ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
M.TECH IN DIGITAL ELECTRONICS AND COMMUNICATION SYSTEMS (DECS)
AK 25 REGULATIONS

SEMESTER – I

S. No	Course Codes	Course Name	Category	Hours per week			Credits	CIE	SEE	Total
				L	T	P				
1.	25DPC3801	Advanced Digital System Design	PC	3	0	0	3	40	60	100
2.	25DPC3802	Wireless Communication and Networks	PC	3	0	0	3	40	60	100
3.	25DPE3801 25DPE3802 25DPE3803	**Program Elective – I** Design for Testability VLSI Technology and Design SoC Architecture	PE	3	0	0	3	40	60	100
4.	25DPE3804 25DPE3805 25DPE3806	**Program Elective – II** Software Defined Radio Optical Communication and Networks 5G Communications	PE	3	0	0	3	40	60	100
5.	25DPC3803	Advanced Digital System Design Lab	PC	0	0	4	2	40	60	100
6.	25DPC3804	Wireless Communication and Networks Lab	PC	0	0	4	2	40	60	100
7.	25MBA0110	Research Methodology and IPR	MC	2	0	0	2	40	60	100
8.	25DSE3801	RTL Synthesis, Simulation and Verification	SE	0	1	2	2	40	60	100
9.	25DAC9901 25DAC2001 25DAC9902	Audit Course – I English for Research paper Writing Disaster Management Essence of Indian Traditional Knowledge	AC	2	0	0	0	40		40
Total				**16**	**01**	**10**	**20**	**360**	**480**	**480**

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
M.TECH IN DIGITAL ELECTRONICS AND COMMUNICATION SYSTEMS (DECS)
AK 25 REGULATIONS

SEMESTER – II

S. No.	Course Code	Course Title	Category	Hours per week			Credits	CIE	SEE	Total
				L	T / CLC	P	C			
1	25DPC3805	Network Security and Cryptography	PC	3	0	0	3	40	60	100
2	25DPC3806	Advanced Communications and Networks	PC	3	0	0	3	40	60	100
3	25DPE3807 25DPE3808 25DPE3809	**Program Elective– III** EmbeddedReal-Time Operating Systems Communication Buses and Interfaces Embedded Systems Protocols	PE	3	0	0	3	40	60	100
4	25DPE3810 25DPE3811 25DPE3812	**Program Elective– IV** Cognitive Radio Image and Video Processing Adhoc and Wireless Sensor Networks	PE	3	0	0	3	40	60	100
5	25DPC3807	Network Security and Cryptography Lab	PC	0	0	4	2	40	60	100
6	25DPC3808	Advanced Communications and Networks Lab	PC	0	0	4	2	40	60	100
7	25DMC5801	Quantum Technologies and Applications	MC	2	0	0	2	40	60	100
8	25DPC3809	Comprehensive Viva voce	PC	0	0	0	2	0	100	100
9	25DAC9903 25DAC0101 25DAC5801 25DAC9001 25DAC9904	**Audit Course – II** Sanskrit for Technical Knowledge Business Ethics and Corporate Governance System Modeling Principles of Automation Stress Management By Yoga	AC	2	0	0	0	40		40
Total				**16**	**0**	**8**	**20**	**320**	**520**	**840**

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)

AK25-REGULATIONS

M.TECH–II YEAR I SEMESTER

S. No.	Course Code	Course Title	Category	Hours per week			Credits	CIE	SEE	Total
				L	T /CLC	P	C			
1	25DPE3813 25DPE3814 25DPE3815	**Program Elective–V** Voice and Data Networks Industrial Internet of Things Artificial Intelligence and Machine learning	PE	3	0	0	3	40	60	100
2	25DOE3801	**Open Elective–IV** IoT and its Applications	OE	3	0	0	3	40	60	100
3	25DPR3801	Dissertation Phase-I	PR	0	0	20	10	100	00	100
4	25DPR3802	Industry Internship	PR	0	0	0	2	100	00	100
5	25DMC5801	Co–Curricular Activities	MC	0	0	0	1	-	-	-
Total				**06**	**0**	**20**	**19**	**280**	**120**	**400**

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)

AK25-REGULATIONS

M.TECH–II YEAR II SEMESTER

S.NO.	Course Code	Course Title	Category	Hours per week		Credits		CIE	SEE	Total
				L	T/CLC	P	C			
1	25DPR3803	Dissertation Phase-II	PR	**0**	**0**	**32**	**16**	**100**	**100**	**200**
Total				**0**	**0**	**32**	**16**	**100**	**100**	**200**

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
M.TECH IN DIGITAL ELECTRONICS AND COMMUNICATION SYSTEMS (DECS)
AK 25 REGULATIONS

SEMESTER – I

S. No	Course Codes	Course Name	Category	Hours per week			Credits	CIE	SEE	Total
				L	T	P				
1.	25DPC3801	Advanced Digital System Design	PC	3	0	0	3	40	60	100
2.	25DPC3802	Wireless Communication and Networks	PC	3	0	0	3	40	60	100
3.	25DPE3801 25DPE3802 25DPE3803	**Program Elective – I** Design for Testability VLSI Technology and Design SoC Architecture	PE	3	0	0	3	40	60	100
4.	25DPE3804 25DPE3805 25DPE3806	**Program Elective – II** Software Defined Radio Optical Communication and Networks 5G Communications	PE	3	0	0	3	40	60	100
5.	25DPC3803	Advanced Digital System Design Lab	PC	0	0	4	2	40	60	100
6.	25DPC3804	Wireless Communication and Networks Lab	PC	0	0	4	2	40	60	100
7.	25MBA0110	Research Methodology and IPR	MC	2	0	0	2	40	60	100
8.	25DSE3801	RTL Synthesis, Simulation and Verification	SE	0	1	2	2	40	60	100
9.	25DAC9901 25DAC2001 25DAC9902	Audit Course – I English for Research paper Writing Disaster Management Essence of Indian Traditional Knowledge	AC	2	0	0	0	40		40
Total				**16**	**01**	**10**	**20**	**360**	**480**	**840**

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
M.TECH IN DIGITAL ELECTRONICS AND COMMUNICATION SYSTEMS (DECS)
AK 25 REGULATIONS

Course Code	Year & Sem	ADVANCED DIGITAL SYSTEM DESIGN	L	T/CLC	P	C
25DPC3801	I-I		3	0	0	3

Course Outcomes (CO): Student will be able to

CO1: Apply the IEEE-754 format of fixed- and floating-point number systems for processor arithmetic.
CO2: Analyze the design procedure of combinational logic circuits using CMOS logic gates.
CO3: Analyze the design procedure of sequential logic circuits and FSMs using flip-flops.
CO4: Understand the subsystem-level combinational circuit designs for reduced design complexity.
CO5: Understand the subsystem-level sequential circuit designs for reduced design complexity.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Apply	the IEEE-754 format of fixed- and floating-point number systems		for processor arithmetic	L3
CO2	Analyze	the design procedure of combinational logic circuits	using CMOS logic gates		L4
CO3	Analyze	the design procedure of sequential logic circuits and FSMs	using flip-flops.		L4
CO4	Understand	the subsystem-level combinational circuit designs		for reduced design complexity	L2
CO5	Understand	the subsystem-level sequential circuit designs		for reduced design complexity	L2

UNIT - I Lecture Hrs:14

Processor Arithmetic: Two's Complement Number System - Arithmetic Operations; Fixed point Number System; Floating Point Number system - IEEE 754 format, Basic binary codes.

UNIT - II Lecture Hrs:15

Combinational circuits: CMOS logic design, Static and dynamic analysis of Combinational circuits, timing hazards. Functional blocks: Decoders, Encoders, Three-state devices, Multiplexers, Parity circuits, Comparators, Adders, Subtractors, Carry look-ahead adder – timing analysis. Combinational multiplier structures.

UNIT - III Lecture Hrs:16

Sequential Logic - Latches and Flip-Flops, Sequential logic circuits - timing analysis (Set up and hold times), State machines - Mealy & Moore machines, Analysis, FSM design using D Flip-Flops, FSM optimization and partitioning; Synchronizers and metastability. FSM Design examples: Vending machine, Traffic light controller, Washing machine.

UNIT - IV Lecture Hrs:15

Subsystem Design using Functional Blocks (1) - Design (including Timing Analysis) of different logical blocks of varying complexities involving mostly combinational circuits: ALU, 4-bit combinational multiplier, Barrel shifter, Simple fixed point to floating point encoder, Dual Priority encoder, Cascading comparators

UNIT - V Lecture Hrs:16

Subsystem Design using Functional Blocks (2) - Design, (including Timing Analysis) of different logical blocks of different complexities involving mostly sequential circuits: Pattern (sequence) detector, Programmable Up-down counter, round robin arbiter with 3 requesters, Process Controller, FIFO

Textbooks:

1. M. Morris Mano, Michael D. Ciletti, "Digital Design: With an Introduction to the Verilog HDL, VHDL, and System Verilog", Pearson Education; 6th Edition, 2018
2. John F. Wakerly, "Digital Design", Prentice Hall, 3rd Edition, 2002.

Reference Books:

1. Digital Circuits and Logic Design-Samuel C.LEE, PHI, 2008.
2. Digital System Design using programmable logic devices- Parag K. Lala, BS publications

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES:

3 = High**,** 2 = Medium**,** 1 = Low**, Blank = No relation)**

CO \ PO	PO1	PO2	PO3
CO1	3		2
CO2	3		3
CO3	3		3
CO4	3	2	3
C05	3	2	3

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
M.TECH IN DIGITAL ELECTRONICS AND COMMUNICATION SYSTEMS (DECS)
AK 25 REGULATIONS

Course Code	Year & Sem	Wireless Communication and Networks	L	T/CLC	P	C
25DPC3802	I-I		3	0	0	3

Course Outcomes (CO): Student will be able to

CO1: Analyze the cellular system design fundamentals for improving cellular coverage and capacity.
CO2: Apply the suitable outdoor and indoor path loss models for estimating signal attenuation.
CO3: Analyze the multipath propagation effects using statistical models to determine fading characteristics
CO4: Apply the equalization and diversity techniques to improve communication performance.
CO5: Analyze the networking architectures using IEEE standard for modern wireless communications.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Analyze	the cellular system design fundamentals		for improving cellular coverage and capacity.	L4
CO2	Apply	the suitable outdoor and indoor path loss models		for estimating signal attenuation	L3
CO3	Analyze	the multipath propagation effects using statistical models		to determine fading characteristics	L4
CO4	Apply	the equalization and diversity techniques		to improve communication performance.	L3
CO5	Analyze	the networking architectures	using IEEE standard.	for modern wireless communications	L4

UNIT - I Lecture Hrs:13

The Cellular Concept-System Design Fundamentals: Introduction, Frequency Reuse, Channel Assignment Strategies, Handoff Strategies- Prioritizing Handoffs, Practical Handoff Considerations, Interference and system capacity – Co channel Interference and system capacity, Channel planning for Wireless Systems, Adjacent Channel interference, Power Control for Reducing interference, Trunking and Grade of Service, Improving Coverage & Capacity in Cellular Systems- Cell Splitting, Sectoring.

UNIT - II Lecture Hrs:

Mobile Radio Propagation: Large-Scale Path Loss: Introduction to Radio Wave Propagation, Free Space Propagation Model, Relating Power to Electric Field, The Three Basic Propagation Mechanisms, Reflection-Reflection from Dielectrics, Brewster Angle, Reflection from prefect conductors, Ground Reflection (Two-Ray) Model, Diffraction-Fresnel Zone Geometry, Knife-edge Diffraction Model, Multiple knife-edge Diffraction, Scattering, Outdoor Propagation Models- Longley-Ryce Model, Okumura Model, Hata Model, PCS Extension to Hata Model, Walfisch and Bertoni Model, Wideband PCS Microcell Model, Indoor Propagation Models-Partition losses (Same Floor), Partition losses between Floors, Log-distance path loss model, Ericsson Multiple Breakpoint Model, Attenuation Factor Model, Signal penetration into buildings, Ray Tracing and Site Specific Modeling.

UNIT - III Lecture Hrs:14

Mobile Radio Propagation: Small Scale Multipath propagation Factors influencing small scale fading, Doppler shift, Impulse Response Model of a multipath channel Relationship between Bandwidth and Received power, Small-Scale Multipath Measurements-Direct RF Pulse System, Spread Spectrum Sliding Correlator Channel Sounding, Frequency Domain Channels Sounding, Parameters of Mobile Multipath Channels-Time Dispersion Parameters, Coherence Bandwidth, Doppler Spread and Coherence Time, Types of Small-Scale Fading-Fading effects Due to Multipath

Time Delay Spread, Flat fading, Frequency selective fading, Fading effects Due to Doppler Spread-Fast fading, slow fading, Statistical Models for multipath Fading Channels Clarke's model for flat fading, spectral shape due to Doppler spread in Clarke's model, Simulation of Clarke and Gans Fading Model, Level crossing and fading statistics, Two-ray Rayleigh Fading Model.

UNIT - IV Lecture Hrs:13

Equalization and Diversity: Introduction, Fundamentals of Equalization, Training A Generic Adaptive Equalizer, Equalizers in a communication Receiver, Linear Equalizers, Non-linear Equalization-Decision Feedback Equalization (DFE), Maximum Likelihood Sequence Estimation (MLSE) Equalizer, Algorithms for adaptive equalization-Zero Forcing Algorithm, Least Mean Square Algorithm, Recursive least squares algorithm. Diversity Techniques-Derivation of selection Diversity improvement, Derivation of Maximal Ratio Combining improvement, Practical Space Diversity Consideration-Selection Diversity, Feedback or Scanning Diversity, Maximal Ratio Combining, Equal Gain Combining, Polarization Diversity, Frequency Diversity, Time Diversity, RAKE Receiver.

UNIT - V Lecture Hrs:10

Wireless Networks: Introduction to wireless Networks, Advantages and disadvantages of Wireless Local Area Networks, WLAN Topologies, WLAN Standard IEEE 802.11, IEEE 802.11 Medium Access Control, Comparison of IEEE 802.11 a, b, g and n standards, IEEE 802.16 and its enhancements, Wireless PANs, Hiper Lan, WLL.

Textbooks:

1. Wireless Communications, Principles, Practice – Theodore, S. Rappaport, 2nd Ed., 2002, PHI.
2. Wireless Communications-Andrea Goldsmith, 2005 Cambridge University Press.
3. Principles of Wireless Networks – Kaveh Pah Laven and P. Krishna Murthy, 2002, PE
4. Mobile Cellular Communication – Gottapu Sasibhushana Rao, Pearson Education, 2012.

Reference Books:

1. Wireless Digital Communications – Kamilo Feher, 1999, PHI.
2. Wireless Communication and Networking – William Stallings, 2003, PHI

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES:

3 = High**,** 2 = Medium**,** 1 = Low**, Blank = No relation)**

CO \ PO	PO1	PO2	PO3
CO1	3	3	2
CO2	3	3	2
CO3	3	3	2
CO4	3	3	3
C05	3	2	2

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
M.TECH IN DIGITAL ELECTRONICS AND COMMUNICATION SYSTEMS (DECS)
AK 25 REGULATIONS

Course Code	Year & Sem	DESIGN FOR TESTABILITY	L	T/CLC	P	C
25DPE3801	I-I	Program Elective -1	3	0	0	3

Course Outcomes (CO): Student will be able to

CO1*:* Analyze the digital and analog VLSI testing and levels of fault models for effective design

CO2*:* Apply the logic and fault simulation techniques for design verification and testing.

CO3*:* Apply the testability measures and scan-based DFT techniques to improve controllability and observability of digital circuits.

CO4: Analyze the Built-In Self-Test architectures for on-chip test generation and response analysis.

CO5: Apply the boundary scan standards using Boundary Scan Description Language for board-level testing.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Analyze	digital and analog VLSI testing and levels of fault models		for effective design	L4
CO2	Apply	the logic and fault simulation techniques		for design verification and testing	L3
CO3	Analyze	the testability measures and scan-based DFT techniques		to improve controllability and observability of digital circuits.	L4
CO4	Analyze	the Built-In Self-Test architectures		for on-chip test generation and response analysis.	L4
CO5	Apply	the boundary scan standards	using Boundary Scan Description Language for board-level testing.		L3

UNIT - I Lecture Hrs:17

Introduction to Testing: Testing Philosophy, Role of Testing, Digital and Analog VLSI Testing, VLSI Technology Trends affecting Testing, Types of Testing, Fault Modelling: Defects, Errors and Faults, Functional Versus Structural Testing, Levels of Fault Models, Single Stuck-at Fault.

Lecture Hrs:16

UNIT - II

Logic and Fault Simulation: Simulation for Design Verification and Test Evaluation, Modelling Circuits for Simulation, Algorithms for True-value Simulation, Algorithms for Fault Simulation.

UNIT - III Lecture Hrs:16

Testability Measures: SCOAP Controllability and Observability, High Level Testability Measures, Digital DFT and Scan Design: Ad-Hoc DFT Methods, Scan Design, Partial-Scan Design, Variations of Scan.

Lecture Hrs:15

UNIT - IV

Built-In Self-Test: The Economic Case for BIST, Random Logic BIST: Definitions, BIST Process, Pattern Generation, Response Compaction, Built-In Logic Block Observers, Test-Per-Clock, Test-Per-Scan BIST Systems, Circular Self-Test Path System, Memory BIST, Delay Fault BIST.

UNIT - V Lecture Hrs:18

Boundary Scan Standard: Motivation, System Configuration with Boundary Scan: TAP Controller and Port, Boundary Scan Test Instructions, Pin Constraints of the Standard, Boundary Scan Description Language: BDSL Description Components, Pin Descriptions.

Textbooks:

1. Essentials of Electronic Testing for Digital, Memory and Mixed Signal VLSI Circuits - M.L. Bushnell, V. D. Agrawal, Kluwer Academic Publishers.
2. VLSI Test Principles and Architectures: Design for Testability" – L.-T. Wang, C.-W. Wu, X. Wen

Reference Books:

1. Digital Systems and Testable Design - M. Abramovici, M. A. Breuer and A.D Friedman, Jaico Publishing House.
2. Digital Circuits Testing and Testability - P.K. Lala, Academic Press.

Mapping of Course Outcomes with Program Outcomes

CO	PO1	PO2	PO3
CO1	3		2
CO2	3		2
CO3	3		2
CO4	3	2	2
CO5	3	3	2

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
M.TECH IN DIGITAL ELECTRONICS AND COMMUNICATION SYSTEMS (DECS)
AK 25 REGULATIONS

Course Code	Year & Sem	VLSI TECHNOLOGY AND DESIGN	L	T/CLC	P	C
25DPE3802	I-I	Program Elective -1	3	0	0	3

Course Outcomes: Students should be able to

CO1: Analyze the electrical characteristics of MOS, CMOS, and Bi CMOS technologies in microelectronics.
CO2: Apply the layout design principles and scalable design rules using modern VLSI design tools for gates.
CO3: Understand the combinational logic networks simulation with optimized power and interconnect delay.
CO4: Analyze the sequential system memory cells, arrays, and clocking strategies for design validation.
CO5: Apply the floor planning methods, interconnect strategies for off-chip connections in VLSI systems.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Analyze	the electrical characteristics of MOS, CMOS, and Bi CMOS technologies		in microelectronics	L4
CO2	Apply	the layout design principles and scalable design rules	using modern VLSI design tools	for gates.	L3
CO3	Understand	and simulate combinational logic networks		with optimized power, delay, and interconnect performance.	L2
CO4	Analyze	sequential systems including memory cells, arrays, and clocking strategies for efficient operation.			L4
CO5	Apply	Floor planning techniques, interconnect design, and off-chip connections in VLSI systems.			L3

UNIT - I Lecture Hrs:17
Review of Microelectronics and Introduction to MOS Technologies- MOS, CMOS, Bi CMOS Technology. Basic Electrical Properties of MOS, CMOS & Bi CMOS Circuits: Ids – Vds relationships, Threshold Voltage V_T, g_m, g_{ds} and ω_o, Pass Transistor, MOS, CMOS & Bi CMOS Inverters, Zpu/Zpd, MOS Transistor circuit model, Latch-up in CMOS circuits.

UNIT - II Lecture Hrs:16
Layout Design and Tools: Transistor structures, Wires and Vias, Scalable Design rules, Layout Design tools.
Logic Gates & Layouts: Static Complementary Gates, Switch Logic, Alternative Gate circuits, Low power gates, Resistive and Inductive interconnect delays.

UNIT - III Lecture Hrs:15
Combinational Logic Networks: Layouts, Simulation, Network delay, Interconnect design, Power optimization, Switch logic networks, Gate and Network testing.

UNIT - IV Lecture Hrs:15
Sequential Systems: Memory cells and Arrays, Clocking disciplines, Design, Power optimization,

Design validation and testing.

UNIT – V Lecture Hrs:14

Floor Planning: Floor planning methods, Global Interconnect, Floor Plan Design, Off-chip connections.

Textbooks:

1. Neil Weste, David Harris, "CMOS VLSI Design: A Circuits and Systems Perspective", 4th Edition, Pearson, 2010
2. Essentials of VLSI Circuits and Systems, K. Eshraghian Eshraghian. D, A. Pucknell, 2005, PHI.
3. Modern VLSI Design – Wayne Wolf, 3rd Ed., 1997, Pearson Education.

Reference Books:

1. Introduction to VLSI Systems: A Logic, Circuit and System Perspective – Ming-BO Lin, CRC Press, 2011.
2. Principals of CMOS VLSI Design – N.H.E Weste, K. Eshraghian, 2nd Ed., Addison Wesley.

Online Learning Resources:

nptel videos

Mapping of Course Outcomes with Program Outcomes

CO	PO1	PO2	PO3
CO1	2		2
CO2	2		3
CO3	2	3	3
CO4	3	3	2
CO5	3		2

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
M.TECH IN DIGITAL ELECTRONICS AND COMMUNICATION SYSTEMS (DECS)
AK 25 REGULATIONS

Course Code	Year & Sem	SoC ARCHITECTURE Program Elective -1	L	T/CL C	P	C
25DPE3803	I-I		3	0	0	3

Course Outcomes (CO): Student will be able to
CO1: Understand the basic SoC architectures and its approaches for SoC Design.
CO2: Analyze the Processor Microarchitecture and Optimization Techniques.
CO3: Analyze the cache organization, memory hierarchies and strategies for Memory design
CO4: Analyze the interconnect architectures and SoC customization techniques to enhance system performance.
CO5: Apply the SoC design approaches to AES encryption and JPEG compression.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the basic SoC architectures and its approaches		for SoC Design.	L2
CO2	Analyze	the Processor Microarchitecture and Optimization Techniques			L4
CO3	Analyze	the cache organization, memory hierarchies and strategies		for Memory design	L4
CO4	Analyze	the interconnect architectures and SoC customization techniques		to enhance system performance	L4
CO5	Apply	the SoC design approaches		to AES encryption and JPEG compression	L3

UNIT - I Lecture Hrs:13

Introduction to the System Approach: System Architecture, Components of the system, Hardware & Software, Processor Architectures, Memory &Addressing. System level interconnection, An approach for SOC Design, System Architecture and Complexity.

UNIT - II Lecture Hrs:11

Processors: Introduction, Processor Selection for SOC, Basic concepts in Processor Architecture, Basic concepts in Processor Micro architecture, Basic elements in Instruction handling. Buffers: minimizing Pipeline Delays, Branches, More Robust Processors, Vector Processors and Vector Instruction extensions, VLIW Processors, Superscalar Processors

UNIT - III Lecture Hrs:16

Memory Design for SOC: Overview: SOC external memory, SOC Internal Memory, Size, Scratchpads and Cache memory, Cache Organization, Cache data, Write Policies, Strategies for line replacement at miss time, Other Types of Cache, Split – I, and D – Caches, Multilevel Caches, SOC Memory System, Models of Simple Processor – memory interaction.

UNIT - IV Lecture Hrs:15

Interconnect, Customization and Configurability: Interconnect Architectures, Bus: Basic Architectures, SOC Standard Buses, Analytic Bus Models, Using the Bus model, Effects of Bus transactions and contention time.

SOC Customization: An overview, Customizing Instruction Processor, Reconfigurable Technologies, Mapping design onto Reconfigurable devices, Instance- Specific design, Customizable Soft Processor, Reconfiguration - overhead analysis and trade-off analysis on reconfigurable Parallelism.

UNIT - V Lecture Hrs:18

Application Studies / Case Studies: SOC Design approach; AES-algorithms, Design and evaluation; Image compression–JPEG compression.

Textbooks:

1. Computer System Design System-on-Chip - Michael J. Flynn and Wayne Luk, Wiely India Pvt. Ltd.
2. ARM System on Chip Architecture – Steve Furber, 2ndEdition, 2000, Addison Wesley Professional.

Reference Books:

1. Design of System on a Chip: Devices and Components – Ricardo Reis, 1st Ed., 2004, Springer
2.Co-Verification of Hardware and Software for ARM System on Chip Design (Embedded Technology) – Jason Andrews – Newnes, BK and CDROM.
3.System on Chip Verification – Methodologies and Techniques –Prakash Rashinkar, Peter Paterson and Leena Singh L, 2001, Kluwer Academic Publishers

Mapping of Course Outcomes with Program Outcomes

CO	PO1	PO2	PO3
CO1	3		2
CO2	3		2
CO3	3		2
CO4	3	2	2
CO5	3	3	2

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
ELECTRONICS AND COMMUNICATION ENGINEERING (ECE)
AK 25 REGULATIONS

Course Code	Year & Sem	SOFTWARE DEFINED RADIO	L	T/CLC	P	C
25DPE3804	I-I	Program Elective - II	3	0	0	3

Course Outcomes: Students should be able to

CO1: Understand the characteristics and design principles of software defined radios.

CO2: Analyze the RF implementation issues in software radio systems for improving overall performance**.**

CO3: Apply the digital signal generation techniques using direct synthesis for evaluating signal behavior**.**

CO4: Analyze the multirate signal processing techniques and filter bank architectures for sample-rate conversion.

CO5: Analyze the A/D and D/A data converter parameters for improving data conversion performance.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the characteristics and design principles of software defined radios			L2
CO2	Analyze	the RF implementation issues in software radio systems	in software radio systems	for improving overall performance**.**	L4
CO3	Apply	the digital signal generation techniques	using direct synthesis	for evaluating signal behavior**.**	L3
CO4	Analyze	the multirate signal processing techniques and filter bank architectures		for sample-rate conversion	L5
CO5	Analyze	the ADC and DAC data converter parameters		for improving data conversion performance	L4

UNIT - I 09 Hrs

Introduction to Software radio concepts: Introduction, need, characteristics, benefits and design principles of Software Radios. Traditional radio implemented in hardware (first generations of 2G cell phones), Software controlled radio (SCR), Software defined radio (SDR), Ideal software radio (ISR), Ultimate software radio (USR)

16Hrs

UNIT - II

Radio frequency implementation issues: The purpose of RF Front-End, Dynamic range, RF Receiver Front-End Topologies, Enhanced Flexibility of the RF Chain with Software Radios, Importance of Components to Overall performance, Transmitter Architecture and their issues, Noise and Distortion in RF Chain.

15Hrs

UNIT - III

Digital generation of signals: Introduction, Comparison of Direct Digital Synthesis with Analog Signal Synthesis, Approaches to Direct Digital Synthesis, Analysis of Spurious Signals, Spurious components due to Periodic Jitter.

15Hrs

UNIT - IV

Multi rate Signal Processing: Introduction, Sample Rate Conversion Principles, Polyphase Filters, Digital Filter Banks, Timing Recovery in Digital receivers Using Multi rate Digital Filters.

14Hrs

UNIT - V

A/D & D/A Conversion: Introduction, Parameters of Ideal Data Converters, Parameters of Practical data Converters, Techniques to improve Data Converter performance, JTRS.

Textbooks:

1. Jeffery H. Reed, “Software Radio, (A modern approach to radio engineering)”, PHI PTR, 2002
2. John J. Rouphael, “RF and Digital Signal Processing for Software Defined Radio” Elsevier, Newness Publications.

Reference Books:

1. C. Richard Johnson, Jr., and William A. Sethares, Telecommunication Breakdown, Prentice Hall, ISBN 0-13-143047-5, 2004
2. Software Defined Radio: Theory and Practice by John M. Reyland (Artech House, 2023)

Mapping of Course Outcomes with Program Outcomes

CO	PO1	PO2	PO3
CO1	1	2	3
CO2	1	1	3
CO3	1	1	3
CO4	1	2	3
CO5	1	2	3

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
M.TECH IN DIGITAL ELECTRONICS AND COMMUNICATION SYSTEMS (DECS)
AK 25 REGULATION

Course Code	Year & Sem	OPTICAL COMMUNICATION AND NETWORKS	L	T/CLC	P	C
25DPE3805	I-I	Program Elective – II	3	0	0	3

Course Outcomes: Students should be able to

CO1: Analyze the characteristics of optical fibers, dispersion mechanisms, and optical sources for fiber-optic communication systems.

CO2: Analyze the photo detector performance, optical receiver characteristics, and WDM components for efficient optical communication.

CO3: Analyze the performance of digital and analog optical links considering modulation techniques, power penalties, and signal-to-noise characteristics.

CO4: Apply the optical and WDM networking topologies with mitigation of transmission impairments for high-speed communication.

CO5: Apply the standard test equipment and monitoring techniques to assess end-to-end optical fiber communication system performance.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Analyze	the characteristics of optical fibers, dispersion mechanisms, and optical sources		for fiber-optic communication systems.	L4
CO2	Analyze	the photodetector performance, optical receiver characteristics, and WDM components		for efficient optical communication.	L4
CO3	Analyze	the performance of digital and analog optical links.	considering modulation techniques, power penalties, and signal-to-noise characteristics.		L4
CO4	Apply	the optical and WDM networking topologies	with mitigation of transmission impairments	for high-speed communication	L3
CO5	Apply	the standard test equipment and monitoring techniques	.	to assess end-to-end optical fiber communication system performance.	L3

UNIT - I Lecture Hrs:17

Optical Fibers: Structures, waveguiding and Fabrication: Nature of Light, Basic optical laws and definitions, Single mode fibers, Graded index fiber structure, Attenuation, Signal Dispersion in fibers.
Optical Sources- LEDs, Laser Diodes, Line Coding.

UNIT - II Lecture Hrs:16

Photo detectors: Photo detector Noise, Detector Response Time, Avalanche Multiplication Noise.
Optical Receiver Operation: Fundamental receiver operation, Digital receiver performance, Eye diagrams.
WDM Concepts and Components: Passive optical Couplers, Isolators and Circulators

UNIT - III Lecture Hrs:15

Digital Links: Point to point links, power penalties, error control, Coherent detection, Differential Quadrature Phase Shift Keying.

Analog Links: Carrier to noise ration, Multichannel Transmission Techniques, RF over Fiber, Radio over fiber links, Microwave Photonics.

UNIT - IV Lecture Hrs:15

Optical Networks: Network Concepts, Network Topologies, SONET/SDH, High speed light wave links, Optical add/ Drop Multiplexing, Optical Switching, WDM Network, Passive Optical Networks, IP Over DWDM, Optical Ethernet, Mitigation of Transmission Impairments

UNIT – V Lecture Hrs:14

Performance Measurement and Monitoring: Measurement standards, Basic Test Equipment, Optical power measurement, Optical fiber characterization, Eye diagram tests, optical time domain reflectometer, optical performance monitoring, optical fiber system performance measurements.

Textbooks:

1. Gerd Keiser, "Optical Fiber Communications", 5th Edition, Mc Graw Hill.
2. Rajeev Ramaswamy and Kumar N Sivarajan, "Optical Networks: A Practical Perspective", 2nd Ed., 2004, Elsevier Morgan Kaufmann Publishers (An imprint of Elsevier).

Reference Books:

1. John. M. Senior, "Optical Fiber Communications: Principles and Practice", 2nd Ed, 2000, PE.
2. Harold Kolimbris, "Fiber Optic Communication", 2nd Ed, 2004, PEI
3. Uyless Black, "Optical Networks: Third Generation Transport Systems", 2nd Ed, 2009, PEI
4. Govind Agarwal, "Optical Fiber Communications", 2nd Ed, 2004, TMH.
5. S. C. Gupta, "Optical Fiber Communications and its Applications", 2004, PH

Online Learning Resources:

nptel videos

Mapping of Course Outcomes with Program Outcomes

CO	PO1	PO2	PO3
CO1	3	1	3
CO2	2	-	3
CO3	3	1	3
CO4	2	-	2
CO5	3	2	3

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
M.TECH IN DIGITAL ELECTRONICS AND COMMUNICATION SYSTEMS (DECS)
AK 25 REGULATIONS

Course Code	Year & Sem	5G Communications	L	T/CLC	P	C
25DPE3806	I-I	Program Elective – II	3	0	0	3

Course Outcomes: Students should be able to

CO1: Analyze the evolution and requirements of 5G wireless communication systems considering spectrum regulations and deployment constraints

CO2: Analyze the propagation characteristics through channel modelling techniques for 5G and mm Wave MIMO communication environments.

CO3: Analyze the advanced transmission and multiple access techniques used in 5G for improved spectral efficiency and performance.

CO4: Apply the device-to-device and machine-to-machine communication strategies for effective resource management and multi-hop connectivity.

CO5: Apply the millimeter-wave and massive MIMO techniques with beamforming and channel estimation approaches for efficient 5G communication.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Analyze	the evolution and requirements of 5G wireless communication systems	considering spectrum regulations and deployment constraints		L4
CO2	Analyze	the propagation characteristics	through channel modelling techniques	for 5G and mm Wave MIMO communication environments.	L4
CO3	Analyze	the advanced transmission and multiple access techniques used in 5G		for improved spectral efficiency and performance.	L4
CO4	Apply	the device-to-device and machine-to-machine communication strategies		for effective resource management and multi-hop connectivity.	L3
CO5	Apply	the millimeter-wave and massive MIMO techniques	with beamforming and channel estimation approaches	for efficient 5G communication	L3

UNIT - I Lecture Hrs:13

Overview of 5G Broadband Wireless Communications:

Evolution of mobile technologies 1G to 4G (LTE, LTEA, LTEA Pro), An Overview of 5G requirements, Regulations for 5G, Spectrum Analysis and Sharing for 5G.

UNIT - II Lecture Hrs: 14

The 5G wireless Propagation Channels:

Channel modeling requirements, propagation scenarios and challenges in the 5G modeling, Channel Models for mm Wave MIMO Systems.

UNIT - III Lecture Hrs:12

Transmission and Design Techniques for 5G:
Basic requirements of transmission over 5G, Modulation Techniques – Orthogonal frequency division multiplexing (OFDM), generalized frequency division multiplexing (GFDM), filter bank multi-carriers (FBMC) and universal filtered multi-carrier (UFMC), Multiple Accesses Techniques – orthogonal frequency division multiple accesses (OFDMA), generalized frequency division multiple accesses (GFDMA), nonorthogonal multiple accesses (NOMA).

UNIT - IV Lecture Hrs:13

Device-to-Device (D2D) and Machine-to-Machine (M2M) type Communications
Extension of 4G D2D standardization to 5G, radio resource management for mobile broadband D2D, multi-hop and multi-operator D2D communications.

UNIT - V Lecture Hrs:12

Millimeter-wave Communications
Spectrum regulations, deployment scenarios, beamforming, physical layer techniques, interference and mobility management, Massive MIMO propagation channel models, Channel Estimation in Massive MIMO, Massive MIMO with Imperfect CSI, Multi-Cell Massive MIMO, Pilot Contamination, Spatial Modulation (SM).

Textbooks:
1. Martin Sauter "From GSM From GSM to LTE–Advanced Pro and 5G: An Introduction to Mobile Networks and Mobile Broadband", Wiley-Blackwell.
2. Afif Osseiran, Jose. F. Monserrat, Patrick Marsch, "Fundamentals of 5G Mobile Networks", Cambridge University Press.
3. Athanasios G. Kanatos, Konstantina S. Nikita, Panagiotis Mathiopoulos, "New Directions in Wireless Communication Systems from Mobile to 5G", CRC Press.
4. Theodore S. Rappaport, Robert W. Heath, Robert C. Danials, James N. Murdock "Millimeter Wave Wireless Communications", Prentice Hall Communications.

Reference Books:
1. Jonathan Rodriguez, "Fundamentals of 5G Mobile Networks", John Wiley & Sons.
2. Amitabha Ghosh and Rapeepat Ratasuk "Essentials of LTE and LTE-A", Cambridge University Press

Mapping of Course Outcomes with Program Outcomes

COs	PO1	PO2	PO3
CO1	3	3	3
CO2	2	3	3
CO3	2	3	3
CO4	2	2	3
CO5	3	3	3

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
M.TECH IN DIGITAL ELECTRONICS AND COMMUNICATION SYSTEMS (DECS)
AK 25 REGULATIONS

Course Code	Year & Sem	ADVANCED DIGITAL SYSTEM DESIGN LAB	L	T/CLC	P	C
25DPC3803	I-I		0	0	4	2

Course Outcomes: Students should be able to
CO1: Apply the HDL programming concepts for designing combinational logic circuits including gates and Arithmetic and Logic Circuits using standard HDL simulator tools.
CO2: Analyze the behaviour of sequential circuits including flip-flops**,** registers and counters by observing timing diagrams using standard HDL simulator tools.
CO3: Analyze the performance of different modelling styles such as behavioural, dataflow, and structural for realizing digital circuits using FPGA synthesis tools
CO4: Analyze the complex digital systems FSM, Meely and Moore Machines by integrating combinational and sequential components on FPGA/CPLD platforms.
CO5: Apply the functionality of designed digital circuits by implementing them on Xilinx/Altera/Cypress based on FPGA/CPLD kits through simulation and hardware

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Apply	the HDL programming concepts for designing including gates and Arithmetic and Logic Circuits.	using standard HDL simulator tools.		L3
CO2	Analyze	the behaviour of sequential circuits including flip-flops**,** registers and counters	by observing timing diagrams using standard HDL simulator tools		L4
CO3	Analyze	the performance of different modelling styles such as behavioural, dataflow, and structural	for realizing digital circuits using FPGA synthesis tools		L4
CO4	Analyze	the complex digital systems FSM, Meely and Moore Machines	by integrating combinational and sequential components	on FPGA/CPLD platforms	L4
CO5	Apply	the functionality of designed digital circuits	by implementing them on Xilinx/Altera/Cypress based on FPGA/CPLD kits	through simulation and hardware	L3

List of Experiments:

Student has to design ANY TWELVE experiments of his/her user defined library components by using and standard HDL simulator / Synthesis tool for target FPGA device.

1. HDL code to realize all the logic gates. (CO1)
2. Design and Simulation of adder, Serial Binary Adder, Multi Precession Adder, Carry Look Ahead Adder. (CO1)
3. Design of 2-to-4 decoder (CO1)
4. Design of 8-to-3 encoder (without and with parity). (CO1)
5. Design of 4 bit binary to gray converter. (CO1)
6. Design of Multiplexer/ Demultiplexer, comparator. (CO3)
7. Design of Full adder using 3 modeling styles. (CO3)
8. Design of flip flops: SR, D, JK, T. (CO2)
9. Design of 4-bit binary, BCD counters (synchronous/ asynchronous reset) or any sequence Counter. (CO2)

10. Design of a N- bit Register of Serial- in Serial –out, Serial in parallel out, Parallel in Serial out and Parallel in Parallel Out. (CO2)
11. Design of Sequence Detector (Finite State Machine- Mealy and Moore Machines). (CO4)
12. Design of 4- Bit Multiplier, Divider. (CO1)
13. Design of ALU to Perform – ADD, SUB, AND-OR, 1's and 2's Compliment, Multiplication, and Division. (CO1)
14. Implementing the above designs on Xilinx/Altera/Cypress/equivalent based FPGA/CPLD kits.(CO5)

Mapping of Course Outcomes with Program Outcomes

CO	**PO1**	**PO2**	**PO3**
CO1	**3**	**1**	**1**
CO2	**3**	**2**	**2**
CO3	**3**	**3**	**3**
CO4	**3**	**3**	**3**
CO5	**3**	**1**	**1**

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
M.TECH IN DIGITAL ELECTRONICS AND COMMUNICATION SYSTEMS (DECS)
AK 25 REGULATIONS

Course Code	Year & Sem	WIRELESS COMMUNICATIONS AND NETWORKS LAB	L	T/CLC	P	C
25DPC3804	I-I		0	0	4	2

Course Outcomes: Students should be able to
CO1: Apply the principles of digital modulation and coding techniques by implementing Convolutional Encoder and Decoder generation using MATLAB tools
CO2: Analyze the performance of wireless propagation models and equalization techniques using MATLAB simulations for different channel conditions
CO3: Analyze the performance of GSM and CDMA network parameters such as call blocking probability, RAKE receiver efficiency, and mobile handset sections using simulation and hardware tools
CO4: Apply the simulation models for advanced wireless communication systems such as PN codes, DSSS, 3G, and adaptive filtering algorithms using MATLAB and Simulink environments.
CO5: Apply the measurement and analytical skills for observing waveforms at various test points of a mobile phone using mobile phone trainer and simulation tools.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Apply	the principles of digital modulation and coding techniques	by implementing Convolutional Encoder, Decoder, and PN code generation using MATLAB tools.		L3
CO2	Analyze	the performance of wireless propagation models and equalization techniques	using MATLAB simulations for different channel conditions		L4
CO3	Analyze	the performance of GSM and CDMA network parameters such as call blocking probability, RAKE receiver efficiency, and mobile handset sections	using simulation and hardware tools		L4
CO4	Apply	the simulation models for advanced wireless communication systems such as DSSS, 3G, and adaptive filtering algorithms	using MATLAB and Simulink environments		L3
CO5	Apply	the measurement and analytical skills for observing waveforms at various test points of a mobile phone	using mobile phone trainer and simulation tools.		L3

List of Experiments:

Student has to design ANY TWELVE experiments.

1. Implementation of Convolutional Encoder and Decoder. (CO1)
2. Simulation of the following Outdoor Path loss propagation models using MATLAB. (CO2)
   a. Free Space Propagation model
   b. Okumura model
   c. Hata model
3. Simulation of Adaptive Linear Equalizer using MAT LAB software. (CO2)
4. Measurement of call blocking probability for GSM &CDMA networks using NetSim software. (CO3)
5. Study of GSM handset for various signaling and fault insertion techniques (Major GSM handset sections: clock, SIM card, charging, LCD module, Keyboard, User interface).

(CO3)
6. Study of transmitter and receiver section in mobile handset and measure frequency of Baseband signal and GMSK modulating signal.
7. Simulation of RAKE Receiver for CDMA communication using MAT LAB software.
8. Simulate and test various types of PN codes, chip rate, spreading factor and processing gain on performance of DSSS in CDMA. (CO4)
9. Simulate and test the 3G Network system features using GSM AT Commands. (Features of 3G Communication system: Transmission of voice, video calls, SMS, MMS, TCP/IP, HTTP, GPS) (CO4)
10. Modelling of communication system using Simulink. (CO4)
11. Simulate Least Mean Square Algorithm (CO4)
12. Simulate Recursive Least Squares Algorithm. (CO4)
13. Observe Waveforms at various test points of a mobile phone using Mobile Phone Trainer (CO5)

Mapping of Course Outcomes with Program Outcomes

CO	PO1	PO2	PO3
CO1	3	1	1
CO2	3	2	2
CO3	3	3	3
CO4	3	3	3
CO5	3	1	1

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
M.TECH.-COMPUTER SCIENCE & ENGINEERING

Course Code	Year &Sem	Research Methodology and IPR (Mandatory Course)	L	T	P	C
25MBA0110	I-I		1	0	2	2

Pre-Requisites	-

Course Objectives:

- To understand the research design process and data collection methods.
- To develop skills in data analysis and reporting.
- To familiarize students with intellectual property rights (IPR) and patents.
- To apply research skills in real-world contexts.

Course Outcomes (CO): Student will be able to

CO1	**Understand**the various research approaches for different research goals to identify suitable methodologies.
CO2	**Analyze**the various sources and tools and technologies to collect the data
CO3	**Apply**the statistical methods for analyzing data and understand the guidelines for report writing.
CO4	**Analyze** the safeguarding of business secrets by using various types of Intellectual Property Rights
CO5	**Understand** the procedure for filling and grant of patent to protect the innovative ideas of the business

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	thevarious research approaches for different research goals.		to identify suitable methodologies	L2
CO2	Analyse	the various sources and tools and technologies		to collect the data	L4
CO3	Apply Understand	the statistical methods for analysing data the guidelines for report writing			L3 L2
CO4	Analyse	the safeguarding of business secrets	by using various types of Intellectual Property Rights		L4
CO5	Understand	the procedure for filling and grant of patent		to protect the innovative ideas of the business	L2

UNIT– I	FUNDAMENTALS OF RESEARCH METHODOLOGY	8 Hrs

Overview of research process and design - Types of Research - Approaches to Research (Qualitative vs Quantitative) - Observation studies, Experiments and Surveys - Use of Secondary and exploratory data to answer the research question - Importance of Reasoning in Research and Research ethics - Documentation Styles (APA/IEEE etc.) - Plagiarism and its consequences

Learning Outcomes

- Recall key concepts of the research process, including different types and approaches to research, and the importance of ethics.
- Differentiate between qualitative and quantitative research approaches and the various uses of secondary data.
- Identify the core principles of research design and ethics, including plagiarism and documentation styles.
- Explain the significance of reasoning and ethical conduct in all stages of the research process.
- Apply knowledge of different documentation styles, such as APA and IEEE, to properly cite sources and avoid plagiarism.

UNIT – II	DATA COLLECTION AND SOURCES	10 Hrs

Importance of Data Collection - Types of Data - Data Collection Methods - Data Sources - primary, secondary and Big Data sources - Data Quality & Ethics - Tools and Technology for Data Collection

Learning Outcomes

- Identify different types of data and the various methods for collecting both primary and secondary data.
- Explain the importance of data quality and ethical considerations in data collection.
- Differentiate between primary, secondary, and Big Data sources.
- Describe the various tools and technologies used for effective data collection.

Analyze the ethical implications of data collection and ensure data quality in a research study.

UNIT – III	DATA ANALYSIS AND REPORTING	8 Hrs

Overview of Multivariate analysis - Experimental research, cause-effect relationship, and development of hypotheses- Measurement systems analysis, error propagation, and validity of experiments - Guidelines for writing abstracts, introductions, methodologies, results, and discussions - Writing Research Papers & proposals

Learning Outcomes

- Apply knowledge of multivariate analysis and experimental research to develop hypotheses and analyze data.
- Explain the process of measurement systems analysis and error propagation in experimental design.
- Formulate clear and concise abstracts, introductions, and methodologies for research papers.
- Write effective results and discussion sections based on data analysis.

Develop comprehensive research papers and proposals based on proper data analysis and reporting guidelines.

UNIT – IV	UNDERSTANDING INTELLECTUAL PROPERTY RIGHTS	9 Hrs

Intellectual Property – The concept of IPR, Evolution and development of concept of IPR, IPR development process, Trade secrets, utility Models, IPR & Bio diversity, Role of WIPO and WTO in IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance.

Learning Outcomes

- Recall the fundamental concepts of Intellectual Property (IP) and its evolution.
- Describe the roles of organizations like **WIPO** and **WTO** in the establishment of IPR.
- Differentiate between various types of IPR, including trade secrets and trademarks.
- Explain the common rules and features of IPR agreements and the role of UNESCO.

Analyze the relationship between IPR and biodiversity, and its broader impact.

UNIT – V	**PATENTS**	9 Hrs

Patents – objectives and benefits of patent, Concept, features of patent, Inventive step, Specification - Types of patent application, process E-filling, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licenses, Licensing of related patents, patent agents, Registration of patent agents

Learning Outcomes

- Explain the objectives, benefits, and key features of a patent, including the concept of an inventive step.
- Differentiate between the various types of patent applications and the e-filing process.
- Describe the process of patent examination, grant, and revocation.
- Identify the roles of patent agents and the process for their registration.

Analyze the concepts of equitable assignments, licenses, and licensing of related patents.

Textbooks:

1.Stuart Melville and Wayne Goddard, *Research Methodology: An introduction for Science & Engineering students*, Juta and Company Ltd, 2004

2.Catherine J. Holland, *Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets*, Entrepreneur Press, 2007.

Reference Books:

1. Cooper Donald R, Schindler Pamela S and Sharma JK, "Business Research Methods", Tata McGraw Hill Education 11e (2012).
2. RanjitKumar ,*Research Methodology: A Step-by-Step Guide for Beginners.* . David Hunt, Long Nguyen, Matthew Rodgers, "Patent searching: tools & techniques", Wiley, 2007.
3. Deborah E. Bouchoux ,*Intellectual Property: The Law of Trademarks, Copyrights, Patents, and Trade Secrets, 6th Edition,* Cengage 2024.
4. Wayne C. Booth, Gregory G. Colomb, Joseph M. Williams, *The Craft of Research*, 5th Edition, University of Chicago Press, 2024
5. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, "Professional Programme Intellectual Property Rights, Law and practice", September 2013.
6. Peter Elbow, *Writing With Power,* Oxford University Press, 1998.

Online Learning Resources:

- **Coursera / edX** – Research Methodology and Data Analysis courses
- **Springer Link &ScienceDirect** – Latest journals on research design and statistics

- **Google Scholar** – Free access to research papers
- **NCBI Bookshelf** – Open-access research methodology resources
- **Khan Academy (Statistics & Probability)** – For fundamentals of hypothesis testing, regression, and ANOVA.

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3
CO1	2		
CO2	3		
CO3	2	2	
CO4	3		
CO5	2		

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
M.TECH IN DIGITAL ELECTRONICS AND COMMUNICATION SYSTEMS (DECS)
AK 25 REGULATIONS

Course Code	Year & Sem	RTL SYNTHESIS, SIMULATION AND VERIFICATION	L	T/CLC	P	C
25DSC3801	I-I		0	1	2	2

Course Outcomes: Students should be able to

CO1: Analyze the RTL design flow and HDL coding principles for synthesizable digital design.

CO2: Apply the synthesis techniques and design constraints to generate gate-level netlists for performance metrics evaluation

CO3: Analyze the functional and timing simulation results using testbenches to validate RTL designs.

CO4: Apply the assertion-based and coverage-driven verification methodologies for ensuring functional correctness.

CO5: Analyze the digital subsystems through RTL design, synthesis, simulation, and verification using EDA tools.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	**Analyze**	the RTL design flow and HDL coding principles.	.	for synthesizable digital design	L4
CO2	**Apply**	the synthesis techniques and design constraints		to generate gate-level netlists for performance metrics evaluation	L3
CO3	**Analyze**	the functional and timing simulation results	using testbenches	to validate RTL designs.	L4
CO4	**Apply**	the assertion-based and coverage-driven verification methodologies		for ensuring functional correctness.	L3
CO5	**Analyze**	the digital subsystems	through RTL design, synthesis, simulation, and verification	using EDA tools.	L4

Module 1 – Introduction to RTL Design

- RTL design flow: Specification → RTL coding → Synthesis → Simulation → Verification.
- HDL coding styles for synthesis (System Verilog/VHDL basics).
- Lab:
    1. Write synthesizable Verilog/System Verilog code for:
        a) Half Adder, Full Adder
        b) 4-bit Ripple Carry Adder
        c) 4-bit Synchronous Counter (Up/Down)
    2. FSM Design: Sequence Detector (e.g., detect “1011”).

Module 2 – RTL Synthesis

- Synthesis concepts: mapping RTL to gate-level netlist.
- Constraints: clock, area, power.
- Lab:
    1. Synthesize combinational and sequential circuits (Adder, Counter, FSM) using EDA tool
    2. Generate gate-level netlist and analyze area, delay, power reports.
    3. Apply constraints (clock, timing) and observe impact on synthesis results.

Module **3 – Simulation**

- Functional vs. Timing simulation.
- Testbench creation, waveforms, debugging.
- Lab: Run simulations
    1. Develop testbenches for:
        a) 4-bit ALU (add, sub, AND, OR).
        b) Universal Shift Register.
    2. Perform functional simulation using EDA tools
    3. Perform post-synthesis (timing) simulation and compare results with functional simulation.

Module 4 – Verification

- Verification basics: functional verification, assertion-based verification.
- Introduction to UVM/OVM concepts.
- Lab: Writing simple verification testbenches.
    1. Write self-checking testbenches for combinational and sequential circuits.
    2. Use assertion-based verification (System Verilog Assertions – SVA) for protocol checks (e.g., handshaking signals).
    3. Coverage-driven verification experiment: Create random test cases for FIFO/Memory.

Module 5 – Case Study & Mini Project

- Design, synthesize, and verify a digital subsystem (e.g., ALU, UART, FIFO).
- End-to-end RTL → Synthesis → Simulation → Verification flow.
- Lab: Design, synthesize, simulate, and verify a **digital subsystem** such as:
    1. UART Transmitter/Receiver
    2. Simple CPU Core Module (Instruction Decoder + ALU + Register File)
    3. FIFO Buffer with full/empty flags

Textbooks / References

1. Samir Palnitkar – *Verilog HDL: A Guide to Digital Design and Synthesis*.
2. Michael Ciletti – *Advanced Digital Design with the Verilog HDL*.
3. Chris Spear & Greg Tumbush – *System Verilog for Verification*.
4. David Rich – *Design and Verification with System Verilog*.

Suggested reading:

1. Samir Palnitkar, “Verilog HDL, a guide to digital design and synthesis”, Prentice Hall 2003.
2. Doug Amos, Austin Lesea, Rene Richter, “FPGA based prototyping methodology manual”, Xilinx, 2011.
3. Bob Zeidman, “Designing with FPGAs & CPLDs”, CMP Books, 2002.

Mapping of Course Outcomes with Program Outcomes

CO	PO1	PO2	PO3
CO1	1	2	3
CO2	3	2	3
CO3	3	2	3
CO4	3	2	3
CO5	3	3	3

SEMESTER – II

S. No.	Course Code	Course Title	Category	Hours per week			Credits	CIE	SEE	Total
				L	T / CLC	P	C			
1	25DPC3805	Network Security and Cryptography	PC	3	0	0	3	40	60	100
2	25DPC3806	Advanced Communications and Networks	PC	3	0	0	3	40	60	100
3	25DPE3807 25DPE3808 25DPE3809	**Program Elective– III** Embedded Real-Time Operating Systems Communication Buses and Interfaces Embedded Systems Protocols	PE	3	0	0	3	40	60	100
4	25DPE3810 25DPE3811 25DPE3812	**Program Elective– IV** Cognitive Radio Image and Video Processing Adhoc and Wireless Sensor Networks	PE	3	0	0	3	40	60	100
5	25DPC3807	Network Security and Cryptography Lab	PC	0	0	4	2	40	60	100
6	25DPC3808	Advanced Communications and Networks Lab	PC	0	0	4	2	40	60	100
7	25DMC5801	Quantum Technologies and Applications	MC	2	0	0	2	40	60	100
8	25DPC3809	Comprehensive Viva voce	PC	0	0	0	2	0	100	100
9	25DAC9903 25DAC0101 25DAC5801 25DAC9001 25DAC9904	**Audit Course – II** Sanskrit for Technical Knowledge Business Ethics and Corporate Governance System Modeling Principles of Automation Stress Management By Yoga	AC	2	0	0	0	40		40
Total				**16**	**0**	**8**	**20**	**320**	**520**	**840**

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
M.TECH IN DIGITAL ELECTRONICS AND COMMUNICATION SYSTEMS (DECS)
AK 25 REGULATIONS

Course Code	Year & Sem		L	T/CLC	P	C
25DPC3805	I-II	**Network Security and Cryptography**	3	0	0	0

Course Outcomes: Students should be able to
CO1: **Apply** classical encryption techniques to secure data and demonstrate basic cryptographic operations.
CO2: **Apply** number theory including modular arithmetic, Euler's theorem, Fermat's theorem, the Chinese Remainder Theorem, and Euclidean algorithms in cryptographic operations.
CO3: **Analyze** symmetric cryptographic techniques using stream ciphers, block ciphers, DES, AES, RC5 and IDEA in evaluating confidentiality mechanisms.
CO4: **Apply** asymmetric cryptographic methods including RSA, Diffie–Hellman, elliptic curve cryptography, and hash-based authentication to assess secure communication approaches.
CO5: Analyze authentication mechanisms, intrusion threats, malware, firewalls, and system security techniques in securing modern networked environments.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Bloom's Level
CO1	Apply	classical encryption techniques to secure data and demonstrate basic cryptographic operations.			L3
CO2	Apply	Number theory including modular arithmetic, Euler/Fermat theorems, CRT, Euclidean algorithms	in cryptographic operations.		L3
CO3	Analyze	Symmetric cryptographic techniques using stream ciphers, block ciphers, DES, AES, RC4, RC5, IDEA	in confidentiality mechanisms.		L4
CO4	Apply	asymmetric cryptographic methods including RSA, Diffie–Hellman, elliptic curve cryptography, and hash-based authentication	to assess secure communication approaches.		L3
CO5	Analyze	Analyze authentication mechanisms, intrusion threats, malware, firewalls, and system security techniques	in securing modern networked environments		L4

Syllabus

UNIT - I Lecture Hrs:10

Security: Need, security services, Attacks, OSI Security Architecture, one-time passwords, Model for Network security, Classical Encryption Techniques like substitution ciphers, Transposition ciphers, Cryptanalysis of Classical Encryption Techniques.

UNIT - II Lecture Hrs:11

Number Theory: Introduction, Fermat's and Euler's Theorem, The Chinese Remainder Theorem, Euclidean Algorithm, Extended Euclidean Algorithm, and Modular Arithmetic.

UNIT - III Lecture Hrs:12

Private-Key (Symmetric) Cryptography: Block Ciphers, Stream Ciphers, RC4 Stream cipher, Data Encryption Standard (DES), Advanced Encryption Standard (AES), Triple DES, RC5, IDEA, Linear and Differential Cryptanalysis.

UNIT - IV Lecture Hrs:10

Public-Key (Asymmetric) Cryptography: RSA, Key Distribution and Management, Diffie-Hellman Key Exchange, Elliptic Curve Cryptography, Message Authentication Code, hash functions, message digest algorithms: MD4 MD5, Secure Hash algorithm, RIPEMD-160, HMAC.

UNIT - V Lecture Hrs:14

Authentication and System Security: IP and Web Security Digital Signatures, Digital Signature Standards, Authentication Protocols, Kerberos, IP security Architecture, Encapsulating Security Payload, Key Management, Web Security Considerations, Secure Socket Layer, Secure Electronic Transaction Intruders, Intrusion Detection, Password Management, Worms, viruses, Trojans, Virus Countermeasures, Firewalls, Trusted Systems.

Textbooks:

1. William Stallings, "Cryptography and Network Security, Principles and Practices", Pearson Education, 3rd Edition.
2. Charlie Kaufman, Radia Perlman and Mike Speciner, "Network Security, Private Communication in a Public World", Prentice Hall, 2ND Edition.

Reference Books:

1. Christopher M. King, ErtemOsmanoglu, Curtis Dalton, "Security Architecture, Design Deployment and Operations", RSA Pres,

Mapping of Course Outcomes with Program Outcomes

CO	PO1	PO2	PO3
CO1	2	1	2
CO2	3	1	3
CO3	3	1	3
CO4	3	1	3
CO5	2	2	3

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
M.TECH IN DIGITAL ELECTRONICS AND COMMUNICATION SYSTEMS (DECS)
AK 25 REGULATIONS

Course Code	Year & Sem	ADVANCED COMMUNICATIONS AND NETWORKS	L	T/CLC	P	C
25DPC3806	I-II		3	0	0	0

Course Outcomes: Students should be able to

CO1: Apply spreading sequence properties to implement secure and reliable spread spectrum techniques
CO2: Analyze OFDM signal modeling including modulation selection, pulse shaping, spectral efficiency and windowing.
CO3: Apply the applications of MIMO in modern wireless systems including 3G, 4G, and MIMO-OFDM.
CO4: Understand the difference between 802.11a/b/g standards and their performance characteristics.
CO5: Analyze the performance and features of various IEEE 802.15 standards.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Apply	Spreading Sequence Properties		to implement secure and reliable spread spectrum techniques	L3
CO2	Analyze	OFDM signal modeling including modulation selection, pulse shaping, spectral efficiency and windowing.			L4
CO3	Apply	the applications of MIMO in modern wireless systems		including 3G, 4G, and MIMO-OFDM.	L3
CO4	Understand	the difference between 802.11a/b/g standards and their		performance characteristics.	L2
CO5	Analyze	the performance and features of various IEEE 802.15 standards.			L4

Syllabus

UNIT - I Lecture Hrs:12

Spread Spectrum Communications: Spreading sequences- Properties of Spreading Sequences, Pseudo- noise sequence, Gold sequences, Kasami sequences, Walsh Sequences, Orthogonal Variable Spreading Factor Sequences, Barker Sequence, Complementary Codes

Direct sequence spread spectrum: DS-CDMA Model, Conventional receiver, Rake Receiver, Synchronization in CDMA, Power Control, Soft handoff, Multiuser detection – Optimum multiuser detector, Liner multiuser detection.

UNIT - II Lecture Hrs:11

Orthogonal Frequency Division Multiplexing: Basic Principles of Orthogonality, Single vs Multicarrier Systems, OFDM Block Diagram and Its Explanation, OFDM Signal Mathematical Representation, Selection parameter for Modulation, Pulse shaping in OFDM Signal and Spectral Efficiency, Window in OFDM Signal and Spectrum, Synchronization in OFDM, Pilot Insert in
OFDM Transmission and Channel Estimation, Amplitude Limitations in OFDM, FFT Point Selection Constraints in OFDM, CDMA vs OFDM, Hybrid OFDM.

UNIT - III Lecture Hrs:10

MIMO Systems: Introduction, Space Diversity and System Based on Space Diversity, Smart Antenna system and MIMO, MIMO Based System Architecture, MIMO Exploits Multipath, Space – Time Processing, Antenna Consideration for MIMO, MIMO Channel Modelling, MIMO Channel Measurement, MIMO Channel Capacity, Cyclic Delay Diversity (CDD), Space Time Coding, Advantages and Applications of MIMO in Present Context, MIMO Applications in 3G Wireless
System and Beyond, MIMO-OFDM

Lecture Hrs:14

UNIT - IV

Wireless LANs/IEEE 802.11x: Introduction to IEEE802.11x Technologies, Evolution of wireless LANs, IEEE 802.11 Design Issues, IEEE 802.11 Services, IEEE 802.11 MAC Layer operations, IEEE 802.11 Layer1, IEEE 802.11 a/b/g Higher Rate Standards, Wireless LAN Security, Computing Wireless Technologies, Typical WLAN Hardware

UNIT - V Lecture Hrs:12

Wireless PANs/IEEE 802.15x: Introduction to IEEE 802.15x Technologies: Wireless PAN Applications and Architecture, IEEE 802.15.1 Physical Layer Details, Bluetooth Link Controllers Basics, Bluetooth Link Controllers Operational States, IEEE 802.15.1 Protocols and Host Control Interface. Evaluation of IEEE 802.15 Standards

Broad Band Wireless MANs/IEEE 802.16x: Introduction to WMAN/IEEE 802.16x Technology, IEEE 802.16Wireless MANs, IEEE 802.16 MAC Layer Details, IEEE 802.16 Physical Layer Details, IEEE 802.16 Physical Layer Details for 2-11 GHz, IEEE 802.16 Common System Operations.

Textbooks:

1. Gary J. Mullett, "Introduction to Wireless Telecommunications Systems and Networks", CENGAGE
2. UpenaDalal, "Wireless Communication", Oxford University Press, 2009

Reference Books:

1. Ke-Lin Du & M N S Swamy, "Wireless Communication System", Cambridge University Press, 2010
2. GottapuSasibhusan Rao, "Mobile Cellular Communication", 1st Edition, Pearson Education, 2012

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES:

3 = High, **2 = Medium**, **1 = Low**, Blank = No relation)

CO \ PO	PO1	PO2	PO3
CO1	2	1	3
CO2	3	2	3
CO3	3	2	3
CO4	2	2	2
C05	2	2	3

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
M.TECH IN DIGITAL ELECTRONICS AND COMMUNICATION SYSTEMS (DECS)
AK 25 REGULATIONS

Course Code	Year & Sem	EMBEDDED REAL TIME OPERATING SYSTEMS	L	T/CLC	P	C
25DPE3807	I-II		3	0	0	0

Course Outcomes: Students should be able to

CO1: Apply UNIX/LINUX command-line tools, file I/O procedures, and process control methods to monitor and interpret system performance.

CO2: Analyze RTOS characteristics, tasks, and scheduling, enabling differentiation among key real-time system components.

CO3: Apply RTOS objects, services, and IPC mechanisms, enabling proper implementation of real-time communication methods.

CO4: Analyze exceptions, interrupts, and timer mechanisms in real-time design and constraint scenarios.

CO5: Analyze real-time operating system case studies to compare their strengths and limitations for specific embedded applications.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Apply	UNIX/LINUX command-line tools, file I/O procedures, and process control methods		to monitor and interpret system performance.	L3
CO2	Analyze	RTOS characteristics, tasks, and scheduling		Enabling differentiation among key real-time system components	L4
CO3	Apply	RTOS objects, services, and IPC mechanisms	Enabling proper implementation of real-time communication methods.		L3
CO4	Analyze	Exceptions, interrupts, and timer mechanisms	In real-time design and constraint scenarios		L4
CO5	Analyze	real-time operating system case studies to compare their strengths and limitations		for specific embedded applications.	L4

Syllabus

UNIT - I Lecture Hrs:11

Introduction

Introduction to UNIX/LINUX, Overview of Commands, File I/O,(open, create, close, lseek, read, write), Process Control (fork, vfork, exit, wait, waitpid, exec).

UNIT - II Lecture Hrs:10

Real Time Operating Systems

Brief History of OS, Defining RTOS, The Scheduler, Objects, Services, Characteristics of RTOS, Defining a Task, asks States and Scheduling, Task Operations, Structure, Synchronization, Communication and Concurrency.

Defining Semaphores, Operations and Use, Defining Message Queue, States, Content, Storage, Operations and Use.

UNIT - III Lecture Hrs:11

Objects, Services and I/O

Pipes, Event Registers, Signals, Other Building Blocks, Component Configuration, Basic I/O Concepts, I/O Subsystem.

Lecture Hrs:12

UNIT - IV

Exceptions, Interrupts and Timers

Exceptions, Interrupts, Applications, Processing of Exceptions and Spurious Interrupts, Real Time Clocks, Programmable Timers, Timer Interrupt Service Routines (ISR), Soft Timers, Operations.

UNIT - V Lecture Hrs:10

Case Studies of RTOS

RT Linux, MicroC/OS-II, Vx Works, Embedded Linux, and Tiny OS.

Textbooks:

1. Real Time Concepts for Embedded Systems – Qing Li, Elsevier, 2011.

Reference Books:

1. Embedded Systems- Architecture, Programming and Design by Rajkamal, TMH, 2007.
2. Advanced UNIX Programming, Richard Stevens.
3. Embedded Linux: Hardware, Software and Interfacing – Dr. Craig Hollabaugh.

Mapping of Course Outcomes with Program Outcomes

CO	PO1	PO2	PO3
CO1	2	1	2
CO2	3	1	3
CO3	3	1	3
CO4	3	1	3
CO5	2	2	3

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
M.TECH IN DIGITAL ELECTRONICS AND COMMUNICATION SYSTEMS (DECS)
AK 25 REGULATIONS

Course Code	Year & Sem	COMMUNICATION BUSES AND INTERFACES	L	T/CLC	P	C
25DPE3808	I-II		3	0	0	0

Course Outcomes: Students should be able to

CO1 — Understand serial communication buses including RS232, RS485, I2C, and SPI with their physical interfaces, signaling methods, features, and applications.

CO2 — Analyze CAN architecture, layered structure, frame formats, and data transmission behavior in automotive and industrial communication environments.

CO3 — Apply PCI Express concepts, revisions, configuration space, and hardware protocols in high-speed system interface applications.

CO4 — Analyze USB transfer types, enumeration processes, descriptor structures, and device driver interactions in USB-based embedded systems.

CO5 — Analyze Serial Front Panel Data Port (SFPDP) communication using fiber-optic and copper media in high-speed data streaming applications.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Bloom's Level
CO1	Understand	Serial communication buses including RS232, RS485, I2C, and SPI	with their physical interfaces, signaling methods, features, and applications.	—	**L2**
CO2	Analyze	CAN architecture, layered structure, frame formats, and data transmission behavior	in automotive and industrial communication environments.	—	**L4**
CO3	Apply	PCI Express concepts, revisions, configuration space, and hardware protocols	in high-speed system interface applications.	—	**L3**
CO4	Analyze	USB transfer types, enumeration processes, descriptor structures, and device driver interactions	in USB-based embedded systems	—	**L4**
CO5	Analyze	Serial Front Panel Data Port (SFPDP) communication using fiber-optic and copper media	in high-speed data streaming applications.	—	**L4**

Syllabus

UNIT - I

Serial Busses - Physical interface, Data and Control signals, features, limitations and applications of RS232, RS485, I2C, SPI

UNIT - II

CAN - Architecture, Data transmission, Layers, Frame formats, applications

UNIT - III

PCIe - Revisions, Configuration space, Hardware protocols, applications

UNIT - IV

USB - Transfer types, enumeration, Descriptor types and contents, Device driver

UNIT - V

Data Streaming Serial Communication Protocol - Serial Front Panel Data Port (SFPDP) using fiber optic and copper cable

TEXT BOOKS:

1. Jan Axelson, "Serial Port Complete - COM Ports, USB Virtual Com Ports, and Ports for Embedded Systems", Lakeview Research, 2nd Edition
2. Jan Axelson, "USB Complete", Penram Publications
3. Mike Jackson, Ravi Budruk, "PCI Express Technology", Mindshare Press
4. Wilfried Voss, "A Comprehensible Guide to Controller Area Network", Copperhill Media Corporation, 2nd Edition, 2005.
5. Serial Front Panel Draft Standard VITA 17.1 –200x
6. Technical references onwww.can-cia.org, http://www.pcisig.com/www.pcisig.com, http://www.usb.org/www.usb.org

Mapping of Course Outcomes with Program Outcomes

CO	PO1	PO2	PO3
CO1	2	1	2
CO2	3	1	3
CO3	3	1	3
CO4	3	1	3
CO5	2	2	3

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
M.TECH IN DIGITAL ELECTRONICS AND COMMUNICATION SYSTEMS (DECS)
AK 25 REGULATIONS

Course Code	Year & Sem	EMBEDDED SYSTEMS PROTOCOLS	L	T/CLC	P	C
25DPE3809	I-II		3	0	0	0

Course Outcomes: Students should be able to

CO1: Understand embedded communication protocols such as serial, parallel, SPI, I2C, and bus standards in embedded data exchange mechanisms.

CO2: Analyze USB and CAN bus architectures, communication frames, and microcontroller interfaces to differentiate among various embedded connectivity options.

CO3: Apply Ethernet fundamentals, controller functions, and networking components for effective design of embedded network systems.

CO4: Analyze embedded Ethernet applications involving UDP, TCP, web services, FTP, and security measures within networked embedded environments.

CO5: Analyze wireless embedded networking concepts including sensor networks, MAC protocols, routing, and synchronization for selection of suitable wireless solutions for embedded applications.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Bloom's Level
CO1	Understand	Embedded communication protocols such as serial, parallel, SPI, I2C, and bus standards	In embedded data exchange mechanisms	—	L2
CO2	Analyze	USB and CAN bus architectures, communication frames, and microcontroller interfaces	—	To differentiate among embedded connectivity options	L4
CO3	Apply	Ethernet fundamentals, controller functions, and networking components	—	For effective design of embedded network systems	L3
CO4	Analyze	UDP, TCP, web services, FTP, and security measures	Within networked embedded environments	—	L4
CO5	Analyze	Wireless sensor networks, MAC protocols, routing, and synchronization concepts	—	For selection of suitable wireless solutions for embedded applications	L4

Syllabus

UNIT - I Lecture Hrs:10

Embedded Communication Protocols

Embedded Networking: Introduction – Serial/Parallel Communication – Serial communication protocols -RS232 standard – RS485 – Synchronous Serial Protocols -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) – PC Parallel port programming - ISA/PCI Bus protocols – Firewire.

UNIT - II Lecture Hrs:12

USB and CAN Bus

USB bus – Introduction – Speed Identification on the bus – USB States – USB bus communication Packets –Data flow types –Enumeration –Descriptors –PIC 18 Microcontroller USB Interface – C Programs –CAN Bus – Introduction - Frames –Bit stuffing –Types of errors –Nominal Bit Timing – PIC microcontroller CAN Interface –A simple application with CAN.

UNIT - III Lecture Hrs:13

Ethernet Basics

Elements of a network – Inside Ethernet – Building a Network: Hardware options – Cables, Connections and network speed – Design choices: Selecting components –Ethernet Controllers – Using the internet in local and internet communications – Inside the Internet protocol.

UNIT - IV Lecture Hrs:10

Embedded Ethernet

Exchanging messages using UDP and TCP – Serving web pages with Dynamic Data – Serving web pages that respond to user Input – Email for Embedded Systems – Using FTP – Keeping Devices and Network secure.

UNIT - V Lecture Hrs:12

Wireless Embedded Networking

Wireless sensor networks – Introduction – Applications – Network Topology – Localization –Time Synchronization - Energy efficient MAC protocols –SMAC – Energy efficient and robust routing – Data Centric routing.

Textbooks:

1. Embedded Systems Design: A Unified Hardware/Software Introduction - Frank Vahid, Tony Givargis, John & Wiley Publications, 2002.

2. Parallel Port Complete: Programming, interfacing and using the PCs parallel printer port - Jan Axelson, Penram Publications, 1996.

Reference Books:

1. Advanced PIC microcontroller projects in C: from USB to RTOS with the PIC18F series - Dogan Ibrahim, Elsevier 2008.

2. Embedded Ethernet and Internet Complete - Jan Axelson, Penram publications, 2003.

Networking Wireless Sensors - BhaskarKrishnamachari, Cambridge press 2005.

Mapping of Course Outcomes with Program Outcomes

CO	PO1	PO2	PO3
CO1	2	1	2
CO2	3	1	3
CO3	3	1	3
CO4	3	1	3
CO5	2	2	3

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
M.TECH IN DIGITAL ELECTRONICS AND COMMUNICATION SYSTEMS (DECS)
AK 25 REGULATIONS

Course Code	Year & Sem	Cognitive Radio	L	T/CLC	P	C
25DPE3810	I-II		3	0	0	0

Course Outcomes:

After completion of the course, students will be able to:

CO1: Understand the architecture, functions, and applications of cognitive radio along with the concept of dynamic spectrum access.

CO2: Analyze spectrum sensing techniques, detection of spectrum holes, and spectrum sharing models used in cognitive radio systems.

CO3: Apply optimization techniques such as linear, nonlinear, and dynamic programming for efficient dynamic spectrum allocation

CO4: Analyze various dynamic spectrum access mechanisms and learning-based spectrum management..

CO5: Analyze spectrum trading models, pricing mechanisms, auction theories, and research challenges in cognitive radio networks

CO	Action Verb	Knowledge Statement	Condition	Criteria	Bloom's level
CO1	Understand	the architecture, functions, and applications of cognitive radio	.	along with the concept of dynamic spectrum access	L2
CO2	Analyze	spectrum sensing techniques, detection of spectrum holes, and spectrum sharing models used in cognitive radio systems			L4
CO3	Apply	optimization techniques such as linear, nonlinear, and dynamic programming	for efficient dynamic spectrum allocation.		L4
CO4	Analyze	various dynamic spectrum access mechanisms and learning-based spectrum management..			L4
CO5	Analyze	spectrum trading models, pricing mechanisms, auction theories, and research challenges in cognitive radio networks			L4

UNIT-I LectureHrs:11

Introduction to Cognitive Radios: Digital dividend, cognitive radio (CR) architecture, functions of cognitive radio, dynamic spectrum access(DSA),components of cognitive radio, spectrum sensing, Spectrum analysis and decision, potential applications of cognitive radio.

LectureHrs:12

UNIT-II

Spectrum Sensing: Spectrum sensing, detection of spectrum holes (TVWS), collaborative sensing, geo-location database and spectrum sharing business models(spectrum of commons, real time Secondary spectrum market).

LectureHrs:10

UNIT-III

Optimization Techniques of Dynamic Spectrum Allocation: Linear programming, convex programming, non-linear programming, integer programming, dynamic programming, stochastic programming.

UNIT-IV LectureHrs:10

Dynamic Spectrum Access and Management: Spectrum broker, cognitive radio architectures, centralized dynamic spectrum access, distributed dynamic spectrum access, learning algorithms and protocols.

UNIT-V LectureHrs:13

Spectrum Trading: Introduction to spectrum trading, classification to spectrum trading, radio resource pricing, brief discussion on economics theories in DSA (utility, auction theory), and classification of auctions (single auctions, double auctions, concurrent, sequential). Research Challenges in Cognitive Radio: Network layer and transport layer issues, cross layer design for cognitive radio networks.

Textbooks:

1. Ekram Hossain, Dusit Niyato, ZhuHan, "Dynamic Spectrum Access and Management in Cognitive Radio Networks", Cambridge University Press, 2009.
2. Kwang-Cheng Chen, Ramjee Prasad,"Cognitiveradionetworks",JohnWiley&SonsLtd.,2009.

Reference Books:

1. Bruce Fette, "Cognitive radio technology", Elsevier,2nd edition, 2009.
2. Husey in Arslan, "Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems", Springer, 2007.
3. Francisco Rodrigo Porto Cavalcanti, Soren Andersson,"Optimizing Wireless Communication Systems" Springer, 2009.
4. Linda Doyle, "Essentials of Cognitive Radio", Cambridge University Press, 2009

Web Resources:

1. https://nptel.ac.in/courses/108102043

Mapping of Course outcomes with Program outcomes

CO/PO	PO1	PO2	PO3
CO1	2	1	
CO2	1	3	
CO3	3	2	
CO4	3	2	1
CO5	3	2	2

(Levels of correlation, viz., 1. Low, 2. Moderate, 3. High)

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
M.TECH IN DIGITAL ELECTRONICS AND COMMUNICATION SYSTEMS (DECS)
AK 25 REGULATIONS

Course Code	Year & Sem	IMAGE AND VIDEO PROCESSING	L	T/CLC	P	C
25DPE3811	I-II		3	0	0	0

Course Outcomes: Students should be able to
CO1: Analyze the basic steps of image processing, pixel relationships and image segmentation methods.
CO2: Apply the image enhancement techniques using spatial and frequency domain methods for improving the visual quality of images.
CO3: Analyze the image compression techniques for reducing the redundancy and storage.
CO4: Understand the fundamental concepts of video processing using time varying image formation models.
CO5: Apply the motion estimation techniques for efficient video coding and visual communication.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Analyze	basic steps of image processing, pixel relationships and image segmentation methods.			L4
CO2	Apply	the image enhancement techniques	using spatial and frequency domain methods	for improving the visual quality of images	L3
CO3	Analyze	the image compression techniques		for reducing the redundancy and storage.	L4
CO4	Understand	the fundamental concepts of video processing	using time varying image formation models		L2
CO5	Apply	the motion estimation techniques		for efficient video coding and visual communication	L3

UNIT - I Lecture Hrs:

Fundamentals of Image Processing and Image Segmentation

Basic steps of Image Processing System Sampling and Quantization of an image, Basic relationship between pixels.

Image Segmentation

Segmentation concepts, Point, Line and Edge Detection, Thresholding, Region based segmentation.

UNIT - II Lecture Hrs:

Image Enhancement

Spatial domain methods: Histogram processing, Fundamentals of Spatial filtering, Smoothing spatial filters, Sharpening spatial filters.

Frequency domain methods: Basics of filtering in frequency domain, image smoothing, image sharpening, Selective filtering.

UNIT - III Lecture Hrs:

Image Compression

Image compression fundamentals - Coding Redundancy, Spatial and Temporal redundancy, Compression models: Lossy& Lossless, Huffman coding, , Bit plane coding, Transform coding, Predictive coding, Wavelet coding, Lossy Predictive coding, JPEG Standards.

UNIT - IV Lecture Hrs:

Basic Steps of Video Processing

Analog Video, Digital Video. Time-Varying Image Formation models: Three-Dimensional Motion Models, Geometric Image Formation, Photometric Image Formation, Sampling of Video signals, Filtering operations.

UNIT - V Lecture Hrs:

2-D Motion Estimation

Optical flow, General Methodologies, Pixel Based Motion Estimation, Block- Matching Algorithm, Mesh based Motion Estimation, Global Motion Estimation, Region based Motion Estimation, Multi resolution motion estimation, Waveform based coding, Block based transform coding, Predictive coding, Application of motion estimation in Video coding.

Textbooks:

1. Digital Image Processing – Gonzaleze and Woods, 4rd Ed., Pearson, 2018.
2. Digital Video Processing – M. Tekalp, Prentice Hall International

Reference Books:

1. Video Processing and Communication – Yao Wang, JoemOstermann and Ya–quin Zhang. 1st Ed., PH Int.
2. Digital Image Processing – S.Jayaraman, S.Esakkirajan, T.Veera Kumar –TMH, 2009

Mapping of Course Outcomes with Program Outcomes

CO	PO1	PO2	PO3
CO1	2	1	1
CO2	3	1	3
CO3	2	1	2
CO4	1	1	1
CO5	2	2	2

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
M.TECH IN DIGITAL ELECTRONICS AND COMMUNICATION SYSTEMS (DECS)
AK 25 REGULATIONS

Course Code	Year & Sem		L	T/CLC	P	C
25DPE3812	I-II	ADHOC AND WIRELESS SENSOR NETWORKS	3	0	0	0

Course Outcomes: Students should be able to
CO1: Understand Wireless LAN/PAN fundamentals of IEEE 802.11, HIPERLAN, Bluetooth, Home RF and ad hoc wireless networks.
CO2 : Analyze the design issues of MAC protocols for ad hoc wireless networks.
CO3: Analyze the design issues of routing protocols for ad hoc wireless networks.
CO4: Analyze the design issues of a transport layer protocols for ad hoc wireless networks.
CO5: Understand sensor network architecture, protocols and issues in wireless sensor networks.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	Understand Wireless LAN/PAN fundamentals of IEEE 802.11, HIPERLAN, Bluetooth, Home RF		ad hoc wireless networks	L2
CO2	Analyze	the design issues of MAC protocols		for ad hoc wireless networks	L4
CO3	Analyze	the design issues of routing protocols		for ad hoc wireless networks	L4
CO4	Analyze	the design issues of a transport layer protocols		for ad hoc wireless networks.	L4
CO5	Understand	sensor network architecture, protocols	.	issues in wireless sensor networks	L2

UNIT - I Lecture Hrs:12

Wireless LANs and PANs: Introduction, Fundamentals of WLANS, IEEE 802.11 Standards, HIPERLAN Standard, Bluetooth, Home RF.

AD HOC WIRELESS NETWORKS: Introduction, Issues in Ad Hoc Wireless Networks

UNIT - II Lecture Hrs:11

MAC Protocols: Introduction, Issues in Designing a MAC protocol for Ad Hoc Wireless Networks, Design goals of a MAC Protocol for Ad Hoc Wireless Networks, Classifications of MAC Protocols, Contention - Based Protocols, Contention - Based Protocols with reservation Mechanisms, Contention – Based MAC Protocols with Scheduling Mechanisms, MAC Protocols that use Directional Antennas, Other MAC Protocols.

UNIT - III Lecture Hrs:12

Routing Protocols: Introduction, Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classification of Routing Protocols, Table –Driven Routing Protocols, On – Demand Routing Protocols, Hybrid Routing Protocols, Routing Protocols with Efficient Flooding Mechanisms, Hierarchical Routing Protocols, Power – Aware Routing Protocols.

UNIT - IV Lecture Hrs:11

Transport Layer Protocols: Introduction, Issues in Designing a Transport Layer Protocol for Ad Hoc Wireless Networks, Design Goals of a Transport Layer Protocol for Ad Hoc Wireless Networks, Classification of Transport Layer Solutions, TCP Over Ad Hoc Wireless Networks, Other Transport Layer Protocol for Ad Hoc Wireless Networks.

UNIT - V Lecture Hrs:10

Wireless Sensor Networks: Introduction, Sensor Network Architecture, Data Dissemination, Data Gathering, MAC Protocols for Sensor Networks, Location Discovery, Quality of a Sensor Network, Evolving Standards, Other Issues.

Textbooks:

1. Ad Hoc Wireless Networks: Architectures and Protocols - C. Siva Ram Murthy and B. S. Manoj, 2004, PHI.
2. Wireless Ad- hoc and Sensor Networks: Protocols, Performance and Control – JagannathanSarangapani, CRC Press.

Reference Books:

1. Ad- Hoc Mobile Wireless Networks: Protocols & Systems, C. K. Toh, 1st Ed. Pearson Education.
2. Wireless Sensor Networks - C. S. Raghavendra, Krishna M. Sivalingam, 2004, Springer

Mapping of Course Outcomes with Program Outcomes

CO	PO1	PO2	PO3
CO1	2		3
CO2	3		3
CO3	2	1	2
CO4	3		3
CO5	3	1	3

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
M.TECH IN DIGITAL ELECTRONICS AND COMMUNICATION SYSTEMS (DECS)
AK 25 REGULATIONS

Course Code	Year & Sem		L	T/CLC	P	C
25DPC3807	I-II	NETWORK SECURITY AND CRYPTOGRAPHY LAB	3	0	0	0

Course Outcomes: Students should be able to
CO1: Apply the symmetric and asymmetric cryptographic algorithms for ensuring confidentiality in secure communication.
CO2: Analyze the encryption and hashing algorithms by evaluating their complexity and efficiency for improving security performance.
CO3: Apply the key generation and key exchange mechanisms using communication models for securing data transmission in networks
CO4: Analyze the secure communication solutions using modern cryptographic tools for message authentication and email security.
CO5: Apply the cryptographic techniques in real-time web/network case studies for practical security enhancement.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Bloom's Level
CO1	Apply	the symmetric and asymmetric cryptographic algorithms		for ensuring data confidentiality in secure communication	L3
CO2	Analyze	the encryption and hashing algorithms	by evaluating complexity and efficiency	for improving security performance	L4
CO3	Apply	the key generation and key exchange mechanisms	using communication models	for securing data transmission in networks	L3
CO4	Analyze	the secure communication solutions	using modern cryptographic tools	for message authentication and email security.	L4
CO5	Apply	the cryptographic techniques	in real-time web/network case studies	for practical security enhancement.	L3

List of Experiments:

1. Write a program to perform encryption and decryption using substitution and ransposition cipher.
2. Write a program to implement DES algorithm logic
3. Write a program for evaluation of AES
4. Write a program for evaluation Triple DES
5. Write a program to implement Blowfish algorithm logic
6. Write a program to implement RSA algorithm logic
7. Implement Diffie-Hellman key exchange mechanism using html
8. Write a program to implement Euclid algorithm
9. Calculate the message digest of a text using SHA-1 algorithm
10. Implement the signature scheme digital signature standard

11. Implement electronic mail security

12. Case study on web security requirement

Software Requirements:

C/C++/Java/Python

Mapping of Course Outcomes with Program Outcomes

CO	PO1	PO2	PO3
CO1	3	2	1
CO2	3	3	2
CO3	3	3	3
CO4	3	3	3
CO5	3	2	2

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
M.TECH IN DIGITAL ELECTRONICS AND COMMUNICATION SYSTEMS (DECS)
AK 25 REGULATIONS

Course Code	Year & Sem	ADVANCED COMMUNICATIONS AND NETWORKS LAB	L	T/CLC	P	C
25DPC3808	I-II		3	0	0	0

Course Outcomes: Students should be able to
CO1: Analyze the matched filter, optimum receiver, and ISI effects for reliable digital communication.
CO2: Analyze the Digital Finite Impulse Response filters design using windowing method.
CO3: Apply the PSK and FSK modulation and demodulation techniques for effective digital communication.
CO4: Apply the QAM modulation and demodulation techniques for efficient signal multiplexing.
CO5: Apply the spectral estimation and sampling rate conversion methods for enhancing signal quality.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Analyze	the matched filter, optimum receiver, and ISI effects		for reliable digital communication	L4
CO2	Analyze	the Digital Finite Impulse Response filters design	using windowing method		L4
CO3	Apply	the PSK and FSK modulation and demodulation techniques		for effective digital communication	L3
CO4	Apply	the QAM modulation and demodulation techniques		for efficient signal multiplexing.	L3
CO5	Apply	the spectral estimation and sampling rate conversion methods		for enhancing signal quality	L3

List of Experiments: Student has to do minimum **TWELVE** experiments in the given list.

1. Implementation of Matched Filters.
2. Optimum receiver for the AWGN channel.
3. Design FIR (LP/HP/BP) filter using Window method.
4. Measurement of effect of Inter Symbol Interference.
5. Generation of constant envelope PSK signal wave form for different values of M.
6. Simulation of PSK system with M=4
7. Simulation of DPSK system with M=4
8. Design of FSK system
9. Simulation of correlation type demodulation for FSK signal
10. BPSK Modulation and Demodulation techniques
11. QPSK Modulation and Demodulation techniques
12. DQPSK Modulation and Demodulation techniques
13. 8-QAM Modulation and Demodulation techniques
14. DQAM Modulation and Demodulation techniques
15. Verification of Decimation and Interpolation of a given signal
16. Power spectrum estimation using AR model

Software Requirements:
MATLAB

Mapping of Course Outcomes with Program Outcomes

CO	PO1	PO2	PO3
CO1	3	2	1
CO2	3	3	2
CO3	3	3	3
CO4	3	3	3
CO5	3	2	2