Syed Ammal Engineering College, Ramanathapuram – 623 502

An Autonomous Institution & Affiliated to Anna University, Chennai.

Regulation 2024

Choice based Credit System

M.E. / EMBEDDED SYSTEM TECHNOLOGIES

Vision	Mission
To be a centre of excellence in teaching and research in Electrical and Electronics Engineering, to produce highly skilled, excellent engineers who can serve the society.	**M 1:** Provide exemplary learning environment and quality professional education. **M 2:** Empower rural students with skills and knowledge for innovation through curricular, co-curricular and extracurricular activities. **M 3:** Providing ample opportunities to learn moral and ethical values to serve the society and nation.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

The graduates of M. E – Embedded System Technologies shall:

PEO1:. Excel in professional career, higher education and research.

PEO2: Have good fundamental and advanced engineering knowledge to comprehend, analyze, design and create novel solutions for real life problems.

PEO3: Demonstrate professionalism, entrepreneurship, ethical behavior, communication skills and collaborative team work to adapt the emerging trends by engaging in lifelong learning.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

At the end of the course, the graduates of M. E – Embedded System Technologies will have the ability to

PSO1: Design and develop an appropriate embedded system for commercial and industrial application by using optimum resources with better performance.

Programme Outcomes (POs)
At the end of the course, the graduates of M. E – Embedded System Technologies will have the ability to

PO1: Independently carry out research/investigation and development work to solve practical problems.

PO2: Write and present a substantial technical report/document.

PO3: Demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

PO4: Acquire fundamental knowledge and understanding of Embedded system design technologies.

PO5: Apply suitable techniques, resources with modern engineering IT tools in the field of embedded system design through continuous learning.

PO6: Communicate and perform effectively as an individual and as a member or leader in a diverse team to prove technical and administrative capability.

S.No	Subject Area	Credits per Semester				Total Credits
	Semester	I	II	III	IV	
1	FC	4	-			
2	PCC	16	16			
3	PEC	-	6			
4	RMC	2	-			
5	OEC	-	-			
6	EEC	-	-			
7	Non-Credit/ (Audit) Courses	0	0			
	Total Credits	22	22			

FC – Foundation Courses (Mathematics)

PCC – Professional Course Core (Branch Compulsory Courses)

PEC – Professional Elective Course (Branch Elective Course)

RMC – Research Methodology and IPR Courses

OEC – Open Elective Course (Elective Courses offered by other branches)

EEC – Employability Enhancement Course (Project Work)

Semester - I

S.No	Course Code	Title	Category	L	T	P	Total Contact Periods	Credits
Theory								
1	24MA004T	Applied Mathematics for Embedded Systems Technologists	FC	3	1	0	4	4
2	24RM101T	Research Methodology and IPR	RMC	2	0	0	2	2
3	24ES101T	Design of Embedded Systems	PCC	3	0	0	3	3
4	24ES102T	Software for Embedded Systems	PCC	3	0	0	3	3
5	24ES103T	Microcontroller Based System Design	PCC	3	0	0	3	3
6	24ES104T	VLSI Design and Reconfigurable Architecture	PCC	3	0	0	3	3
Practical								
7	24ES101P	Embedded System Laboratory - I	PCC	0	0	4	4	2
8	24ES102P	Embedded Programming Laboratory - I	PCC	0	0	4	4	2
Total				**17**	**1**	**8**	**26**	**22**

Semester - II

S.No	Course Code	Title	Category	L	T	P	Total Contact Periods	Credits
Theory								
1	24ES201T	Real Time Operating System	PCC	3	0	0	3	3
2	24ES202T	Embedded System Networking	PCC	3	0	0	3	3
3	24ES203T	Embedded Control for Electric Drives	PCC	3	0	0	3	3
4	24ES204T	IoT for Smart Systems	PCC	3	0	0	3	3
5		Professional Elective I	PEC	3	0	0	3	3
6		Professional Elective II	PEC	3	0	0	3	3
Practical								
7	24ES201P	Embedded System Laboratory - II	PCC	0	0	4	4	2
8	24ES202P	Embedded Programming Laboratory - II	PCC	0	0	4	4	2
Total				**18**	**0**	**8**	**26**	**22**

24MA004T	APPLIED MATHEMATICS FOR EMBEDDED SYSTEMS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To understand the techniques of Fourier transform to solve partial differential equations.
- To become familiar with graph theory for modelling the embedded system.
- To understand various optimization techniques for utilizing system and network resources.
- To understand the basic concepts of probability to apply in embedded technology.
- To understand the basic concept of random variables and queuing theories to address stochastic and dynamic environment in embedded technology.

UNIT I FOURIER TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS **12**

Fourier Transform: Definitions - Properties – Transform of elementary functions - Dirac delta function – Convolution theorem – Parseval's identity – Solutions to partial differential equations: Heat equation - Wave equation - Laplace and Poison's equations.

UNIT II GRAPH THEORY **12**

Introduction to paths, trees, vector spaces - Matrix coloring and directed graphs - Some basic algorithms – Shortest path algorithms – Depth - First search on a graph – Isomorphism – Other Graph - Theoretic algorithms — Performance of graph theoretic algorithms — Graph theoretic computer languages.

UNIT III OPTIMIZATION TECHNIQUES **12**

Linear programming - Basic concepts – Graphical and simplex methods – Big M method - Two phase simplex method - Revised simplex method - Transportation problems – Assignment problems.

UNIT IV PROBABILITY AND RANDOM VARIABLES **12**

Probability – Axioms of probability – Conditional probability – Baye's theorem - Random variables - Probability function — Moments — Moment generating functions and their properties — Binomial Poisson, Exponential, Normal distributions – Two dimensional random variables - Poisson process.

UNIT V QUEUEING THEORY **12**

Single and multiple servers - Markovian queuing models - Finite and infinite capacity queues – Finite source model – Queuing applications.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

After completing this course, the students will be able to

CO1: Apply Fourier transform techniques to solve PDE technology.
CO2: Model the networks in embedded systems using graph theory.
CO3: Apply various optimization techniques for utilizing system and network resources.
CO4: Use the ideas of probability and random variables in solving engineering problems.
CO5: Address stochastic and dynamic behavior of data transfer using queuing theories in embedded systems technologies.

References:

1. Taha H. A, “Operations Research: An Introduction”, 9th Edition, Pearson Education Asia, New Delhi, 2016.
2. Walpole R.E., Myer R.H., Myer S.L., and Ye, K., “Probability and Statistics for Engineers. and Scientists”, 7th Edition, Pearson Education, Delhi, 2002.
3. Sankara Rao, K., “Introduction to Partial Differential Equations”, Prentice Hall of India Pvt. Ltd., New Delhi, 1997.
4. Narasingh Deo, “Graph Theory with Applications to Engineering and Computer Science”, Prentice Hall India, 1997.
5. S. S. Rao, “Engineering Optimization, Theory and Practice”, 4th Edition, John Wiley and Sons, 2009.

Mapping of COs with POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1
1	1	-	1	-	1	-	1
2	1	-	1	-	1	-	1
3	1	-	1	-	1	-	1
4	1	-	1	-	1	-	1
5	1	-	1	-	1	-	1
Avg.	**1**	**-**	**1**	**-**	**1**	**-**	**1**
1 - Low, 2 - Medium, 3 - High, ‘-' - No Correlation							

24RM101T	RESEARCH METHODOLOGY AND IPR	L	T	P	C
		2	0	0	2

UNIT I RESEARCH DESIGN **6**

Overview of research process and design, Use of Secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys

UNIT II DATA COLLECTION AND SOURCES **6**

Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying.

UNIT III DATA ANALYSIS AND REPORTING **6**

Overview of Multivariate analysis, Hypotheses testing and Measures of Association. Presenting Insights and findings using written reports and oral presentation.

UNIT IV INTELLECTUAL PROPERTY RIGHTS **6**

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.

UNIT V PATENTS **6**

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.

TOTAL: 30 PERIODS

References:

1. Cooper Donald R, Schindler Pamela S and Sharma JK, "Business Research Methods", Tata McGraw Hill Education, 11e (2012).
2. Catherine J. Holland, "Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets", Entrepreneur Press, 2007.
3. David Hunt, Long Nguyen, Matthew Rodgers, "Patent searching: tools & Techniques", Wiley, 2007.
4. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, "Professional Programme Intellectual Property Rights, Law and practice", September 2013.

24ES101T	DESIGN OF EMBEDDED SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To provide knowledge on the basics, building blocks of Embedded System.
- To discuss Input/output Interfacing & Bus Communication with processors.
- To teach automation using scheduling algorithms and Real time operating system.
- To discuss on different Phases & Modeling of a new embedded product.
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills.

UNIT I INTRODUCTION TO EMBEDDED SYSTEMS **9**

Introduction to Embedded Systems –built in features for embedded Target Architecture - selection of Embedded processor — DMA- memory devices — Memory management methods-memory mapping, cache replacement policies- Timer and Counting devices, Watchdog Timer, Real Time Clock-Software Development tools-IDE, assembler, compiler, linker, simulator, debugger, In circuit emulator, Target Hardware Debugging- Overview of functional safety standards for embedded systems.

UNIT II EMBEDDED NETWORKING BY PROCESSORS **9**

Embedded Networking: Introduction, I/O Device Ports & Buses- multiple interrupts and interrupt service mechanism — Serial Bus communication protocols -RS232 standard–RS485–USB–Inter Integrated Circuits (I^2C)- CAN Bus –Wireless protocol based on Wifi , Bluetooth, Zigbee – Introduction to Device Drivers.

UNIT III RTOS BASED EMBEDDED SYSTEM DESIGN **9**

Introduction to basic concepts of RTOS- Need, Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Task communicationcontext switching, interrupt latency and deadline shared memory, message passing-, Interprocess Communication — synchronization between processes-semaphores, Mailbox, pipes, priority inversion, priority inheritance, comparison of Real time Operating systems: VxWorks, µC/OS-II, RT Linux.

UNIT IV MODELLING WITH HARDWARE/SOFTWARE DESIGN APPROACHES 9

Modelling embedded systems- embedded software development approach -Overview of UML modeling with UML, UML Diagrams- Hardware/Software Partitioning, Co-Design Approaches for System Specification and modeling- Co Synthesis- features comparing Single-processor Architectures & Multi-Processor Architectures-design approach on parallelism in uniprocessors & Multiprocessors.

UNIT V EMBEDDED SYSTEM APPLICATION DEVELOPMENT 9

Objective, Need, different Phases & Modelling of the EDLC - Choice of Target Architectures for Embedded Application Development-for Control Dominated-Data Dominated Systems-Case studies on Digital Camera, Adaptive Cruise control in a Car, Mobile Phone software for key inputs.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will

CO1: Demonstrate the functionalities of processor internal blocks, with their requirement.
CO2: Analyze that Bus standards are chosen based on interface overheads without sacrificing processor performance.
CO3: Explain the role and features of RT operating system, that makes multitask execution possible by processors.
CO4: Illustrate that using multiple CPU based on either hardcore or softcore helps data overhead management with processing- speed reduction for µC execution.
CO5: Recommend Embedded consumer product design based on phases of product development.

References:

1. Rajkamal, "Embedded System-Architecture, Programming, Design", TMH,2011.
2. Peckol, "Embedded system Design", John Wiley & Sons,2010.
3. Lyla B Das, "Embedded Systems-An Integrated Approach", Pearson, 2013.
4. Elicia White, "Making Embedded Systems", O'Reilly Series, SPD, 2011.
5. Bruce Powel Douglass, "Real-Time UML Workshop for Embedded Systems", Elsevier, 2011.
6. "Advanced Computer architecture", By Rajiv Chopra, S Chand, 2010
7. Jorgen Staunstrup, Wayne Wolf, "Hardware / Software Co- Design Principles and Practice", Springer, 2009.
8. Shibu.K.V, "Introduction to Embedded Systems", Tata Mcgraw Hill, 2009.
9. Tammy Noergaard, "Embedded System Architecture, A comprehensive Guide for Engineers and Programmers", Elsevier, 2006.
10. Giovanni De Micheli, Mariagiovanna Sami, "Hardware / Software Co- Design", Kluwer Academic Publishers, 2002.

Mapping of COs with POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1
1	-	-	3	2	1	-	1
2	2	-	1	2	-	-	1
3	-	2	2	3	-	-	2
4	2	-	3	3	-	-	2
5	2	-	1	2	-	2	2
Avg.	**1.2**	**0.4**	**2**	**2.4**	**0.2**	**0.4**	**1.6**
1 - Low, 2 - Medium, 3 - High, '-' - No Correlation							

24ES102T SOFTWARE FOR EMBEDDED SYSTEMS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To expose the students to the fundamentals of embedded Programming.
- To Introduce the GNU C Programming Tool Chain in Linux.
- To study the basic concepts of embedded C.
- To teach the basics of Python Programming.
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills.

UNIT I BASIC C PROGRAMMING 9

Typical C Program Development Environment - Introduction to C Programming - Structured Program Development in C - Data Types and Operators - C Program Control - C Functions - Introduction to Arrays.

UNIT II EMBEDDED C 9

Adding Structure to 'C' Code: Object oriented programming with C, Header files for Project and Port, Examples. Meeting Real-time constraints: Creating hardware delays - Need for timeout mechanism - Creating loop timeouts - Creating hardware timeouts.

UNIT III C PROGRAMMING TOOL - CHAIN IN LINUX 9

C preprocessor - Stages of Compilation - Introduction to GCC - Debugging with GDB - The Make utility - GNU Configure and Build System - GNU Binary utilities - Profiling - using gprof - Introduction to GNU C Library.

UNIT IV PYTHON PROGRAMMING 9

Introduction - Parts of Python Programming Language - Control Flow Statements - Functions – Strings - Lists - Dictionaries - Tuples and Sets.

UNIT V MODULES, PACKAGES AND LIBRARIES IN PYTHON 9

Python Modules and Packages - Creating Modules and Packages - Practical Example - Libraries for Python - Library for Mathematical functionalities and Tools - Numerical Plotting Library - GUI Libraries for Python - Imaging Libraries for Python - Networking Libraries.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will demonstrate the ability to

CO1: Demonstrate C programming and its salient features for embedded systems.
CO2: Deliver insight into various programming languages/software compatible to embedded process development with improved design & programming skills.
CO3: Develop knowledge on C programming in Linux environment.
CO4: Possess ability to write python programming for Embedded applications.
CO5: Have improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded programming skills.

References:

1. Paul Deitel and Harvey Deitel, "C How to Program", 8^{th} Edition, Pearson Education Limited, 2016.
2. Michael J Pont, "Embedded C", Addison-Wesley, An imprint of Pearson Education, 2002.
3. William von Hagen, "The Definitive Guide to GCC", 2^{nd} Edition, Apress Inc., 2006.
4. Gowrishankar S and Veena A, "Introduction to Python Programming", CRC Press, Taylor & Francis Group, 2019.
5. Noel Kalicharan, "Learn to Program with C", Apress Inc., 2015.
6. Steve Oualline, "Practical C programming", O'Reilly Media, 1997.
7. Fabrizio Romano, "Learn Python Programming", Second Edition, Packt Publishing, 2018.
8. John Paul Mueller, "Beginning Programming with Python for Dummies", 2^{nd} Edition, John Wiley & Sons Inc., 2018.
9. Mark Lutz, "Programming Python", 4^{th} Edition, O'Reilly Media Inc., 2010.

Mapping of COs with POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1
1	-	-	2	-	3	-	1
2	1	-	1	-	2	-	-
3	-	2	-	-	2	-	-
4	1	-	1	1	1	-	-
5	-	-	2	2	3	2	2
Avg.	**0.4**	**0.4**	**1.2**	**0.6**	**2.2**	**0.4**	**0.6**
1 - Low, 2 - Medium, 3 - High, '-' - No Correlation							

24ES103T	MICROCONTROLLER BASED SYSTEM DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To teach the architecture of PIC Microcontroller and RISC processor.
- To compare the architecture and programming of 8,16, 32-bit RISC processor.
- To teach the implementation of DSP in ARM processor.

- To discuss on memory management, application development in RISC processor.
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills.

UNIT I PIC MICROCONTROLLER 9

Architecture — memory organization — addressing modes — instruction set — PIC programming in Assembly & C –I/O port, Data Conversion, RAM & ROM Allocation, Timer programming, practice in MP-LAB.

UNIT II ARM ARCHITECTURE 9

Architecture – memory organization – addressing modes –The ARM Programmer's model -Registers – Pipeline – Interrupts – Coprocessors – Interrupt Structure.

UNIT III PERIPHERALS OF PIC AND ARM MICROCONTROLLER 9

PIC: ADC, DAC and Sensor Interfacing –Flash and EEPROM memories. ARM: I/O Memory — EEPROM — I/O Ports — SRAM –Timer –UART – Serial Communication with PC — ADC/DAC Interfacing.

UNIT IV ARM MICROCONTROLLER PROGRAMMING 9

ARM general Instruction set – Thumb instruction set –Introduction to DSP on ARM – Implementation example of Filters.

UNIT V DESIGN WITH PIC AND ARM MICROCONTROLLERS 9

PIC implementation – Generation of Gate signals for converters and Inverters – Motor Control – Controlling DC/ AC appliances – Measurement of frequency – Standalone Data Acquisition System – ARM Implementation- Simple ASM/C programs- Loops –Look up table- Block copy- subroutines- Hamming Code.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completing this course, the students will be able to

CO1: Understand the basics and requirement of processor functional blocks.
CO2: Observe the specialty of RISC processor Architecture.
CO3: Incorporate I/O hardware interface of a processor-based automation for consumer application with peripherals.
CO4: Incorporate I/O software interface of a processor with peripherals.
CO5: Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in commercial embedded processors.

References:

1. Steve Furber, "ARM system on chip architecture", Addision Wesley,2010.
2. Andrew N. Sloss, Dominic Symes, Chris Wright, John Rayfield "ARM System Developer's Guide Designing and Optimizing System Software", Elsevier 2007.
3. Muhammad Ali Mazidi, Rolin D. Mckinlay, Danny Causey "PIC Microcontroller and Embedded Systems using Assembly and C for PIC18", Pearson Education 2008.

4. John Iovine, "PIC Microcontroller Project Book", McGraw Hill 2000.
5. William Hohl, "ARM Assembly Language" Fundamentals and Techniques,2009.
6. Rajkamal, "Microcontrollers Architecture, Programming, Interfacing, & System Design", Pearson,2012.
7. ARM Architecture Reference Manual, LPC213x User Manual
8. www.Nuvoton .com/websites on Advanced ARM Cortex Processors

Mapping of COs with POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1
1	-	-	2	-	-	-	-
2	1	-	3	2	-	-	1
3	-	-	1	3	1	-	1
4	1	-	-	1	2	-	-
5	-	-	2	-	-	-	-
Avg.	**0.4**	**-**	**1.6**	**1.2**	**0.6**	**-**	**0.4**
1 - Low, 2 - Medium, 3 - High, '-' - No Correlation							

24ES104T VLSI DESIGN AND RECONFIGURABLE ARCHITECTURE

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To expose the students to the fundamentals of sequential system design, synchronous and Asynchronous circuits.
- To understand the basic concepts of CMOS and to introduce the IC fabrication methods.
- To introduce the Reconfigurable Processor technologies and to provide an insight and architecture significance of SOC.
- To introduce the basics of analog VLSI design and its importance.
- To learn about the programming of Programmable device using Hardware description Language.

UNIT I INTRODUCTION TO ADVANCED DIGITAL SYSTEM DESIGN 9

Modeling of Clocked Synchronous Sequential Network (CSSN), Design of CSSN, Design of Asynchronous Sequential Circuits (ASC), Designing Vending Machine Controller, Races in ASC, Static and Dynamic Hazards, Essential Hazards, Designing Hazard free circuits.

UNIT II CMOS BASICS & IC FABRICATION 9

Moore's Law-MOSFET Scaling - MOS Transistor Model-Determination of pull up / pull down ratios-CMOS based combinational logic & sequential design- Dynamic CMOS –Transmission Gates- BiCMOS-Low power VLSI — CMOS IC Fabrications - Stick Diagrams, Design Rules and Layout.

UNIT III ASIC AND RECONFIGURABLE PROCESSOR AND SoC DESIGN 9

Introduction to ASIC, ASIC design flow- programmable ASICs- Introduction to reconfigurable processor-Architecture -Reconfigurable Computing, SoC Overview, recent trends in Reconfigurable Processor & SoC, Reconfigurable processor-based DC motor control.

UNIT IV ANALOG VLSI DESIGN 9

Introduction to analog VLSI- Design of CMOS 2stage-3 stage Op-Amp –High Speed and High frequency op-amps-Super MOS- Analog primitive cells- Introduction to FPAA.

UNIT V HDL PROGRAMMING 9

Overview of digital design with VHDL, structural, data flow and behavioural modeling concepts- logic synthesis-simulation-Design examples, Ripple carry Adders, Carry Look ahead adders, Multiplier, ALU, Shift Registers, Test Bench.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completing this course, the students will be able to

CO1: Incorporate synchronous and asynchronous switching logics, with clocked circuits design.
CO2: Deliver insight into developing CMOS design techniques and IC fabrication methods.
CO3: Explain the need of reconfigurable computing, hardware-software co design and operation of SoC processor.
CO4: Design and development of reprogrammable analog devices and its usage for Embedded applications.
CO5: Illustrate and develop HDL computational processes with improved design strategies.

References:

1. Donald G. Givone, “Digital principles and Design”, Tata McGraw Hill 2002.
2. Charles H. Roth Jr., “Fundamentals of Logic design”, Thomson Learning, 2004.
3. Nurmi, Jari (Ed.) "Processor Design System-On-Chip Computing for ASICs and FPGAs" Springer, 2007.
4. Joao Cardoso, Michael Hübner, "Reconfigurable Computing: From FPGAs to Hardware/Software Codesign" Springer, 2011.
5. Pierre-Emmanuel Gaillardon, “Reconfigurable Logic: Architecture, Tools, and Applications”, 1st Edition, CRC Press, 2015.
6. Mohamed Ismail, TerriFiez, “Analog VLSI Signal and information Processing”, McGraw Hill International Editions,1994.
7. William J. Dally / Curtis Harting / Tor M. Aamodt, “Digital Design Using VHDL:A Systems Approach”, Cambridge Univerity Press,2015
8. Zainalatsedin Navabi, “VHDL Analysis and Modelling of Digital Systems”, 2nd Edition, Tata McGraw Hill, 1998.

Mapping of COs with POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1
1	-	-	-	1	-	-	**-**
2	2	-	2	2	-	-	1
3	-	-	3	3	2	1	2
4	2	-	2	3	1	-	2
5	-	1	1	3	3	1	2
Avg.	**0.8**	**0.2**	**1.6**	**2.4**	**1.2**	**0.4**	**1.4**
1 - Low, 2 - Medium, 3 - High, ‘-’ - No Correlation							

24ES101P **EMBEDDED SYSTEM LABORATORY – I**

L	T	P	C
0	0	4	2

COURSE OBJECTIVES:

- To involve the students to Practice on Workbench /Software Tools/ Hardware Processor Boards with the supporting Peripherals.
- To teach the concepts of algorithm development & programming on software tools and Digital processors with peripheral interfaces.
- To encourage students to practice in open-source software / packages /tools.
- To train though hands-on practices in commercial and licensed Hardware-software suites.
- Practicing through the subdivisions covered within experiments listed below to expose the students into the revising the concepts acquired from theory subjects.

LIST OF EXPERIMENTS		
Domain	**EXPERIMENT DETAILS**	**EQUIPMENT/ SUPPORTS REQUIRED**
1	Programming with 8-bit Microcontrollers # Assembly programming	8051/ other 8-bit Microcontrollers with peripherals; IDE, Board Support Software Tools / Compiler/others
2	Programming with 8-bit Microcontrollers # C programming	8051/ other 8-bit Microcontrollers with peripherals; IDE, Board Support Software Tools / Compiler/others
3	I/O Programming with 8-bit Microcontrollers I/O Interfacing: Serial port programming/ LCD/Sensor Interfacing /PWM Generation/ Motor Control	8051 Microcontrollers with peripherals; Board Support Software Tools, peripherals with interface
4	Programming with PIC Microcontrollers: ✓ Assembly ✓ C programming	PIC Microcontrollers with peripherals; ;IDE, Board Support Software Tools /C Compiler/others
5	I/O Programming with PIC Microcontrollers I/O Interfacing: PWM Generation/ Motor Control/ADC/DAC/ LCD/Sensor Interfacing	PIC Microcontrollers with peripherals; Board Support Software Tools, peripherals with interface

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will have the ability to

CO1: Experiment insight into various embedded processors of CISC and RISC architecture / computational processors with peripheral interface.
CO2: Understand the fundamental concepts of how process can be controlled with µC.
CO3: Experimenting on programming logic of Processor based on software suites (simulators, emulators).
CO4: Incorporate I/O software interface of a processor with peripherals.
CO5: Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in interfacing and use of commercial embedded processors.

Reference Books:

1. Mohamammad Ali Mazidi & Mazidi "8051 Microcontroller and Embedded Systems", Pearson Education.
2. Mohammad Ali Mazidi, Rolind Mckinley and Danny Causey, "PIC Microcontroller and Embedded Systems" Pearson Education.
3. Simon Monk,"Make Action-with Arduino and Raspberry Pi", SPD ,2016.
4. Wesley J.Chun, "Core Python Applications Programming",3rd ed,Pearson,2016.
5. Kraig Mitzner, "Complete PCB Design using ORCAD Capture and Layout", Elsevier.
6. Vinay K.Ingle, John G.Proakis, "DSP-A Matlab Based Approach",Cengage Learning,2010.
7. Taan S.Elali, "Discrete Systems and Digital Signal Processing with Matlab",CRC Press2009.
8. Jovitha Jerome, "Virtual Instrumentation using Labview" PHI,2010.
9. Woon-Seng Gan, Sen M. Kuo, "Embedded Signal Processing with the Micro Signal Architecture", John Wiley & Sons, Inc., Hoboken, New Jersey 2007.
10. Dogan Ibrahim, "Advanced PIC microcontroller projects in C", Elsevier 2008.

Mapping of COs with POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1
1	2	1	2	1	-	-	1
2	-	-	1	1	2	1	1
3	2	3	1	2	3	-	3
4	2	-	2	1	2	-	2
5	-	-	1	1	3	2	2
Avg.	**1.2**	**0.8**	**1.4**	**1.2**	**2**	**0.6**	**1.8**
1 - Low, 2 - Medium, 3 - High, '-' - No Correlation							

24ES102P	**EMBEDDED PROGRAMMING LABORATORY – I**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

COURSE OBJECTIVES:

- To involve the students to Practice on Workbench /Software Tools/ Hardware Processor Boards with the supporting Peripherals.
- To teach the concepts of algorithm development & programming on software tools and Digital processors with peripheral interfaces.
- To encourage students to practice in open-source software / packages /tools.
- To train though hands-on practices in commercial and licensed Hardware-software suites.
- Practicing through the subdivisions covered within experiments listed below to expose the students into the revising the concepts acquired from theory subjects.

LIST OF EXPERIMENTS		
Domain	**EXPERIMENT DETAILS**	**EQUIPMENT/ SUPPORTS REQUIRED**
1	Programming in Higher Level Languages / Open-Source Platforms	C/C++/Java/Embedded C/Embedded Java/ Compilers &Platforms/cloud
2	Programming with Arduino Microcontroller Board	Arduino Boards with peripherals ; IDE, peripherals; IDE, Board Support Software Tools / Compiler / others
3	HDL Programming in FPGA processors	Processor Boards with Board Support Tools & Interfaces
4	Programming & Simulation in Simulators / Tools / others	Simulation Tools as Proteus/ ORCAD
5	Programming & Simulation in Simulators / Tools / others	Simulation Tools as MATLAB /others

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will demonstrate the ability in
CO1: Developing Optimized code for embedded processor.
CO2: Understanding the fundamental concepts of how process can be realized using Software Modules.
CO3: Circuit and System level simulators to develop solution for embedded based applications.
CO4: Incorporate I/O software interface of a processor with peripherals.
CO5: Improved Employability and entrepreneurship capacity due to knowledge up gradation on Embedded computing and algorithm development with programming concepts.

Mapping of COs with POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1
1	2	1	1	2	2	1	2
2	2	-	2	-	3	2	2
3	2	1	3	1	2	2	3
4	2	1	2	2	2	-	2
5	-	-	2	-	3	1	2
Avg.	**1.6**	**0.6**	**2**	**1**	**2.4**	**1.2**	**2.2**
1 - Low, 2 - Medium, 3 - High, '-' - No Correlation							

24ES201T	REAL TIME OPERATING SYSTEM	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To expose the students to the fundamentals of interaction of OS with a computer and User computation.
- To teach the fundamental concepts of how process is created and controlled with OS.
- To study on programming logic of modeling Process based on range of OS features.
- To compare types and Functionalities in commercial OS, application development using RTOS.
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills.

UNIT I REVIEW OF OPERATING SYSTEMS **9**

Basic Principles - Operating System structures — System Calls — Files — Processes — Design and Implementation of processes — Communication between processes — Introduction to Distributed operating system – Embedded operating systems.

UNIT II OVERVIEW OF RTOS **9**

RTOS Task and Task state –Multithreaded Preemptive scheduler- Process Synchronization- Message queues– Mail boxes -pipes – Critical section – Semaphores – Classical synchronization problem – Deadlocks.

UNIT III REALTIME MODELS AND LANGUAGES **9**

Event Based – Process Based and Graph based Models – Real Time Languages – RTOS Tasks – RT scheduling - Interrupt processing – Synchronization – Control Blocks – Memory Requirements.

UNIT IV REALTIME KERNEL **9**

Principles — Design issues — Polled Loop Systems — RTOS Porting to a Target — Comparison and Basic study of various RTOS like – VX works – Linux supportive RTOS – C Executive.

UNIT V APPLICATION DEVELOPMENT **9**

Discussions on Basics of Linux supportive RTOS – µCOS-C Executive for development of RTOS Application — Case study.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will have the ability to

CO1: Outline Operating System structures and types.
CO2: Insight into scheduling, disciplining of various processes execution.
CO3: Illustrate knowledge on various RTOS support modelling.
CO4: Demonstrate commercial RTOS Suite features to work on real time processes design.
CO5: Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in RTOS and embedded automation design

References:

1. Silberschatz, Galvin, Gagne, “Operating System Concepts”, 6th ed, John Wiley, 2003.
2. Charles Crowley, “Operating Systems-A Design Oriented approach” McGraw Hill,1997.
3. Raj Kamal, “Embedded Systems- Architecture, Programming and Design” Tata McGraw Hill, 2006.
4. Karim Yaghmour, “Building Embedded Linux System”, O’reilly Pub, 2003.
5. Mukesh Sighal and N G Shi “Advanced Concepts in Operating System”, McGraw Hill, 2000.

Mapping of COs with POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1
1	2	-	1	-	2	-	1
2	-	-	2	-	3	1	1
3	2	-	2	1	2	2	2
4	2	2	3	2	1	3	3
5	-	-	1	-	3	1	5
Avg.	**1.2**	**0.4**	**1.8**	**0.6**	**2.2**	**1.4**	**2.4**
1 - Low, 2 - Medium, 3 - High, '-' - No Correlation							

24ES202T	EMBEDDED SYSTEM NETWORKING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To expose the students to the fundamentals of wired embedded networking techniques.
- To introduce the concepts of embedded ethernet.
- To expose the students to the fundamentals of wireless embedded networking.
- To discuss the fundamental building blocks of digital instrumentation.
- To introduce design of Programmable measurement & control of electrical Device.

UNIT I EMBEDDED PROCESS COMMUNICATION WITH INSTRUMENT BUS 9

Embedded networking: Introduction – Cluster of instruments in System: Introduction to bus protocols – comparison of bus protocols – RS 232C, RS 422, RS 485 and USB standards – embedded ethernet – MOD bus, LIN bus and CAN bus.

UNIT II EMBEDDED ETHERNET 9

Elements of a network — Inside Ethernet — Building a Network: Hardware options — Cables, Connections and network speed – Ethernet controllers – Inside the internet protocol – Exchanging messages using UDP and TCP – Email for Embedded systems using FTP – Security of devices and network.

UNIT III WIRELESS EMBEDDED NETWORKING 9

Wireless sensor networks – Introduction – Node architecture – Network topology -Localization – Time synchronization — Energy efficient MAC protocols — SMAC — Energy efficient and robust routing — Data centric routing - WSN Applications - Home Control - Building Automation - Industrial Automation.

UNIT IV BUILDING SYSTEM AUTOMATION 9

Sensor Types & Characteristics: Sensing Voltage, Current, flux, Torque, Position, Proximity, Accelerometer - Data acquisition system- Signal conditioning circuit design- Uc Based & PC based data acquisition — UC for automation and protection of electrical appliances –processor based digital controllers for switching Actuators: Stepper motors, Relays –System automation with multi-channel Instrumentation and interface.

UNIT V COMMUNICATION FOR LARGE ELECTRICAL SYSTEM AUTOMATION 9

Data Acquisition, Monitoring, Communication, Event Processing, and Polling Principles, SCADA system principles — outage management– Decision support application - substation automation, extended control feeder automation, Performance measure and response time, SCADA Data Models, need, sources, interface.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completing this course, the students will be able to

CO1: Analyze the different bus communication protocols used for embedded networking.
CO2: Explain the basic concepts of embedded networking.
CO3: Apply the embedded networking concepts in wireless networks.
CO4: Relate different data acquisition concepts.
CO5: Build a system automation for different applications.

Reference Books:

1. Mohammad Ilyas and Imad Mahgoub, "Handbook of sensor Networks: Compact wireless and wired sensing systems", CRC Press, 2005.
2. Peter W Gofton, "Understanding Serial Communication", Sybes International, 2000.
3. Jan Axelson "Embedded Ethernet and Internet Complete", Penram publications.
4. Krzysztof Iniewski, "Smart Grid, Infrastructure & Networking", TMcGH,2012.
5. "Control and automation of electrical power distribution systems", James Northcote-Green, Robert Wilson, CRC, Taylor and Francis, 2006.

Mapping of COs with POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1
1	1	2	-	-	3	1	2
2	-	2	-	-	2	1	2
3	3	2	2	3	2	3	3
4	2	-	3	3	-	2	2
5	3	-	3	3	-	2	3
Avg.	**1.8**	**1.2**	**1.6**	**1.8**	**1.4**	**1.8**	**2.4**
1 – Low, 2 – Medium, 3 – High, '-' – No Correlation							

24ES203T	**EMBEDDED CONTROL FOR ELECTRIC DRIVES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To provide the control concept for electrical drives.
- To emphasis the need for embedded system for controlling the electrical drives.
- To provide knowledge about various embedded system-based control for electrical drives.

- To Impart the knowledge of optimization and machine learning techniques used for electrical drives.
- To familiarize the high-performance computing for electrical drives.

UNIT I INTRODUCTION TO ELECTRICAL DRIVES 9

Electric drive and its classifications, Four-quadrant drive, Dependence of load torque on various factors, Dynamics of motor-load combination-Solid State Controlled Drives-Machine learning and optimization techniques for electrical drives- IoT for Electrical drives applications.

UNIT II OVERVIEW OF EMBEDDED PROCESSOR 9

Embedded Processor architecture-RTOS — Hardware/software co-design-Programming with SoC processors.

UNIT III INDUCTION MOTOR CONTROL 9

Types- Speed control methods-PWM techniques- VSI fed three-phase induction motor- Fuzzy logic Based speed control for three phase induction motor-FPGA based three phase induction motor control.

UNIT IV BLDC MOTOR CONTROL 9

Overview of BLDC Motor -Speed control methods -PWM techniques- ARM processor based BDLC motor control- ANN for BLDC Motor control and operation.

UNIT V SRM MOTOR CONTROL 9

Overview of SRM Motor -Speed control methods -PWM techniques- FPGA based SRM motor control- DNN for SRM Motor control and operation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will have the ability to

CO1: Interpret the significance of embedded control of electrical drives.
CO2: Deliver insight into various control strategy for electrical drives.
CO3: Developing knowledge on Machine learning and optimization techniques for motor control.
CO4: Develop embedded system solution for real time application such as Electric vehicles and UAVs.
CO5: Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded system skills required for motor control strategy.

References:

1. R.Krishnan, "Electric Motor Drives – Modeling, Analysis and Control", Prentice-Hall of India Pvt. Ltd., New Delhi,2010.
2. Vedam Subramanyam, "Electric Drives — Concepts and Applications", Tata McGraw-Hill publishing company Ltd., New Delhi, 2002.
3. K. Venkataratnam, "Special Electrical Machines", Universities Press, 2014.
4. Steve Furber, "ARM system on chip architecture", Addision Wesley,2010.
5. Ron Sass and Anderew G.Schmidt, "Embedded System design with platform FPGAs: Principles and Practices", Elsevier, 2010.
6. Steve Kilts, "Advanced FPGA Design: Architecture, Implementation, and Optimization", Willey, 2007.

Mapping of COs with POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1
1	1	-	2	-	2	-	1
2	1	1	3	-	-	2	1
3	2	-	-	-	3	-	1
4	1	2	3	1	-	-	1
5	-	-	-	-	3	-	1
Avg.	**1**	**0.6**	**1.6**	**0.2**	**1.6**	**0.4**	**1**
1 – Low, 2 – Medium, 3 – High, '-' – No Correlation							

24ES204T	IoT FOR SMART SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To study about Internet of Things technologies and its role in real time applications.
- To introduce the infrastructure required for IoT.
- To familiarize the accessories and communication techniques for IoT.
- To discuss the fundamental building blocks of digital instrumentation.
- To introduce design of Programmable measurement & control of electrical Device.

UNIT I INTRODUCTION TO INTERNET OF THINGS 9

Overview, Hardware and software requirements for IOT, Sensor and actuators, Technology drivers, Business drivers, Typical IoT applications, Trends and implications.

UNIT II IOT ARCHITECTURE 9

IoT reference model and architecture -Node Structure - Sensing, Processing, Communication, Powering, Networking - Topologies, Layer/Stack architecture, IoT standards, Cloud computing for IoT, Bluetooth, Bluetooth Low Energy beacons.

UNIT III PROTOCOLS AND WIRELESS TECHNOLOGIES FOR IOT PROTOCOLS: 9

NFC, SCADA and RFID, Zigbee MIPI, M-PHY, UniPro, SPMI, SPI, M-PCIe GSM, CDMA, LTE, GPRS, small cell.

Wireless technologies for IoT: WiFi (IEEE 802.11), Bluetooth/Bluetooth Smart, ZigBee/ZigBee Smart, UWB (IEEE 802.15.4), 6LoWPAN, Proprietary Systems - Recent trends.

UNIT IV IOT PROCESSORS 9

Services/Attributes: Big-Data Analytics for IOT, Dependability, Interoperability, Security, Maintainability.

Embedded processors for IOT: Introduction to Python programming - Building IOT with RASPERRY PI and Arduino.

UNIT V CASE STUDIES 9

Industrial IoT, Home Automation, smart cities, Smart Grid, connected vehicles, electric vehicle charging, Environment, Agriculture, Productivity Applications, IOT Defense.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will have the ability to

CO1: Analyze the concepts of IoT and its present developments.
CO2: Compare and contrast different platforms and infrastructures available for IoT.
CO3: Explain different protocols and communication technologies used in IoT.
CO4: Analyze the big data analytic and programming of IoT.
CO5: Implement IoT solutions for smart applications.

References:

1. Arshdeep Bahga and Vijai Madisetti: A Hands-on Approach “Internet of Things”, Universities Press 2015
2. Oliver Hersent, David Boswarthick and Omar Elloumi, “The Internet of Things”, Wiley,2016.
3. Samuel Greengard, “The Internet of Things”, The MIT press, 2015
4. Adrian McEwen and Hakim Cassimally, “Designing the Internet of Things “Wiley,2014.
5. Jean- Philippe Vasseur, Adam Dunkels, “Interconnecting Smart Objects with IP: The Next Internet” Morgan Kuffmann Publishers, 2010.
6. Adrian McEwen and Hakim Cassimally, “Designing the Internet of Things”, John Wiley and sons, 2014.
7. Lingyang Song / Dusit Niyato / Zhu Han / Ekram Hossain, “Wireless Device-to-Device Communications and Networks”, CAMBRIDGE UNIVERSITY PRESS,2015.
8. Ovidiu Vermesan and Peter Friess (Editors), “Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems”, River Publishers Series in Communication, 2013.
9. Vijay Madisetti , Arshdeep Bahga, “Internet of Things (A Hands on-Approach)”, 2014.
10. Zach Shelby, Carsten Bormann, “6LoWPAN: The Wireless Embedded Internet”, John Wiley and sons, 2009.
11. Lars T.Berger and Krzysztof Iniewski, “Smart Grid applications, communications and security”, Wiley, 2015.
12. Janaka Ekanayake, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama and Nick Jenkins, “Smart Grid Technology and Applications”, Wiley, 2015.

Mapping of COs with POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1
1	1	2	1	-	-	-	1
2	-	2	-	-	-	-	1
3	1	2	-	1	3	-	1
4	2	-	3	3	3	3	3
5	3	2	3	3	3	3	3
Avg.	**1.4**	**1.6**	**1.4**	**1.4**	**1.8**	**1.2**	**1.8**
1 – Low, 2 – Medium, 3 – High, ‘-‘ – No Correlation							

24ES201P **EMBEDDED SYSTEM LABORATORY - II**

L	T	P	C
0	0	4	2

COURSE OBJECTIVES:

- To involve the students to Practice on Workbench /Software Tools/ Hardware Processor Boards with the supporting Peripherals.
- To teach the concepts of algorithm development & programming on software tools and Digital processors with peripheral interfaces.
- To encourage students to practice in open source softwares / packages / tools.
- To train though hands-on practices in commercial and licensed Hardware-software suites.
- Practicing through the subdivisions covered within experiments listed below to expose the students into the revising the concepts acquired from theory subjects.

LIST OF EXPERIMENTS		
S.No	**EXPERIMENT DETAILS**	**EQUIPMENT/ SUPPORTS REQUIRED**
1	Programming ARM processor: ARM7 / ARM9/ARM Cortex Study on In-circuit Emulators, cross compilers, debuggers	Microcontrollers with peripherals; IDE, Board Support Software Tools / Keil / µCOS, Compiler / others
2	I/O Programming with ARM processor: ARM7 / ARM9/ARM Cortex Microcontrollers I/O Interfacing: Timers/ Interrupts/ Serial port programming/PWM Generation/ Motor Control/ADC/DAC/ LCD/ RTC Interfacing/ Sensor Interfacing	ARM Processor: ARM7 / ARM9/ARM Cortex Microcontrollers with peripherals; Board Support Software Tools, peripherals with interface
3	Programming with Rasberry Pi Microcontroller Board: Study on In-circuit Emulators, cross compilers, debuggers	Rasberry Pi Boards with peripherals; IDE; Board Support Software Tools, / Compiler / others
4	I/O Programming with Arduino, Rasberry Pi Microcontroller Boards I/O Interfacing: Timers / Interrupts / Serial port programming / PWM Generation / Motor Control / ADC / DAC/ LCD / RTC Interfacing / Sensor Interfacing /IoT Applications	Arduino, Rasberry Pi Microcontroller Boards with peripherals; Board Support Software Tools, peripherals with interface
5	Programming with DSP processors	Processor Boards with Board Support Tools & Interfaces
6	Study of one type of Real Time Operating Systems (RTOS)	Compilers & Platforms with VXWorks / Keil / Android / Tiny OS / Linux Support/any RTOS/Java Semaphore implementations

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will have the ability to

CO1: Experiment and demonstrate with simulators, in programming processor boards, processor interfacing/ designing digital controllers.
CO2: Design & simulate Arithmetic, Logic programs, Filters, Signal analysis with simulators/ experiments, in programming processor boards, processor interfacing/ Tools.
CO3: Develop real time solution for embedded applications.
CO4: Program and compile in various tools & software domains.
CO5: Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in commercial embedded processors and its programmable interfacing.

Mapping of COs with POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1
1	1	3	1	1	2	1	2
2	-	1	2	-	-	-	1
3	1	-	3	2	3	-	2
4	2	2	3	3	3	3	3
5	3	2	3	3	3	3	3
Avg.	**1.4**	**1.6**	**2.4**	**1.8**	**2.2**	**1.4**	**2.2**
1 – Low, 2 – Medium, 3 – High, '-' – No Correlation							

24ES202P	**EMBEDDED PROGRAMMING LABORATORY - II**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

COURSE OBJECTIVES:

- To involve the students to Practice on Workbench /Software Tools/ Hardware Processor Boards with the supporting Peripherals.
- To teach the concepts of algorithm development & programming on software tools and Digital processors with peripheral interfaces.
- To encourage students to practice in open-source software / packages /tools.
- To train though hands-on practices in commercial and licensed Hardware-software suites.
- Practicing through the subdivisions covered within experiments listed below to expose the students into the revising the concepts acquired from theory subjects.

LIST OF EXPERIMENTS		
S.No	**EXPERIMENT DETAILS**	**EQUIPMENT/ SUPPORTS REQUIRED**
1	Programming in Freeware software / Platforms	Programming Compilers & Platforms on freeware
2	<u>Software & Modelling tools</u> ✓ Study on MEMS Tools ✓ Study on process Controller modeling ✓ PLC/SCADA/PCB ✓ One type CAD Tool	Personal Computers, Software & programming/modelling tools

3	Programming & Simulation in Simulators / Tools / others ✓ Graphical User interface simulations & modeling of instrumentation & controllers	Simulation Tools as Labview /others
4	Programming & Simulation in Python Simulators / Tools / others	Programming in Python Platform
5	Programming with wired/wireless communication protocol / Network Simulators	Learning Communication Protocols & Support Software Tools for BUS & network communication
6	Linux programming Tool chain	PC with Linux OS

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will demonstrate the ability in

CO1: Developing Optimized algorithms for embedded processor on IDE and compilers.
CO2: Outline the concepts of how process can be realized using Software Modules.
CO3: Compare and analyze device, Circuit and System level simulators/emulators to develop embedded applications.
CO4: Incorporate I/O software interface using IDE and High-level languages with processor.
CO5: Improved Employability and entrepreneurship capacity due to knowledge up gradation on Embedded programming concepts.

Mapping of COs with POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1
1	2	2	1	1	2	1	2
2	-	3	2	2	-	-	1
3	2	3	3	2	3	2	3
4	-	1	3	3	3	3	3
5	-	-	3	3	3	3	3
Avg.	**0.8**	**1.8**	**2.4**	**2.2**	**2.2**	**1.8**	**2.4**
1 – Low, 2 – Medium, 3 – High, '-' – No Correlation							

		L	T	P	C
24ES201E	**WIRELESS AND MOBILE COMMUNICATION**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

- To study the Channel planning for Wireless Systems.
- To study the Mobile Radio Propagation and Equalization and Diversity.
- To study the Equalization and Diversity.
- To provide insight about wideband code division-based access.
- To study the Wireless multiple access and IP.

UNIT I THE CELLULAR CONCEPT 9

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 MOBILE RADIO PROPAGATION: LARGE-SCALE PATH LOSS 9

Introduction to Radio Wave Propagation, Free Space Propagation Model, Relating Power to Electric Field, Diffraction-Fresnel Zone Geometry, Knife edge Diffraction Model, Multiple knife-edge Diffraction, Scattering, Outdoor Propagation Models-Longley-Ryce Model, Okumura Model, Hata Model, Indoor Propagation Models-Partition losses, 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 Modelling.

UNIT III MOBILE RADIO PROPAGATION 9

Small –Scale Fading and Multipath: 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 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, Fundamentals of Equalization, Training A Generic Adaptive Equalizer, Equalizers in a communication Receiver, Linear Equalizers, Nonlinear Equalization.

UNIT IV WIDEBAND CODE DIVISION MULTIPLE ACCESS 9

CDMA system overview -air interface –physical and logical channel–speech coding, multiplexing and channel coding – spreading and modulation: frame structure, spreading codes-uplink-downlink – physical layer procedures: cell search and synchronization-establishing a connection-power control-handover-overload control.

UNIT V IP MOBILITY FRAMEWORK 9

Challenges of IP Mobility -Address Management -Dynamic Host Configuration Protocol and Domain Name Server Interfaces –Security –Mobility-Based AAA Protocol -IP Mobility Architecture Framework -x Access Network -IPv6 Challenges for IP Mobility.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will have the ability to

CO1: Understand Cellular communication concepts.
CO2: Explain the mobile radio propagation.
CO3: Perceive the wireless network different type of MAC protocols.
CO4: Analyze the Equalization and Diversity.
CO5: Build the Wireless multiple access and IP.

References:

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.
5. "Wireless Digital Communications" –Kamilo Feher, 1999, PHI.
6. "Wireless Communication and Networking" –William Stallings, 2003, PHI.

Mapping of COs with POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1
1	3	3	2	1	-	-	2
2	3	3	2	2	-	-	2
3	3	3	2	3	2	2	3
4	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-
Avg.	**1.8**	**1.8**	**1.2**	**1.2**	**0.4**	**0.4**	**1.4**
1 – Low, 2 – Medium, 3 – High, '-' – No Correlation							

24ES202E	VIRTUAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understanding the difference between conventional and graphical programming.
- Introducing the basics of Lab VIEW and programming concepts.
- Differentiating the real time and virtual instrument.
- Represent and review signals acquire process in digital domain.
- Analyzing the basics of data acquisition and learning the concepts of data acquisition with LabVIEW.

UNIT I FUNDAMENTALS OF VIRTUAL INSTRUMENTATION 9

Fundamental Concepts of Virtual Instrumentation (VI) and Graphical Programming - Virtual instruments and Traditional instruments, Hardware and Software in virtual instrumentation, Data Flow Programming - Data Types – Customization of VI Properties - VI Documentation.

UNIT II VI PROGRAMMING STRUCTURES 9

Software Environment - Modular programming - Formula Nodes - Loops - Shift Registers - Local and Global Variables — Case and Sequence Structures - Arrays and Clusters - Graphs and Charts - State Machines - String and File I/O.

UNIT III DATA ACQUISITION AND INTERFACING STANDARDS 10

PC based data acquisition — DAQ hardware and software architecture — DAQ hardware configuration, sampling methods and grounding techniques, analog I/O, digital I/O, counter/timer - Communication: Interfacing of external instruments to a PC - RS232 - RS485 - GPIB — System Interface Buses: USB-PCI, PXI; Introduction to bus protocols of MOD bus and CAN bus - Industrial Ethernet.

UNIT IV ADVANCED PROGRAMMING 10

Introduction, Definition of State Machine, A Simple State Machine, Event Structures. File Input / Output: Introduction, File Formats, File I/O Functions, Path Functions, Sample VIs to Demonstrate File WRITE and READ Function String Handling: Introduction, String Functions, Lab VIEW String Formats, Typical examples Use of analysis tools and application of VI: Fourier transforms, Power spectrum, Simulation of systems using VI: Development of Control system, Image acquisition and processing.

UNIT V CASE STUDIES 7

Temperature Monitoring System using PC based Data Acquisition System - Machine vision, Motion control, Configuration of Real-Time I/O Hardware in MAX - Host & Target VI — Prioritization of Tasks — Timed Programming Structures in Lab VIEW — Real-Time Application Deployment using my RIO — Run-time Interaction with Deployed Applications – Running Web Services in my RIO.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will have the ability in

CO1: Infer and interpret the fundamentals of Virtual Instrumentation and data Acquisition.
CO2: Explain the difference between the traditional and virtual instrumentation.
CO3: Illustrate the theoretical concepts to realize practical systems.
CO4: Analyze and evaluate the performance of Virtual Instrumentation Systems.
CO5: Build a VI system to solve real time problems using data acquisition.

References:

1. Jovitha Jerome, - "Virtual Instrumentation using Lab VIEW", PHI Learning Pvt. Ltd., 2010.
2. Sanjay Gupta and Joseph John, "Virtual Instrumentation Using Lab VIEW", Tata McGraw Hill, 2008.
3. Gary Johnson and Richard Jennings, - "Lab VIEW Graphical Programming", McGraw Hill Inc., Fourth Edition, 2006
4. Rick Bitter, Taqi Mohiuddin and Matt Nawrocki, "Lab VIEW Advanced Programming Techniques", CRC Press, 2009.
5. Lisa. K. Wills, "Lab VIEW for Everyone", Prentice Hall of India, 2nd Edition, 2008.
6. William Buchanan, - "Computer Buses Design and Application", CRC Press, 2000.
7. Clyde F Coombs, - "Electronic Instruments Handbook", McGraw Hill Inc., Third Edition, 1999.

Mapping of COs with POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1
1	-	2	1	2	-	-	1
2	-	-	2	-	-	-	1
3	1	3	3	3	1	1	3
4	2	2	3	3	2	2	3
5	3	3	3	3	3	3	3
Avg.	**1.2**	**2**	**2.4**	**2.2**	**1.2**	**1.2**	**2.2**
1 – Low, 2 – Medium, 3 – High, '-' – No Correlation							

24ES203E **EMBEDDED PROCESSOR DEVELOPMENT**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To learn about basic concepts of embedded system.
- To learn about ARM architecture.
- To learn C language and assembly programming.
- To learn Object orientation for programming and C++.
- To learn software modelling fundamentals.

UNIT I EMBEDDED SYSTEM CONCEPTS 9

Introduction to embedded systems, Application Areas, Categories of embedded systems, Overview of embedded system architecture, Specialties of embedded systems, recent trends in embedded systems, Architecture of embedded systems, Hardware architecture, Software architecture, Application Software, Communication Software, Development and debugging Tools.

UNIT II ARM ARCHITECTURE AND OVERVIEW OF CORTEX 9

Background of ARM Architecture, Architecture Versions, Processor Naming, Instruction Set Development, Thumb-2 and Instruction Set Architecture. Overview of Cortex-M3. Cortex-M3 Basics: Registers, General Purpose Registers, Stack Pointer, Link Register, Program Counter, Special Registers, Operation Mode, Exceptions and Interrupts, Vector. Tables, Stack Memory Operations, Reset Sequence. Instruction Sets: Assembly Basics, Instruction List, Instruction Descriptions. Cortex-M3 Implementation Overview: Pipeline, Block Diagram, Bus Interfaces on Cortex-M3, I-Code Bus, D-Code Bus, System Bus, External PPB and DAP Bus.

UNIT III CORTEX-M3/M4 PROGRAMMING 9

Overview, Typical Development Flow, Using C, CMSIS (Cortex Microcontroller Software Interface Standard), Using Assembly Exception Programming: Using Interrupts, Exception/Interrupt Handlers, Software Interrupts, Vector Table Relocation. Memory Protection Unit and other Cortex-M3 features: MPU Registers, Setting Up the MPU, Power Management, Multiprocessor Communication.

UNIT IV UNIFIED MODELING LANGUAGE 9

Connecting the object model with the use case model – Key strategies for object identification – UML basics. Object state behavior – UML state charts – Role of scenarios in the definition of behavior – Timing diagrams – Sequence diagrams – Event hierarchies – types and strategies of operations – Architectural design in UML concurrency design – threads in UML.

UNIT V EMBEDDED SOFTWARE DEVELOPMENT TOOLS AND RTOS 9

The compilation process — libraries — porting kernels — C extensions for embedded systems — emulation and debugging techniques – RTOS - system design using RTOS.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will have the ability to

CO1: Demonstrate about basic concepts of embedded system.
CO2: Build ARM architecture.
CO3: Understand C language and assembly programming.

CO4: Build and compile Object orientation for programming and C++.
CO5: Create software modelling.

References:

1. "The Definitive Guide to the ARM Cortex-M3", Joseph Yiu, Second Edition, Elsevier Inc. 2010.
2. "Embedded/Real Time Systems Concepts, Design and Programming Black Book", Prasad, KVK.
3. David Seal "ARM Architecture Reference Manual", 2001 Addison Wesley, England; Morgan Kaufmann Publishers.
4. Andrew N Sloss, Dominic Symes, C0hris Wright, "ARM System Developer's Guide - Designing and Optimizing System Software", 2006, Elsevier.
5. Steve Furber, "ARM System-on-Chip Architecture", 2nd Edition, Pearson Education.
6. "Cortex-M series-ARM Reference Manual".
7. "Cortex-M3 Technical Reference Manual (TRM)".
8. "STM32L152xx ARM Cortex M3 Microcontroller Reference Manual".
9. ARM Company Ltd. "ARM Architecture Reference Manual–RM DDI 0100E".
10. "ARM v7-M Architecture Reference Manual" (ARM v7-M ARM).
11. Ajay Deshmukh, "Microcontroller -Theory & Applications", Tata McGraw Hill.
12. Arnold. S. Berger, "Embedded Systems Design -An introduction to Processes, Tools and Techniques", Easwer Press.
13. David E. Simon, "An Embedded Software Primer", Pearson Education, 2003.

Mapping of COs with POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1
1	2	3	1	1	-	3	2
2	3	-	3	3	2	-	3
3	-	-	2	2	3	-	1
4	-	-	3	-	3	-	1
5	2	-	3	2	3	-	2
Avg.	**1.4**	**0.6**	**2.4**	**1.6**	**2.2**	**0.6**	**1.8**
1 – Low, 2 – Medium, 3 – High, '-' – No Correlation							

24ES204E **AUTOMOTIVE EMBEDDED SYSTEM**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To expose the students to the fundamentals and building of Electronic Engine Control systems.
- To teach on functional components and circuits for vehicles.
- To discuss on programmable controllers for vehicles management systems.
- To teach logics of automation & commercial techniques for vehicle communication.
- To introduce the embedded systems concepts for E-vehicle system development.

UNIT I BASIC OF ELECTRONIC ENGINE CONTROL SYSTEMS 9

Overview of Automotive systems, fuel economy, air-fuel ratio, emission limits and vehicle performance; Automotive microcontrollers- Electronic control Unit- Hardware & software selection and requirements for Automotive applications - open-source ECU- RTOS - Concept for Engine Management- Standards; Introduction to AUTOSAR and Introduction to Society SAE- Functional safety ISO 26262- Simulation and modeling of automotive system components.

UNIT II SENSORS AND ACTUATORS FOR AUTOMOTIVES 9

Review of sensors- sensors interface to the ECU, conventional sensors and actuators, Modern sensor and actuators - LIDAR sensor- smart sensors- MEMS/NEMS sensors and actuators for automotive applications.

UNIT III VEHICLE MANAGEMENT SYSTEMS 9

Electronic Engine Control-engine mapping, air/fuel ratio spark timing control strategy, fuel control, electronic ignition- Adaptive cruise control - speed control-anti-locking braking system-electronic suspension - electronic steering, Automatic wiper control- body control system; Vehicle system schematic for interfacing with EMS, ECU. Energy Management system for electric vehicles- Battery management system, power management system-electrically assisted power steering system- Adaptive lighting system- Safety and Collision Avoidance.

UNIT IV ONBOARD DIAGONSTICS AND TELEMATICS 9

On board diagnosis of vehicles -System diagnostic standards and regulation requirements Vehicle communication protocols Bluetooth, CAN, LIN, FLEXRAY, MOST, KWP2000 and recent trends in vehicle communications- Navigation- Connected Cars technology–Tracking- Security for data communication- dashboard display and Virtual Instrumentation, multimedia electronics- Role of IOT in Automotive systems.

UNIT V ELECTRIC VEHICLES 9

Electric vehicles - Components- Plug in Electrical vehicle- Charging station – Aggregators- Fuel cells/Solar powered vehicles- Autonomous vehicles.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will have the ability to

CO1: Insight into the significance of the role of embedded system for automotive applications.
CO2: Illustrate the need, selection of sensors and actuators and interfacing with ECU.
CO3: Develop the Embedded concepts for vehicle management and control systems.
CO4: Demonstrate the need of Electrical vehicle and able to apply the embedded system technology for various aspects of EVs.
CO5: Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design and its application in automotive systems.

References:

1. William B. Ribbens, "Understanding Automotive Electronics", Elseiver,2012.
2. Ali Emedi, Mehrdedehsani, John M Miller, "Vehicular Electric power system- land, Sea, Air and Space Vehicles" Marcel Decker, 2004.

3. L.Vlacic, M.Parent, F.Harahima, "Intelligent Vehicle Technologies", SAE International,2001.
4. Jack Erjavec, Jeff Arias, "Alternate Fuel Technology-Electric Hybrid & Fuel Cell Vehicles", Cengage ,2012.
5. "Electronic Engine Control technology – Ronald K Jurgen Chilton's guide to Fuel Injection" – Ford
6. "Automotive Electricals / Electronics System and Components", Tom Denton, 3rd Edition, 2004.
7. Uwe Kiencke, Lars Nielsen, "Automotive Control Systems: For Engine, Driveline, and Vehicle", Springer; 1st edition, March 30, 2000.
8. "Automotive Electricals Electronics System and Components", Robert Bosch Gmbh, 4th Edition, 2004.
9. "Automotive Hand Book", Robert Bosch, Bently Publishers, 1997.
10. Jurgen, R., "Automotive Electronics Hand Book".

Mapping of COs with POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1
1	-	2	1	1	-	2	1
2	2	3	2	2	2	3	3
3	3	3	3	3	3	2	3
4	3	3	3	3	3	2	3
5	3	3	3	3	3	2	3
Avg.	**2.2**	**2.8**	**2.4**	**2.4**	**2.2**	**2.2**	**2.6**
1 – Low, 2 – Medium, 3 – High, '-' – No Correlation							

24ES205E	INTELLIGENT CONTROL AND AUTOMATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To Impart the knowledge of various optimization techniques and hybrid schemes.
- To introduce the concept, Analysis and implementation of ANN and Fuzzy logic controllers.
- To Emphasis the need for Genetic algorithm and its role for automation.
- To provide the basics of automation and its requirements.
- To demonstrate the role of Intelligent controller in automation applications

UNIT I ARTIFICIAL NEURAL NETWORK & FUZZY LOGIC 9

Artificial Neural Network: Learning with ANNs, single-layer networks, multi-layer perceptrons, Back propagation algorithm (BPA) ANNs for identification, ANNs for control, Adaptive neuro controller. **Fuzzy Logic Control:** Introduction, fuzzy sets, fuzzy logic, fuzzy logic controller design, Fuzzy Modelling & identification, Adaptive Fuzzy Control Design.

UNIT II GENETIC ALGORITHM 9

Basic concept of Genetic algorithm and detail algorithmic steps- Hybrid genetic algorithm - Solution for typical control problems using genetic algorithm. Concept on some other search techniques like Tabu search, Ant-colony search and Particle Swarm Optimization.

UNIT III HYBRID CONTROL SCHEMES **9**

Fuzzification and rule base using ANN–Neuro fuzzy systems-ANFIS–Optimization of membership function and rule base using Genetic Algorithm and Particle Swarm Optimization.

UNIT IV AUTOMATION **9**

Introduction to Automation - Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations-Industrial Automation -computer vision for automation- PLC and SCADA based Automation- IoT for automation- Industry 4.0.

UNIT V INTELLIGENT CONTROLLER FOR AUTOMATION APPLICATION **9**

Applications of Intelligent controllers in Industrial Monitoring, optimization and control- Smart Appliances- Automation concept for Electrical vehicle- Intelligent controller and Automation for Power System.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will have the ability to

CO1: Demonstrate the basic architectures of NN and Fuzzy logics.
CO2: Design and implement GA algorithms and know their limitations.
CO3: Explain and evaluate hybrid control schemes and PSO.
CO4: Interpret the significance of Automation concepts.
CO5: Develop the intelligent controller for automation applications.

References:

1. Laurene V. Fausett, "Fundamentals of Neural Networks, Architecture, Algorithms, and Applications", Pearson Education, 2008.
2. Timothy J.Ross, "Fuzzy Logic with Engineering Applications", Wiley, Third Edition, 2010.
3. David E.Goldberg, "Genetic Algorithms in Search, Optimization, and Machine Learning", Pearson Education, 2009.
4. W.T.Miller, R.S.Sutton and P.J.Webrose, "Neural Networks for Control", MIT Press, 1996.
5. Srinivas Medida, " Pocket Guide on Industrial Automation for Engineers and Technicians", IDC Technologies.
6. Chanchal Dey and Sunit Kumar Sen, " Industrial Automation Technologies", 1st Edition, CRC Press, 2022.

Mapping of COs with POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1
1	1	1	1	1	-	1	1
2	2	2	3	3	3	2	3
3	3	2	2	2	-	-	2
4	3	2	2	2	-	-	2
5	3	-	3	3	-	2	3
Avg.	**2.4**	**1.4**	**2.2**	**2.2**	**0.6**	**1**	**2.2**
1 – Low, 2 – Medium, 3 – High, '-' – No Correlation							

24ES206E	UNMANNED AERIAL VEHICLE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To make the students to understand the basic concepts and components of UAV systems.
- To teach the UAV design concepts.
- To provide an insight about the hardware structure for UAVs.
- To emphasis the communication protocol requirements and control strategy for UAVs.
- To highlight the need and the role of UAVs for real time applications and development of real time UAVs.

UNIT I INTRODUCTION TO UAV **9**

Overview and background – History of UAV – classification — societal impact and future outlook Unmanned Aerial System (UAS) components – models and prototypes — System Composition-applications.

UNIT II THE DESIGN OF UAV SYSTEMS **9**

Introduction to Design and Selection of the System- Aerodynamics and Airframe Configurations-Characteristics of Aircraft Types- Design Standards- Regulatories and regulations – Design for Stealth–control surfaces-specifications.

UNIT III HARDWAREs for UAVs **9**

Real time Embedded processors for UAVs – sensors-servos-accelerometer –gyros-actuators- power supply- integration, installation, configuration, and testing –MEMS/NEMS sensors and actuators for UAVs- Autopilot — AGL.

UNIT IV COMMUNICATION PAYLOADS AND CONTROLS **9**

Payloads-Telemetry-tracking-Aerial photography-controls-PID feedback-radio control frequency range – modems-memory system-simulation-ground test-analysis-trouble shooting.

UNIT V THE DEVELOPMENT OF UAV SYSTEMS **9**

Waypoints navigation-ground control software- System Ground Testing- System In-flight Testing- Mini, Micro and Nano UAVs- Case study: Agriculture- Health- Surveying- Disaster Management and Defense.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will have the ability to

CO1: Identify different hardware for UAV.
CO2: Determine preliminary design requirements for an unmanned aerial vehicle.
CO3: Design UAV system.
CO4: Identify and integrate various systems of unmanned aerial vehicle.
CO5: Design micro aerial vehicle systems by considering practical limitations.

References:

1. Reg Austin "Unmanned Aircraft Systems UAV design, development and deployment", Wiley, 2010.
2. Paul G Fahlstrom, Thomas J Gleason, "Introduction to UAV Systems", UAV Systems, Inc, 1998.
3. Dr. Armand J. Chaput, "Design of Unmanned Air Vehicle Systems", Lockheed Martin Aeronautics Company, 2001.
4. Kimon P. Valavanis, "Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy", Springer, 2007.
5. Robert C. Nelson, "Flight Stability and Automatic Control", McGraw-Hill, Inc, 1998.

Mapping of COs with POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1
1	1	3	2	-	-	2	1
2	3	3	3	-	-	2	3
3	3	3	3	3	3	3	3
4	-	-	2	3	3	2	3
5	3	-	3	3	3	3	3
Avg.	**2**	**1.8**	**2.6**	**1.8**	**1.8**	**2.4**	**2.6**
1 – Low, 2 – Medium, 3 – High, '-' – No Correlation							

24ES207E	DSP BASED SYSTEM DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand various representation methods of DSP system.
- To provide insight about different DSP algorithms.
- To familiarize the various architectures of DSP system.
- To perform analysis of DSP architectures and to learn the implementation of DSP system in programmable hardware.
- To learn the details of DSP system interfacing with other peripherals.

UNIT I REPRESENTATION OF DSP SYSTEM 9

Single Core and Multicore, Architectural requirement of DSPs – high throughput, low cost, low power, small code size, embedded applications. Representation of digital signal processing systems – block diagrams, signal flow graphs, data-flow graphs, dependence graphs. Techniques for enhancing computational throughput – parallelism and pipelining.

UNIT II DSP ALGORITHMS 9

DSP algorithms – Convolution, Correlation, FIR/IIR filters, FFT, adaptive filters, sampling rate converters, DCT, Decimator, Expander and Filter Banks. DSP applications. Computational characteristics of DSP algorithms and applications, Numerical representation of signals-word length effect and its impact, Carry free adders, Multiplier.

UNIT III SYSTEM ARCHITECTURE **9**

Introduction, Basic Architectural Features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Features for External Interfacing. VLIW architecture. Basic performance issue in pipelining, Simple implementation of MIPS, Instruction Level Parallelism, Dynamic Scheduling, Dynamic Hardware Prediction, Memory hierarchy. Study of Fixed point and floating-point DSP architectures.

UNIT IV ARCHITECTURE ANALYSIS ON PROGRAMMABLE HARDWARE **9**

Analysis of basic DSP Architectures on programmable hardware. Algorithms for FIR, IIR, Lattice filter structures, architectures for real and complex fast Fourier transforms, 1D/2D Convolutions, Winograd minimal filtering algorithm. FPGA: Architecture, different sub-systems, design flow for DSP system design, mapping of DSP algorithms onto FPGA.

UNIT V SYSTEM INTERFACING **9**

Examples of digital signal processing algorithms suitable for parallel architectures such as GPUs and multi-GPUs. Interfacing: Introduction, Synchronous Serial Interface CODE, A CODEC Interface Circuit, ADC interface.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will have the ability to

CO1: Evaluate the DSP system using various methods.
CO2: Design algorithm suitable for different DSP applications.
CO3: Explain various architectures of DSP system.
CO4: Implement DSP system in programmable hardware.
CO5: Build interfacing of DSP system with various peripherals.

References:

1. Sen M Kuo, Woon Seng S Gan, “Digital Signal Processors”.
2. “Digital Signal Processing and Application with C6713 and C6416 DSK”, Rulph Chassaing, Worcester Polytechnic Institute, A Wiley Inter Science Publication.
3. “Architectures for Digital Signal Processing”, Peter Pirsch John Weily, 2007.
4. “DSP Processor and Fundamentals: Architecture and Features”. Phil Lapsley, J Bier, Amit Sohan, Edward A Lee; Wiley IEEE Press
5. K. K. Parhi – “VLSI Digital Signal Processing Systems” - Wiley – 1999.
6. Rulph Chassaing, “Digital signal processing and applications with C6713 and C6416 DSK”, Wiley, 2005
7. Keshab K Parhi, “VLSI Digital Signal Processing Systems: Design and Implementation”, student Edition, Wiley, 1999.
8. Nasser Kehtarnavaz, “Digital Signal Processing System Design: LabVIEW-Based Hybrid Programming”, Academic Press, 2008.

Mapping of COs with POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1
1	-	3	-	-	-	-	1
2	3	3	3	2	3	2	3
3	-	3	-	-	-	-	1
4	3	-	3	3	3	3	3
5	2	-	3	2	3	3	3
Avg.	**1.6**	**1.8**	**1.8**	**1.4**	**1.8**	**1.6**	**2.2**
1 – Low, 2 – Medium, 3 – High, '-' – No Correlation							

24ES208E	MACHINE LEARNING AND DEEP LEARNING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand about the learning problem and algorithms.
- To provide insight about neural networks.
- To introduce the machine learning fundamentals and significance.
- To enable the students to acquire knowledge about pattern recognition.
- To motivate the students to apply deep learning algorithms for solving real life problems.

UNIT I LEARNING PROBLEMS AND ALGORITHMS 9

Various paradigms of learning problems, Supervised, Semi-supervised and Unsupervised algorithms.

UNIT II NEURAL NETWORKS 9

Differences between Biological and Artificial Neural Networks - Typical Architecture, Common Activation Functions, Multi-layer neural network, Linear Separability, Hebb Net, Perceptron, Adaline, Standard Back propagation Training Algorithms for Pattern Association - Hebb rule and Delta rule, Hetero associative, Auto associative, Kohonen Self Organizing Maps, Examples of Feature Maps, Learning Vector Quantization, Gradient descent, Boltzmann Machine Learning.

UNIT III MACHINE LEARNING – FUNDAMENTALS & FEATURE SELECTIONS & CLASSIFICATIONS 9

Classifying Samples: The confusion matrix, Accuracy, Precision, Recall, F1- Score, the curse of dimensionality, training, testing, validation, cross validation, overfitting, under-fitting the data, early stopping, regularization, bias and variance. Feature Selection, normalization, dimensionality reduction, Classifiers: KNN, SVM, Decision trees, Naïve Bayes, Binary classification, multi class classification, clustering.

UNIT IV DEEP LEARNING: CONVOLUTIONAL NEURAL NETWORKS 9

Feed forward networks, Activation functions, back propagation in CNN, optimizers, batch normalization, convolution layers, pooling layers, fully connected layers, dropout, Examples of CNNs.

UNIT V DEEP LEARNING: RNNS, AUTOENCODERS AND GANS 9

State, Structure of RNN Cell, LSTM and GRU, Time distributed layers, Generating Text, Autoencoders:

Convolutional Autoencoders, Denoising autoencoders, Variational autoencoders, GANs: The discriminator, generator, DCGANs.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will have the ability to

CO1: Illustrate the categorization of machine learning algorithms.
CO2: Compare and contrast the types of neural network architectures, activation functions.
CO3: Acquaint with the pattern association using neural networks.
CO4: Elaborate various terminologies related with pattern recognition and architectures of convolutional neural networks.
CO5: Construct different feature selection and classification techniques and advanced neural network architectures such as RNN, Autoencoders, and GANs.

References:

1. J. S. R. Jang, C. T. Sun, E. Mizutani, "Neuro Fuzzy and Soft Computing - A Computational Approach to Learning and Machine Intelligence", 2012, PHI learning.
2. "Deep Learning", Ian Good fellow, Yoshua Bengio and Aaron Courville, MIT Press, ISBN: 9780262035613, 2016.
3. "The Elements of Statistical Learning", Trevor Hastie, Robert Tibshirani and Jerome Friedman. Second Edition. 2009.
4. "Pattern Recognition and Machine Learning". Christopher Bishop. Springer. 2006.
5. "Understanding Machine Learning", Shai Shalev-Shwartz and Shai Ben-David. Cambridge University Press. 2017.

Mapping of COs with POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1
1	1	3	1	-	-	-	1
2	2	3	2	-	-	-	1
3	3	-	3	-	3	-	2
4	2	3	3	-	-	-	2
5	3	3	3	-	3	-	3
Avg.	**2.2**	**2.4**	**2.4**	**-**	**1.2**	**-**	**1.8**
1 – Low, 2 – Medium, 3 – High, '-' – No Correlation							