

M.Phil/Pre PhD

Paper II: Advances in Electronics Engineering

Unit I: Wireless Communication and Networks

Computer simulation of radio channels, Overview of 4G-LTE networks, IP switching and MPLS- Overview of IP over ATM and its evolution to IP switching, Optical communication networks- DWDM based network, Optical network on chip, Introduction to near field communication, LoRa communication

Unit II: MIMO and multicarrier modulation

Narrowband MIMO model-parallel decomposition of MIMO channel-MIMO channel capacity-MIMO diversity gain Space-Time modulation and coding

Unit III: Mobile Data Networks and Ad-hoc Wireless Networks

Introduction, Data oriented CDPD Network, GPRS and higher data rates, Short messaging service in GSM, Mobile application protocol. Cellular and Adhoc wireless networks, applications, MAC protocols, Routing, Multicasting, Transport layer Protocols, quality of service browsing, deployment considerations, Adhoc wireless Internet

Unit IV: Capacity of wireless channel

AWGN channel capacity Resources of AWGN channel, Linear time invariant Gaussian channel, Capacity of Fading Channels

Unit V: Wireless Security

Use of Wi-Fi , Service Set Identification (SSID) , Types of Wireless Security , WPA Security problems , Wi-Fi Protected Access (WPA) and Wi-Fi Protected Access II (WPA2) , Difference between WPA & WPA2 , Wireless Security Policy

Unit VI: Recent Technologies in Electronics & Telecommunication Engineering

Internet of Things,5G Network &Technology, Artificial Intelligence and Machine learning, Cloud Computing ,Cyber security

Text Books/References:

1. Data Communication and Tele Processing Systems - T. Housely, 2ndEdition, 2008, BSP.
2. Wireless communications, Principles and Practice, Theodore S.Rappaport, Pearson, 2nd Edition 2010
3. Introduction to Wireless Telecommunications systems and Networks - Gary J. Mullett. Publications- Cengage Learning India Edition.
4. Mobile Computing – Ashok K Talukdar, Roopa R Yavagal, Publication-TATA MGH
5. Vijay Garg, Wireless communication and networking, Morgan Kaufmann

6. William Stallings, Wireless Communications and Networks, PHI
7. Ram Murthy C. Siva, Gurusamy Mohan, Wdm Optical Networks: Concepts, Design and Algorithms, 2011, PHI Learning
8. Jochen Schiller, Mobile Communication, 2/e, PEA, 2003

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Paper III: Advances in Computer Communication Networks

Unit 1 Introduction

Building a Network, Requirements, Perspectives, Scalable Connectivity, Cost-Effective Resource sharing, Support for Common Services, Manageability, Protocol layering, Performance, Bandwidth and Latency, Delay X Bandwidth Product, Perspectives on Connecting, Classes of Links, Reliable Transmission, Stop-and-Wait , Sliding Window, Concurrent Logical Channels.

Unit 2 Internetworking I:

Switching and Bridging, Datagram's, Virtual Circuit Switching, Source Routing, Bridges and LAN Switches, Basic Internetworking (IP), What is an Internetwork?, Service Model, Global Addresses, Datagram Forwarding in IP, sub netting and classless addressing, Address Translation (ARP), Host Configuration (DHCP), Error Reporting (ICMP), Virtual Networks and Tunnels.

Unit 3 Internetworking- II:

Network as a Graph, Distance Vector (RIP), Link State (OSPF), Metrics, The Global Internet, Routing Areas, Routing among Autonomous systems (BGP), IP Version 6 (IPv6), Mobility and Mobile IP

Unit 4 End-to-End Protocols:

Simple Demultiplexer (UDP), Reliable Byte Stream(TCP), End-toEnd Issues, Segment Format, Connecting Establishment and Termination, Sliding Window Revisited, Triggering Transmission, Adaptive Retransmission, Record Boundaries,

Unit 5 TCP

TCP Extensions, Queuing Disciplines, FIFO, Fair Queuing, TCP Congestion Control, Additive Increase/ Multiplicative Decrease, Slow Start, Fast Retransmit and Fast Recovery

Unit 6 Congestion Control and Resource Allocation

Congestion-Avoidance Mechanisms, DEC bit, Random Early Detection (RED), Source-Based Congestion Avoidance. The Domain Name System (DNS), Electronic Mail (SMTP,POP,IMAP,MIME), World Wide Web(HTTP), Network Management (SNMP)

Books and references

1. High Performance Switches and Routers, H. Jonathan Chao, Bin Liu, 2007, John Wiley & Sons, Inc. ISBN-10:0-470-05367-4
2. Information-Centric Networks: A New Paradigm for the Internet (Focus Series in Networks and Telecommunications), Gabriel M. de Brito, Pedro B. Velloso, Igor M. Moraes, Wiley-ISTE; 1st edition, 2013, ISBN:9781848214491
3. Information-Centric Networking (ICN): Content Centric Networking (CCNx) and Named Data Networking (NDN) Terminology, B. Wessingh, C. Wood, A. Afanasyev, L. Zhang, D. Oran and C. Tschudin, RFC 8793, June 2020
4. Software-Defined Networks: A Systems Approach, Peterson, Cascone, O'Connor, Vachuska, and Davie, Online Free Reference Book available at <https://sdn.systemsapproach.org/index.html>
5. Cloud Networking: Understanding Cloud-based Data Centre Networks, Gary Lee (Author), Morgan Kaufmann (Publisher), 2014, ISBN-139780128007280

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Paper III: Advances in VLSI system

Unit 1: VLSI Circuit Design

A) Combinational Circuit Design: Circuit families- Static CMOS, ratioed circuits, cascade voltage switch logic, dynamic circuits, pass transistors circuits; Circuit pitfalls-Threshold drops, ratio failures, leakage, charge sharing, power supply noise, hot spots, minority carrier injection, Back gate coupling, diffusion input noise sensitivity, process sensitivity; Silicon on Insulator circuit design with advantages & disadvantages; subthreshold circuit design- sizing and gate selection **B) Sequential Circuit Design:** Sequencing static circuits- sequencing methods, Max Delay constraints, Min delay constraints, time borrowing, clock skew. Latches and Flip flops design- CMOS latches, CMOS flip-flops, pulsed latches, resettable latches and flip-flops, enabled latches and flip-flops, logic incorporating into latches, Class Semi dynamics FF, differential flip-flops, dual edge triggered flip-flops, radiation hardened flip-flops, true single phase clock latches and flip flops

Unit 2: Datapath Subsystems

Addition / subtraction- single bit addition, carry propagation addition, subtraction, multiple input addition, flagged prefix adders, 1/0 detectors, Comparators- magnitude comparator, equality comparator, $K = A + B$ comparator. Counters- Binary counters, Fast binary counters, ring counter, Johnson counter, linear feedback shift register. Boolean logical operations, Coding- Parity, Error correcting codes, gray codes, XOR / XNOR Circuit forms. Shifters- funnel shifter, barrel shifter, alternate shift functions. Multiplication- Unsigned array multiplication 2's complement array multiplication, Boolean encoding, column addition, fused multiply array, final addition, serial multiplication. Parallel prefix computations.

Unit 3: Memory array subsystems

SRAM- SRAM cells, Row circuitry, column circuitry, multi ported SRAM, register files, large SRAMs, low power SRAMs. Area, delay and power calculations in SRAM and register files. DRAM- subarray architectures, column circuitry, embedded RAM. ROM- Programmable ROMs, NAND ROMs, flash ROMs. Serial Access Memories- shift registers, queues. Content addressable memory. Programmable logic arrays. Robust Memory Design- Redundancy, Error correcting codes, Radiation hardening

Unit 4: Special purpose subsystems

Packaging and cooling- Package options, Chip to package connections, Package parasitic, heat dissipation, temperature sensors. Power distribution- On chip power distribution network, IR drops, $L di/dt$ noise, On chip bypass capacitance, Power network modeling, power supply filtering, charge pumps, substrate noise, energy scavenging. Clocks- Clock system architecture, Global clock generation, Global clock distribution, Local clock gates,

clock skew budgets, Adaptive deskewing. PLLs and DLLs- PLLs, DLLs. I/Os-I/O pad circuit, Electrostatic discharge protection, MOSIS I/O pads, Mixed Voltage I/O. High Speed Links- High speed I/O channel, channel noise and inference, high speed transmitters and receivers, synchronous data transmission, Clock recovery in various systems. Random circuits- Random number generators, Chip identification

Unit 5: Design methodology and tools

Structured design strategies- A software radio, hierarchy, regularity, modularity, locality. Design methods- microprocessor / DSP, Programmable logic, Gate array, cell based design, full custom design, system on chip. Design flows- Behavioral synthesis design flow, automated layout generation, mixed signal design flow. Design economics- Non recurring engineering costs, recurring costs, fixed costs, schedule, person power, project management, design reuse. Datasheets and documentation- pinout, operation description, AC and DC specifications, package diagram

Textbooks:

- 1) Neil H. E. Weste, David M. Harris, “CMOS VLSI Design- A circuits and system perspective”, fourth edition, Pearson
- 2) Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, “Digital Integrated circuits- A design perspective, Pearson

M.Phil/Pre PhD

Paper-III ANTENNA THEORY AND DESIGN

Unit I: Microstrip radiators

Introduction, Advantages and Limitations of Microstrip Antennas, Radiation Mechanism of a Microstrip Antenna, Various Microstrip Antenna Configurations, Microstrip Patch Antennas, Microstrip or Printed Dipole Antennas, Printed slot Antennas, Microstrip Traveling-Wave Antennas,

Unit I: Microstrip Feeding Techniques and Modeling

Coaxial Feed/Probe Coupling, Microstrip (Coplanar) Feeds, Proximity (Electromagnetically) Coupled Microstrip Feed, Aperture-Coupled Microstrip Feed, Coplanar Waveguide Feed, Radiation Fields, Vector Potentials and Radiation Field Formulation, Microstrip Antenna characteristics Calculations, Surface Waves and Photonic Bandgap Structures, Surface Waves, Photonic Bandgap Structures, Applications.

Unit III: Analytical Models for Microstrip Antennas

Introduction, Transmission Line Model, Simple Transmission Line Model, Transmission Line Model With Mutual Coupling, Generalized Transmission Line Model, Lossy Transmission Line Model, Cavity Model, Generalized Cavity Model, Multiport Network Model, Radiation Fields, Aperture Admittance, Aperture Conductance, G_s , Edge Susceptance, B_s , Mutual Admittance, Y_m , Mutual Conductance, G_m , Mutual Susceptance, B_m , Model for Coaxial Probe in Microstrip Antennas, Comparison of Analytical Models.

Unit IV: Broadbanding of Microstrip Antennas

Introduction, Effects of Substrate Parameters on Bandwidth, Selection of Suitable Patch Shape, Selection of Suitable Feeding Technique, Aperture-Coupled Microstrip Antennas, Transmission Line Model of Aperture Coupling, Modal Expansion Model of Aperture Coupling, Multimoding Techniques, Broadbanding Using Stacked Elements, Broadbanding Using Coplanar Parasitic Elements, Other Multimoding Techniques, Other Broadbanding Techniques, Impedance Matching, Resistive Loading, Multi-frequency Operation

Unit V; Active Integrated Microstrip Antennas

Introduction, Classification of Active Integrated Microstrip Antennas, Oscillator Type, Amplifier Type, Frequency Conversion Type, Theory and Design of Active Integrated Microstrip Antenna Oscillators, One-Port Active Integrated Microstrip Antenna Oscillators, Active Patch Antennas Integrated With Diodes, Active Patch Antennas Integrated With Two-Port Devices, Theory and Design of Active Integrated Microstrip Antenna Amplifiers, Analysis and Design of Active Integrated Microstrip Antenna Amplifiers, Specified Gain Active Integrated Microstrip Antenna Amplifier Design, Low-Noise Active Integrated Microstrip Antenna Amplifier Design, Frequency Conversion Active Integrated Microstrip Antenna Theory and Design, Operational Principle of Trans-conductance Mixers, Self-Oscillating Mixer Active Integrated Microstrip Antennas

Unit VI: Smart Antennas

Introduction, Smart-Antenna Analogy, Cellular Radio Systems Evolution, Signal Propagation, Smart Antennas' Benefits, Smart Antennas' Drawbacks, Antenna Beamforming, Mobile Ad hoc Networks (MANETs), Smart-Antenna System Design, Simulation and Results, Beamforming, Diversity Combining, Rayleigh-Fading, and Trellis-Coded Modulation, Other Geometries

References:

1. Antenna theory analysis and design, by Constantine A. Balanis, third edition, A John Wiley & sons, INC publication.
2. Microstrip antenna design Handbook, Ramesh Garg, Prakash Bhartia, Inder Bhal, Apisak Ittipiboon, Artech House Boston London, www.artechhouse.com
3. Broadband Microstrip Antenna, Girish Kumar, K P Ray, Artech House Boston London, www.artechhouse.com
4. Antenna theory analysis and design, revised edition, Robert S. Elliott University of California, IEEE Antenna and propagation Society, A John Wiley publication

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Paper III: Cyber Security

Unit 1: Introduction to Information Systems

Introduction, Modelling the Business System, Information System Components and Categories, Individuals in Information System, Development of Information System.

Unit 2: Information Security

Introduction, Threats to Information System, Information Assurance, Cyber Security and Security Risk Analysis. Application Security: Introduction, Data Security consideration, Security Technology, Intrusion Detection and Access Control.

Unit 3: Security Threats

Introduction to Security Threats, Network and Services Attacks, Security Threats to Ecommerce.

Unit 4: Development of Secured Information System

Introduction, Developing Secured Information System, Key elements of Information Security Policies, Information System Development Life Cycle, Application Security, Information Security Governance and Risk Management, Risk Management, Security Architecture and Design.

Unit 5: Security Issues in Hardware:

Introduction, Data Storage and Downloadable devices, Physical Security of IT Assets, CCTV and Intrusion Detection System, Security Measures.

Unit 6: Security Policies and Information Security Standards:

Security Policies: Introduction, Why do we need Security Policies ?, Security Policy Development, E-mail Security Policies, Policy Review Process, Corporate Policy, Sample Template of Cyber Security Policy. Information Security Standards: Introduction, IT Act 2000, Copyright, Patent, Intellectual Property Rights, Cyber Laws in India, Software Licensing, Semiconductor Laws and Patent Law.

Textbooks:

1. Fundamentals of Cyber Security, By Mayank Bhushan, Rajkumar Rathore and Aatif Jamshed, BPB Publications.

References:

1. Data communication and Networking by Behrouz A. Forouzan, McGraw Hill Education (India) Pvt. Ltd.
2. Certified Ethical Hacker Certification Exam by William Manning

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Paper III: Internet of Things

UNIT I. Introduction (6)

What is the Internet of Things? : History of IoT, About objects/things in the IoT, Overview and motivations, Examples of applications, IoT definitions, IoT Frame work, General observations, ITU-T views, working definitions, Basic nodal capabilities.

UNIT II. Fundamental IoT Mechanisms & Key Technologies : (6)

Identification of IoT objects and services, Structural aspects of the IoT, Environment characteristics, Traffic characteristics ,scalability, Interoperability, Security and Privacy, Open architecture, Key IoT Technologies ,Device Intelligence, Communication capabilities, Mobility support, Device Power, Sensor Technology, RFID technology, Satellite Technology.

UNIT III. RFID and Wireless Technologies for IoT : (7)

Introduction, Principles of RFID, Components of an RFID system, Reader, RFID tags, RFID Middleware. Wireless Sensor Networks: History and context, node, connecting nodes, networking nodes, securing communication .WPAN Technologies for IoT/M2M, Zigbee /IEEE 802.15.4, Radio Frequency for consumer Electronics (RF4CE), Bluetooth and its low-energy profile , IEEE 802.15.6 WBANS, IEEE 802.15 WPAN TG4j,MBANS,NFC,dedicated short range communication(DSRC) & related protocols. Comparison of WPAN technologies cellular & mobile network technologies for IoT/M2M.

UNIT IV. Governance of the Internet of Things: (6)

Introduction, Notion of governance, aspects of governance, Aspects of governance Bodies subject to governing principles, private organizations, International regulation and supervisor, substantive principles for IoT governance, Legitimacy and inclusion of stakeholders, transparency, accountability. IoT infrastructure governance, robustness, availability, reliability, interoperability, access. Future governance issues, practical implications, legal implications.

UNIT V: Platforms and Programming techniques used in IoT :

Introduction to Raspberry Pi , Arduinio ,IIOT, AWS-IOT, Introduction to Lora-wan, Node MCU IOT Platform . Introduction to Arduino Programming, Introduction to Python programming, Implementation of IoT with Raspberry Pi, Integration of Sensors and Actuators with Arduino. Designing prototype.

UNIT VI. Internet of Things Application with Examples and case studies: (6)

Smart Metering, advanced metering infrastructure, e-Health/Body area network, City automation, automotive applications. Home automation, smart cards, Tracking, Over-The-Air

passive surveillance/Ring of steel, Control application examples. Case studies: Agriculture, Healthcare, Activity Monitoring

Text Books :

1. Hakima Chaouchi, The Internet of Things, Connecting Objects to the Web, Wiley Publications
2. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6 The Evolving World of M2M Communications", Wiley Publications
3. S. Misra, A. Mukherjee, and A. Roy, 2020. Introduction to IoT. Cambridge University Press.

Reference Books :

1. Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", ISBN 978-3842-19156-5, Springer.
2. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things" Key Applications and Protocols, ISBN 978-1-119-99435-0, Wiley Publications.
3. Arashdeep Bahga ,Vijay Madisetti Internet of Things an Hands on Approach,University Press.

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Paper III: Image Processing and Machine Learning

Unit 1 Introduction to Digital Image Processing

Fundamentals of digital image processing, Image acquisition, representation, and visualization, Image enhancement and restoration techniques

Unit 2 Image Filtering and Transformations

Spatial domain filtering and convolution, Frequency domain analysis: Fourier Transform, Discrete Fourier Transform (DFT), Image compression techniques: Discrete Cosine Transform (DCT), wavelet transform

Unit 3 Morphological Image Processing and Image Segmentation

Dilation, Erosion, Labelling connected components, Thresholding and region-based segmentation, Edge detection and boundary extraction, Feature extraction techniques: texture analysis, shape analysis

Unit 4 Introduction to Machine Learning

Basics of machine learning and artificial intelligence, types of learning- supervised, unsupervised, and reinforcement learning, classification and regression, learning rules, model selection, Evaluation metrics and performance measures, life cycle of AI model

Unit 5 ANN and CNN

Human brain and biological neuron, artificial Neural network, activation functions, Convolutional Neural Networks (CNN) for image analysis, classical CNN architectures, transfer learning

Unit 6 Linear and Nonlinear Models

Linear Model- Linear Regression, Logistic regression

Non-linear Models and Kernel Methods: Support Vector Machines (SVM), Kernel methods and kernel trick, Non-linear regression and classification

Text and Reference Books

- 1) Digital Image Processing by Rafael C. Gonzalez and Richard E. Woods, 3rd Edition, Pearson International Edition
- 2) Digital Image Processing Using MATLAB by Rafael C. Gonzalez, Richard E. Woods, and Steven L. Eddins, 3rd Edition, Pearson International Edition
- 3) Deep Learning by Ian Goodfellow, Yoshua Bengio, and Aaron Courville, MIT Press
- 4) Pattern Recognition and Machine Learning by Christopher Bishop, Springer (India) Private Limited
- 5) Deep Learning with Python by François Chollet, Manning Publications