TECHNO INDIA UNIVERSITY
WEST BENGAL

M.Tech in Electronics & Communication Engineering

Syllabus

2024-25

SECOND SEMESTER

Program: M. Tech. in ECE	**Year, Semester:** 1st Yr., 2nd Sem.
Course Title: Antennas and Radiating Systems	**Subject Code:** TIU-PEC-T108
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE:

- To understand the various types of antennas, including wire, aperture, microstrip, array, reflector, and lens antennas, along with their radiation mechanisms and current distribution.
- To explore the fundamental parameters of antennas such as radiation pattern, gain, directivity, impedance, and efficiency, and apply concepts like Friis Transmission equation and antenna temperature.
- To analyze linear wire antennas and loop antennas, focusing on dipoles, region separation, and current distributions.
- To study the design and operation of linear arrays, including uniform amplitude and spacing, broadside, end-fire arrays, and planar arrays.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1:	Understand and explain the different types of antennas such as wire, aperture, microstrip, array, reflector, and lens antennas, as well as their radiation mechanisms and fundamental parameters like directivity, gain, and efficiency.	K2
CO-2:	Analyze the radiation characteristics and current distribution of linear wire antennas, including infinitesimal and small dipoles, half-wave dipoles, and the effects of ground planes.	K4
CO-3:	Design and evaluate linear arrays of antennas, considering uniform amplitude, spacing, and performance aspects like broadside and end-fire arrays, super directivity, and planar arrays.	K5
CO-4:	Apply Huygen's Field Equivalence principle to aperture antennas and understand the radiation equations for rectangular and circular apertures, as well as the design and operation of horn antennas.	K3
CO-5:	Examine the characteristics of microstrip antennas, including feeding mechanisms, analysis methods, and the design of rectangular and circular patch antennas.	K3
CO-6:	Explore the operation and design of reflector antennas, including plane, parabolic, and Cassegrain reflectors, and gain a basic understanding of MIMO (Multiple Input Multiple Output) systems.	K3

COURSE CONTENT:

MODULE 1:	**Antenna Types and Fundamentals**	**13 Hours**

Introduction to wire, aperture, microstrip, array, reflector, and lens antennas. Covers radiation mechanisms, antenna parameters such as gain, efficiency, polarization, input impedance, and Friis transmission equation.		
MODULE 2:	**Linear Wire and Loop Antennas**	**12 Hours**
Study of infinitesimal and finite-length dipoles, ground effects, small circular loops, and loops with constant and non-uniform current distributions.		
MODULE 3:	**Aperture and Microstrip Antennas**	**14 Hours**
Covers Huygen's field equivalence principle, radiation equations, rectangular and circular apertures, E/H-plane horns, pyramidal horns, and basic characteristics of microstrip antennas including feeding mechanisms.		
TOTAL LECTURES		**39 Hours**

Books:

E. C. Jordan and K. G. Balmain, "Electromagnetic Waves and Radiating Systems", Prentice Hall, 2nd Edition, 1964. 2. C. A. Balanis, "Antenna Theory Analysis and Design", John Wiley & Sons, 4th edition, 2016. 3. J. D. Kraus, R. J. Marhefka and Ahmad S. Khan, "Antennas for All Applications", Tata McGraw-Hill, 2002. 4. C. A. Balanis, "Advanced Electromagnetic Engineering", Wiley, 2nd edition, 2012. 5. R. F. Harrington, "Time Harmonic Electromagnetic Fields", Wiley, 2001. 6. S. Ramo, J. R. Whinnery and T. Van Duzer, "Fields and Waves in Communication Engineering", Wiley, 3rd edition, 1994. 7. R. C. Johnson and H. Jasik, "Antenna Engineering hand book", Mc-Graw Hill, 1984. 8. I. J. Bhal and P. Bhartia, "Microstrip antennas", Artech house, 1980.

Program: M. Tech. in ECE	**Year, Semester:** 1st Yr., 2nd Sem.
Course Title: Advanced Digital Signal Processing	**Subject Code:** TIU-PEC-T110
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE:

- To provide a comprehensive overview of Digital Signal Processing (DSP), including time and frequency characterization, and to understand digital filter design techniques and structures for both FIR and IIR filters.
- To introduce the concepts of multirate DSP, including decimation, interpolation, sampling rate conversion, and the design and application of multistage decimators, interpolators, polyphase filters, and filter banks.
- To study linear prediction techniques and optimum linear filters, including forward-backward linear prediction, AR/ARMA lattice filters, and Wiener filters for filtering and prediction.
- To explore adaptive filtering techniques and algorithms, including Gradient Adaptive Lattice, LMS, and Recursive Least Squares, with practical applications.
- To understand power spectrum estimation using both non-parametric and parametric methods, along with advanced spectral estimation techniques such as eigen analysis algorithms.

- To examine the applications of DSP and multirate DSP in fields like radar, image processing, speech processing, phase shifters, and wavelets.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1:	Understand the fundamentals of Digital Signal Processing (DSP), including time and frequency characterization, and apply FFT algorithms for signal analysis and digital filter design for FIR and IIR filters.	K2
CO-2:	Analyze multirate DSP systems and design decimators, interpolators, sampling rate converters, and polyphase filters, and explore their applications in subband coding and digital filter banks.	K4
CO-3:	Explore linear prediction techniques and optimum linear filters, solve normal equations using AR and ARMA lattice filters, and apply Wiener filters for filtering and prediction in stationary random	K3
CO-4:	Understand and apply adaptive filter algorithms, including Gradient Adaptive Lattice, LMS, and Recursive Least Squares, and explore their applications in various DSP systems.	K2
CO-5:	Investigate different methods of power spectrum estimation, including nonparametric and parametric techniques, and analyze minimum variance spectral estimation and eigen analysis	K4
CO-6:	Apply DSP and multirate DSP techniques to practical applications in areas like radar, image processing, speech processing, and wavelet design, with a focus on designing phase shifters and other DSP-based applications.	K3

COURSE CONTENT :

MODULE 1:	**Digital Filter Design and Structures**	**12 Hours**
Overview of DSP, characterization in time and frequency, FIR/IIR filter design, and FFT algorithms. Techniques like impulse invariance, bilinear transformation, and parallel realization of IIR filters.		
MODULE 2:	**Multirate DSP and Sampling Rate Conversion**	**15 Hours**
Multirate DSP concepts, decimators, interpolators, polyphase filters, and digital filter banks with applications in subband coding and multistage systems.		
MODULE 3:	**Adaptive Filters and Spectral Estimation**	**15 Hours**
Adaptive filters, LMS and RLS algorithms, nonparametric and parametric methods for power spectrum estimation, and Eigen analysis algorithms for spectral estimation.		
TOTAL LECTURES		**42Hours****

Books:

1. J.G.ProakisandD.G.Manolakis,“Digital Signal Processing:Principles,Algorithm and Applications”, 4th Edition, Prentice Hall, 2007.
2. N .J. Fliege, “Multi rate Digital Signal Processing: Multi rate Systems-Filter Banks–Wavelets”, 1st Edition, Wiley, 1999.

3. Bruce W. Suter, "Multi rate and Wavelet Signal Processing",1stEdition, Academic Press, 1997.
4. M. H. Hayes, " Statistical Digital Signal Processing and Modeling", Wiley,2002.
5. S.Haykin,"Adaptive Filter Theory ", Pearson,5th edition,2013.
6. D. G .Manolakis, V. K .Ingle and S. M. Kogon, " Statistical and Adaptive Signal Processing", McGraw Hill, 2000

Program: M. Tech. in ECE	**Year, Semester:** 1st Yr., 2nd Sem.
Course Title: Satellite Communication	**Subject Code:**TIU-PEC-E102
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE:

1. To understand the principles, architecture, and historical development of satellite communication systems, including the advantages, disadvantages, applications, and frequency bands used.
2. To perform orbital analysis using Kepler's laws and other related orbital equations, and to calculate key satellite parameters such as velocity, period, and angular velocity.
3. To study the architecture and functions of various satellite subsystems, including telemetry, tracking, command and monitoring (TTC & M), attitude and orbit control, communication, power, and antenna subsystems.
4. To analyze typical phenomena in satellite communication, such as solar eclipses, sun transit outages, and Doppler frequency shifts, and learn the effects and solutions.
5. To understand satellite link budgets, including system noise temperature, received signal power, noise power, and calculate the carrier-to-noise (C/N) ratio under clear air and rainy conditions.
6. To explore modulation and multiple access schemes in satellite communication, and review case studies of systems such as VSAT, DBS-TV, GPS, and recent NASA/ISRO satellite launches.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1:	Understand the principles, architecture, history, and applications of satellite communication systems, along with an analysis of the advantages, disadvantages, and frequency bands used in satellite communication.	K2
CO-2:	Analyze orbital dynamics and apply Kepler's laws to calculate important orbital parameters such as velocity, orbital period, and angular velocity for satellites in various orbits.	K4
CO-3:	Understand the architecture and roles of different satellite subsystems, including Telemetry, Tracking, Command & Monitoring (TTC & M), Attitude and Orbit Control System (AOCS), communication, power, and antenna subsystems.	K2

CO-4:	Examine and understand typical satellite communication phenomena like solar eclipses, Sun Transit Outage, and Doppler frequency shift, and apply remedies for these effects.	K2
CO-5:	Draft satellite link budgets, calculate received signal power, system noise temperature, and Carrier-to-Noise (C/N) ratio under different conditions, with a case study on satellite telephony using Low Earth Orbit (LEO) satellites.	K3
CO-6:	Explore modulation and multiple access schemes used in satellite communication and study real-world applications through case studies of VSAT, DBS-TV, GPS, and communication satellites launched by organizations like NASA and ISRO.	K4

COURSE CONTENT :

MODULE 1:	**Satellite Communication System Architecture**	**13 Hours**
Principles, history, advantages, disadvantages, applications, and frequency bands used in satellite communication.		
MODULE 2:	**Orbital Analysis and Satellite Subsystems**	**13 Hours**
Kepler's laws, orbital parameters, satellite velocity and period, satellite subsystems such as TTC&M, AOCS, communication, and power systems.		
MODULE 3:	**Satellite Link Budget and Phenomena**	**14 Hours**
Flux density, system noise, link budget calculations, Doppler shift, solar eclipse effects, and case studies of LEO, VSAT, and GPS satellites.		
TOTAL LECTURES		**40 Hours**

Books:

T. Pratt, C. Bostian and J. Alnutt, “Satellite Communications”, Wiley India, 2nd edition, 2010.
2. M. Mitra, “Satellite Communications”, Prentice Hall of India, 2005.
3. Tri T. Ha,“ Digital Satellite Communications”, Tata McGrawHill, 2009.
4. Dennis Roddy, “Satellite Communication”, McGraw Hill, 4th Edition, 2008.
5. G. Maral and M. Bosquet, “SatelliteCommunicationSystems”, Wiley, 5th edition, 2010.
6. S. K. Raman, “Fundamentals of Satellite Communication”, Pearson Education India, 2011.

Program: M. Tech. in ECE	**Year, Semester:** 1st Yr., 2nd Sem.
Course Title: Voice and Data Networks	**Subject Code:**TIU-PEC-E112
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE:

Enable the student to:

1. Understand and analyze key concepts in network design and performancelearn about the design and operation of various linear wire antennas.
2. Master advanced concepts in network protocols and congestion management.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1:	Understand the key network terminologies and concepts.	K4
CO-2:	Identify the various network design methodologies and communication models.	K3
CO-3:	Apply network design principles to solve real-world networking problems.	K3
CO-4:	Interpret the performance of link layer protocols and retransmission mechanisms.	K4
CO-5:	Analyze the impact of queuing models, congestion control, and quality of service on network performance	K2
CO-6:	Analyze efficient voice and data networks considering real-time performance and quality of service.	K4

COURSE CONTENT:

MODULE 1:	**6 Hours**
Network Design Issues, Network Performance Issues, Network Terminology, centralized and distributed approaches for networks design, Issues in design of voice and data networks.	
MODULE 2:	**6 Hours**
Layered and Layer less Communication, Cross layer design of Networks, Voice Networks (wired and wireless)and Switching,Circuit Switching and Packet Switching,Statistical Multiplexing.	
MODULE 3:	**6 Hours**
Data Networks and their Design, Link layer design- Link adaptation, Link Layer Protocols, Retransmission. Mechanisms (ARQ), Hybrid ARQ (HARQ), Go Back N, Selective Repeat protocols and their analysis.	
MODULE 4:	**6 Hours**
Queuing Models of Networks , Traffic Models , Little's Theorem, Markov chains, M/M/1 and other Markov systems, Multiple Access Protocols , Aloha System , Carrier Sensing, Examples of Local area networks.	
MODULE 5:	**8 Hours**

Inter-networking, Bridging, Global Internet , IP protocol and addressing , Subnetting, Classless Inter domain Routing (CIDR) , IP address lookup , Routing in Internet. End to End Protocols, TCP and UDP. Congestion Control , Additive Increase/Multiplicative Decrease , Slow Start, Fast Retransmit/Fast Recovery.	
MODULE 6:	**8 Hours**
Congestion avoidance, RED TCP Throughput Analysis, Quality of Service in Packet Networks. Network Calculus, Packet Scheduling Algorithms.	
TOTAL LECTURES	**40 Hours**

Books:

1. D. Bertsekas and R. Gallager, "Data Networks", 2nd Edition, Prentice Hall, 1992.
2. L. Peterson and B. S. Davie, "Computer Networks: A Systems Approach", 5th Edition, Morgan Kaufman, 2011.
3. Kumar, D. Manjunath and J. Kuri, "Communication Networking: An analytical approach", 1st Edition, Morgan Kaufman, 2004.
4. Walrand, "Communications Network: A First Course", 2 nd Edition, McGraw Hill, 2002.
5. Leonard Kleinrock, "Queueing Systems, Volume I: Theory", 1 st Edition, John Wiley and Sons, 1975.
6. Aaron Kershenbaum, "Telecommunication Network Design Algorithms", McGraw Hill, 1993.
7. Vijay Ahuja, "Design and Analysis of Computer Communication Networks", McGraw Hill, 1987

Program: M. Tech. in ECE	**Year, Semester:** 1st Yr., 2nd Sem.
Course Title: MIMO Systems	**Subject Code:**TIU-PEC-E114
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE:

1. To introduce multi-antenna systems, including MIMO and their advantages over traditional multi-antenna systems.
2. To explore diversity techniques such as transmit diversity, receive diversity, space-time and space-frequency codes, and the mathematical foundations behind these techniques.
3. To understand the MIMO system model, including singular value decomposition, channel state information, and techniques like pre-distortion, equalization, precoding, and combining.
4. To study MIMO beamforming principles, their role in spectrum efficiency, interference

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1:	Understand channel modelling and propagation, MIMO Capacity, space-time coding,	K2

CO-2:	MIMO receivers, MIMO for multi-carrier systems (e.g. MIMO-OFDM), multi-user	K2
CO-3:	communications, multi-user MIMO.	K2
CO-4:	Understand cooperative and coordinated multi-cell MIMO, introduction to MIMO in 4G	K4
CO-5:	(LTE, LTE-Advanced, WiMAX)..	K3
CO-6:	Perform Mathematical modelling and analysis of MIMO systems	K3

COURSE CONTENT:

MODULE 1:	**Multi-Antenna Systems and Diversity Techniques**	**13 Hours**
Introduction to multi-antenna systems, MIMO vs. multi-antenna systems, transmit and receive diversity, space-time codes, Alamouti scheme, and combining techniques.		
MODULE 2:	**MIMO Systems and Pre-coding**	**14 Hours**
Singular value decomposition, MIMO equalization, pre-distortion, pre-coding, combining techniques, and channel state information in MIMO systems.		
MODULE 3:	**MIMO in LTE and Channel Estimation**	**12 Hours**
MIMO in LTE, beamforming, precoding, propagation channels, multipath propagation, channel estimation techniques, training-based and blind channel estimation, and estimation for OFDM and CDMA systems.		
TOTAL LECTURES		**39 Hours****

Books:

1. A. Paulraj, R. Nabar and D. Gore, “Introduction to Space-Time Wireless Communications”, Cambridge, 2008.
2. E. Biglieriet. al. , “MIMO Wireless Communications”, Cambridge, 2007.
3. A. Chockalingam and B. Sunder Rajan, “Large MIMO Systems”, Cambridge, 2013.
4. G. L. Stüber, “Principles of Mobile Communications”, Springer, 2013.
5. D. Tse and P. Viswanath, “Fundamentals of Wireless Communications”, Cambridge, 2005.
6. A. J. Goldsmith, “Wireless Communications”, Cambridge , 2005.
7. A. F. Molisch, “Wireless Communications”, Wiley, 2011.
8. R. S. Kshetrimayum, “Fundamentals of MIMO Wireless Communications”, Cambridge, 2017.
9. S. Sesia, I. Toufik and M. Baker, “LTE - The UMTS Long Term Evolution: From Theory to Practice”, Wiley , 2009.
10. H. Holma and A. Toskala, “LTE for UMTS: Evolution to LTE–Advanced ”, Wiley, 2011.
11. R. van Nee and R. Prasad, “OFDM for Wireless Multimedia Communications”, Artech House, 1999.
12. S. S. Das and R. Prasad, “Evolution of Air Interface towards 5G”, River Publications, 2018.
13. Claude Oestges, Bruno Clerckx, "MIMO Wireless Communications: From Real-world Propagation to Space-time Code Design",Academic Press, 1st edition, 2010.
14. MohinderJanakiraman, “Space - Time Codes and MIMO Systems”, Artech House Publishers, 2004.

Program: M. Tech. in ECE	**Year, Semester:** 1st Yr., 2nd Sem.

Course Title: Programming Networks-SDN,NFV	**Subject Code:**TIU-PEC-E116
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE:

Enable the student to:

1. Understand the architecture and principles behind Software-Defined Networking (SDN) and Network Function Virtualization (NFV)
2. Explore the integration of SDN and NFV for modern networking solutions and services.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1:	Understand the key concepts and terminologies related to SDN and NFV.	K4
CO-2:	Explain the architecture and working principles of SDN and NFV.	K3
CO-3:	Interpret network applications and services using SDN and NFV concepts.	K4
CO-4:	Analyze the integration of SDN and NFV to optimize network performance.	K4
CO-5:	Understand the impact of SDN and NFV on network performance, scalability, and flexibility.	K2
CO-6:	Implement innovative SDN-NFV-based network solutions for future networking challenges.	K4

COURSE CONTENT:

MODULE 1: Introduction to Software-Defined Networking (SDN)	**6 Hours**
Overview of SDN: Concept, Architecture, and Benefits, Traditional Networking vs SDN: Centralized Control Plane, SDN Components: SDN Controller, OpenFlow protocol, Network Devices, SDN Applications and Use Cases: Data Center Networking, Network Automation, Network Monitoring, SDN Programming Languages: OpenFlow, P4, Python for SDN, SDN Control Plane and Data Plane separation.	
MODULE 2: SDN Architecture and Protocols	**6 Hours**
SDN Architecture: Control Layer, Data Layer, Application Layer, OpenFlow Protocol: Message Types, Flow Tables, Flow Modifications, SDN Controllers: ONOS, OpenDaylight, Ryu Controller, SDN Application Development: REST APIs, SDN Network Programming, SDN Security Considerations: Attacks on SDN, Secure Controller Design.	
MODULE 3: Introduction to Network Function Virtualization (NFV)	**6 Hours**
Overview of NFV: Concept, Architecture, and Use Cases, Virtual Network Functions (VNFs) and Virtualization: VNF Instantiation, Lifecycle Management, NFV Infrastructure: NFV Orchestrators, Virtualization Platforms (KVM, OpenStack), Benefits of NFV: Scalability, Flexibility, Cost Reduction, NFV Management and Orchestration (MANO) Model: ETSI NFV MANO Framework.	

MODULE 4: Integration of SDN and NFV	**6 Hours**
SDN and NFV: Synergies and Differences, Orchestration of SDN and NFV: Management of Virtualized Networks, Service Chaining with SDN and NFV: Dynamic Flow Management, Automation in SDN-NFV: Network Programmability and Service Delivery, Case Study: Integration of SDN and NFV in Cloud and Edge Networks.	
MODULE 5: Programming and Tools for SDN & NFV	**6 Hours**
SDN Programming with OpenFlow: Flow Tables and Packet Processing, SDN Application Development using Ryu and OpenDaylight Controllers, Introduction to P4 Programming Language for SDN, NFV Virtualization: Configuring Virtualized Network Functions (VNFs), Tools for Network Automation: Ansible, OpenStack, Docker, Performance Evaluation of SDN and NFV: Latency, Throughput, Scalability.	
MODULE 6: Advanced Topics and Research Directions in SDN and NFV	**8 Hours**
SDN for 5G Networks and IoT Integration, Network Slicing in SDN/NFV: Enabling 5G Networks, Edge Computing and SDN/NFV Integration, Artificial Intelligence and Machine Learning in SDN for Traffic Management, Future of SDN and NFV: Edge, Fog, and Cloud Computing Integration, Research Trends and Challenges in SDN and NFV.	
TOTAL LECTURES	**38 Hours**

Books:

1. "Software-Defined Networking: Design and Deployment" by Patricia A. Morreale and Jeffery S. Chase.

2. "Network Function Virtualization: Challenges and Opportunities" by Mahmut A. Akar and Sergio A. F. de Moura.

3. "SDN: Software Defined Networks" by Thomas D. Nadeau and Ken Gray.

4. "Network Virtualization: Technology and Architecture" by Rajendra Chayapathi and Naveen L. D.

5. Research Papers: Selected papers on SDN and NFV technologies, trends, and case studies from IEEE, ACM, and other journals.

Program: M.Tech. in ECE	**Year, Semester:** 1^{st}, 2^{nd}.
Course Title: Antennas and Radiating Systems Lab	**Subject Code:**TIU-PEC-L112
Contact Hours/Week: 0–0–3	**Credit:** 2

COURSE OBJECTIVE:

Enable the student to:

1. **To provide experience in testing different types of antennas** for various applications, allowing students to apply theoretical concepts in practical scenarios through simulation.
2. **To develop proficiency in design**and analysis of antenna parameters such as radiation patterns, gain, enabling students to interpret results and optimize antenna performance.

COURSE OUTCOME:

On completion of the course, the student will be able to

CO-1	Understand the working principle of dipole antennas	K2
CO-2	Analyze the impact of physical dimensions on antenna frequency	K4
CO-3	Compare different antenna types and their performance parameters	K4
CO-4	Test monopole antennas with and without ground plane	K3
CO-5	Investigate the effect of monopole height on radiation characteristics.	K4
CO-6	Interpret the radiation pattern of dipole antenna arrays	K4

COURSE CONTENT:

MODULE 1:	**DIPOLE ANTENNA**	**6 Hours**
1. Simulation of half wave dipole antenna. 2. Simulation of change of the radius and length of dipole wire on frequency of resonance of antenna.		
MODULE 2:	MONOPOLE ANTENNA	**12 Hours**
1. Simulation of quarter wave, full wave antenna and comparison of their parameters. 2. Simulation of monopole antenna with and without ground plane. 3. Study the effect of the height of the monopole antenna on the radiation characteristics of the antenna.		
MODULE 3:	**ARRAY ANTENNA**	**12 Hours**
1. Simulation of a half wave dipole antenna array. 2. Study the effect of change in distance between elements of array on radiation pattern of dipole array. 3. Study the effect of the variation of phase difference 'beta' between the elements of the array on the radiation pattern of the dipole array.		
TOTAL LAB HOURS		**30 Hours**

Books:

1. "Antennas" by David J. D. Kraus

2. "Antenna Theory: Analysis and Design" by Constantine A. Balanis

3. "Electromagnetic Waves and Antennas" by Sophocles J. Orfanidis

4. "Microwave Engineering" by David M. Pozar

5. "Electromagnetic Field Theory Fundamentals" by Bhag Guru and HüseyinHiziroglu

Program: M.Tech. in ECE	**Year, Semester:** 1ST, 2nd SEM
Course Title: Advanced Digital Signal Processing Lab	Subject Code : TIU-PEC- L114
Contact Hours/Week: 0–0–3	**Credit:** 2

COURSE OBJECTIVE:

Enable the student to:

1.Understanding Signal Representation and Correlation Techniques

2. Analyzing System Stability with Hurwitz-Routh Criteria

3. Designing and Implementing Digital Filters

COURSE OUTCOME:

On completion of the course, the student will be able:

CO-1	Understand and Represent Signals	K2
CO-2	Apply Stability Criteria for Systems	K3
CO-3	Design and Implement Filters	K3
CO-4	Analyze State-Space and Transfer Functions	K4
CO-5	Understand and Implement Decimation and Interpolation	K2
CO-6	Implement and Analyze Digital Filters	K3

COURSE CONTENT:

MODULE 1:	Signal Representation and Correlation	**9 Hours**

Basic signal representation techniques Auto and cross-correlation analysis of signals		
MODULE 2:	Stability and Filter Design	**9 Hours**
Stability analysis using Hurwitz-Routh criteria Design of Butterworth lowpass and highpass filters		
MODULE 3:	Chebyshev Filter Design and State-Space Analysis	**6 Hours**
Design and analysis of Chebyshev Type I and II filters Deriving state-space matrices from differential equations		
MODULE 4:	Dipole Antenna Array Simulation	**6 Hours**
Simulation of half-wave dipole antenna arrays Understanding the effect of element spacing on the radiation pattern		
MODULE 5:	Advanced Signal Processing Techniques	**6 Hours**
Sampling and FFT of input sequences Normal equation solutions using the Levinson-Durbin algorithm		
MODULE 6:	Convolution, Decimation, and Spectral Estimation	**9 Hours**
Convolution techniques and M-fold decimation Power Spectral Density (PSD) estimation and inverse Z-transform analysis		
TOTAL LAB HOURS		**45 Hours**