SRI SIDDHARTHA ACADEMY OF HIGHER EDUCATION

(DEEMED TO BE UNIVERSITY), Accredited A+ Grade by NAAC

SRI SIDDHARTHA INSTITUTE OF TECHNOLOGY

(A constituent College of Siddhartha Academy of Higher Education, Tumakuru)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SCHEME OF TEACHING AND EXAMINATION FOR BE DEGREE COURSE

Academic Year 2025-26 `

Vision

Mould quality technocrats in the field of Electronics and Communication with human values to cater the societal needs

Mission

- To impart high-quality academic environment.
- To provide training in new tools and technologies.
- To facilitate continuous learning and research environment.
- To inculcate professionalism with ethical values, with little impact on environment.

Program Educational Objectives:

PEO-1: Proficient to apply the knowledge gained in mathematics, science and engineering to the field of electronics and communication engineering for the synthesis and analysis of systems

PEO-2: Competent to pursue higher studies and research, with effective communication

PEO-3: Aware of new technologies in the domain field, apply the same for the societal requirement minimizing the impact on environment and ethical practices in their domain

Knowledge and Attitude Profile (WK):

WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.

WK2: Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.

WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.

WK4: Engineering specialist knowledge that provides theoretical frameworks and

bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.

WK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.

WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

WK7: Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.

WK8: Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.

WK9: Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability, etc., with mutual understanding and respect, and of inclusive attitudes.

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 solutions to 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 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 iii) Critical thinking in the broadest context of technological change. (WK8)

Program Specific Outcomes (PSOs)

PSO1: The ability to identify, analyze and design systems related to modern engineering hardware and software tools, in Electronics and Communication Engineering in the areas of electronics, communication, image processing, VLSI, signal processing and embedded systems for solving day to day problems.

PSO2: Impact the awareness about the impact of professional engineering solutions in societal and environmental context, professional ethics and be able

to communicate effectively.

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SCHEME OF TEACHING AND EXAMINATION FOR BE DEGREE COURSE-2022 (160 Credits Scheme, NEP Batch)

FOURTH YEAR B.E

7th Semester B E **Academic Year: 2025-26**

Sl No.	Course Code		Course Title	Teaching Dept.	Teaching Hours					Credits	Examination			
					L	T	P	S	Total		CIE	SEE	Total Marks	Exam Hrs.
1	PC	22EC701	Mobile and Wireless Communications	EC	42	-	28	50	120	4	50	50	100	3
2	PC	22EC702	IOT and its Applications	EC	42	-	28	50	120	4	50	50	100	3
3	PE	22EC7PE3X	Professional Elective III	EC	42	-	-	48	90	3	50	50	100	3
4	PE	22EC7PE4X	Professional Elective IV	EC	42	-	-	48	90	3	50	50	100	3
5	PE	22EC7PE5X	Professional Elective V	EC	42	-	-	48	90	3	50	50	100	3
6	PW	22ECPW706	Project Phase-I	EC	-		28	32	60	2	50	-	50	-
7	PC	22ECTS707	Technical seminar	EC	-	-	-	30	30	1	50	-	50	-
				Total	210		84	306	600	20	350	250	600	-

Elective III 22EC7PE31 – Digital Signal Compression 22EC7PE32 – Advanced Digital Signal Processing 22EC7PE33 – Multimedia Communication	**Elective IV** 22EC7PE41 – MEMS and Nanoelectronics 22EC7PE42 – VLSI Testing and Testability 22EC7PE43 – Submicron Devices
Elective V 22EC7PE51 – RF IC Design 22EC7PE52 – Natural Language Processing 22EC7PE53 – Optimization Methods in Machine Learning	

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SCHEME OF TEACHING AND EXAMINATION FOR BE DEGREE COURSE-2022 (160 Credits Scheme, NEP Batch)

FOURTH YEAR B.E

8th Semester B E **Academic Year: 2025-26**

Sl No.	Course Code		Course Title	Teaching Dept.	Teaching Hours					Credits	Examination			
					L	T	P	S	Total		CIE	SEE	Total Marks	Exam Hrs.
1	PE	22EC8PE1X	Professional Elective VI	EC	42	-	-	48	90	3	50	50	100	3
2	PE	22EC8PE2X	Professional Elective VII	EC	42	-	-	48	90	3	50	50	100	3
3	PW	22ECPW803	Project Phase-2	EC	-	-	126	114	240	8	50	50	100	3
4	PC	22ECIN804	Internship (Mandatory Non-Credit course)	EC	-	-	-	-	-	-	50	-	50	-
				Total	84	0	126	210	420	14	200	150	350	-

Elective VI	**Elective VII**
22EC8PE11 – Advanced Communication System	22EC8PE21 – Applied Embedded Systems
22EC8PE12 – Low Power VLSI Design	22EC8PE22 – Wireless Sensor Networks
22EC8PE13 – High Performance Computing	22EC8PE23 – Digital Signal Processing for Wireless Communication

Department:Electronics and Communication Engineering	**Semester:**	**7**

Subject: Mobile and Wireless Communications				
Subject Code:	**22EC701**	**L – T – P - S:**	**42-0-28-50 (In Hrs)**	
			Credits	**4**

Sl. No	Course Objectives
1	**Understand** the basics of cellular system concepts.
2	**Learn** various signal propagation mechanisms including large scale and small-scale effects.
3	**Study** multiple access techniques and modulation schemes for mobile communication.
4	**Acquire** the knowledge of wireless standards.

Module	Description	Hrs
I	**Cellular concepts:** Introduction, Cellular Telephone systems and call initiation, Cell structure, frequency reuse, cell splitting, channel assignment, handoff, interference, capacity, power control, Wireless Standards: Overview of 2G to 5G cellular standards. System examples- GSM, EDGE, GPRS, IS-95, CDMA 2000 and WCDMA. (Text 1: 1.1,1.3 to 1.4.4, 2.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 3.1 to 3.7.4)	**9**
II	**Signal propagation:** Introduction, Propagation mechanism-reflection, refraction, diffraction and scattering. Large scale signal propagation, Practical link budget design using path loss models, Outdoor and indoor Propagation models. (Text 1: 4.1 to 4.10.1, 4.10.3 to 4.10.4, 4.11 to 4.11.4)	**9**
III	**Fading channels:** Introduction, Multipath and small scale fading- Doppler shift, power delay profile, average and RMS delay spread, coherence bandwidth and coherence time, flat and frequency selective fading, slow and fast fading, average fade duration and level crossing rate, statistical multipath channel models, Capacity of flat and frequency selective channels. (Text 1: 5.1 to 5.1.2, 5.4 to 5.5.2, 5.7.3, 5.7.4)	**8**
IV	**Antennas and multiple access schemes:** Introduction, Antennas at Cell site and mobile terminal- Smart antennas, Types and applications, Handset considerations, RF antenna characterization and types of handsets, monopole antennas, PIFA, base station antennas and arrays, SDMA Modulation scheme, QAM, MSK and GMSK, M-ary and OFDM. (Text 2: 8.13, 8.15, 8.16 to 8.17.4 Text 1: 9.5, 6.9.2. 6.9.3, 6.10.2 , 6.10.3)	**8**
V	**Receiver structure:** Introduction, Diversity techniques, Practical space diversity considerations -selection and MRC receivers RAKE receiver. Equalization techniques, Maximum Likelihood Sequence	**8**

	Estimation (MLSE) equalizer, multiple antenna communications, MIMO. (Text 1: 7.5, 7.7.2, 7.10,7.10.3, 7.11 Text2: 8.15.4)	

LAB CONTENT

Sl. No	Experiment Description
1	Determine power received using Free space propagation – Path loss model
2	Determine power received using Outdoor propagation model - Okumura model
3	Determine power received using Outdoor propagation model - Hata model
4	Generate orthogonal codes in Code Division Multiple Access (CDMA)
5	Comparison of Bit Error Rate between Coherent and Noncoherent modulation techniques
6	Simulate Rayleigh Fading channel.
7	Simulate of wireless channel Equalizer.
8	Study Constellation diagram of Quadrature Amplitude Modulation (QAM) technique using MATLAB SIMULINK.
9	To study radiation pattern of Dipole antenna using 4NEC2 simulator
10	To study radiation pattern of Yagi-Uda Antenna (3, 5 and 7 – element) using 4NEC2 simulator

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Wireless Communications, Principles and Practice	Theodore S. Rappaport	Prentice Hall, 2nd Edition, 2010
2	Wireless and Cellular Telecommunications	WCY Lee	McGraw Hill, 3rd Edition, 2006

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Mobile communications Design Fundamentals	WCY Lee	Prentice Hall, 2ndEdition, 1993.
2	Wireless communications and Networks	William Stallings	Pearson, 2ndEdition, 2009.
3	Wireless communications	P.Muthu Chidambara Nathan	PHI Publications, 2008.
4	Mobile Radio Communications	Aymond Steele	IEEE Press, 2nd Edition, 1992.

Course Outcomes:

Course outcome	Descriptions
CO1	**Recall** wireless standards for telecommunication applications. (L1)
CO2	**Demonstrate** the effects of fading channels. (L2)
CO3	**Identify** and simulate different models for path loss measurement under different environment. (L3)

CO4	**Apply** various methodologies to improve cellular capacity. (L3)
CO5	**Analyze** multiple access techniques and handoff strategies used in cellular networks.(L4)

Course Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3											
CO2	3	2	2		1								
CO3	2	1	2		1								
CO4		1	1		2	2							
CO5		2	2	2	2	2							

Department:Electronics and Communication Engineering	**Semester:**	**7**

Subject: IoT and its Applications				
Subject Code:	**22EC702**	**L – T – P - S:**	**42-0-28-50 (In Hrs)**	
			Credits	**4**

Sl. No	Course Objectives
1	**Understand** the basic concepts, evolution, and architecture of the Internet of Things (IoT).
2	**Learn** design principles, network protocols, and communication technologies for IoT systems.
3	**Study** skills in prototyping and programming for IoT applications using hardware and software tools.
4	**Identify** the roles of sensors, actuat1ors, and associated cloud technologies in IoT environments.

Module	Description	Hrs
I	**Overview of Internet of Things:** Introduction, IOT definitions,Characteristic and History, IoT Conceptual Framework, IoT Architectural View, Technology Behind IoT, Sources of IoT, M2M communication, Examples of IoT. Modified OSI Model for the IoT/M2M Systems,web communication protocols used by connected IoT/M2M devices, Message communication protocols (CoAP-SMS, CoAP-MQ, MQTT, XMPP) for IoT/M2M devices. (Text 1:1.1 to 1.6 Text 2:2.1-2.3)	**9**
II	**Architecture and Design Principles for IoT:** Introduction, Internet connectivity, Internet-based communication, IPv4, IPv6, 6LoWPAN protocol, IP Addressing in the IoT, Application layer protocols: HTTP, HTTPS, FTP, TELNET and ports, Data Collection, (Text 1: 4.1 to 4.6)	**9**
III	**Prototyping and Designing Software for IoT Applications:** Introduction, Prototyping Embedded device software, Programming Embedded Device Arduino Platform using IDE, Reading data from sensors and devices, Devices, Gateways, Internet and Web/Cloud services software development. (Text 1: 9.1,9.2,9.3)	**8**
IV	**IOT Sensing and actuation :** Introduction, Sensors, Sensor Characteristics, Sensourial deviations, Sensing types, sensing considerations, actuators, actuator types, actuator characteristics. (Text2:5.1 - 5.9)	**8**
V	**Associated IOT Technologies:** Cloud Computing,Introduction to Cloud models , Service level agreement in cloud computing ,cloud implementation, Sensor Cloud Sensors as a service. (Text 2: 10.1 to 10.6,12.1 to 12.2).	**8**

LAB CONTENT

Sl. No	Experiment Description
1	On/off an LED,Buzzer,Relay using Arduino/raspberry pi.
2	program for displaying "SMART CITY TUMKUR" in 16×2 LCD display using Arduino/raspberry pi.

3	Write a program to interface a Stepper motor using Arduino/raspberry pi.
4	Write a program for measuring Temperature & Humidity using Arduino/raspberry pi.
5	Write a program to detect Light Intensity using LDR ,obstacle using Ultrasonic sensor and moisture content using moisture sensor with Arduino/raspberry pi.
6	Write a program for Up-counter/ Down-Counter with 7-segment display using Arduino.
7	Send sensor data to Google Sheets using Arduino + USB + PC + Python bridge
8	Publish and subscribe sensor data using MQTT on Raspberry Pi (e.g., temperature sensor)
9	Remote logging of sensor data to a text file on Raspberry Pi using Python and local network
10	Control an Bulb via HTTP request using Raspberry Pi as a web server

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Internet of Things Architecture and design principles	Raj Kamal	McGraw Hill Education, 1st 2017
2	Introduction to IOT	Sudip Mishra, Anandarup Mukherjee, Arijit Roy	Cambridge University Press 2021

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Introduction to Industrial Internet of Things and Industry 4.0	S Mishra, A Mukherjee, C Roy	Cambridge University Press 2020
2	Rethinking the IOT : A scalable approach to connect everything	Francis DaCosta	Apress Publication, 2013,First Edition

Course Outcomes:

Course outcome	Descriptions
CO1	**Outline** the fundamental concepts and communication protocols of IoT.(L2)
CO2	**Apply** IoT system architecture and related cloud-based technologies.(L3)
CO3	**Interpret** networking concepts and address schemes in IoT-based applications.(L2)
CO4	**Develop** IoT prototypes using sensors, actuators, and Arduino.(L3)
CO5	**Design** and implement secure and scalable IoT systems using modern tools and frameworks.(L4)

Course Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2											
CO2		3		3	2								
CO3	2	1											
CO4			3	2	3						2		
CO5	2			3	2						2		

Department: Electronics and Communication Engineering			**Semester:**	**7**
Subject: Digital Signal Compression				
Subject Code:	**22EC7PE31**	**L – T – P - S:**	**42-0-0-48 (In Hrs)**	
			Credits:	**3**

Sl. No	Course Objectives
1	**Explain** source coding techniques for signal compression.
2	**Summarize** various quantization techniques in digital signal compression.
3	**Outline** the different applications of digital signal compression.
4	**Illustrate** the concepts of audio, image and video compression standards.

Module	Description	Hrs
I	**Introduction to compression techniques**: Introduction, Compression techniques, probability model, markov model, The Kraft-McMillan Inequality, The Huffman Coding Algorithm, Applications of Huffman Coding, Static Dictionary, Adaptive Dictionary, Applications of Adaptive Dictionary. (Text 1:1.1, 2.3.2, 2.3.3, 2.4.3, 3.2, 3.8 ,5.3 to 5.5)	**9**
II	**Quantization** : Introduction ,Uniform Quantizer , Adaptive Quantization, Entropy-Coded Quantization , Advantages of Vector Quantization over Scalar Quantization,LBG algorithm, Tree-Structured Vector Quantizers, Trellis-Coded Quantization.(Text 1:9.4,9.5,9.7,10.3,10.4,10.8)	**8**
III	**Transform coding** : Introduction, Coding: Transforms – DCT, DST, DWHT, Quantization and Coding of Transform Coefficients, Application to Image Compression—JPEG. **Sub-band Coding :** Sub-band Coding,Application to Speech Coding—G.722,Application to Audio Coding—MPEG Audio, Application to Image Compression.(Text 1:13.4 to 13.6,14.4,14.10 to 14.12)	**9**
IV	**Wavelet Based Compression**: Introduction, Wavelets, Multi resolution analysis & scaling function, Implementation using filters, Image compression, JPEG 2000. (Text 1:15.3 to 15.6 and 15.9)	**8**
V	**Video Compression**: Introduction, Motion compensation, Video signal representation, ITU-T Recommendation H.261, The MPEG-1 Video Standard, MPEG-2 Video Standard—H.262 Algorithms, ITU-T Recommendation H.263. (Text 1:18.3 to 18.5 and 18.8 to 18.10)	**8**

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Introduction to Data Compression	Khalid Sayood	2013, Third Edition, Morgan Kaufmann Publishers

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Fundamentals of Multimedia	Z. Li and M.S. Drew.	2014, Second Edition, Pearson Education (Asia) Pte. Ltd.,
2	Data Compression: The Complete Reference	D. Salomon	2007, Fourth Edition, Springer

Course Outcomes:

Course outcome	Descriptions
CO1	**Outline** the principles of various compression techniques applied in digital signal compression.(L2).
CO2	**Interpret** the concepts of different filters for application of speech compression.(L2).
CO3	**Apply** the concepts of transform coding techniques and wavelet techniques for image compression.(L3).
CO4	**Utilize** quantization algorithms for effective data representation.(L3).
CO5	**Analyze** the different algorithms for video compression.(L4).

Course Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3												
CO2	3	1											
CO3		3	2										
CO4		2	2										
CO5		3	3	2							2		

Department: Electronics and Communication Engineering			**Semester:**	**7**
Subject: Advanced Digital Signal Processing				
Subject Code:	**22EC7PE32**	**L – T – P - S:**	**42-0-0-48 (In Hrs)**	
			Credits:	**3**

Sl. No	Course Objectives
1	**Understand** the fundamentals of discrete-time signal processing and analyze multirate signal processing techniques such as decimation and interpolation.
2	**Study** the modern digital signal processing algorithms and applications.
3	Gain in-depth **knowledge** of use of digital systems in real time application
4	**Apply** the algorithms for wide area of recent applications.

Module	Description	Hrs
I	**Introduction to Digital Signal Processing:** Review of Discrete time signals and systems and frequency analysis of discrete time linear time invariant systems, implementation of discrete time systems, correlation of discrete time systems Sampling, decimation by a factor 'D', Interpolation by a factor 'I', sampling rate conversion by a factor 'I/D', Implementation of sampling rate conversion, Multistage implementation of sampling rate conversion. (Text 1- 11.2, 11.3, 11.4, 11.5, 11.6, Text2)	**9**
II	**Multirate Digital Signal Processing:** Multirate signal processing and its applications, Design of Digital filters, Design of FIR filters, Design of IIR filters, frequency transformations, Digital filter banks, two channel quadrature mirror filter banks, Mchannel QMF bank. (Text 1- 11.9, 10.2, 10.3, 10.4,11.10,11.11, 11.12)	**8**
III	**Linear prediction and Optimum Linear Filters:** Random signals, Correlation Functions and Power Spectra, Innovations Representation of a Stationary Random Process. Forward and Backward Linear Prediction. Solution of the Normal Equations. The Levinson-Durbin Algorithm. Properties of the Linear Prediction-Error Filters. (Text 1-12.1, 12.2,12.3,12.4,12.5)	**8**
IV	**Adaptive filters:** Applications of Adaptive Filters-Adaptive Channel Equalization, Adaptive noise cancellation, Linear Predictive coding of Speech Signals, Adaptive direct form FIR filters-The LMS algorithm, Properties of LMS algorithm. Adaptive direct form filters- RLS algorithm. (Text 1- 13.1.2, 13.1.6,13.1.7, 13.2.2,13.2.4, 13.3))	**8**
V	**Power Spectrum Estimation:** Non parametric Methods for Power Spectrum Estimation - Bartlett Method, Welch Method, Blackman &Tukey Methods.Parametric Methods for Power Spectrum Estimation: Relationship between the auto correlation and themodel parameters, Yule and Walker methods for the AR Model Parameters, Burg Method for the AR Model parameters, Unconstrained least-squares method for the AR Model parameters, Sequential estimation methods for the AR Model parameters, ARMA Model for Power Spectrum Estimation. (Text 1-14.2, 14.2.1,14.2.2, 14.2.3, 14.3.1,14.3.2, 14.3.3, 14.3.4, 14.3.5, 14.3.8)	**9**

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Digital Signal Processing Principles, Algorithms, and Applications	John G. Proakis,	Prentice-Hall International Inc., 4th Edition, 2012.

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Discrete-time signal processing.	Oppenheim, Alan V.	Pearson Education India, 1999.
2	Digital signal processing: a computer-based approach.	Mitra, Sanjit Kumar, and Yonghong KuoVolume	Volume 2. New York: McGraw-Hill Higher Education, 2006.

Course Outcomes:

Course outcome	Descriptions
CO1	**Summarize** the principles of sampling, decimation, and interpolation(L2)
CO2	**Implement** digital filter banks for multiband signal processing.
CO3	**Analyse** forward and backward linear prediction of a stationary random process using Levinson-Durbin Algorithm(L3)
CO4	**Apply** LMS algorithm & RLS algorithm to analyze adaptive filters and its application (L3)
CO5	**Utilize** parametric & non-parametric methods for power spectrum Estimation(L3)

Course Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	1		3										
CO2	1	2	2										
CO3	1	3											
CO4	1	3		2									
CO5	2	3											

Department: Electronics and Communication Engineering			**Semester:**	**7**
Subject: Multimedia Communication				
Subject Code:	**22EC7PE33**	**L – T – P - S:**	**42– 0 – 0 – 48 (In Hrs)**	
			Credits:	**3**

Sl. No	Course Objectives
1	**Study** the models of Multimedia Communication.
2	**Understand** the concept of Multimedia Transport in Wireless Networks.
3	**Learn** the Security issues in multimedia networks.
4	**Acquire** the knowledge of real-time multimedia network applications.

Module	Description	Hrs
I	**Multimedia Communications:** Introduction, Multimedia information representation, multimedia networks, multimedia applications, Application and networking terminology, Information representation, text, Images. (Text 1: 1.1 to 1.5, 2.2, 2.3)	**9**
II	**Information Representation:** Introduction, Audio and Video, Distributed multimedia systems, main Features of a DMS, Resource management of DMS, Networking and Multimedia operating systems. (Text 1: 2.4, 2.5 Text-2: 4.1 to 4.5)	**9**
III	**Multimedia Processing in Communication:** Introduction, Perceptual coding of digital Audio signals, Transform Audio Coders, Audio Sub Band Coders. (Text 2: 3.1, 3.2, 3.6, 3.7)	**8**
IV	**Multimedia Communication Standards:** Introduction, MPEG approach to multimedia standardization, MPEG-1, MPEG-2, Overview of MPEG-4. (Text 2: 5.1 to 5.4, 5.5.1)	**8**
V	**Multimedia Communication Across Networks:** Introduction, Packet audio/video in the network environment, Video transport across generic networks, Multimedia Transport across ATM Networks. (Text 2: 6.1 to 6.3)	**8**

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Multimedia Communications	Fred Halsall, K.	Pearson education, 2001.
2	Multimedia Communication	R. Rao, Zoran S.	Pearson education, 2004.

	Systems	Bojkovic, Dragorad A. Milovanovic	

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Multimedia: Computing, Communications and Applications	Ralf Steinmetz, Klara Nahrstedt,	Pearson education, 2002

Course Outcomes:

Course outcome	Descriptions
CO1	**Rephrase** basic methodologies of design and development of multimedia communication and management systems(L1)
CO2	**Analyse** the stages of creating and editing multimedia content such as digitization, editing, coding, compression, transmission, analysis and retrieval of multimedia information(L4)
CO3	**Choose** the best Internet, streaming technologies for multimedia systems(L2)
CO4	**Interpret** problems across different application areas and select the right mechanisms for managing multimedia content. (L3)
CO5	**Evaluate** the performance, quality of service (QoS), and efficiency of multimedia communication systems under different network conditions (L5)

Course Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	1	2								2		
CO2	2	2									2		
CO3	3	1	2			1							
CO4		1	2										
CO5				2		1							

Department: Electronics and Communication Engineering			**Semester:**	**7**
Subject: MEMS AND NANO ELECTRONICS				
Subject Code:	**22EC7PE41**	**L – T – P - S:**	**42 – 0 – 0 – 48 (In Hrs)**	
			Credits:	**3**

Sl. No	Course Objectives
1	**Understand** the physical scaling laws influence the behavior of MEMS devices and assess the operational principles of commonly used MEMS components such as sensors and actuators.
2	**Gain** knowledge of various microfabrication processes and techniques used in MEMS manufacturing.
3	**Analyze** the packaging approaches essential for device protection and functionality.
4	**To Introduce** the principles of nanoelectronics, focusing on fabrication approaches (top-down and bottom-up), and exploring the quantum behavior of light and electrons compared to classical systems at the nanoscale.

Module	Description	Hrs
I	**Overview of MEMS and Microsystems:** Microsystems and microelectronics, Microsystems and miniaturization, Working principle of micro system - Micro sensors, Micro actuators, MEMS with Micro actuators. **Scaling Laws in Miniaturization**-Scaling in Geometry, scaling in Electrostatic Forces, scaling in Electromagnetic Forces, scaling in Fluid Mechanics. **Materials for MEMS** - Substrate & wafer, Si as a substrate material, Si compound, Si Piezo-resistors. (Text 1: 1.4,1.6, 2.2,2.3,2.4, 6.2,6.4,6.5,6.7, 7.2,7.4,7.5,7.6.)	10
II	**Microsystems Fabrication Process:** Photolithography, Ion implantation, Diffusion, Oxidation, Chemical vapor deposition (CVD), Physical vapor deposition, Deposition by Epitaxy, Etching. (Text 1: 8.2,to 8.9)	08
III	**Manufacturing Process:** Introduction, Bulk Micromachining, Surface Micromachining and LIGA Process, Summery of Micromachining. **Microsystems Design:** Design consideration,Process design. (Text1:9.1,to 9.5, 10.2,10.3)	08
IV	**Microsystems Design and Packaging:** Mechanical design using MEMS. Microsystems packaging, interfacings in Microsystems packaging, packaging technology, selection of packaging materials. (Text 1: 10.4,11.3,11.4,11.5,11.8)	08
V	**Introduction to Nano electronics:** “Top-Down approach, “Bottom-Up” approach, nanotechnology potential, comparison of classical and quantum	08

	systems, light as a wave, light as a particle, electrons as particles, electrons as waves. (Text 2: 1.1,1.2,1.3,2.1,2.3,2.4)	

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	"MEMS and Microsystems Design and Manufacturing"	Tai-Ran Hsu, John Wiley and Sons,	2ndEdition, Tata McGraw Hill, 2008.
2	"Fundamentals of Nano Electronics"	George W. Hanson,	Pearson Education India, 2009

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	"Micro and Smart Systems"	G.K. Ananthasuresh, K.J. Vinoy, S. Gopala Krishnan, K.N. Bhat, V.K. Aatre,	1st Edition, Wiley India, 2010.
2	"Introduction to Nanotechnology"	Charles P. Poole, Jr, Frank J. Owens,	John Wiley & Sons, Inc. 2003.

Course Outcomes:

Course outcome	Descriptions
CO1	**Explain** the structure and operation of MEMS and microsystems, including sensors, actuators, and the effects of scaling laws and material properties(L1).
CO2	**Describe** various microsystem fabrication processes such as lithography, ion implantation, and deposition techniques(L2).
CO3	**Compare** and apply different MEMS manufacturing methods including bulk micromachining, surface micromachining, and the LIGA process(L4).
CO4	**Design** simple MEMS-based systems with appropriate packaging and interfacing techniques by considering mechanical and material constraints(L4).
CO5	**Analyze** Nano electronic principles, including quantum effects and nanoscale fabrication approaches, to differentiate classical and quantum systems(L4).

Course Articulation Matrix:

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2											
CO2					2								
CO3	1		1	3									
CO4		1	3		2								
CO5			3	2									

Department: Electronics and Communication Engineering			**Semester:**	**7**
Subject: VLSI Testing and Testability				
Subject Code:	**22EC7PE42**	**L – T – P - S:**	**42-0-0-48 (In Hrs)**	
			Credits:	**3**

Sl. No	Course Objectives
1	**Introduce** the concepts of testing and verification.
2	**Understand** the test generation techniques.
3	**Explore** design-for-testability (DFT) techniques.
4	**Study** memory testing methods.

Module	Description	Hrs
I	**Introduction to Modeling:** Basic Concepts, Functional modeling at the Logic level, Functional Modeling at the Register Level, structural models, Level of Modeling. (Text 1: 2.1 to 2.5)	**8**
II	**Fault modeling:** Defects, Errors, and Faults, Functional v/s Structural testing, Levels of Fault models, Single stuck-at fault: Fault equivalence, Equivalence of single stuck-at faults, Fault collapsing, Fault Dominance and checkpoint theorem. (Text 2: 4.1, 4.2, 4.3, 4.5)	**8**
III	**Logic and fault simulation:** Simulation for design verification, Simulation for test evaluation, Modeling circuits for simulation: Modeling levels and types of simulators, Hierarchical connectivity description, Gate level modeling of MOS Networks, modeling signal states, timing. (Text 2: 5.1 to 5.3)	**9**
IV	**Design for testability:** Ad-Hoc DFT methods, Scan design, scan design rules, Tests for scan circuits, multiple scan register, overheads of scan design, Built-in-self-test: the economic case for BIST, Random logic BIST: Definitions, BIST process, BIST pattern generation, BIST response compaction, built-in logic block observers. (Text 2: 14.1, 14.2, 14.2.1 to 14.2.4, 15.1,15.2.1 to 15.2.5.)	**9**
V	**Test-per-clock BIST systems:**Test-per-scan BIST systems, circular self-test path system, circuit initialization, device level BIST, test point insertion. Memory BIST: Definition, march test SRAM BIST, SRAM BIST with MISR. (Text 2: 15.2.6 to 15.2.11, 15.3, 15.3.1 to 15.3.3)	**8**

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Digital System Testing and Testable Design	M. Abramovici, M. A. Breuer, and A. D. Friedman	IEEE Press,1994.
2	Essentials of Electronic Testing	M.L. Bushnell and V. D. Agarwal	Kluwer Academic Publishers,2000

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Learning Module for the course – VLSI Testing and Testability	Ajai Jain	IIT, Kanpur,2001

Course Outcomes:

Course outcome	Descriptions
CO1	**Understand** the role of test generation and test application in VLSI design flow. (L2)
CO2	**Analyze** different fault models and test generation techniques. (L4)
CO3	**Demonstrate** fault list and test pattern generation for a given gate-level netlist. (L3)
CO4	**Evaluate** and **implement** test strategies for sequential circuits using Design-for-Testability (DFT) techniques.(L3)
CO5	**Design** logic subsystem conforming to testability requirements. (L4)

Course Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	1	1	1									
CO2		1	3	2									
CO3		2	3	3									
CO4		2	3	2									
CO5	2	2	1	1									

Department:Electronics and Communication Engineering			**Semester:**	**7**
Subject: Submicron Devices				
Subject Code:	**22EC7PE43**	**L – T – P - S:**	**42-0-0-48 (In Hrs)**	
			Credits:	**3**

Sl. No	Course Objectives
1	**Understand** the basics of device physics and MOS transistor theory relevant to submicron devices.
2	**Learn** the effects of scaling, short channel effects, and the associated reliability issues in advanced MOS technologies.
3	**Analyze** the performance metrics, trade-offs, and design considerations of modern submicron transistors.
4	**Study** emerging technologies like SOI and ITRS roadmap applicable to submicron and nanoscale device design.

Module	Description	Hrs
I	**Review of Device Physics and MOS Capacitor:** Basics of semiconductor device physics, MOS capacitor theory and characteristics, threshold voltage. Transistor Theory: Basic operation of MOSFETs, characteristics, threshold behavior. Scaling Trends: Moore's Law, evolution of submicron technology. MOS Device Scaling Theory.(Text 1: 1.1 to1.4, 2.1 to 2.6, 4.1 to 4.5)	9
II	**Short Channel Effects and Leakage:** Short channel effects, sub-threshold conduction, punch through, DIBL. High Field Effects: Carrier velocity saturation, mobility degradation, velocity overshoot. Reliability Issues in Scaled Devices. (Text 1: 5.1 to 5.6, 6.1 to 6.4)	9
III	**Advanced Concepts:** Definitions of channel length, impact of scaling on performance, performance metrics of digital technologies. Transistor Design Trade-offs: Power vs. performance, threshold voltage engineering. Technology Case Studies.(Text 1: 6.5 to 6.9, 7.1 to 7.3 Text2: Ch. 7, 8)	8
IV	**SOI Technology:** Introduction to Silicon on Insulator (SOI) devices, partially and fully depleted SOI, floating body effects. SOI for Low Power Applications. (Text1: 8.1 to 8.4 Text2: 9.1 to 9.3)	8
V	**Interconnect and Foundry Technology:** Interconnect limitations in submicron regime, impact on circuit performance, technology integration. Semiconductor Roadmap: ITRS, future trends. (Text1: 9.1 to 9.5)	8

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Integrated Microelectronic Devices: Physics and	J. A. del Alamo	Pearson, 2017

	Modeling		
2	Fundamentals of Modern VLSI Devices	Yuan Taur, Tak H. Ning	Cambridge University Press, 1998

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Solid State Electronic Devices	B. G. Streetman & S. Banerjee	Prentice Hall, 1999
2	Fundamentals of Semiconductor Devices	M. K. Achuthan and K. N. Bhat	McGraw Hill, 2006
3	Semiconductor Devices: Modelling and Technology	Nandita Dasgupta, Amitava Dasgupta	PHI, 2009

Course Outcomes:

Course outcome	Descriptions
CO1	**Outline** the fundamental device physics concepts and MOS operation in submicron regimes.(L2)
CO2	**Identify** the effects of device scaling and analyze performance and reliability trade-offs.(L3)
CO3	**Analyze** emerging device structures such as SOI and their advantages for modern circuits.(L3)
CO4	**Interpret** trends and projections from ITRS for technology planning and design.(L2)
CO5	**Evaluate** the limitations of interconnects and their impact on circuit design in scaled technologies.(L3)

Course Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	1	1				3						
CO2	1	3	2	2									
CO3		2	3	2									
CO4	2	2	2	1									
CO5			3	2	3								

Department:Electronics and Communication Engineering			Semester:	7
Subject: RF IC Design				
Subject Code:	**22EC7PE51**	**L – T – P - S:**	**42-0-0-48 (In Hrs)**	
			Credits:	**3**

Sl. No	Course Objectives
1	**Introduce** the concept of Radio Frequency Integrated system.
2	**Study** different types of key RF circuits.
3	**Learn** the design trade-off of radio frequency communication systems.
4	**Understand** the concepts of High frequency amplifiers, Low Noise amplifiers and RF amplifiers.

Module	Description	Hrs
I	**Wireless Principles:** Introduction, A brief history of wireless systems, Non-cellular wireless applications, Shannon, Modulations & Alphabet Soup, Propagation. Passive RLC Networks: Parallel RLC Tank, Series RLC Networks, Other RLC networks, RLC Networks as impedance Transformers. (Text 1: 2.1–2.6, 3.1–3.4)	
II	**Distributed Systems:** Introduction, Link between lumped and distributed regimes, Driving-point Impedance of Iterated structures, Transmission lines in more detail, Behavior of Finite – length transmission lines. (Text 1: 6.1–6.7)	
III	**High frequency amplifier design:** Introduction, Zeros as bandwidth Enhancers, The shunt –series amplifier, Bandwidth Enhancement with fT-Doublers, Tuned amplifiers, Neutralization and unilateralization, Cascaded amplifiers, AM – PM conversion. (Text 1: 9.1–9.9)	
IV	**Voltage references and biasing:** Introduction, Review of diode behavior, Diodes and bipolar transistors in CMOS technology, Supply – independent bias circuits, Bandgap voltage reference, Constant gm bias. Noise: Thermal noise, Shot noise, Flicker noise, Popcorn noise, Classical two- port noise theory, Examples of noise calculations, A handy rule of thumb, Typical noise performance. (Text 1: 10.1–10.6, 10.8–10.12)	
V	**RF Power Amplifiers:** Introduction, General considerations, Class A, AB, B and C power amplifier. Low noise Amplifier: Introduction, amplifiers with feedback, Noise, linearity , stability, Broad band linear amplifier design example. (Text 1:12.1–12.6, Text-2: 7.1–7.5)	

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	The Design of CMOS Radio Frequency Integrated Circuit	Thomas H. Lee	Cambridge, 2004, 2nd edition.
2	Radio Frequency Integrated Circuits Design	John Rogers	Artech House, 2003.

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Design of Analog CMOS Integrated Circuits,	Behzad Razavi	Tata McGraw Hill, 2005
2	RF circuit design, theory and applications	Reinhold Ludwig, Pavel Bretchko	Pearson Asia Education edition, 2001

Course Outcomes:

Course outcome	Descriptions
CO1	**Summarize** the Wireless systems, RLC networks, Transmission lines, Amplifiers and Mixer. (L2)
CO2	**Analyze** characteristics of RLC Networks. (L2)
CO3	**Compute** the parameters for designing circuit networks of High frequency amplifiers, and RF amplifiers. (L2)
CO4	**Analyze** the operating principles, performance parameters, and application-specific characteristics of different types of RF amplifiers.(L3)
CO5	**Evaluate** the noise characteristics, biasing techniques, and performance trade-offs in RF power amplifiers and low-noise amplifiers for wireless applications. (L3)

Course Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	1	1										
CO2		3	2	1									
CO3		2	3	2									
CO4		3	3	2									
CO5		3	2	1							1		

Department: Electronics and Communication Engineering			**Semester:**	**7**
Subject: Natural Language Processing				
Subject Code:	22EC7PE52	**L – T – P - S:**	**42-0-0-48 (In Hrs)**	
		Credits:	**3**	

Sl. No	**Course Objectives**
1	**Describe** the foundational problems and scope of Natural Language Processing (NLP).
2	**Classify** linguistic features using formal grammar rules and morphological structures.
3	**Explain** the procedures for training and evaluating NLP systems using experimental methods.
4	**Summarize** various NLP techniques used for syntax, semantics, and language modeling.

Module	**Description**	**Hrs**
I	**Natural Language processing (NLP) :** Introduction, Applications or Use cases of NLP, Components of NLP, Steps in NLP, Finding the Structure of Words: Words and Their Components, Lexemes, Morphemes, Morphology, Problems in morphological processing, Typology, Morphological Typology, Natural Language Processing with python NLTK package (Text Preprocessing Tasks): Word Tokenization, Sentence Tokenization, Filtering Stop words, Stemming, Tagging . Parts of Speech, Lemmatization, Chunking, Chinking, Named Entity Recognition, Term Frequency and Inverse Document Frequency (TF-IDF). Text 1: 1.1–1.4 (Text 2: 1.1–1.5, 2.1–2.4, 3.1–3.5, 6.1–6.4, 23.1–23.3)	**9**
II	**Syntax Analysis:** Parsing Natural Language, Tree banks: A Data-Driven Approach to Syntax, Representation of Syntactic Structure: Syntax Analysis using Dependency Graph, Syntax Analysis using Phrase Structure Trees, Parsing Algorithms: Shift Reduce Parsing, Hyper Graphs and Chart Parsing (CYK Parsing), Models for ambiguity Resolution in Parsing: Probabilistic Context Free Grammar, Generative Models, Discriminative models for Parsing. (Text 1: 2.1–2.6 Text 2: 12.1–12.6, 13.1–13.5, 14.1–14.3, 15.1–15.4, 16.1–16.3)	**9**
III	**Language Modeling:** Introduction, N-Gram Models, Language Model Evaluation, Parameter Estimation, Language Model Adaptation, Types of Language Models, Language-Specific Modeling Problems. (Text 1: 3.1–3.4 Text 2: 4.1–4.5, 5.1–5.3, 6.1–6.2, 7.1–7.3)	**8**
IV	**Semantic Parsing:** Introduction, Semantic Interpretation, System Paradigms, Word Sense Systems, Software. (Text 1: 4.1–4.3 Text 2: 17.1–17.4, 18.1–18.3, 20.1–20.2)	**8**
V	**Predicate-Argument Structure:** Meaning Representation Systems, Software. Discourse Processing: Cohesion, Reference Resolution, Discourse Cohesion and Structure. (Text 1: 5.1–5.3 Text 2: 19.1–19.4, 21.1–21.3, 22.1–22.3)	**8**

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Multilingual natural Language Processing Applications: From Theory to Practice	Daniel M.Bikel and Imed Zitouni,	Pearson Publication.
2	Speech and Natural Language Processing-	Daniel Jurafsky & James H Martin,	Pearson Publications.

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Natural Language Processing and Information Retrieval:	Tanvier Siddiqui, U.S.Tiwary.	1st Edition , Oxford University Press

Course Outcomes:

Course outcome	Descriptions
CO1	**Identify** language patterns using formal grammar rules. (L2)
CO2	**Apply** suitable methods for training and evaluating NLP systems. (L3)
CO3	**Build** simple statistical models using probability techniques. (L3)
CO4	**Analyze** different NLP methods using supervised and unsupervised learning techniques.(L4)
CO5	**Explain** the meaning of text using semantic and discourse analysis techniques. (L2)

Course Articulation Matrix:

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2		1								
CO2	2	2	2	2	1								
CO3	2	2	2	2	2								
CO4		2	2	2	2								
CO5	2	2			1						2		

Department: Electronics and Communication Engineering			**Semester:**	**7**
Subject: Optimization Methods in Machine Learning				
Subject Code:	22EC7PE53		**L – T – P - S:**	**42-0-28-50**
			Credits:	**3**

Sl. No	Course Objectives
1	**Summarize** basic concepts of machine learning and the need of optimization.
2	**Understand** the various optimization methods that underlie machine learning methods
3	**Outline** various gradient methods for optimization
4	**Study** convex and cutting plane methods for optimization in machine learning.

Unit	Description	Hrs
I	**Optimization and Machine Learning**: Introduction , Support vector machine, Regularized optimization, algorithms, Vector spaces (Text1 : 1.1- 1.10, text 2: 1.1- 1.3)	**8**
II	**Gradient Methods**: Introduction, Definitions and First Examples, Properties of the Sub differential Set, Directional, Derivatives, Incremental Sub gradient, Proximal Methods, Convergence for Methods with Cyclic Order Convergence for Methods with Randomized Order, Some Applications (Text1 : 3.1-3.3, Text 2:4.1-.4.5)	**9**
III	**Convex Optimization methods in machine learning** : Introduction ,Basic properties, Convexity, black box model, structured optimization (Text 3: 1.1-1.5)	**8**
IV	**Convex Optimization methods in finite dimension:** Introduction, the center of gravity method, ellipsoid method, Vaidya's cutting plane method (Text 3: 2.1-2.3)	**8**
V	**Cutting plane methods in machine learning**: Primal and Dual Projected Sub gradient Methods Introduction, Regularized Risk Minimization, Multiple Kernel Learning, MAP Inference in Graphical Models, (Text 1: 8.1-8.3, Text 2: 7.1-7.4)	**9**

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	First-Order Methods in Optimization	Amir Beck	Kivmars Bowling publisher, II vol, 2018
2	Optimization for Machine Learning	Suvrit Sra, Sebastian Nowozin, and Stephen J.	MIT Press,vol 1, 2021

		Wright	
3.	Convex Optimization: Algorithms and Complexity	Sébastien Bubeck	Bubeck , Vol 8, 2015

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	The LION Way: Machine Learning plus Intelligent Optimization	Roberto Battiti, Mauro Brunato.	Lionsolver, Inc. 2013.
2	Learning with Submodular Functions: A Convex Optimization Perspective"	F. Bach,	Foundations and Trends in Machine Learning, Now Publishers Inc, vol 2, 2018

Course Outcomes:

Course outcome	Descriptions
CO1	**Comprehend** the various techniques and applications for optimization. (L1)
CO2	A**nalyze** characteristics of gradient methods and various methods for convergence.(L2)
CO3	**Summarize** cutting plane methods and convex optimization methods (L2)
CO4	**Apply** basic concepts of mathematics to formulate an optimization problem(L3)
CO5	**Outline** cutting plane methods in machine learning(L2)

Course Articulation Matrix:

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	1		1										
CO2		2											
CO3		3	2										
CO4	1												
CO5	1												

Department: Electronics and Communication Engineering			**Semester:**	**7**
Subject: Project Phase-I				
Subject Code:	**22ECPW706**		**L – T – P - S:**	**0-0-28-32**
			Credits:	**2**

Description
1. Students (maximum-4) shall carry out a detailed survey on the area and the topic on which they are interested to do the Project work. 2. Students are instructed to prepare synopsis of three different topics with tittle of the project work and submit to class teachers. 3. Project Evaluation Committee will review the synopsis and suggest suitable title in relevance to the recent trends in Electronics and Communication Engineering domain. 4. Students are instructed to give a detailed presentation and justify the tittle of the project with problem definition. 5. Get the observations and recommendations in the dairy from the respective Guide with signature and Submit the project dairy to HoD. 6. Project work Seminar consists of overview of the Project work: Introduction, Literature Survey (minimum-10 papers related to the topic), problem statement, motivation, objectives, proposed methodology for solving societal problems. 7. **Evaluation Scheme:** Continuous evaluation will be done by respective Project Guides and PEC members based on the Regularity, Technical Knowledge and Competence, Programming Skills, Communication Skills, Demonstration skills, Collaborative Learning and Documentation Skills of the students. NOTE: **Maintain project work dairy**: Frequently monitored (every 15 days) by the respective guide.

Course Outcomes:

Course Outcome	**Descriptions**
CO1	**Identify** the problem in the specified area by literature survey. (L2)
CO2	**Apply** the proposed methodology for solving the problems. (L3)

CO3	**Interpret** Hardware and software tools for implementation of project work. (L3)

Course Articulation Matrix:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3							3			3		
CO2	2		2			2							
CO3			3			2			3	3		2	

Department: Electronics and Communication Engineering			**Semester:**	**7**
Subject: Technical seminar				
Subject Code:	**22ECTS707**		**L – T – P - S:**	**0-0-0-30**
			Credits:	**1**

Description
1. Selection of topic/area: • Each Student shall carry out a detailed survey on the area and the topic on which they are interested to present the Technical seminar. • Student are instructed to prepare the abstract of three different topics with tittle of the Technical seminar and submit to class teachers. • Evaluation Committee members will review the abstract of the topic and suggest suitable title in relevance to recent trends in Electronics and Communication Engineering domain. • Student are instructed to give a detailed presentation and justify the tittle of the paper with recent trends and applications. • Presentation consists of Overview of the topic: Introduction, Literature Survey (minimum-06 papers related to the topic), recent trends and applications. 2. **Evaluation Scheme:** Continuous evaluation will be done by respective Guide and Evaluation Committee members based on Technical Knowledge and Competence,Communication Skills, Presentation skills (Slide preparation) and report submission.

Course Outcomes:

Course Outcome	Descriptions
CO1	**Outline** the recent technologies relevant to the topic selected. (L2)
CO2	**Interpret** the impact of the technology on the society, environment and domain. (L3)
CO3	**Compile** and present the report of the study made. (L3)

Course Articulation Matrix:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3					2					1		
CO2	3	2		2							2		
CO3									3	2			

Department: Electronics and Communication Engineering			**Semester:**	**8**
Subject: Advanced Communication System				
Subject Code:	**22EC8PE11**	**L – T – P - C:**	**42-0-0-48 (In Hrs)**	
		Credits:	**3**	

Sl. No	Course Objectives
1	**Understand** and represent signals and modulated waveforms using low-pass equivalents and study digitally modulated schemes in both power-limited and band-limited environments.
2	**Study** the optimal detection techniques and evaluate performance of coherent and non-coherent receivers for modulation schemes with and without memory over vector and AWGN channels.
3	**Learn** equalization techniques—linear, non-linear, and adaptive—to mitigate inter-symbol interference in bandlimited channels and enhance receiver performance.
4	**Explore** and assess emerging technologies in 5G wireless communication, including advanced waveforms like OTFS, NOMA, IRS, and physical layer security, with a focus on performance optimization

Unit	Description	Hrs
I	**Signal Representation**: Low pass representation of bandpass signals, Low pass representation of bandpass random process [Text 1, Chapter 2:2.1, and 2.9 only]. **Modulation**: Representation of digitally modulated Signals, Modulation Schemes without memory (Band Limited Schemes - PAM, BPSK, QPSK, MPSK, MQAM, Power Limited Schemes – FSK, MFSK, DPSK), modulation schemes with memory (Basics of CPFSK and CPM – Full Treatment of MSK), Transmit PSD for Modulation Schemes. (Section 3.4) [Text 1, Chapter 3:3.1, 3.2 and 3.3].	**9**
II	**Demodulation**: Vector Channel, Vector Channel +AWGN, Performance parameters, Optimum Coherent Detection for power limited and Bandlimited schemes, Optimal Coherent detection for schemes with memory, Optimal Non– Coherent detection for schemes without and with memory (FSK, DPSK), [Text 1, Chapter 4: 4.1, 4.2.- 4.2.2, 4.3, 4.4, 4.5.1, 4.5.2, 4.5.5 and 4.6].	**8**
III	**Bandlimited Channels**: Bandlimited channel characterization, signaling through band limited linear filter channels, Sinc, RC, Duobinary and Modified Duobinary signaling schemes, Optimum receiver for channel with ISI and AWGN. **Linear Equalizers**: Zero forcing Equalizer, MSE and MMSE, Baseband and Passband Linear Equalizers. (Excluding 9.4-3, 9.4-4) [Text 1, Chapter 9: 9.1, 9.2 - 9.2.1,9.2.2, 9.2.3, 9.3-9.3.1, 9.3.2 and 9.4].	**8**
IV	**Non-Linear Equalizers**: Decision - feedback equalization, Predictive DFE, Performance of DFE [Text 1, Chapter 9: 9.5: 9.5-1 only] .	**8**

	Adaptive equalization: Adaptive linear equalizer, adaptive decision feedback equalizer, Adaptive Fractionally spaced Equalizer (Tap Leakage Algorithm), Adaptive equalization of Trellis - coded signals [Text 1, Chapter 10: 10.1, 10.1- 1, 10.1-2, 10.1-3, 10.1-6,10.1-7, 10.2, 10.3].	
V	**Introduction:** 5G New radio frame structure, Numerology, Standardization, Review of orthogonal frequency division multiplexing **Waveforms:** Orthogonal time frequency space, non-orthogonal multiple access, Index modulation, Spatial modulation, intelligent reflecting surface,Physical Layer Security [Text 2: Chapter 1&2, 5.4,5.9,7.1,7.2 ,7.3, Chapter 11, Chapter 20, Text 3: 1.3, 2.7, 5.1,6.1, Chapter 7]	**9**

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	**"Digital Communications"**	John G. Proakis	Pearson Education, ISBN:978-9332535893, 5th edition, 2014
2	**5G NR: The Next Generation Wireless Access Technology"**	Erik Dahlman	Elsevier, 2E, 2020
3	**5G Physical Layer: Principals, Models and Technology Components**	Ali Zaidi	Academic Press, 2018

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	"Digital Communications- Fundamentals and Applications"	Bernard Sklar	Pearson Education (Asia) Pvt. Ltd, 2nd Edition, 2014, ISBN: 1292026065, 9781292026060.
2	"Wireless Communications"	Andrea Goldsmith	Cambridge University Press, 2005.
3	'Digital Communications Systems'	Simon Haykin	Wiley, ISBN:9788126542314, 1st edition, 2014

Course Outcomes:

Course outcome	Descriptions
CO1	**Apply** the concepts of low pass and Bandpass signals representations at the Transmitter, the process of Detection and Estimation at the receiver in the presence of AWGN. (L2)
CO2	**Interpret** the Receiver performance for various types of single carrier symbol modulations through ideal and AWGN Non-bandlimited and bandlimited channels. (L3)
CO3	**Analyze** and demonstrate the model of discrete time channel with ISI & the model of discrete time channel by equalizer.(L4)
CO4	**Outline** the modulation techniques used in 5G systems, highlighting their spectral efficiency, robustness, and suitability for different channel conditions.(L2)
CO5	**Evaluate** different modulation waveforms based on performance metrics such as bandwidth efficiency, power efficiency, and error rate in various communication environments.(L3)

Course Articulation Matrix:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1		3	3							2			
CO2		2											
CO3		3	3	3						2			
CO4	3												
CO5		2	1										

Department: Electronics and Communication Engineering			**Semester:**	**8**
Subject: Low power VLSI Design				
Subject Code:	**22EC8PE12**	**L – T – P - S:**	**42-0-0-48 (In Hrs)**	
			Credits:	**3**

Sl. No	Course Objectives
1	**Understand** the power optimization techniques and trade off in digital circuits.
2	**Study** the power estimation at different abstract levels.
3	**Acquire** the knowledge of generic and special techniques for low power system design.
4	**Learn** the software co-design in low power design.

Module	Description	Hrs
I	**Low Power VLSI Design and Analysis:** Introduction to low power VLSI design, need for low power, charging and discharging capacitance, short-circuit current in CMOS, CMOS leakage current -Static current, basic principles of low power design. (Text 1: 1.1 to 1.6)	**9**
II	**Simulation and Probabilistic Power Analysis:** Introduction, Spice circuit simulation, discrete transistor modeling and analysis, gate level logic simulation, architecture level analysis, probabilistic power analysis-random logic signal, probability and frequency, power analysis techniques, signal entropy. (Text 1: 2.1 to 2.6, 3.1 to 3.4)	**9**
III	**Circuit level and Logic Level Design Techniques:** Introduction, Circuit- transistor and gate sizing, pin ordering, network restructuring and reorganization, logic-gate reorganization, signal gating, logic encoding, pre-computation logic.(Text 1: 4.1 to 4.3, 5.1 to 5.3,5.5)	**8**
IV	**Special Low Power VLSI Design Techniques:** Introduction, Power reduction in clock networks, CMOS floating node, Delay balancing, Switching activity reduction, parallel architecture voltage reduction, operator reduction, loop unrolling. (Text 1: 6.1 to 6.4, 7.2 to 7.4)	**8**
V	**Software Design and Power Estimation:** Introduction, Low power circuit design style, sources of software power dissipation, software power estimation, co-design for low power. (Text 2: 7.6,7.7 8.1 to 8.4)	**8**

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Practical Low Power Digital VLSI Design	Gary Yeap	Springer US, Kluwer Academic Publishers, 2002.
2	Low power CMOS VLSI circuit design	Kaushik Roy, Sharat C. Prasad	Wiley Inter science Publications, 2000.

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Low Voltage Low Power VLSI Subsystems	Kiat-Seng Yeo, Kaushik Roy	Tata Mc-Graw Hill, 2017
2	Low Power Design Methodologies	Jan M. Rabaey, Massoud Pedram	Springer,1996
3	Low Power Design Essentials	Jan Rabaey	Springer,2009

Course Outcomes:

Course outcome	Descriptions
CO1	**Outline** the need for low power design and different sources of power dissipation in CMOS circuits. (L2)
CO2	**Interpret** the simulation and probability techniques for power analysis (L2)
CO3	**Apply** the different power optimization technique at various levels of abstraction. (L3)
CO4	**Identify** the special power optimization techniques for low power applications. (L2)
CO5	**Analyze** the different sources of software power and their considerations in low power co-design. (L2)

Course Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	1												
CO2		2											
CO3	1	3	2										
CO4			2										
CO5		2	1										

Department: Electronics and Communication Engineering		**Semester:**	**8**
Subject: HIGH PERFORMANCE COMPUTING			
Subject Code:	**22EC8PE13**	**L – T – P - S:**	**42 – 0 – 0 – 48 (Hrs.)**
		Credits:	**3**

Sl. No	Course Objectives
1	**Study** the trends in parallel programming.
2	**Understand** basic ideas of multiprocessing and parallel operations with case studies.
3	**Acquire** the Principles of Parallel Algorithm design.
4	**Learn** parallel programming using MPI, OpenAcc and OpenMP

Unit	Description	Hrs
I	**Multiprocessors and Thread level parallelism:** Introduction, Symmetric shared memory architectures; Performance of symmetric shared-memory multiprocessors, Distributed shared memory and directory-based coherence, Basics of synchronization, Models of memory consistency. (Text 1: 1.1–1.4, 2.2, 2.4, 4.3)	**9**
II	**Data-Level Parallelism in Vector:**SIMD, and GPU Architectures Introduction, Vector Architecture, SIMD Instruction Set Extensions for Multimedia, Graphics Processing Units, Detecting and Enhancing Loop-Level Parallelism, Mobile versus Server GPUs and Tesla versus Core i7 (Text 2: 1.1–1.4, 2.2, 2.3, 3.1)	**9**
III	**Introduction to Parallel Programming:** Motivation, Scope of Parallel Computing, Principles of Parallel Algorithm design: Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for containing Interaction Overheads, Parallel Algorithms Models. (Text 1: 4.1–4.6, 5.1–5.5)	**8**
IV	**Programming Using the Message Passing Paradigm :** Principles of Message Passing Programming, Building Blocks, MPI, Topologies and Embedding, Overlapping Communication with computation, Collective Communication and computation operations, Groups and Communicators. (Text 1: 6.1–6.7)	**8**
V	**GPU Programming using OpenACC Serial to parallel programming using OpenACC:** A Simple Data-Parallel Loop, Task-Parallel Example, Amdahl's Law and Scaling, Parallel Execution and Race Conditions, Lock-Free Programming, Controlling Parallel Resources. Pipelining data transfers with OpenACC Introduction to Pipelining, Mandelbrot Generator, Pipelining Across Multiple Devices. (Text 2: 7.1–7.5, 8.1–8.3)	**8**

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Introduction to Parallel Computing,	Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar,.	2nd Edition, 2013, Pearson Education, ISBN 13: 9788131708071
2	CUDA Programming: A Developers Guide to Parallel Computing with GPUs,	Shane Cook,	1 st Edition, 2013, Morgan Kaufmann, ISBN:9780124159334.

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Parallel Programming with Open ACC	Rob Farber	1st Edition, 2016, Morgan Kaufmann (MK) Publication, ISBN :9780124103979
2	ARM System Developers Guide,	Andrew N Sloss, Dominic Symes, Chris Wright, Elsevier	Morgan Kaufman publishers, 2008, ISBN-13:9788181476463
3	Parallel Programming: Techniques and Applications Using Networked Workstations and Parallel Computers,	Wilkinson and M. Allen	2/E, Prentice Hall, 2005

Course Outcomes:

Course outcome	Descriptions
CO1	**Outline** the fundamentals of high-performance computing concepts. (L2)
CO2	**Interpret** the performance of parallel programming. (L2)
CO3	**Design** parallel computing constructs for different applications. (L3)
CO4	**Apply** Parallel Algorithm (L3)
CO5	**Analyze** GPU Programming using OpenACC (L3)

Course Articulation Matrix:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	1												

CO2			2										
CO3	1		3	2									
CO4		2	3	3	2								
CO5		2		1									

Department:Electronics and Communication Engineering			Semester:	8
Subject: Applied Embedded Systems				
Subject Code:	**22EC8PE21**	**L – T – P - S:**	**42-0-0-48 (In Hrs)**	
			Credits:	**3**

Sl. No	Course Objectives
1	**Understand** the implementation and applications of the embedded system.
2	**Learn** the historical background of real-time systems and its classifications.
3	**Study** the various software development approaches and a operating system services required.
4	**Acquire** the knowledge of languages to develop software for real- time Applications

Module	Description	Hrs
I	**Real-Time Systems:** Introduction, Historical background, Elements of a Computer Control System, RTS-Definition, Classification- time Systems, Time Constraints, Classification of Programs. Concepts of Computer Control: Introduction, Sequence Control, Loop Control, Supervisory Control, Centralized Computer Control, Hierarchical Systems. (Text 1: 1.1 to 1.6 and 2.1 to 2.6)	9
II	**Embedded controller (PIC) CPU architecture and instruction sets:** Introduction, Hardware architecture and pipelining, program memory consideration, Register file structure and Addressing modes, CPU register, Instruction set, Loop time subroutine, Timer2 and Interrupts: Timer2 use interrupt logic, Timer2 Scalar Initialization. External interrupts and Timers: Timer0 Compare/capture mode, Timer1/CCP programmable period scalar. Timer1 and sleep mode, PWM O/P Port B change interrupts. (Text 2: 2.1 to 2.6, 2.9 to 2.10, 2.12)	9
III	**Computer Hardware Requirements for Real-Time Applications:** Introduction, General Purpose Computer, Single Chip Microcomputers and Microcontrollers, Specialized Processors, Process-Related Interfaces, Data Transfer Techniques, Communications, Standard Interface. (Text 1 : 3.1 to 3.8)	8
IV	**Operating Systems:** Introduction, Real-Time Multi-Tasking OS, Scheduling Strategies, Priority Structures, Task Management, Scheduler and Real-Time Clock Interrupt Handler, Memory Management, Code Sharing, Resource Control, Task Co-Operation and Communication, Mutual Exclusion. (Text 1: 6.1 to 6.11)	8
V	**Embedded RTOS Inter process communication:** Introduction, Process Management, Timer Functions , Event Functions, Memory management, Device, File, and IO Subsystems Management, Interrupt Routines in RTOS environment and handling of interrupt source calls by RTOS, Introduction to Real Time Operating System, Basic Design Using a Real Time Operating System, RTOS Task Scheduling Models, Latency,	8

	Response Times, Deadline as Performance Metric, Latency and Deadlines as Performance Metric in Scheduling Models For Periodic, Sporadic and Aperiodic Tasks, CPU Load as Performance Metric, Sporadic Task Model Performance Metric. OS security issues. (Text 3 : 8.1 to 8.11)	

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Real-Time Computer Control	Stuart Bennet	Pearson Education, 2nd Edition, 2008.
2	Design with PIC Microcontrollers	John BPitman	Pearson Education, 1st Edition, 1996.
3	Embedded Systems: Architecture and Programming	Raj Kamal	Mcgraw Hill, 2nd Edition, 2008.

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Real-Time Systems Analysis	Phillip. A. Laplante	Prentice Hall, 2nd Edition, 2005.
2	Real –Time Systems	C.M. Krishna, Kang G. Shin	McGraw –Hill, , 3rd Edition, 1997.

Course Outcomes:

Course outcome	Descriptions
CO1	**Describe** the fundamentals of real-time systems, computer control systems, and time constraints.(L2)
CO2	**Classify** different types of real-time programs and control models such as sequence, loop, and supervisory control.(L3)
CO3	**Explain** the architecture, instruction set, and timer functionalities of PIC microcontroller.(L3)
CO4	**Analyze** various hardware components, data transfer techniques, and standard interfaces for real-time embedded systems.(L4)
CO5	**Evaluate** task scheduling, memory management, and communication strategies in real-time operating systems.(L4)

Course Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2											
CO2	3	2	1										
CO3	3	3	2										
CO4	3	3	2	2	2								
CO5	3	3	3	2	2								

Department:Electronics and Communication Engineering			Semester:	8
Subject: Wireless Sensor Networks				
Subject Code:	**22EC8PE22**	**L – T – P - S:**	**42-0-0-48 (In Hrs)**	
			Credits:	**3**

Sl. No	Course Objectives
1	**Acquire** the knowledge of the fundamentals of wireless sensor networks including its critical real time applications.
2	**Study** the different protocols related to different layers and its difference with conventional protocols.
3	**Understand** the issues in relevant to the sensor networks and the challenges demanded in managing and maintaining sensor networks.
4	**Explore** quality of service (QoS) and energy management strategies essential for efficient sensor network performance and sustainability.

Unit	Description	Hrs
I	**Introduction:** Fundamentals of Wireless communication technology; The Electromagnetic spectrum; radio propagation; characteristics of wireless channels; modulation techniques; multiple access techniques; wireless LANs, PANs, WANs, and MANs; wireless internet.(Text 1: 1.1 to 1.6, 2.1, 2.2, 2.5, 2.5.1, 3.1, 3.2, 3.2.1, 4.1, 4.2)	**10**
II	**Adhoc/ sensor networks:** Key definitions of Adhoc/ sensor networks, unique constraints and challenges, advantages of Adhoc/sensor networks, driving application, issues in adhoc wireless networks, issues in design of sensor network, sensor network architecture, data dissemination and gathering.(Text 1: 5.1 to 5.3)	**8**
III	**MAC protocols:** Issues in designing MAC protocols for adhoc wireless networks, design goals, classification of MAC protocols, MAC protocol for sensor network, location discovery, quality, other issues, S-MAC, IEEE 802.15.4.(Text 1: 6.2 to 6.8)	**8**
IV	**Routing Protocols:** Issues in designing a routing protocol, classification of routing protocols, table driven, on demand, hybrid, flooding, hierarchical, and power aware routing protocols.(Text 1: 7.1 to 7.9)	**8**
V	**QoS and Energy management:** Issues and challenges in providing QoS, classifications, MAC, network layer solutions, QoS frameworks, need for energy management, classifications, Battery, transmission power and system power management schemes.(Text 1: 10.1 to 10.5, 10.57, 11.2 to 11.6)	**8**

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Ad Hoc Wireless Networks	C. Siva Ram Murthy and B. S. Manoj	Pearson Education,2nd edition, 2008.
2	Wireless Sensor networks,	Kazem Sohraby,	John Wiley & Sons, Inc1st

	Technology Protocols & Architectures	Daniel Minoli, Taieb Znayi	Edition 2007.

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Wireless Sensor Networks	Feng Zhao and Leonidas J. Guibas	.Elsevier, 2004.
2	Mobile Communications	Jochen Schiller	Pearson Education, 2nd Edition, 2003.
3	Wireless Communications and Networks	William Stallings,	Pearson Education, 2004.

Course Outcomes:

Course outcome	Descriptions
CO1	**Outline** the significance of wireless channel and wireless network standards.(L2)
CO2	**Illustrate** the characteristics of MAC protocols, QoS and Energy management techniques in wireless Adhoc Networks.(L2)
CO3	**Summarize** different MAC routing protocols of adhoc/ sensor networks.(L3)
CO4	**Analyze** various critical parameters of node deployment, location discovery, QoS and Energy management issues.(L4)
CO5	**Classify** different routing protocols and multiple access techniques (L2)

Course Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2											
CO2		3	2										
CO3		2	3	2									
CO4		3	2	3			1						
CO5	1	1											

Department: Electronics and Communication Engineering		**Semester:**	**8**
Subject: DSP for Wireless Communication			
Subject Code:	**22EC8PE23**	**L – T – P - S:**	**42 – 0 – 0 – 48(Hrs)**
		CREDITS	**3**

Sl. No	Course Objectives
1	**Develop** a thorough understanding of physical and statistical models of wireless channels.
2	**Analyze** and design DSP techniques to mitigate multipath fading and optimize link performance.
3	**Apply** multiple access (TDMA/FDMA/CDMA/OFDM) and MIMO signal-processing techniques in modern wireless systems.
4	**Compare** and evaluate DSP techniques used across various wireless standards (GSM, WCDMA, LTE, IS-95, 5G).

Unit	Description	Hrs.
I	**Physical Wireless Channel Modeling:** Covers input/output models for wireless channels, impulse response of LTV systems, and baseband equivalents. Discusses delay and Doppler spreads, coherence time and bandwidth, and introduces Jakes model for simulating fading. (Text 1 :1.1–2.3)	9
II	**Statistical Channel Models:**Introduces statistical models including Rayleigh and Rician fading, non-coherent detection, and channel measurement using probing signals. Covers Rake receiver, Jakes spectrum, and large-scale fading models like Okumura, Hata, and log-normal shadowing.(Text 1: 3.1 – 4.5)	9
III	**Statistical Channel Models:** Introduces statistical models including Rayleigh and Rician fading, non-coherent detection, and channel measurement using probing signals. Covers Rake receiver, Jakes spectrum, and large-scale fading models like Okumura, Hata, and log-normal shadowing. (Text 1: 5.1 – 6.4)	8
IV	**Multiple Access and OFDM:** Explains TDMA, FDMA, CDMA (with PN sequences), Rake receiver, and multicarrier modulation. Focuses on OFDM structure, cyclic prefix, frequency offset, and PAPR problems. (Text 1: 7.1 – 8.3)	8
V	**MIMO and Wireless Standards :** Discusses MIMO capacity, diversity, spatial multiplexing, and beamforming. Reviews standards: GSM, IS-95, WCDMA, LTE, 5G NR, and video over wireless. (Text 1: 9.1 – 10.2; Text 2: 7)	8

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Digital Signal Processing for Wireless Communication Using MATLAB	E.S. Gopi	Springer, 2016
2	Wireless Communication Principles	T.S. Rappaport	Pearson, 2002
3	Wireless Communication (MIT Open Courseware)	Robert Gallager	MIT OCW, 2006

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Advanced 3G and 4G Wireless Mobile Communications (NPTEL Lectures)	A.K. Jagannatham	IIT Kanpur, NPTEL
2	Fundamentals of LTE	Christophe F. Mecklenbräuker, Martin Taranetz	Wiley, 2010
3	5G NR: The Next Generation Wireless Access Technology	Erik Dahlman, Stefan Parkvall, Johan Sköld	ISBN-10: 0128143231 August 17/31, 2018

Course Outcomes:

Course outcome	Descriptions
CO1	**Understand** characterize of wireless channels using physical and statistical parameters (L2).
CO2	**Analyze** link budgets, including path-loss, fading margins, and traffic engineering aspects(L4).
CO3	**Design** multipath diversity receivers (RAKE) and multi-carrier (OFDM) systems, considering PAPR and ICI(L4).
CO4	**Compare** and evaluate DSP techniques used in various multiple access schemes and MIMO/OFDM-based wireless systems(L4).
CO5	**Apply** MATLAB or equivalent tools to simulate and analyze real-world wireless communication scenarios(L3).

Course Articulation Matrix:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3												
CO2	2	2											
CO3	2		3										
CO4		1		2									
CO5		2			2								

Department: Electronics and Communication Engineering			**Semester:**	**8**
Subject: Project Work Phase-2				
Subject Code:	**22ECPW803**		**L – T – P - S:**	**0-0-126-114**
			Credits:	**8**

Description
1. Each project group are instructed to demonstrate the partial outcome of the project during beginning of the final semester. 2. Each project group are instructed to meet the guide for reviewing the progress with dairy. 3. Get the observations and recommendations in the dairy from the respective Guide with signature and Submit the project dairy to HoD. 4. After completion of the project work, each group need to make an arrangement for final demonstration at Department/Institution/Industry. 5. Final presentation includes: Introduction, Literature Survey, problem statement, motivation, objectives, proposed methodology, implementation details, Software/Hardware tools used and experimental results for fulfilling the defined objectives and conclusion of the project work. 6. Final report submission as per guidelines of Department. Note: All the above activities in adherence with calendar of events of the department (Late submission will not be permitted).

Course Outcomes:

Course outcome	Descriptions
CO1	**Design** and Implement the work using appropriate Hardware and Software tools. **(L6)**
CO2	**Test** the performance of the system with suitable data. (L3)
CO3	**Analyze** and compare earlier results with obtained results. (L4)
CO4	**Work** effectively as an individual and team member to manage tasks, documentation, and project milestones.(L3)

CO5	**Present** and defend project outcomes effectively through oral and written communication.(L3)

Course Articulation Matrix:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1			3	3	2		2					3	
CO2		2				2			2				
CO3		2		2						2			
CO4						2	2	3	2	2	1		
CO5								2	3	2			

Department: Electronics and Communication Engineering			Semester:	8
Subject: Internship(Mandatory Non Credit Course)				
Subject Code:	**22ECIN804**			

Description
1) Each student must undergo a full-time internship at an industry/research organization/institute approved by the department, during the prescribed period in the final semester.
2) Students are required to maintain a detailed internship diary/logbook with regular entries on activities, tasks, tools learned, and observations during the internship.
3) Students must regularly communicate with the internal guide and obtain periodic reviews of their progress.
4) The logbook must include observations and recommendations from the industry supervisor, duly signed and verified by the concerned authority.
5) On completion of the internship, the student should prepare a comprehensive report containing: company profile, internship objectives, work carried out, skills acquired, challenges faced, tools/technologies used, outcomes achieved, and conclusion.
6) The student shall make a final presentation of their internship experience to a department evaluation committee.
7) The internship report must be submitted to the department as per the specified format and guidelines.
Note: All internship-related activities must strictly adhere to the department's calendar of events. Late submissions or failure to comply with requirements will not be permitted.

Course Outcomes:

Course outcome	Descriptions
CO1	**Apply** engineering knowledge and professional skills to solve real-world problems in industry or research environments.(L3)
CO2	**Analyze** the structure, workflow, and project management practices of the

	host organization to identify areas for innovation or improvement.(L4)
CO3	**Develop** technical documentation and reports that reflect practical experiences and learning outcomes.(L4)

Course Articulation Matrix:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1		2	3		3				2		3	3	2
CO2		2	3	2				3	3				2
CO3		2		2		3	2			2	3		2