DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Course Structure & Syllabus

2025- 2026

Phd Course Structure and Syllabus

SR University

Ananthasagar, Hasanparthy, Warangal Urban 506371

Telangana, India.

SR UNIVERSITY

Department of Electronics and Communication Engineering

R25 Course Structure and Syllabus - Ph.D ECE

I SEM						
S.No.	Course Code	Course	Hours / Week			
			L	R	P	C
1	25EC400PC701	RESEARCH METHODOLOGY AND PUBLICATION ETHICS	4	0	0	4
2	25EC400PC702	ADVANCED DIGITAL SIGNAL & IMAGE PROCESSING	4	0	0	4
3	25EC400PC703	ADVANCED WIRELESS COMMUNICATION SYSTEMS	4	0	0	4
4	25EC400PC704	CMOS VLSI DESIGN	4	0	0	4
5	25EC400PC705	IOT ARCHITECTURE AND PROTOCOLS	4	0	0	4

(25EC400PC701) RESEARCH METHODOLOGY AND PUBLICATION ETHICS			L	R	P	C
			4	0	0	4
Course type	-	**Pre-requisite**	-			

Unit I Objectives and Types of Research

1. Motivation and objectives of research
2. Scope and types of research
3. Research methods vs methodology
4. Research problem identification
5. Defining objectives and research questions
6. Overview of literature review process
7. Identifying research gaps in literature

Unit II Research Design and Methodology

8. Principles of engineering research design
9. Types of research design
10. Features of good research design
11. Data collection techniques
12. Data analysis methods
13. Quantitative and qualitative data analysis
14. Sampling methods and data validation
15. Simulation tools and software's in ECE
16. AI applications in research

Unit III Research Ethics and Publication

17. Research ethics-scientific integrity and honesty
18. Data integrity and simulation manipulation
19. Publication ethics and its importance
20. Misconduct in research-falsification, fabrication, and plagiarism
21. Plagiarism detection tools
22. Authorship and CRediT taxonomy
23. Best practices in publication ethics
24. Ethical use of AI and big data analytics
25. Case studies on ethical violations in engineering research
26. Predatory journals and identification tools

Unit IV Journal Access and Metrics

27. Types of journals-open access, subscription-based, and hybrid
28. Open access movement-Budapest open access initiative
29. Repositories and journal databases-SHERPA/RoMEO, DOAJ, arXiv
30. Indexing databases overview-Scopus, WoS, ProQuest
31. Author metrics-h-index, g-index, i10-index, altmetrics
32. Citation analysis and its significance
33. Journal metrics-JCR, SNIP, SJR, Citescore

34. Characteristics of reputable research journals
35. AI tools for journal selection

Unit V Research Writing and IPR

36. Technical writing skills for engineering research
37. Structuring research papers using IMRAD format
38. Selecting appropriate journals for publication
39. Peer review process in journals
40. Responding to reviewers' comments effectively
41. Citation and referencing techniques
42. Reference management tools-Mendeley and Zotero
43. Presentation tools and visual aids
44. Key components of a research proposal
45. Intellectual property rights in research
46. Patents and copyrights in electronics innovations
47. Patent search and filing process
48. Patent search tools and databases

Textbooks:

1. W. C. Booth, G. G. Colomb, J. M. Williams, J. Bizup, and W. T. FitzGerald, *The Craft of Research*, 5th ed. Chicago, IL, USA: Univ. of Chicago Press, 2024.
2. C.R. Kothari and Gaurav Garg, *Research Methodology: Methods and Techniques*, New Age International, 2023.

Reference Books:

1. M. Hammond and J. Wellington, *Research Methods: The Key Concepts*, Routledge Publication, 2021.

(25EC400PC702) ADVANCED DIGITAL SIGNAL AND IMAGE PROCESSING			L	R	P	C
			4	0	0	4
Course type	-	**Pre-requisite**	-			

Unit I Introduction to Digital Signal Processing

1. Discrete-time signals and systems overview
2. Frequency analysis of LTI Discrete-time systems
3. Implementation techniques for discrete-time systems
4. Correlation of discrete-time signals
5. sampling of discrete-time signals
6. Decimation by a factor D
7. Interpolation by a factor I
8. Sampling rate conversion by a factor I/D
9. Implementation methods for sampling rate conversion
10. Multistage sampling rate conversion techniques

Unit II Multirate Digital Signal Processing

11. Multirate signal processing concepts
12. Applications of multirate signal processing
13. Design techniques for digital filters
14. Finite impulse response filter design
15. Infinite impulse response filter design
16. Frequency transformations in digital filters
17. Digital filter bank architectures
18. Two-channel quadrature mirror filter banks
19. M-channel QMF bank design
20. Implementation of multirate filter banks

Unit III Linear Prediction and Optimum Linear Filters

21. Random signals and their characteristics
22. Correlation functions and power spectral density
23. Innovations representation of stationary random processes
24. Forward linear prediction techniques
25. Backward linear prediction approaches
26. Normal equations in linear prediction
27. Levinson-Durbin algorithm for efficient computation
28. Properties of linear prediction-error filters
29. Applications of linear prediction in signal processing

Unit IV Applications of Adaptive Filters

30. Adaptive channel equalization techniques
31. Adaptive noise cancellation methods
32. Linear predictive coding of speech signals
33. Adaptive direct form FIR Filters

34. Least mean squares algorithm
35. Properties of the LMS algorithm
36. Recursive least squares algorithm
37. Comparison of LMS and RLS algorithms
38. Applications of adaptive filters in signal processing

Unit V Digital Image Processing Fundamentals

39. Image models and representation
40. Colour image and colour models
41. Sampling and quantization in image processing
42. Pixel relationships-neighbour and adjacency
43. Spatial domain enhancement techniques
44. Brightness and contrast enhancement
45. Gray level enhancement-image negative
46. Histogram equalization for image enhancement
47. Smoothing and sharpening filters in spatial domain
48. 2D fourier transform and frequency domain filtering

Textbooks:

3. J. G. Proakis and D. G. Manolakis, *Digital Signal Processing: Principles, Algorithms, and Applications*, 5th ed. Boston, MA, USA: Pearson, 2021.
4. R. C. Gonzalez and R. E. Woods, *Digital Image Processing*, 4th ed. Boston, MA, USA: Pearson, 2022.

Reference Books:

1. A. K. Jain, *Fundamentals of Digital Image Processing*, Prentice Hall, 2021.

(25EC400PC703) ADVANCED WIRELESS COMMUNICATION SYSTEMS			L	R	P	C
			4	0	0	4
Course type	-	**Pre-requisite**	-			

Unit I Propagation and Noise

1. Path-loss in wireless communication
2. Large-scale fading and shadowing effects
3. Small-scale fading and channel variability
4. Doppler spread and coherence time
5. Delay spread and coherence bandwidth
6. Flat fading vs frequency selective fading
7. Multipath fading and its effects
8. Rayleigh fading and statistical characterization
9. Coherent vs differential detection techniques
10. Antenna diversity techniques in fading channels

Unit II Radio Access Technology

11. Direct sequence spread spectrum techniques
12. Code division multiple access principles
13. CDMA transmitter and receiver architectures
14. Key features of CDMA systems
15. Wideband CDMA systems
16. Core features of WCDMA technology
17. Orthogonal frequency division multiple access
18. Non-orthogonal multiple access schemes
19. Comparison of multiple access techniques
20. Receiver design in CDMA and WCDMA networks

Unit III Advances in Wireless Communication

21. MIMO transceiver design
22. MIMO channel modelling techniques
23. Capacity analysis in MIMO systems
24. MIMO receiver architectures
25. Massive MIMO systems
26. Cell-free MIMO technology
27. Millimeter-wave communication
28. Cognitive radio and software defined radio
29. Terahertz communication
30. Intelligent reflecting surfaces in wireless networks

Unit IV 5G Communication Technology

31. 5G operating scenarios and use cases
32. Waveform design in 5G networks
33. Windowed OFDM in 5G

34. Filtered OFDM techniques
35. Universal filtered multi-carrier
36. Filter bank multi-carrier in 5G
37. Generalized frequency division multiplexing
38. Adaptive OFDM for dynamic 5G environments
39. Modulation and coding schemes in 5G
40. Propagation and channel characteristics in 5G

Unit V MIMO Signal Processing with MATLAB

41. Modulation techniques in wireless communication
42. Waveform generation methods
43. Beamforming techniques and applications
44. Wireless channel modelling approaches
45. Channel estimation in fading environments
46. Pilot-based channel estimation techniques
47. Implementation of fading channels in simulations
48. Effect of channel impairments on modulation and detection

Textbooks:

1. A. F. Molisch, *Wireless Communications: From Fundamentals to Beyond 5G*, Hoboken, NJ, USA: Wiley, 2022.
2. T. L. Marzetta and H. Yang, *Fundamentals of Massive MIMO*, Cambridge, U.K.: Cambridge Univ. Press, 2016.

Reference Books:

1. H. Zhang, B. Di, L. Song, and Z. Han, *Reconfigurable Intelligent Surface-Empowered 6G*. Berlin, Germany: Springer, 2021.
2. A. Bhowmick, Y. K. Choukiker, I. Singh, and A. Nallanathan, *5G and Beyond Wireless Communications: Fundamentals, Applications, and Challenges*, 1st ed. Boca Raton, FL, USA: CRC Press, Sep. 2024.

(25EC400PC704) **CMOS VLSI DESIGN**			**L**	**R**	**P**	**C**
			4	0	0	4
Course type	-	**Pre-requisite**	-			

Unit I VLSI Design Fundamentals

1. VLSI design flow
2. Design hierarchy in VLSI
3. Design regularity, modularity, and locality
4. VLSI design styles
5. Design quality
6. Packaging technology
7. MOS device design equations
8. Second-order effects in MOS design
9. Complementary CMOS inverter DC characteristics

Unit II Circuit Characterization and Performance Estimation

10. Circuit characterization and performance estimation
11. Parasitic effects in integrated circuits
12. Resistance estimation
13. Capacitance estimation
14. Inductance and its effects
15. Switching characteristics of CMOS circuits
16. CMOS gate transistor sizing
17. Power dissipation in CMOS circuits
18. CMOS logic structures
19. Clocking strategies

Unit III CMOS Process and Layout Considerations

20. CMOS process enhancement techniques
21. Layout considerations
22. Interconnect circuit elements
23. Stick diagram
24. Layout design rules
25. Latch-up in CMOS circuits
26. Latch-up triggering mechanisms
27. Latch-up prevention techniques
28. Technology-related CAD issues

Unit IV CMOS Combinational and Sequential Logic Design

29. Static CMOS logic design
30. Logic effort and delay estimation
31. Ratioed logic and its characteristics
32. Pass transistor logic design

33. Dynamic logic-principles and operation
34. Speed and power dissipation in dynamic logic
35. Cascading of dynamic logic gates
36. CMOS transmission gate logic
37. Static latches and registers
38. Mux-based latches and master-slave edge-triggered registers

Unit V Reprogrammable Logic Devices and Gate Array Design

39. Reprogrammable gate arrays-overview and applications
40. Commercially available simple programmable logic devices
41. Complex programmable logic devices-architecture and use cases
42. Field programmable gate arrays-structure and features
43. Comparison of SPLDs, CPLDs, and FPGAs
44. Gate array design methodology
45. Sea-of-gates architecture
46. Design flow for gate arrays
47. Programming technologies in reprogrammable devices
48. Applications of reprogrammable logic in VLSI systems

Textbooks:

5. N. H. E. Weste and D. Harris, *CMOS VLSI Design: A Circuits and Systems Perspective*, 5th ed. Pearson Education, 2022.
6. S. Saurabh, *Introduction to VLSI Design Flow*, Cambridge University Press, 2023.

Reference Books:

2. S. Saurabh, *Introduction to VLSI Design Flow*, Cambridge University Press, 2023.
3. E. G. Friedman and R. Bairamkulov, *Graphs in VLSI*, Springer, 2023.

(25EC400PC705) **IOT ARCHITECTURE AND PROTOCOLS**			**L**	**R**	**P**	**C**
			4	0	0	4
Course type	-	**Pre-requisite**	-			

Unit I Fundamentals of IoT

1. Evolution of the internet of things
2. Enabling technologies for IoT
3. Machine-to-machine communication
4. IoT world forum standardized architecture
5. Simplified IoT architecture
6. Core IoT functional stack
7. Role of fog, edge, and cloud computing in IoT
8. Functional blocks of an IoT ecosystem
9. Sensors and actuators in IoT
10. Smart objects and connecting smart objects

Unit II IoT Protocols

11. IoT access technologies-physical and MAC layers
12. Topology and security of IEEE 802.15.4
13. Topology and security of IEEE 802.11ah
14. Security and features of LoRaWAN
15. Network layer-IP versions in IoT
16. Constrained nodes and constrained networks in IoT
17. 6LoWPAN-IPv6 over low power wireless personal area networks
18. SCADA systems for IoT application transport
19. Application layer protocols-CoAP
20. Application layer protocols-MQTT

Unit III Design and Development of IoT Applications

21. IoT design methodology
22. Embedded computing logic in IoT systems
23. Microcontroller-based IoT systems
24. System on chips in IoT applications
25. IoT system building blocks
26. Overview of IoT platforms
27. Raspberry Pi as an IoT hardware platform
28. IoT hardware platform selection criteria
29. Integration of sensors with IoT platforms
30. IoT platform software and middleware

Unit IV Data Analytics and Supporting Services

31. Introduction to data analytics in IoT
32. Structured vs unstructured data
33. Data in motion vs data at rest

34. IoT data analytics challenges
35. Data acquisition in IoT/M2M systems
36. Organizing data in IoT/M2M environments
37. Computing with cloud platforms for IoT/M2M applications
38. Cloud services in IoT/M2M ecosystems
39. Everything as a service (XaaS) in IoT
40. Cloud service models for IoT applications
41. Supporting services for IoT data analytics

Unit V Case Studies/Industrial Applications

42. IoT applications in smart homes
43. IoT in infrastructure and building management
44. IoT-based security systems
45. IoT in industrial automation
46. IoT for home appliances
47. Other IoT electronic equipment and devices
48. Industry 4.0 and IoT integration

Textbooks:

1. R. Herrero, *Fundamentals of IoT Communication Technologies*, Cham, Switzerland: Springer Nature, Apr. 2022.
2. Rajkamal, *Internet of Things: Architecture, Design Principles and Applications,* New Delhi, India: McGraw Hill Higher Education, Jun. 14, 2022.

Reference Books:

1. F. J. Dian, *Fundamentals of Internet of Things: For Students and Professionals*, Hoboken, NJ, USA: Wiley, Nov. 2022.