Department of Electronics and Communication Engineering

Information Brochure
2022-23

IIT ROORKEE

FROM THE DESK OF HOD

Welcome to the Department of Electronics and Communication Engineering of IIT Roorkee. This department has a long tradition of excellence in educating, mentoring, and inspiring future technology leaders and researchers in the area of Electronics and Communication Engineering, and conducting research that is in consonance with our societal needs and our country's aspirations.

Our up-to-date academic programs as well as our research activities have been nationally recognized year-after-year, and our alumni have an extensive track record of making a positive difference in the world. Today, the department features innovative undergraduate and graduate programs and world-class research centers and labs, combining theory with practice, for our students to learn, develop, and lead lives of high value and impact. With this brief introduction, I welcome you to be a part of our journey towards extending the industry-academia exchanges and partnership.

Prof. N. P. Pathak

DEPARTMENT AT A GLANCE

- Established in 1964

38
FACULTY MEMBERS

313
UG STUDENTS

75
PG STUDENTS

46
RESEARCH PROJECTS

164
PHD SCHOLARS

Programmes Offered

- B.Tech (4 years)
- M.Tech in Communication, Network & Signal Processing (2 years)
- M.Tech in Microelectronics and VLSI (2 years)
- M.Tech in RF & Microwave Engineering (2 years)
- M.Tech in VLSI for Industry Professionals (3 years)
- PhD

Certification Courses

- PG Certificate in VLSI Design* (6 months)
- PG Certificate in 5G Technology and IoT* (6 months)

* With Coursera

Specializations

RF and Microwave Engineering

Communication, Networks and Signal Processing

Microelectronics and VLSI

UNDERGRADUATE PROGRAM

Major Courses

- ❑ Semiconductor Devices
- ❑ Analog VLSI Circuit Design
- ❑ Digital Signal Processing
- ❑ Principles of Digital Communication
- ❑ RF and Mixed Signal Circuit Design
- ❑ Data Structures*
- ❑ Artificial Intelligence and Machine Learning*
- ❑ Computer Architecture and Organisation
- ❑ Computer Networks*
- ❑ Operating Systems*
- ❑ Digital VLSI Circuit Design
- ❑ Network Theory
- ❑ Linear IC Applications
- ❑ Embedded Systems

*Courses offered by the Department of Computer Science & Engineering

Undergraduate Student Activities

- ❑ Rigorous lab courses on VHDL, System Verilog, FPGA, SPICE modelling, TCAD device modelling
- ❑ IEEE student branch events : Quantum computing, Emerging technologies, etc.
- ❑ Artificial Intelligence & Electronic Section(ArIES) club events: Drones, microcontrollers-based projects.

RESEARCH FOCUS

Research Groups

Microelectronics & VLSI

- Fabrication of MEMS/CNT sensors.
- Design of testchips for fabrication in SCL, UMC, MOSIS, CMP.
- Testing/measurement of ICs.
- Embedded system design and prototyping.
- Solar cells, advanced diodes and MOSFETs
- Accelerators for AI

RF and Microwave

- RF Circuits
- Microwave Imaging
- Radar & Satellite Imaging
- Power Amplifier

Communication, Networks and Signal Processing

- 5G/6G and beyond
- Optical communication
- Software defined radios
- Big data analytics
- Multimedia security
- Deep learning, Machine learning
- Image and video processing

MICROELECTRONICS AND VLSI

Microelectronics and VLSI group envisions to bridge the gap between academic institutions and microelectronics industry. The students of this group are trained with state-of-the-art curriculum which provides a strong foundation needed for meeting their future responsibilities as leaders and researchers of future VLSI applications. Students are given comprehensive exposure in latest CAD tools for IC design and basic semiconductor fabrication and characterization techniques. The PG students and research scholars undertake projects related to present challenges of industry. The group undertakes projects sponsored by industry and government agencies.

Research Highlights

- Analog and digital circuit design using Euro Practice, SCL's 180nm and other PDK's
- Fabrication, characterization and TCAD modelling of VLSI devices
- EDA tool and SPICE model development
- Embedded system design and physical layout
- Memory (ReRAM, Spintronic and Ferromagnetic) device and circuit design
- Quantum electronic devices
- Optoelectronic devices (organic & III-V), MEMS and sensors

Major Courses

- Semiconductor Device Physics
- Nanoscale Devices
- VLSI Technology
- Digital VLSI Circuit Design
- Digital System Design
- Analog VLSI Circuit Design
- VLSI Physical Design
- CAD for VLSI
- Mixed Signal Circuit Design
- Optoelectronic Materials and Devices
- MEMS and NEMS

RF AND MICROWAVE ENGINEERING

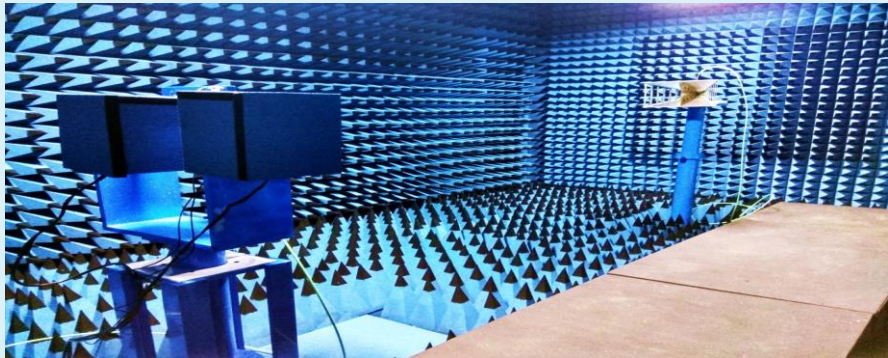
The RF and Microwave group at IIT Roorkee is a recognized group in industry, academia, and government research partnerships. This group has proven track record to deliver its research in the field of RF and THz technologies. Our researchers in this group are PI/CO-PI of various projects. Our group is recognized globally by its research presents. The research carried out by our professors and PhD students is published in highly ranked journals. Some technologies have also been transferred and patent has been filed. In the country, such type of overall expertise in RF technologies is rarely available.

Research Highlights

- Metamaterials
- High power mm/THz wave engineering by using gyrotron technology
- Soft-computing in microwave domain gyrotron
- Design Studio (GDS-V2019) developed in IIT Roorkee
- Development of radar-based detection system, radar polarimeter, interferometry
- SAR systems and analysis
- Target detection and estimation
- Microwave imaging
- Development of optical fiber for various applications
- RF transmitter and receiver design

Major Courses

- RF CMOS Transceiver Design
- RF Power Amplifier
- Microwave Integrated Circuits
- Microwave Engineering
- RADAR Signal Processing
- Microwave and Millimeter Wave Circuits
- Antenna Theory and Design
- Advanced Electromagnetic Field Theory
- Computational Electromagnetics
- Fibre Optics
- Microwave Imaging
- Adaptive Beamforming and Smart Antennas
- RF Receiver Design



COMMUNICATION, NETWORKS AND SIGNAL PROCESSING

Communication Systems group at the Indian Institute of Technology Roorkee envisions to perform cutting edge research in the area of wireless and optical communication, signal processing and computer vision, wireless sensor networks and big data mining, and cognitive radio. We aim to bridge the gap between academic institutions and communications, signal processing, and data mining industry. The students of this group are trained with state of art curriculum which provide a strong foundation needed for meeting their future responsibilities as leaders and researchers of future communications applications. Students are given comprehensive exposure in latest system designing and characterization tools along with real life experimentation.

Major Courses

- ❑ Wireless Communication Systems
- ❑ Detection and Estimation Theory
- ❑ Digital Communication and Signal Processing Techniques
- ❑ Information and Coding Theory
- ❑ Adaptive Signal Processing Techniques
- ❑ Linear Algebra and Random Processes
- ❑ Wireless Technologies: 5G and Beyond
- ❑ Advanced Wireless Communication

Research Highlights

- ❑ Optical communication systems
- ❑ Cognitive radio
- ❑ Image and video processing
- ❑ Biomedical applications
- ❑ 5G wireless communication
- ❑ IoT systems
- ❑ Data mining and machine learning

FACULTY STRENGTH



Associate Professor
08

Assistant Professor
16





Professor
10

Total
38

DST
Inspire -1
Visiting -3

























LABORATORIES

RF & Microwave

- Microwave Lab
- Advanced Microwave Lab
- Antenna Lab
- RF Measurement & Characterization Lab
- RFIC Lab
- Wireless Communication Lab
- MM & THz Wave Lab
- Microwave Imaging and Space Technology Lab
- Remote Sensing Lab
- PCB Prototyping Facility
- Nonlinear RF Characterization Lab

Microelectronics & VLSI

- Digital Electronics Lab
- Solid State Lab
- Microelectronics Lab
- Characterization Lab
- Optoelectronics Lab
- Device research lab
- VLSI Lab -I
- VLSI Lab - II
- IC Testing Lab
- Sponsored Project Lab

Communication, Networks and Signal Processing

- Communication System Lab
- Signal Processing Lab
- Image processing Lab
- Control System Lab
- Software Defined Radio Lab

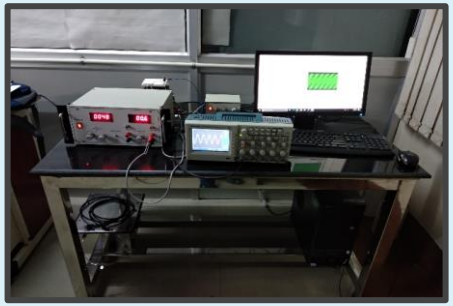
LABORATORIES

Microelectronics Lab

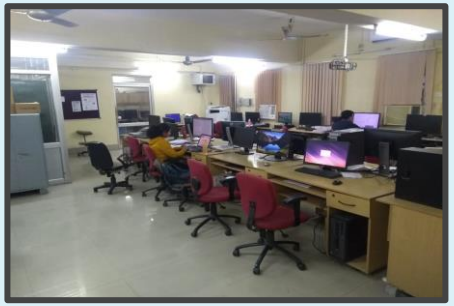
Class 1000 Clean Room

Comm System Lab

IC Testing Lab

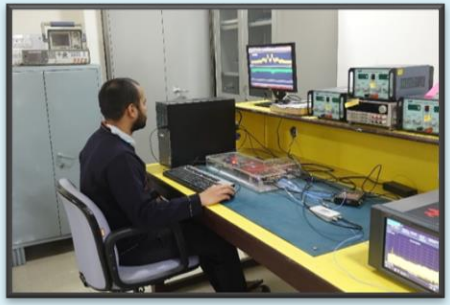


Characterization Lab

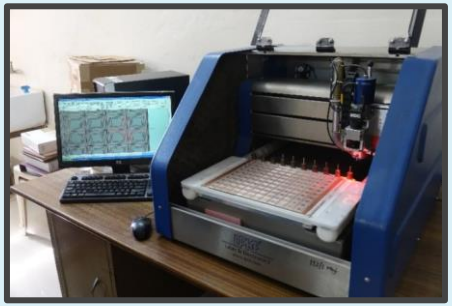


VLSI Design Lab

LABORATORIES



Software Defined Radio Lab



PCB Prototyping Facility

Solid State Lab

Anechoic Chamber

RFIC Lab

Wireless Comm. Lab

COLLABORATIONS

E & ICT Academy

- Provides training programs with emphasis on hands-on learning in basic/advanced topics and emerging technologies in the Electronics and ICT domain. The project is sponsored by Ministry of Electronics and Information Technology, Govt. of India.

Special Manpower Development Programme (SMDP)

- This lab provides state-of-art simulation tools and computational facility for VLSI device/circuit analysis and design.
- The lab is funded by Special manpower Development Project (Chips-to-System Design), DeiTy, Government Of India.

Railtel- IITR Centre of Excellence in Telecom

- DoT in partnership with RailTel, Established ‘Telecom Centre of Excellence’ (TCOE) at IIT Roorkee to work particularly in the area of ICT and broadband application.

Texas Instruments Centre of Excellence

- The lab set up in collaboration with Texas Instruments (TI) provides an opportunity for students to learn new technology.

SAMSUNG Digital Academy

- Samsung Digital Academy, part of Samsung’s citizenship initiative, aims to bridge the digital divide and proficiency gaps in the country by training students on cutting-edge technology.

iHUB DivyaSampark

- A joint initiative of Government of India Department of Science and Technology (DST) and IIT Roorkee.
- The hub fosters research innovation towards product technology development and commercialization in cyber-physical system (CPS) with relevant and next generation **Devices and Materials** in the areas of Healthcare, Industry 4.0, Smart Cities.
- The major flagship program of the hub include:
  - Chanakya Fellowship
  - Sponsored and Consultancy Projects
  - Start-up Programs
  - Innovation Support Program

Centre for Drone Research

- Objective is to stimulate cutting edge research and innovation in the drone segment.
- Dedicated to incubating groundbreaking ideas which can contribute to the growth of drone technology and its application leading us to technological empowerment.

FACULTY LED START-UPS

Founded by Prof. Dharmendra Singh, the primary aim of DTPL is to provide a cost-effective solution for the applications involving contactless detection and identifying the targets with development for the products such as satellite-based agriculture information system, ground penetration radar.

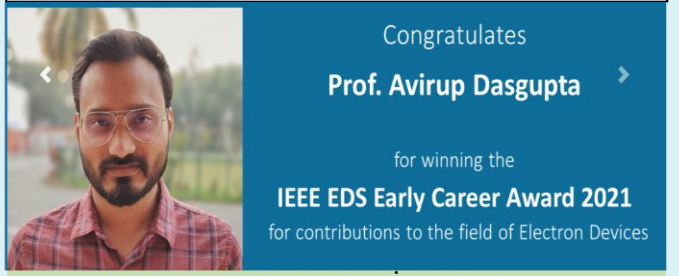
Formed by faculty and students of IIT Roorkee, Linear-AmpTech is dedicated towards indigenous development of radio frequency front end and wireless solutions. Major products of the company include RF power amplifiers design, SDR Spirit Software.

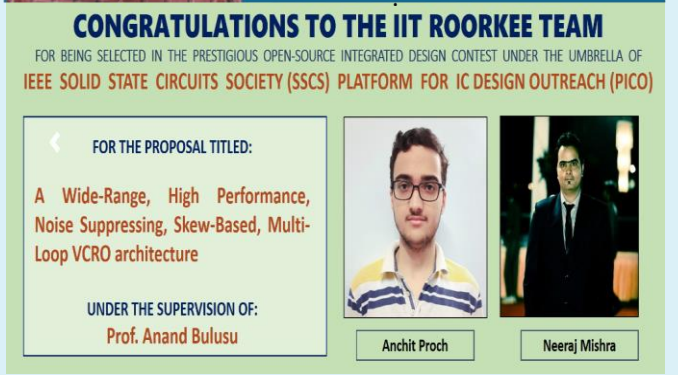
Founded by Prof. B. K. Kaushik, the primary objectives of the NANOAI are the development of new frontiers in edge computing, reduction in processing time, computational resources and power, and designing innovative applications and novel architectures for artificial intelligence.

RECENT UPDATES

- Department started a new 3-year M.Tech program “M.Tech (VLSI) for Industry Professionals” from the academic year 2021-22.
- Our department, with its pioneering and ongoing research and training in the domains of microelectronics, VLSI and communication systems, is offering post graduate certificate programmes in VLSI Design, 5G Technology and IoT on Coursera platform.
  https://www.coursera.org/iit-roorkee
- MFSDSAI: With the expertise in the areas of artificial intelligence and machine learning, some of our department’s faculty are associated with the newly established Mehta Family School of Data Science and Artificial Intelligence
  https://iitr.ac.in/centers/CAIDS/pages/
- SPARK Internship: The SPARK program is an attempt to provide research exposure to interested undergraduate students of IITR and attract and nurture talented undergraduate students at other institutes.

Spark Presentations





Highlights

Prestigious fellowships

- PM’s research fellowship, Humboldt, UKIERI, Newton Bhabha, Fulbright, JSPS, IITR Ajit Singhavi Institute Chair Professor, Indo-French Center for Advanced Mathematics Fellowship

Awards

- National GOLD Award for e-governance, Award of Excellence for Innovation (India Mobile Congress)

Competition Winners

- Passive BCI Hackathon, E-waste artifacts design competition, All India Drone Festival

Many patents, top publications, technology transfer, and more!

JEE rank (Open Category Gender Neutral)

	Opening	Closing
2021	734	1421
2020	994	1333
2019	852	1198
2018	915	1266
2017	833	1406
2016	948	1441
2015	886	1282

OUR TOP RECRUITERS

PROJECTS & PUBLICATIONS

Our department, with immense experience and fame in research and innovation, is the hub for sponsored projects from both government bodies and private organizations.

Our faculty members are involved in several sponsored projects from agencies like by DRDO, DST, UGC, ISRO, DOE, AICTE, MCIT SERB, Space Application Centre, Semiconductor Research Corporation, Railtel, ICAR, Lekha Wireless Solutions, Applied Materials, etc. The Department has successfully completed a large number of sponsored research projects funded by them. Besides, the Department provides R &D and consultancy services to various industries.

Our research work is constantly being published in various reputed national and international journals and conferences. Various book chapters has also been published by our research students and faculty.

Faculty Profiles: Microelectronics & VLSI

Dr. Sudeb Dasgupta

Ultra Low Power, Adiabatic Logic for Portable Applications, Low Power Application, Subthreshold Logic Design, Radiation Effects on ICs, Design and Development of 6T FinFET Based Rad Hard SRAM Cell, Novel Semiconductor Devices, FinFETs, PDSOI, FDSOI, Nanoelectronics, Semiconductor Device Modelling.

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Dr. Bishnu P. Das

VLSI Circuit and System Level Designs, Cyber Physical System Designs and FPGA based Designs., Standard Cell library Design, Resilient circuit design, Hardware security, Variability Measurement.

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Dr. Anand Bulusu

CMOS Digital Circuits, Timing models and design of near threshold voltage circuits, VLSI Devices, Novel device/circuit co-design methodologies, MIxed-Signal Design, Low Voltage CMOS Circuit Design and Modeling.

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Faculty Profiles: Microelectronics & VLSI

Dr. Sanjeev Manhas

Nanoscale Devices and Circuits: Nanowire MOSFET Modeling and Circuit Design, Novel Memories: FeFET for NVM and AI Applications, 3D NAND: Performance Enhancement of NAND Memories, MEMs: Cantilever based MEMs and Applications, Nano Scale DRAM: Novel Techniques for Improving Refresh and Reliability, Sensors: CNT Based Sensors, Novel ISFET Devices for Soil Sensing, Reliability: CMOS Reliability- BTI, TDDB, Nanofabrication: Nanoscale CMOS Process and VLSI Technologies.

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Dr. Arnab Dutta

Micro (Nano) Electronic Devices: Electrical Characterization and Modeling of Semiconductor Devices, Non-Volatile Memories, Advanced MOSFET Reliability, MOS Device Fabrication, MEMS: Electro-mechanical Switches, Device Failure Mechanism, Photonics: Semiconductor Photonic Devices, Novel Photonic Devices.

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Faculty Profiles: Microelectronics & VLSI

Dr. Brajesh K. Kaushik

Nanotechnology Design, Nanoscale Interconnects and Devices; CNT Based Applications; Organic Electronics; Spintronics.

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Dr. Brijesh Kumar

Optoelectronics, Quantum Dot-Light Emitting Devices, High efficiency solar cells, Microelectronic Fabrication, Minimizing RF sputtered Al's roughness, Moisture resistant alternative to sapphire, Organic Semiconductors, Fabrication and modeling of organic LEDs and Solar cells.

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Dr. Sourajeet Roy

Numerical modeling and simulation of high-speed devices/circuits, computational algorithms for uncertainty quantification, stochastic modeling & reliability analysis, Carbon nanotubes, modeling and simulation of CNT for electronic packaging applications, Modeling of high-speed interconnects, CAD for signal and power integrity analysis, Microwave/RF circuit simulation, numerical algorithms for steady-state, transient, and frequency-domain simulation.

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Faculty Profiles: Microelectronics & VLSI

Dr. Biplab Sarkar

Ultra-wide bandgap VLSI Devices, Power Schottky diodes, HEMTs, LEDs, Photodetectors.

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Dr. V. S. Poonia

Quantum effects in biological systems, avian magnetoreception, role of coherence in photosynthetic apparatus, Quantum computing, spin based systems, Nanoelectronics, emulation of quantum biological systems, Organic spintronics, spin transport in biomolecules.

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Dr. Sparsh Mittal

Architectures for machine learning, neural network accelerators, computer architecture, high performance computing, VLSI

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Faculty Profiles: Microelectronics & VLSI

Dr. Avirup Dasgupta

Numerical and compact models for emerging semiconductor technologies, modeling of psychopathology, room temperature quantum computing and genome sequencing.

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Dr. Tanmoy Pramanik

Magnetic random access memory, growth and characterization of magnetic thin films for device application, memory reliability of cache and embedded memories in advanced technology nodes.

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Faculty Profiles: RF & Microwave

Dr. Dharmendra Singh

Polarimetric, Interferometric application of Radar, Electromagnetic wave interaction with various me.

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Dr. M. V. Kartikeyan

High-power Millimeter/THz Wave Engineering, Sources and Allied Components, Metamaterials and Fractals, Application in Planar Antennas, Filters and Microwave Circuits, Soft-computing, Soft-computing in Microwave Domain, Antenna Engineering/MICs, Printed Antennas, Filters and Allied Passive Components.

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Dr. R. K. Panigrahi

Information extraction from radar images, Radar signal processing,Target detection and estimation, Radar based remote sensing, Disaster Management, Sensors Development And Networking.

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Faculty Profiles: RF & Microwave

Dr. N. P. Pathak

Integrated Circuits for THz Wireless Communication, Plasmonics, Spoof Plasmonics, Graphene Plasmonics, Dielectric Integrated Guide Based Transceiver for Millimeter Wave/Sub-Millimeter Wave Frequencies, Non-Radiative Dielectric Wave Guides, Dielectric Lens Antenna, Filters, Coupler, Mixer, Oscillator, RF/Microwave Integrated Circuits, Design and development of front end circuits : Filters, Coupler, LNA, Mixers, Oscillators, Non-Invasive RF Sensors, Development of RF sensors for Transportation, Civil, Defense, Agricultural & Medical Applications, Advanced Functional Materials, Ferroelectric and Multiferroic materials for RF applications.

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Dr. Amalendu Patnaik

RF and Microwave Engineering, Machine learning applications in Electromagnetics, CAD of antennas, Plasmonic antennas.

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Faculty Profiles: RF & Microwave

Dr. Karun Rawat

Power Amplifiers: Broadband, load modulation, Doherty PA, pulse gate modulation, High Efficient PAs, Switch Mode PAs, Transceiver Design: All-digital transmitters, Transceivers, Digital control of RF circuits, Transmit/Receive module, Chip Design:, CMOS and GaN MMIC based power amplifiers design, mixed signal design, GaN MMIC based RF Chip design, Modelling:, RF PA Design with Embedding Device Model, Non-linear device modelling, RF measurement, RF Circuits: Multi-port Networks, Modulators , RF Analog Processing, mixers, LNA, Embedded Design: FPGA based transceivers for wireless applications, Sensor Integration with IOT: IOT based pedestrian counting, Cloud centric IOT, Wireless Communication using embedded platforms: Software defined radio for Wireless communication.

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Dr. Darshak Bhatt

RF Microelectronics, Analog circuits for wireless application, RFIC, Transceiver design.

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Faculty Profiles: RF & Microwave

Dr. Debidas Kundu

RF and Microwave Engineering, Frequency Selective Surface and Metasurface, Thin Electromagnetic Absorber, Applied Electromagnetics, Scattering and Polarization Control of EM Wave, RCS Analysis.

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Dr. Akhilesh Mohan

Design of planar antennas, microwave filters, and absorbers for wireless communication systems.

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Dr. Gowrish B

Design of waveguide filters, dielectric resonator filters, co-axial cavity filters for satellite application, passive component design using waveguide, rect-ax and microstrip technology.

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Faculty Profiles: Communication, Networks and Signal Processing

Dr. Ajit K Chaturvedi

Wireless Communications, MIMO, OFDM, Cognitive Radio.

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Dr. Debashis Ghosh

Communication Systems & Signal Processing, Cognitive radio & Sensor networks, Image & video processing, Computer vision & pattern recognition.

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Dr. Anshul Tyagi

Wireless Communications, Coding Theory, Cognitive Radio Networks.

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Faculty Profiles: Communication, Networks and Signal Processing

Dr. Vinod P

Signal Processing, Image & Video Processing, Multimedia Forensics.

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Dr. Meenakshi Rawat

Software defined radios, Digital and RF predistortion for power amplifiers, Software defined radios, SDR solutions for multiband transmission, RF/digital Signal processing, RF/Digital hybrid predistortion.

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Dr. P. M. Pradhan

Wireless Communication, Cognitive Radio, Time-Frequency Representation, Time-Frequency Transforms, Wireless Sensor Network, Distributed Data Estimation.

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Faculty Profiles: Communication, Networks and Signal Processing

Dr. Anshul Jaiswal

Free-space optical communications, MIMO systems and channel modelling for optical wireless communications, visible light communication, Li-Fi.

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Dr. Dheeraj Kumar

Big data mining for smart city and intelligent transportation applications, Urban analytics, Data clustering.

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Dr. Saurabh Khanna

Compressive Sensing, Inference and learning with sparse/deep generative models, Signal processing for communication and imaging.

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Faculty Profiles: Communication, Networks and Signal Processing

Dr. Abhay Kumar Sah

Wireless Communication, 5G and beyond Systems, Next Generation Massive MIMO Systems, Applications of Deep Learning.

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Dr. Ekant Sharma

Beyond 5G/6G communication, Practical massive MIMO, Cell-fee massive MIMO, Intelligent reflecting surfaces, Non-orthogonal multiple access, Full-duplex, Multi-cell and multi-hop communication, Unmanned aerial vehicles/Drones, Energy-efficient systems.

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Dr. Tharun Kumar Reddy Bollu

Machine Learning for Signal processing, Deep Neural Networks, EEG signal processing and Brain Computer Interfaces.

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CONTACT DETAILS

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Prof. Abhay Kumar Sah **Faculty In-Charge** **Placement and Internship**	fic.pi@ece.iitr.ac.in

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