achieved.

Mamidi Harshitha
23881A04A1

EDITORIAL

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INTELLIGENCE, ONE
LOGIC GATE AT A
TIME."**

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SECTION-I

PART - A

FACULTY TECHNICAL ARTICLES



Edge Computing: Powering Real-Time IoT Intelligence

Edge computing is revolutionizing the Internet of Things (IoT) by bringing data processing closer to the source of generation, reducing latency and enhancing real-time decision-making. Unlike traditional cloud-based architectures, edge computing enables devices and sensors to analyze and act on data locally, minimizing the need for constant communication with centralized servers. This approach is particularly valuable in applications such as autonomous vehicles, industrial automation, and healthcare monitoring, where immediate responses are critical. By distributing computational power across the network, edge computing reduces bandwidth usage, enhances security, and ensures faster insights. As IoT ecosystems expand, the integration of edge computing with AI and LPWAN technologies creates a powerful synergy, enabling smarter, more efficient, and resilient digital infrastructures across industries.

Edge computing also strengthens IoT ecosystems by enabling greater resilience and autonomy in connected devices. Since data is processed locally, systems can continue functioning even when cloud connectivity is limited or disrupted, which is crucial for mission-critical applications like disaster response, remote healthcare, and industrial safety monitoring. This decentralized approach not only reduces dependence on centralized infrastructure but also enhances privacy by keeping sensitive data closer to its source. As industries increasingly adopt IoT solutions, edge computing ensures that devices are not just connected but also intelligent, adaptive, and capable of delivering real-time insights that drive smarter decision-making and sustainable innovation.

*- Dr. Ch. Sreenivasa Rao
(Professor)*

Advanced Signal Processing: Driving Intelligent Systems



Signal processing has evolved significantly from its classical foundations of filtering, modulation, and transformation to become a core enabler of modern intelligent systems. Today's advanced signal processing techniques focus on extracting meaningful information from complex, noisy, and high-dimensional data. Algorithms such as adaptive filtering, wavelet transforms, spectral estimation, and multi-resolution analysis allow systems to dynamically adjust to changing environments. With the integration of machine learning and artificial intelligence, signal processing now plays a crucial role in enabling systems to learn patterns, make predictions, and respond intelligently in real time.

In the healthcare and biomedical domain, advanced signal processing has revolutionized diagnosis and monitoring. Subtle variations in physiological signals such as ECG, EEG, and EMG can now be detected and analyzed with high accuracy, enabling early identification of cardiac disorders, neurological conditions, and sleep abnormalities. Wearable medical devices rely heavily on real-time signal processing to continuously monitor vital parameters while minimizing noise and power consumption. These advancements not only enhance diagnostic precision but also support personalized healthcare and remote patient monitoring systems.

Signal processing also forms the backbone of modern communication and sensing technologies. In wireless communication systems, including 5G and emerging 6G networks, advanced signal processing techniques are essential for efficient spectrum utilization, interference cancellation, beamforming, and massive MIMO operations. Similarly, in radar, sonar, and satellite systems, sophisticated signal processing algorithms enable accurate target detection, tracking, and classification even in highly cluttered and hostile environments. These capabilities are critical for applications in defense, aerospace, autonomous vehicles, and smart transportation systems.

- Dr. G.A.E. Satish Kumar
(Associate Professor)

Cognitive Signal Processing: Brain-Inspired Pathways for Adaptive Intelligence



Cognitive signal processing represents a transformative evolution in the field of signal analysis, blending traditional mathematical techniques with principles inspired by human cognition. Unlike conventional signal processing systems that operate on predefined and static algorithms, cognitive systems are designed to observe, learn, and adapt continuously.

By mimicking cognitive functions such as perception, attention, learning, and decision-making, these systems can intelligently filter noise, recognize patterns, and respond effectively to changing environments. This approach enables more robust and flexible signal interpretation, even in the presence of uncertainty or incomplete data.

The strength of cognitive signal processing lies in its ability to dynamically manage vast and complex data streams. In applications such as the Internet of Things (IoT), autonomous robotics, and smart sensing platforms, systems are required to interpret multimodal signals—audio, visual, RF, and sensor data—in real time. Cognitive signal processing integrates machine learning models, adaptive filtering, and context-aware algorithms to prioritize relevant information while suppressing redundancy and interference. This capability leads to improved efficiency, reduced energy consumption, and enhanced system reliability, particularly in resource-constrained environments.

Beyond technical optimization, cognitive signal processing enables machines to interpret signals with contextual awareness, similar to human reasoning. This allows systems to infer meaning, anticipate events, and make informed decisions in uncertain or ambiguous conditions. As a result, networks become self-optimizing and capable of evolving with usage patterns, minimizing the need for manual configuration. By transforming signal processing from a static analytical tool into a dynamic, knowledge-driven intelligence engine, cognitive signal processing paves the way for smarter connectivity, autonomous systems, and truly adaptive digital ecosystems.

-Dr.Purna Chandra Reddy V



Dynamic Beam Steering in Millimeter Wave Antennas: Enabling Ultra-Fast Beyond 5G/6G Connectivity

Millimeter wave (mmWave) beam steering antennas are emerging as a cornerstone technology for beyond 5G and 6G networks, addressing the challenges of high-frequency communication where signals are prone to attenuation and limited coverage. By dynamically directing narrow beams toward users and devices, these antennas maximize signal strength, reduce interference, and enable ultra-high data rates essential for applications like holographic communication, immersive extended reality (XR), and autonomous vehicle networks. Unlike traditional fixed antennas, beam steering systems leverage phased arrays, metamaterials, and reconfigurable intelligent surfaces to adapt in real time, ensuring reliable connectivity even in dense urban environments.

The integration of mmWave beam steering into next-generation networks also paves the way for unprecedented scalability and efficiency. In smart cities, these antennas can intelligently allocate bandwidth to thousands of devices simultaneously, while in industrial automation, they ensure seamless machine-to-machine communication with minimal latency. Moreover, coupling beam steering with AI-driven optimization allows networks to predict user movement and proactively adjust signal direction, creating a self-adaptive communication ecosystem. As 6G envisions terahertz frequencies and ultra-reliable low-latency communication (URLLC), mmWave beam steering antennas will be indispensable in unlocking the full potential of hyper-connected societies.

- Dr. Sulakshana Chilukuri
(Associate Professor)

AI-Powered Design Automation in VLSI



The rapid growth of integrated circuit complexity has placed unprecedented demands on traditional VLSI design methodologies. As semiconductor technologies advance toward smaller nodes and support applications such as beyond-5G communication, Internet of Things (IoT), artificial intelligence accelerators, and high-performance computing systems, manual and rule-based design approaches struggle to scale efficiently. AI-powered design automation introduces machine learning and data-driven intelligence into the VLSI design flow, transforming conventional processes such as synthesis, verification, placement, and routing. By learning from vast volumes of historical design data, AI tools can predict design challenges early, significantly reducing development cycles and time-to-market.

One of the most impactful contributions of AI in VLSI design is intelligent optimization across multiple abstraction levels. Machine learning models analyze transistor-level and layout-level parameters to identify congestion, timing violations, and power hotspots before they become critical issues. AI-driven placement and routing algorithms dynamically explore millions of design possibilities to achieve optimal performance, area, and power trade-offs. In verification and testing, AI accelerates fault detection and coverage analysis, improving reliability while minimizing costly design iterations. This level of automation enables designers to focus on innovation rather than repetitive optimization tasks.

AI-powered automation plays a crucial role in low-power and energy-efficient chip design, which is essential for mobile, wearable, and edge computing devices. Intelligent power modeling allows AI tools to predict dynamic and static power consumption under varying workloads, enabling adaptive voltage scaling and clock optimization strategies. By continuously learning from simulation and silicon data, AI-driven tools can balance performance and energy efficiency in real time. Additionally, AI assists in thermal management by forecasting heat distribution and suggesting design modifications that enhance chip longevity and stability.

*- Mr. R. Phani Vidhyadhar
(Assistant Professor)*

Chiplet-Based Architectures: Redefining Scalable VLSI Design



As semiconductor systems grow in complexity and functionality, traditional monolithic system-on-chip (SoC) designs face increasing challenges related to cost, yield, and scalability. Chiplet-based architectures offer a compelling alternative by adopting a modular design philosophy. Instead of fabricating a single large die, complex systems are assembled from multiple smaller chiplets, each designed and optimized for a specific function such as processing cores, AI accelerators, memory, or I/O interfaces. These chiplets are integrated within a single package using advanced interconnect technologies like silicon interposers, 2.5D/3D integration, and high-speed die-to-die links, enabling high performance while significantly improving manufacturing efficiency.

One of the key advantages of chiplet-based design is improved yield and cost-effectiveness. Smaller dies have a lower probability of defects compared to large monolithic chips, leading to higher overall yield and reduced fabrication losses. Moreover, chiplets can be manufactured using different process nodes based on functional requirements—for example, advanced nodes for compute-intensive logic and mature nodes for analog or I/O components. This heterogeneous integration allows designers to optimize performance, power, and cost more effectively than traditional single-node designs, making chiplet architectures highly attractive for next-generation VLSI systems.

Chiplet-based architectures also enable unprecedented scalability and design flexibility. System designers can customize configurations by combining chiplets in various arrangements to meet specific application needs, accelerating innovation across domains such as high-performance computing (HPC), data centers, 5G/6G communication infrastructure, and edge AI platforms. Upgrading or adding new functionality becomes simpler, as individual chiplets can be replaced or enhanced without redesigning the entire system. This modularity significantly shortens development cycles and supports rapid adaptation to evolving technological requirements.

*- Mr. Nagarjuna Malladhi
(Assistant Professor)*

PART - B

STUDENT TECHNICAL ARTICLES

6G Wireless: The Future of Seamless Connectivity

The evolution from 5G to 6G communication marks a significant leap in wireless technology, aiming to deliver unprecedented data rates, ultra-low latency, and intelligent network behavior. While 5G focuses on enhanced mobile broadband and massive machine-type communications, 6G envisions a fully connected digital ecosystem where communication, sensing, and intelligence coexist. With expected data rates reaching terabits per second and latency reduced to microseconds, 6G will support futuristic applications such as holographic communication, immersive extended reality (XR), and autonomous systems.

Advanced signal processing, artificial intelligence, and terahertz (THz) frequency bands form the foundation of 6G networks. Operating at extremely high frequencies allows for wider bandwidths but introduces challenges such as signal attenuation and hardware limitations. To overcome these issues, intelligent beamforming, reconfigurable intelligent surfaces (RIS), and AI-driven resource management are being actively researched. These technologies enable adaptive and energy-efficient communication, ensuring reliable connectivity in dynamic environments.

6G also integrates communication with sensing and localization, enabling networks to perceive their surroundings. This capability supports applications like smart cities, precision healthcare, and autonomous transportation systems. Devices connected through 6G will not only exchange data but also sense physical parameters such as position, movement, and environment conditions, enhancing situational awareness and decision-making.



Manne Deepshika
(24881A0434)

Edge AI: Intelligence at the Network Boundary

Edge Artificial Intelligence (Edge AI) is transforming the way data is processed by bringing intelligence closer to the source of data generation. Unlike cloud-based systems that rely on centralized processing, Edge AI performs computation locally on devices such as sensors, cameras, and embedded systems. This approach reduces latency, enhances privacy, and minimizes bandwidth usage, making it ideal for real-time applications.



Bheemagouni Bhavitha
(24881A04D3)

In domains such as smart surveillance, autonomous vehicles, industrial automation, and healthcare monitoring, Edge AI enables instant decision-making without dependence on cloud connectivity. Advanced embedded processors, neural processing units (NPUs), and optimized machine learning models allow complex inference tasks to be executed efficiently on resource-constrained devices. Signal processing plays a crucial role in preprocessing sensor data to improve accuracy and reduce computational load.

Edge AI also enhances system reliability and security by keeping sensitive data local. This is particularly important in applications involving personal or mission-critical information. Furthermore, adaptive learning mechanisms allow edge devices to respond dynamically to environmental changes, improving performance over time.

Edge AI offers interdisciplinary learning opportunities combining embedded systems, VLSI design, signal processing, and machine learning. As industries increasingly adopt decentralized intelligence, Edge AI is emerging as a cornerstone technology for future smart systems.

Reconfigurable Intelligent Surfaces (RIS): Smart Control of Wireless Environments

Reconfigurable Intelligent Surfaces (RIS) represent a revolutionary approach to wireless communication by enabling control over the propagation of electromagnetic waves. These surfaces consist of programmable meta-materials that can dynamically reflect, refract, or absorb signals to optimize communication performance. Unlike traditional antennas or relays, RIS operates with low power consumption and minimal hardware complexity.

By intelligently manipulating wireless channels, RIS improves signal strength, coverage, and interference management. This technology is particularly valuable in dense urban environments, indoor communication systems, and next-generation wireless networks such as 6G. RIS can transform passive environments into active participants in communication, enhancing connectivity without increasing transmission power.

RIS also supports energy-efficient and sustainable network designs. Its passive or semi-passive nature reduces power consumption while enabling adaptive beam steering and spatial diversity. Combined with AI-driven control algorithms, RIS can continuously adapt to changing channel conditions, ensuring reliable communication.

RIS opens new research avenues in electromagnetics, antenna design, signal processing, and wireless networks. As smart environments become essential to future communication systems, RIS technology will play a key role in shaping intelligent and green wireless infrastructure.



SK. Jani Pasha
(21881A04B9)



S Indrani
22881A04H8

Neuromorphic Computing: Brain-Inspired Electronics

For Neuromorphic computing is an emerging paradigm that mimics the structure and functioning of the human brain to achieve efficient and intelligent computation. Unlike conventional von Neumann architectures, neuromorphic systems integrate memory and processing, enabling parallelism and low-power operation. This approach is particularly suitable for applications requiring real-time learning and pattern recognition.

Using spiking neural networks (SNNs) and bio-inspired circuits, neuromorphic systems process information in an event-driven manner. This makes them highly energy-efficient compared to traditional AI accelerators. Applications include robotics, sensory processing, autonomous systems, and cognitive signal processing. Advances in VLSI design, memristors, and nanoelectronics are accelerating the development of neuromorphic hardware. These systems can adapt and learn from experience, enabling machines to interact more naturally with their environment. Integration with edge devices further enhances their applicability in real-world scenarios.

Neuromorphic computing offers a unique intersection of electronics, neuroscience, and artificial intelligence. As demand for intelligent and power-efficient systems grows, neuromorphic computing is poised to play a significant role in the future of electronics and communication engineering.



SECTION -II

PHOTOGRAPHY

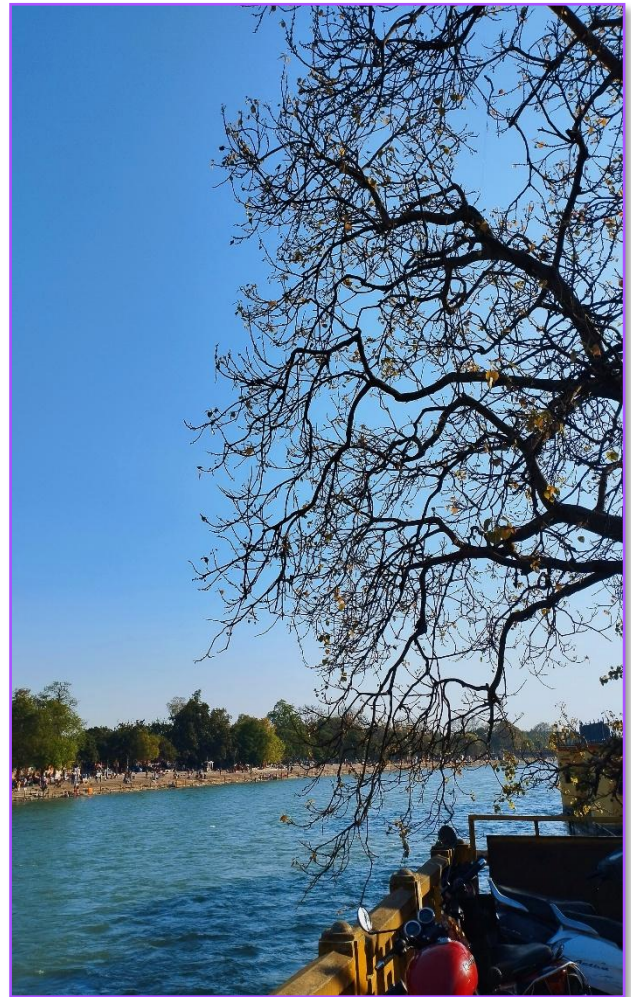
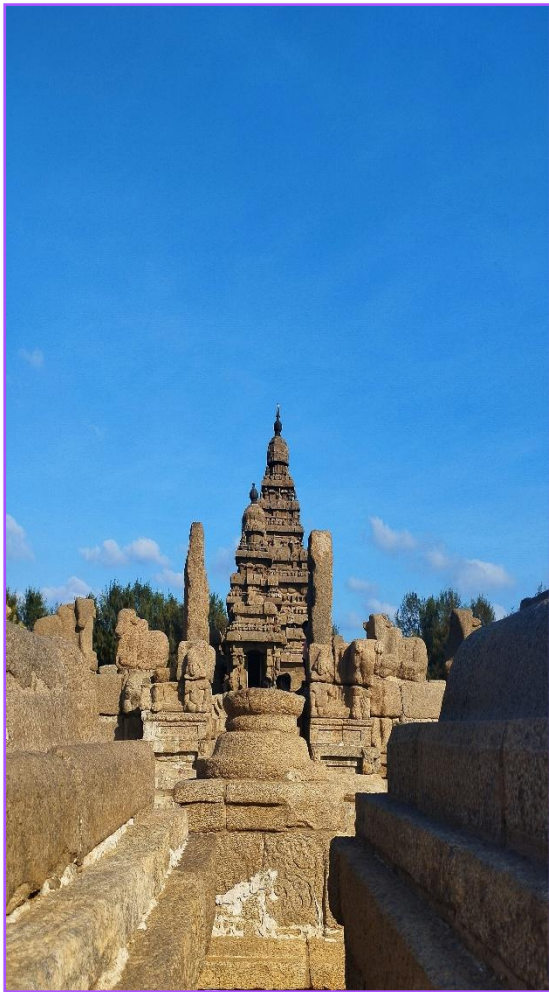


T Neha Kiran
22881A04J5





K. S. Ambika
22881A0496



SECTION -III

ARTWORKS



Chenneram Kiran
24881A0478



Program Educational Objectives (PEOs):

PEO1: Graduates will be able to foster continuing education with their existing knowledge in the field of Electronics and Communication Engineering.

PEO2: Graduates will be able to evolve with the ever-changing global technological advancements and cater

to the needs of the society.

PEO3: Graduates will be able to demonstrate leadership skills to address issues in a responsive, ethical and innovative manner.

PEO4: Graduates will be able to excel in a career while contributing to the growth of their organization

Program Outcomes (POs):

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

Program Specific Outcomes (PSOs):

PSO1: Apply the knowledge of domain-specific skill set for the design and analysis of components in VLSI and Embedded systems.

PSO2: Demonstrate the technical competency and use appropriate techniques in the realization of advanced communication systems.

VISION AND MISSION

Vision of the College

To be a pioneer institute and leader in engineering education to address societal needs through education and practice.

Mission of the College

- To adopt innovative student centric learning methods.
- To enhance professional and entrepreneurial skills through industry institute interaction.
- To train the students to meet dynamic needs of the society.
- To promote research and continuing education.

Quality Policy

- We at Vardhaman College of Engineering, endeavor to uphold excellence in all spheres by adopting best practices in effort and effect.

Vision and Mission of the Department:

Vision:

To produce competent engineers with social responsibility to address the global challenges in the field of Electronics and Communication Engineering.

Mission

- Promote active learning strategies to facilitate student centric learning.
- Provide self-learning capabilities to enhance employability and entrepreneurial skills.
- Inculcate human values and ethics to make learners sensitive towards societal issues.
- Strengthen core competencies among the learners through experiential curriculum.

VARDHAMAN COLLEGE OF ENGINEERING (AUTONOMOUS)

Affiliated to JNTUH, Approved by AICTE, Accredited by NAAC with A++ Grade, ISO 9001:2015 Certified
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