Sri SAI RAM ENGINEERING COLLEGE
An Autonomous Institution
West Tambaram, Chennai - 44
www.sairam.edu.in

Approved by AICTE, New Delhi
Affiliated to Anna University

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

M.E. EMBEDDED SYSTEMS TECHNOLOGIES

AUTONOMOUS

REGULATIONS
2024

Academic Year 2024-25 onwards

PG CURRICULUM AND
SYLLABUS
I - IV
SEMESTERS

SRI SAIRAM ENGINEERING COLLEGE

VISION

To emerge as a "Centre of excellence " offering Technical Education and Research opportunities of very high standards to students, develop the total personality of the individual and instil high levels of discipline and strive to set global standards, making our students technologically superior and ethically stronger, who in turn shall contribute to the advancement of society and humankind.

MISSION

We dedicate and commit ourselves to achieve, sustain and foster unmatched excellence in Technical Education. To this end, we will pursue continuous development of infra-structure and enhance state-of-the-art equipment to provide our students a technologically up-to date and intellectually inspiring environment of learning, research, creativity, innovation and professional activity and inculcate in them ethical and moral values.

QUALITY POLICY

We at Sri Sai Ram Engineering College are committed to build a better Nation through Quality Education with team spirit. Our students are enabled to excel in all values of Life and become Good Citizens. We continually improve the System, Infrastructure and Service to satisfy the Students, Parents, Industry and Society.

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGG.

VISION

To emerge as a "centre of excellence" in the field of Electronics and Communication Engineering and to mould our students to become technically and ethically strong to meet the global challenges. The Students in turn contribute to the advancement and welfare of the society.

MISSION

Department of Electronics and Communication Engineering, SRI SAIRAM ENGINEERING COLLEGE is committed to

M1 Achieve, sustain and foster excellence in the field of Electronics and Communication Engineering.

M2 Adopt proper pedagogical methods to maximize the knowledge transfer.

M3 Enhance the understanding of theoretical concepts through professional society activities

M4 Improve the infrastructure and provide conducive environment of learning and research following ethical and moral values

AUTONOMOUS CURRICULA AND SYLLABI
Regulations 2024

SEMESTER I

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
THEORY							
1	24PESMA102	Applied Mathematics for Electrical Engineers	4	0	0	4	4
2	24PESPC101	Advanced Digital Principles and Design	3	0	0	3	3
3	24PESPC102	Microcontroller Based System Design	3	0	0	3	3
4	24PESPC103	Design of Embedded Systems	3	0	0	3	3
5	24PESPC104	Software for Embedded Systems	3	0	0	3	3
PRACTICAL							
6	24PESPL101	Embedded System Lab - I	0	0	3	3	1.5
VALUE ADDITIONS - I							
7	24PESTE101	Innovative Design Project - I	0	0	4	4	2
TOTAL						**23**	**19.5**

SEMESTER II

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
THEORY							
1	24PESPC201	Real Time Operating Systems	3	0	0	3	3
2	24PESPC202	Pervasive Devices and Technology	3	0	0	3	3
3	24PESPC203	RISC Processor Architecture and Programming	3	0	0	3	3
4	24PESPC204	Internet of Things	3	0	0	3	3
5	24PESELXXX	Professional Elective – I	3	0	0	3	3
PRACTICAL							
6	24PESPL201	Embedded System Lab - II	0	0	3	3	1.5
VALUE ADDITIONS - I							
7	24PESTE201	Innovative Design project-II	0	0	4	4	2
TOTAL						**22**	**18.5**

SEMESTER III

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
THEORY							
1	24PESELXXX	Professional Elective – II	3	0	0	3	3
2	24PESELXXX	Professional Elective – III	3	0	0	3	3
3	24PESELXXX	Professional Elective - IV	3	0	0	3	3
PRACTICAL							
4	24PESPJ301	Project Work Phase - I	0	0	12	12	6
TOTAL						**21**	**15**

SEMESTER IV

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDITS
			L	T	P		
PRACTICAL							
1	24PESPJ401	Project Work Phase - II	0	0	24	24	12
TOTAL						**24**	**12**

PROFESSIONAL ELECTIVES - I

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDIT
			L	T	P		
1	24PESEL201	MEMS Technology	3	0	0	3	3
2	24PESEL202	Advanced Computer Architecture and Parallel Processing	3	0	0	3	3
3	24PESEL203	Digital Instrumentation	3	0	0	3	3
4	24PESEL204	VLSI Architecture and Design Methodologies	3	0	0	3	3
5	24PESEL205	Robotics and Control	3	0	0	3	3
6	24PESEL206	Distributed Embedded Computing	3	0	0	3	3
7	24PESEL207	Cryptography And Network Security	3	0	0	3	3

PROFESSIONAL ELECTIVES - II

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDIT
			L	T	P		
1	24PESEL301	Embedded Linux	3	0	0	3	3
2	24PESEL302	Advanced Digital Signal Processing	3	0	0	3	3
3	24PESEL303	Python Programming	3	0	0	3	3
4	24PESEL304	Embedded Product Development	3	0	0	3	3
5	24PESEL305	Automotive Embedded System	3	0	0	3	3
6	24PESEL306	Machine Learning	3	0	0	3	3
7	24PESEL307	Advanced Embedded Systems	3	0	0	3	3

PROFESSIONAL ELECTIVES - III

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDIT
			L	T	P		
1	24PESEL308	Reconfigurable Processor and SoC Design	3	0	0	3	3
2	24PESEL309	Embedded Wireless Sensor Networks	3	0	0	3	3
3	24PESEL310	Protocols and Architectures for Wireless Sensor Networks	3	0	0	3	3
4	24PESEL311	Digital Image Processing	3	0	0	3	3
5	24PESEL312	Soft Computing and Optimization Techniques	3	0	0	3	3
6	24PESEL313	Analysis and Modelling of Digital System Using VHDL	3	0	0	3	3
7	24PESEL314	Bluetooth Technology	3	0	0	3	3

PROFESSIONAL ELECTIVES - IV

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			TOTAL CONTACT HOURS	CREDIT
			L	T	P		
1	24PESEL315	Wireless And Mobile Communication	3	0	0	3	3
2	24PESEL316	Electric Vehicles and Power Management	3	0	0	3	3
3	24PESEL317	Smart Grid	3	0	0	3	3
4	24PESEL318	Embedded Networking and Automation of Electrical System	3	0	0	3	3
5	24PESEL319	Nano Electronics	3	0	0	3	3
6	24PESEL320	Programming in Matlab and Labview	3	0	0	3	3
7	24PESEL321	Embedded Control Systems Design	3	0	0	3	3

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1 To prepare students for successful careers in industry that meets the needs of Indian and global industries as employable professionals.

PEO2 To develop the ability among students to synthesize data and technical concepts for application to product design, system development of societal importance.

PEO3 To provide opportunity for students to work as part of teams on multi disciplinary projects to solve engineering, technical issues of societal demands.

PEO4 To provide the P.G students with a sound foundation in the mathematical, scientific and engineering fundamentals necessary to formulate, solve and analyze engineering problems and to prepare them for employability and higher studies.

PEO5 To promote student awareness of the life long learning and to introduce them to professional ethics and codes of professional practice.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO1 Acquire competency in areas of Embedded Systems, Networking, IC Fabrication, Design, Testing, Verification and prototype development focusing on applications.

PSO2 Integrate multiple sub-systems to develop System On Chip, optimize its performance and excel in industry sectors related to Embedded domain

PROGRAMME OUTCOMES(POs)

PO1 **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

PO2 **Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 **Design / Development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6 **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7 **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8 **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 **Individual and team work:** Function effectively as an individual and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11 **Project management and finance:** Demonstrate knowledge and understanding of the engineering management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12 **Life-long learning:** Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

SEMESTER - I

24PESMA102 SDG NO. 4	APPLIED MATHEMATICS FOR ELECTRICAL ENGINEERS	L	T	P	C
		4	0	0	4

OBJECTIVES:

- To demonstrate various analytical skills in applied mathematics applicable for the students of electrical engineering
- To get extensive experience with the tactics of problem solving and logical thinking
- To identify, formulate, abstract, and solve problems in electrical engineering using mathematical tools
- To understand a variety of mathematical areas, including matrix theory, calculus of variations, probability, linear programming
- To get extensive experience in Fourier series

UNIT 1 MATRIX THEORY **12**

Cholesky decomposition - Generalized Eigenvectors - Canonical basis - QR Factorization – Least squares method - Singular value decomposition.

UNIT II CALCULUS OF VARIATIONS **12**

Concept of variation and its properties – Euler's equation – Functional dependent on first and higher order derivatives – Functionals dependent on functions of several independent variables – Variational problems with moving boundaries – Isoperimetric problems - Direct methods : Ritz and Kantorovich methods.

UNIT III 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, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a random variable.

UNIT IV LINEAR PROGRAMMING **12**

Formulation – Graphical solution – Simplex method – Big M method - Two phase method -Transportation and Assignment models.

UNIT V FOURIER SERIES **12**

Fourier trigonometric series: Periodic function as power signals –

Convergence of series – Even and odd function: Cosine and sine series – Non periodic function: Extension to other intervals – Power signals: Exponential Fourier series – Parseval's theorem and power spectrum – Eigenvalue problems and orthogonal functions – Regular Sturm - Liouville systems – Generalized Fourier series.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Andrews L.C. and Phillips R.L., "Mathematical Techniques for Engineers and Scientists", Prentice Hall of India Pvt. Ltd., New Delhi, 2005.
2. Bronson, R. "Matrix Operation", Schaum's outline series, 2nd Edition, McGraw Hill, 2011.
3. Elsgolc, L. D. "Calculus of Variations", Dover Publications, New York, 2007.

REFERENCES:

1. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
2. O'Neil, P.V., "Advanced Engineering Mathematics", Thomson Asia Pvt. Ltd., Singapore, 2003.
3. Taha, H.A., "Operations Research, An Introduction", 9th Edition, Pearson education, New Delhi, 2016.

OUTCOMES:

Upon completion of the course, the student should be able to:

1. Apply various methods in matrix theory to solve system of linear equations.
2. Maximizing and minimizing the functional that occur in electrical engineering discipline.
3. Computation of probability and moments, standard distributions of discrete and continuous random variables and functions of a random variable.
4. Could develop a fundamental understanding of linear programming models, able to develop a linear programming model from problem description, apply the simplex method for solving linear programming problems.
5. Fourier series analysis and its uses in representing the power signals.

CO – PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	1	-	-	-	-	-	-	1	3	3
CO2	3	3	3	2	1	-	-	-	-	-	-	1	3	3
CO3	3	3	3	2	1	-	-	-	-	-	-	1	3	3
CO4	3	3	3	2	1	-	-	-	-	-	-	1	3	3
CO5	3	3	3	2	1	-	-	-	-	-	-	1	3	3

SEMESTER - I

24PESPC101 SDG NO. 4	ADVANCED DIGITAL PRINCIPLES AND DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To expose the students to the fundamentals of sequential system design, Asynchronous circuits, switching errors
- To teach the fundamentals of modelling through comparative study on the classification of commercial family of Programmable Device
- To study on Fault identification in digital switching circuits
- To introduce logics for design of Programmable Devices
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I SEQUENTIAL CIRCUIT DESIGN 9

Analysis of Clocked Synchronous Sequential Networks (CSSN) Modeling of CSSN – State tableAssignment and Reduction – Design of CSSN – ASM Chart – ASM Realization.

UNIT II ASYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN 9

Analysis of Asynchronous Sequential Circuit (ASC) – Flow Table Reduction – Races in ASC – StateAssignment Problem and the Transition Table – Design of ASC – Static and Dynamic Hazards –Essential Hazards – Designing Hazard free circuits

UNIT III FAULT DIAGNOSIS AND TESTABILITY ALGORITHMS 9

Fault Table Method – Path Sensitization Method – Boolean Difference Method – Kohavi Algorithm –Tolerance Techniques –Built-in Self Test.

UNIT IV ARCHITECTURES & DESIGN USING PROGRAMMABLE DEVICES 9

Realize combinational, Arithmetic, Sequential Circuit with Programmable Array Logic; Architectureand application of Field Programmable Logic Sequence. Architecture of EPLD, ProgrammableElectrically Erasable Logic – Programming Techniques -Re-Programmable Devices Architecture-Function blocks, I/O blocks, Interconnects- Xilinx FPGA – Xilinx 2000 - Xilinx 4000 family.

UNIT V HDL PROGRAMMING 9

Overview of digital design with VHDL, hierarchical modelling concepts, gate level modelling, dataflow modelling, behavioural modelling, task & functions, logic synthesis-simulation-Designexamples,Ripple carry Adders, Carry Look ahead adders, Multiplier, ALU, Shift Registers, Multiplexer,Comparator, Test Bench.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Donald G. Givone, "Digital principles and Design", Tata McGraw Hill 2002.
2. Stephen Brown and Zvonko Vranesic, "Fundamentals of Digital Logic with VHDL Design", TataMcGraw Hill, 2002
3. William J. Dally / Curtis Harting / Tor M. Aamodt," Digital Design Using VHDL:A SystemsApproach, Cambridge University Press,2015.
4. Charles H. Roth Jr., "Digital Systems design using VHDL", Cengage Learning, 2010.
5. Mark Zwolinski, "Digital System Design with VHDL", Pearson Education, 2004

REFERENCES:

1. Parag K Lala, "Digital System design using PLD", BS Publications, 2003
2. Stephen M.Trimberger,"FPGA Technology",Springer,1994.
3. Nripendra N Biswas, "Logic Design Theory", Prentice Hall of India, 2001
4. Charles H. Roth Jr., "Fundamentals of Logic design", Thomson Learning, 2004.
5. John V.O ldfeild,Richard C.Dorf,"Field Programmable Gate Arrays",Wiley India Edition,2008.

OUTCOMES:

Upon completion of the course, the student should be able to

1. Analyze and design sequential digital circuits.
2. Design and use programming tools for implementing digital circuits of industry standards.
3. Identify the requirements and specifications of the system required for a given application.
4. Learners can acquire knowledge about HDL programming.
5. Improved Employability and entrepreneurship capacity due to knowledge upgradation on recent trends in digital design for embedded systems.

CO – PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	1	2	1	-	-	-	1	-	2	2	-
CO2	2	2	2	1	2	1	-	-	-	1	-	2	2	-
CO3	2	2	2	1	2	1	-	-	-	1	-	2	2	-
CO4	2	2	2	1	2	1	-	-	-	1	-	2	2	-
CO5	2	2	2	1	2	1	-	-	-	1	-	2	2	-

SEMESTER - I

24PESPC102 SDG NO. 4	MICROCONTROLLER BASED SYSTEM DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the fundamentals of microcontroller based system design
- To teach I/O and RTOS role on microcontroller
- To know Microcontroller based system design, applications.
- To teach I/O interface in system Design
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I 8051 ARCHITECTURE **9**

Architecture – memory organization – addressing modes – instruction set – Timers - Interrupts - I/O ports, Interfacing I/O Devices – Serial Communication.

UNIT II 8051 PROGRAMMING 9

Assembly language programming – Arithmetic Instructions – Logical Instructions –Single bit Instructions – Timer Counter Programming – Serial Communication Programming, Interrupt Programming, LCD digital clock, thermometer – Significance of RTOS for 8051.

UNIT III 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 IV PERIPHERAL OF PIC MICROCONTROLLER 9

Timers – Interrupts, I/O ports- I2C bus-A/D converter-UART- CCP modules - ADC, DAC and Sensor Interfacing –Flash and EEPROM memories.

UNIT V SYSTEM DESIGN – CASE STUDY 9

Interfacing LCD Display – Keypad Interfacing - Generation of Gate signals for converters and Inverters - Motor Control – Controlling DC/ AC appliances – Measurement of frequency - Stand alone Data Acquisition System.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Muhammad Ali Mazidi, Rolin D. Mckinlay, Danny Causey 'PIC Microcontroller and Embedded Systems using Assembly and C for PIC18', Pearson Education 2008
2. Rajkamal,"Microcontrollers Architecture, Programming Interfacing, & System Design, Pearson, 2012.
3. Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi'AVR Microcontroller and Embedded Systems using Assembly and C", Pearson Education 2014.
4. Muhammad Ali Mazidi, Janice G. Mazidi and Rolin D. McKinlay, 'The 8051 Microcontroller and Embedded Systems' Prentice Hall, 2005.

REFERENCES:

1. John Iovine, 'PIC Microcontroller Project Book', McGraw Hill 2000
2. Senthil Kumar, Saravanan, Jeevanathan,"microprocessor & microcontrollers, Oxford, 2013.
3. Myke Predko, "Programming and customizing the 8051 microcontroller", TMcGraw Hill 2001.

WEB RESOURCES:

1. swayam.gov.in/nd1_noc20_ee42/preview
2. pic-microcontroller.com/online-courses-learn-pic

OUTCOMES:

Upon completion of the course, the student should be able to

1. 8-bit microcontrollers, learn assembly and C-programming of PIC.
2. Learn Interfacing of Microcontroller.
3. Learners will study about PIC microcontroller and system design.
4. The course would enable students to enrich their knowledge with hands-on experiments and project based learning.
5. Effectively utilize microcontroller software development tools such as a compiler, make files, or compile scripts.

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	2	2	1	2	-	-	-	-	-	2	2	1
CO2	2	1	2	2	2	2	-	-	-	-	-	2	2	2
CO3	1	2	2	2	2	2	-	-	-	-	-	2	2	1
CO4	2	1	2	1	1	2	-	-	-	-	-	1	1	1
CO5	2	2	2	2	1	2	-	-	-	-	-	1	2	2

SEMESTER - I

24PESPC103 SDG NO. 4	DESIGN OF EMBEDDED SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide a clear understanding on the basic concepts, Building Blocks of Embedded System
- To teach the fundamentals of Embedded processor Modelling , Bus Communication in Processors, Input/output interfacing
- To introduce on processor scheduling algorithms , Basics of Real time operating system
- To discuss on aspects required in developing a new embedded processor, different Phases & Modelling of embedded system

- 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 –Structural units in Embedded processor, selection of processor & memory devices- DMA, Memory management methods- memory mapping, cache replacement concept, Timer and Counting devices, Watchdog Timer, Real Time Clock

UNIT II EMBEDDED NETWORKING AND INTERRUPTS SERVICE MECHANISM 9

Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocols -RS232 standard – RS485 –USB – Inter Integrated Circuits (I2C) – interrupt sources , Programmed-I/O busy-wait approach without interrupt service mechanism- ISR concept-– multiple interrupts – context and periods for context switching, interrupt latency and deadline - Introduction to Basic Concept Device Drivers.

UNIT III RTOS BASED EMBEDDED SYSTEM DESIG 9

Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Task communication shared memory, message passing-, Interprocess Communication – synchronization between processes-semaphores, Mailbox, pipes, priority inversion, priority inheritance-comparison of commercial RTOS features - RTOS Lite, Full RTOS, VxWorks, µC/OS-II, RT Linux.

UNIT IV SOFTWARE DEVELOPMENT TOOLS 9

Software Development environment-IDE, assembler, compiler, linker, simulator, debugger, In Circuit emulator, Target Hardware Debugging, need for Hardware-Software Partitioning and Co-Design. Overview of UML, Scope of UML modeling, Conceptual model of UML, Architectural, UML basic elements-Diagram- Modeling techniques - structural, Behavioral, Activity Diagrams.

UNIT V EMBEDDED SYSTEM APPLICATION DEVELOPMENT 9

Objectives, different Phases & Modeling of the Embedded product Development Life Cycle (EDLC), Case studies on Smart card- Adaptive Cruise control in a Car -Mobile Phone software for key inputs.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Rajkamal, 'Embedded system-Architecture, Programming, Design', TMH, 2011.
2. Peckol, "Embedded system Design", JohnWiley & Sons, 2010
3. Shibu.K.V, "Introduction to Embedded Systems", TataMcgraw Hill, 2009
4. Lyla B Das," Embedded Systems-An Integrated Approach", Pearson2013
5. Elicia White,"Making Embedded Systems", O'Reilly Series, SPD,2011

REFERENCES:

1. Bruce Powel Douglass,"Real-Time UML Workshop for Embedded Systems, Elsevier,2011
2. Simon Monk, "Make: Action, Movement, Light and Sound with Arduino and Raspberry Pi", O'Reilly Series , SPD,2016.
3. Tammy Noergaard, "Embedded System Architecture, A comprehensive Guide for Engineers and Programmers", Elsevier, 2006
4. Jonathan W.Valvano,"Embedded Microcomputer Systems ,Real Time Interfacing", Cengage Learning,3rd edition,2012
5. Michael Margolis,"Arduino Cookbook", O'Reilly Series ,SPD,2013.

ONLINE RESOURCES:

1. http://nptel.ac.in/courses/108102045/
2. https://nptel.ac.in/courses/106105159/
3. https://www.classcentral.com/course/swayam-embedded-systems-design-7943
4. https://openlabpro.com/online-courses/

OUTCOMES:

Upon completion of the course, the student should be able to

1. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
2. Describe the differences between the general computing system and the embedded system, also recognize the classification of embedded systems.
3. Design real time embedded systems using the concepts of RTOS.
4. Foster ability to understand the role of embedded systems in industry.
5. Design embedded applications for different applications.

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	1	1	-	-	-	-	-	1	3	3	3
CO2	2	3	2	2	2	1	-	-	-	-	2	2	3	3
CO3	2	2	3	3	3	2	-	-	-	-	3	2	3	3
CO4	2	3	3	2	3	2	1	-	-	-	3	2	3	3
CO5	2	3	3	2	3	3	2	1	2	1	3	2	3	3

SEMESTER - I

24PESPC104 SDG NO. 4	SOFTWARE FOR EMBEDDED SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To expose the students to the fundamentals of embedded Programming
- To Introduce the GNU C Programming Toolchain in Linux.
- To study basic concepts of embedded C , Embedded OS & Python Programming
- To introduce time driven architecture, Serial Interface with a case study
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I EMBEDDED PROGRAMMING 9

C and Assembly - Programming Style - Declarations and Expressions - Arrays, Qualifiers andReading Numbers - Decision and Control Statements - Programming Process - More ControlStatements - Variable Scope and Functions - C Preprocessor - Advanced Types – Simple Pointers -Debugging and Optimization – In-line Assembly.

UNIT II C PROGRAMMING TOOLCHAIN IN LINUX 9

C preprocessor - Stages of Compilation - Introduction to GCC - Debugging with GDB - The Makeutility - GNU Configure and Build System - GNU Binary utilities - Profiling - using gprof - Memory Leak Detection with valgrind - Introduction to GNU C Library

UNIT III 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 IV EMBEDDED OS **9**

Creating embedded operating system: Basis of a simple embedded OS, Introduction to sEOS, Using Timer 0 and Timer 1, Portability issue, Alternative system architecture, Important design considerations when using sEOS-Memory requirements - embedding serial communication & scheduling data transmission - Case study: Intruder alarm system.

UNIT V PYTHON PROGRAMMING **9**

Basics of PYTHON Programming Syntax and Style – Python Objects– Dictionaries – comparison withC programming on Conditionals and Loops – Files – Input and Output – Errors and Exceptions –Functions – Modules – Classes and OOP – Execution Environment.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Steve Oualline, 'Practical C Programming 3rd Edition', O'Reilly Media, Inc, 2006.
2. Michael J Pont, "Embedded C", Pearson Education, 2007.
3. Christian Hill, Learning Scientific Programming with Python, CAMBRIDGE UNIVERSITY PRESS ,2016.
4. Wesley J.Chun, "Core python application Programming 3rd Edition", Pearson Educat, 2016.
5. Mark J.Guzdial," introduction to computing and programming in python – a Multimedia approach ,4th edition, Pearson Education, 2015.

REFERENCES:

1. Stephen Kochan, "Programming in C", 3rd Edition, Sams Publishing, 2009.
2. Mark Lutz,"Learning Python, Powerful OOPs,O'reilly,2011.
3. Peter Prinzs, Tony Crawford, "C in a Nutshell", O'Reilly, 2016.
4. Dr. Bandu Meshram, "Object Oriented Paradigm C++ Beginners Guide C&C++", SPD, 2016.
5. David Griffiths, Dawn Griffiths, "Head First C", O'reilly, 2015.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/117106112/
2. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/108102045/lec19.pdf
3. https://swayam.gov.in/nd1_noc20_cs14/preview
4. https://www.coursera.org/learn/introduction-embedded-systems

OUTCOMES:

Upon completion of the course, the student should be able to

1. Ability to use GNU C to develop embedded software.
2. Knowledge and understanding of fundamental embedded systems design paradigms, architectures, possibilities and challenges, both with respect to software and hardware.
3. Improved Employability and entrepreneurship capacity due to knowledge upgradation on recent trends in embedded systems design.
4. Understand the concepts of operating systems to design embedded systems.
5. Understand embedded programming using python.

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	2	1	1	1	-	-	-	-	-	2	2	1
CO2	3	2	2	2	2	1	-	-	-	-	-	1	2	1
CO3	3	2	3	3	3	2	-	-	-	-	-	1	2	2
CO4	3	2	3	3	3	2	-	-	-	-	-	1	2	2
CO5	3	3	3	3	3	2	-	-	-	-	-	1	2	1

SEMESTER - I

24PESPL101 SDG NO. 4	EMBEDDED SYSTEM LAB - I	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- The students will learn design with simulators/ programming environments
- The students will learn design with simulators/experiments,
- The students will learn design in programming processor boards, processor interfacing/ designing digital controllers

LIST OF EXPERIMENTS:

1. Programming in Higher Level Languages/ Platforms
2. Programming with 8 bit Microcontrollers, Assembly programming, Study on in circuit Emulators, cross compilers, debuggers
3. I/O Programming with 8 bit Microcontrollers I/O Interfacing: Timers/ Interrupts/ Serial port programming/PWM Generation/ Motor Control/ADC/DAC/ LCD/ RTC Interfacing/ Sensor Interfacing
4. Programming with AVR/ PIC Microcontrollers: Assembly, C programming, programming Interfacing peripherals Study on in circuit, Emulators, cross compilers, debuggers
5. I/O Programming with AVR/ PIC Microcontrollers I/O Interfacing: Timers/ Interrupts/ Serial port programming/PWM Generation/Motor Control/ADC/DAC/ LCD/ RTC Interfacing/ Sensor Interfacing
6. Programming with Arduino Microcontroller Board: Study on in circuit Emulators, cross compilers, debuggers
7. VHDL Programming in FPGA processors
8. Verilog HDL Programming in FPGA processors
9. Programming & Simulation in Simulators/Tools/others

LIST OF EQUIPMENT FOR A BATCH:

1. C/C++/Java/Embedded C/Embedded Java/Compilers & Platforms
2. 8051 Microcontrollers with peripherals; IDE, Board Support Software Tools /C Compiler / others
3. 8051 Microcontrollers with peripherals; Board Support Software Tools, peripherals with interface
4. AVR/ PIC Microcontrollers with peripherals; IDE, Board Support Software Tools /C Compiler/others
5. AVR/ PIC Microcontrollers with peripherals; Board Support Software Tools, peripherals with interface
6. Arduino Boards with peripherals; IDE, Board Support Software Tools /Compiler/others
7. Simulation Tools as Proteus/ ORCAD
8. Simulation Tools as Xilllinx
9. Simulation Tools as Matlab

ONLINE RESOURCES

1. https://www.arm.com/resources/education/online-courses
2. http://users.ece.utexas.edu/~valvano/Volume1/E-Book/C1_Embedded SystemsShapeTheWorld.htm

3. https://www.embedded.com/set-up-an-embedded-systems-training-lab-for-under-1000/
4. https://tec.ee.ethz.ch/education/lectures/embedded-systems.html

OUTCOMES:

Upon completion of the course, the student be able to

1. Design ,modelling & simulation of Combinational, Sequential, Synchronous, Asynchronous circuits with simulators/experiments.
2. Design in programming processor boards, processor interfacing/ designing reprogrammable system.
3. Design with experiments, in programming suites/ simulators/Tool Bench.
4. Apply the programming knowledge for designing embedded system applications.
5. Design with digital controllers for embedded applications.

CO – PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	3	2	-	-	-	-	-	3	3	3
CO2	2	2	3	2	3	2	-	1	-	-	-	2	3	3
CO3	2	3	3	3	3	3	-	1	-	-	-	2	3	3
CO4	3	3	3	3	3	2	-	1	2	-	-	2	3	3
CO5	3	3	3	3	3	2	-	2	2	-	3	2	3	3

SEMESTER - I

24PESTE101 SDG NO. 4 & 9	INNOVATIVE DESIGN PROJECT - I	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To encourage in identifying problems with social relevance
- To think of an innovative solution for the problem
- To design and conduct suitable experiment with modern tool
- To develop a cost effective prototype of the innovative design
- To understand the practical aspects and associated challenges in implementing the design

METHODOLOGY:

1. Student should do it individually.
2. Student should submit / present his/her ideas to the Faculty-in-Charge for approval.
3. Student should submit proposal with system/ technical details and cost implications.
4. Student should periodically demonstrate his/her progress.

EVALUATION:

Evaluation will be based on:

1. The social relevance of the work.
2. The utility of the system developed.
3. The Level of proof of concept.
4. Industry support if obtained.etc.

WEB REFERENCES:

1. https://www.mathworks.com/academia/books.html
2. http://www.mathcs.emory.edu/~cheung/Courses/455/Syllabus/A3-NS/Book/Introduction-to- Network-Simulator-NS2-2012.pdf

ONLINE REFERENCES

1. http://www.jgyan.com/ns2/
2. https://matlabacademy.mathworks.com/

OUTCOMES:

Upon completion of the course, the student should be able to

1. The student would be able to identify socially relevant issues and apply his/her knowledge to evolve feasible solutions.
2. The student would be able to comprehensively record and report the measured data, write reports, communicate research ideas and do oral presentations effectively.

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	1	1	1	2	1	3	2	3	3
CO2	3	3	3	3	3	1	1	1	2	1	3	2	3	3

SEMESTER - II

24PESPC201 SDG NO. 4	REAL TIME OPERATING SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To review the fundamentals of basic operating systems and its implementation
- To review the fundamentals of real time operating systems and its implementation
- To impart knowledge on programming real time scheduling and interrupt processing
- To compare the types and functionalities in commercial OS, application development using RTOS
- To introduce the basics involved in Linux supported RTOS application and android user interface

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 – issues in distributed system: states, events, clocks-Distributed scheduling-Fault & recovery.

UNIT II OVERVIEW OF RTOS 9

RTOS Task and Task state –Multithreaded Preemptive scheduler- Process Synchronisation- Message queues– Mailboxes -pipes – Critical section – Semaphores – Classical synchronisation problem – Deadlocks

UNIT III REAL TIME 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 REAL TIME KERNEL 9

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

UNIT V INTRODUCTION TO EMBEDDED OS 9

Discussions on Basics of Linux supportive RTOS – uCOS-C Executive for

development of RTOS Application –introduction to Android Environment -The Stack – Android User Interface – Preferences, the File System, the Options Menu and Intents, with one Case study.

TOTAL: 45 PERIODS

TEXT BOOKS:

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. C.M. Krishna, Kang, G.Shin, "Real Time Systems", McGraw Hill, 1997.

REFERENCES:

1. Marko Gargenta, "Learning Android ",O'reilly 2011.
2. Herma K., "Real Time Systems – Design for distributed Embedded Applications", Kluwer Academic, 1997.
3. Corbet Rubini, Kroah-Hartman, "Linux Device Drivers", O'reilly, 2016.
4. Mukesh Sighal and N G Shi "Advanced Concepts in Operating System", McGraw Hill,2000.
5. D.M.Dhamdhere, "Operating Systems, A Concept-Based Approach", TMH,2008.

OUTCOMES:

Upon completion of the course, the student be able to

1. Real-time scheduling and analysis, including clock-driven and priority-driven scheduling.
2. Theoretical background (specification/verification) and practical knowledge of real-time operating systems..
3. After completing the course students will appreciate the use of multitasking techniques in real time systems.
4. Understand the fundamental concepts of real-time operating systems.
5. Improved Employability and entrepreneurship capacity due to knowledge upgradation on recent trends in embedded systems design.

CO – PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	2	3	-	-	-	-	-	1	2	3	2
CO2	2	1	1	1	3	-	-	-	-	-	1	2	3	2
CO3	2	2	2	2	3	-	-	-	-	-	1	2	3	2
CO4	2	2	2	2	3	-	-	-	-	-	1	2	3	2
CO5	2	2	2	2	3	2	2	-	2	2	1	2	3	2

SEMESTER - II

24PESPC202 SDG NO. 4	PERVASIVE DEVICES AND TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To expose the fundamentals of wireless sensor technology classification
- To teach the infrastructure of WSN processor and its functions in networking
- To study on challenges in on interconnectivity of networks & network communication
- To discuss on commercial wireless technology
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I WIRELESS SENSOR DEVICES & NETWORKING 9

Challenges for Wireless Sensor Networks- Characteristic requirements for WSN ,WSN vs Adhoc Networks - introduction to Sensor node networking with any Commercially available sensor nodes –Physical layer and transceiver design considerations in WSNs, -Applications of sensor networks

UNIT II BUILDING PERVASIVE SENSOR NETWORK 9

Single-Node Architecture - Hardware Components, constraints & challenges in resources- Energy Consumption of Sensor Nodes, Operating Systems for Wireless Sensor Networks – Introduction - Operating System Design Issues - Network Architecture -Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts. Data Dissemination-Flooding and

Gossiping-Data gathering Sensor Network Scenarios –Optimization, Goals and Figures of Merit – Design Principles for WSNs- Gateway Concepts – Need for gateway

UNIT III WIRELESS TECHNOLOGY 9

Wireless LAN – IEEE 802.11 System Architecture, protocol Architecture – Services, AdHoc Networks, Hiper LAN, Bluetooth, Wireless PAN, Wireless MAN, Wireless Backbone Networks, Wireless Access Technology

UNIT IV OVERVIEW OF SENSOR NETWORK PROTOCOLS 9

Introduction to fundamentals of Wireless sensor network MAC Protocols - Low duty cycle protocols and wakeup concepts - Contention-based protocols - Schedule-based protocols - IEEE 802.15.4 MAC protocol- Energy usage profile, Choice of modulation scheme-basic principle for data transfer and energy management for SMAC , Leach & Zigbee communication

UNIT V WIRELESS NETWORKING OF DEVICES 9

Classification of Wireless Networking of Devices, introduction to RF WPAN 802.15.1 & Bluetooth -protocol stack, frame, link manager layer –Bluetooth piconet–application.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Holger Karl, Andreas Willig," Protocols & Architectures for WSN", John Wiley,2012
2. Mark Ciampa, Jorge Olenewa," Wireless Communications, Cengage Learning,2009.
3. Frank Adelstein, SandeepK.S Gupta et al," Fundamentals of Mobile & Pervasive Computing, TMcHill,2010.
4. Jaganathan Sarangapani, Wireless AdHoc & Sensor N/Ws-Protocols & Control, CRC2007.
5. Kaveh Pahlavan, Prasanth Krishnamoorthy, "Principles of Wireless Networks" PHI/Pearson Education, 2003

REFERENCES:

1. Natalia Olifer and Victor Olifer, "Computer Networks principles. technologies and protocols for network design", Wiley, 2015
2. Feng Zhao,Leonidas Guibas, "Wireless Sensor Networks", Elsevier,2005.
3. William Stallings, "Wireless communications and Networks", PHI/Pearson Education, 2002.

4. Mullet, "Introduction to wireless telecommunications systems and networks", cengage learning, 2010.

WEB REFERENCES:

1. https://nptel.ac.in/courses/106106147/
2. https://nptel.ac.in/courses/106/106/106106167/
3. https://nptel.ac.in/courses/106/105/106105160/

ONLINE RESOURCES:

1. https://www.coursera.org/courses?query=wireless
2. https://www.edx.org/learn/iot-internet-of-things

OUTCOMES:

Upon completion of the course, the student should be able to

1. Relate to current trends in pervasive computing and develop a sense of their practicality.
2. Identify distinguishing features of the different mobile device categories, namely, Pocket PCs, Personal Digital Assistants (PDAs), and wireless phones.
3. Recognize the difference between writing code for workstations and servers on one hand and for resource-constrained devices on the other hand.
4. The learning process delivers insight on to building of sensor networks, communication in zigbee network and sensor network protocols are studied.
5. Design and develop a pervasive computing device for a specific need.

CO- PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	3	3	3	-	-	-	-	3	3	3
CO2	3	2	3	2	3	3	3	-	-	-	-	3	2	2
CO3	3	2	2	2	3	3	3	-	-	-	-	3	2	2
CO4	3	2	3	2	2	3	3	-	-	-	-	3	2	3
CO5	3	2	3	2	2	2	2	-	-	-	-	3	3	3

SEMESTER - II

24PESPC203 SDG NO. 4	RISC PROCESSOR ARCHITECTURE AND PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To teach the architecture of general AVR processor
- To teach the architecture and programming of 8/16 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 AVR MICROCONTROLLER ARCHITECTURE 9

Architecture – memory organization – addressing modes – I/O Memory – EEPROM – I/O Ports –SRAM –Timer –UART – Interrupt Structure- Serial Communication with PC – ADC/DAC Interfacing.

UNIT II ARM ARCHITECTURE AND PROGRAMMING 9

Arcon RISC Machine – Architectural Inheritance – Core & Architectures -- The ARM Programmer's model -Registers – Pipeline - Interrupts – ARM organization - ARM processor family – Co-processors.Instruction set – Thumb instruction set – Instruction cycle timings.

UNIT III ARM APPLICATION DEVELOPMENT 9

Introduction to RT implementation with ARM – –Exception Handling – Interrupts – Interrupt handling schemes- Firmware and bootloader – Free RTOS Embedded Operating Systems concepts –example on ARM core like ARM9 processor.

UNIT IV MEMORY PROTECTION AND MANAGEMENT 9

Protected Regions-Initializing MPU, Cache and Write Buffer-MPU to MMU-Virtual Memory-PageTables-TLB-Domain and Memory Access Permission-Fast Context Switch Extension.

UNIT V DESIGN WITH ARM MICROCONTROLLERS 9

Assembler Rules and Directives- Simple ASM/C programs- Hamming Code-Division-Negation-Simple Loops –Look up table- Block copy- subroutines-application. **TOTAL: 45 PERIODS**

TEXT BOOKS:

1. Steve Furber, "ARM system on chip architecture", Addision Wesley
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, SarmadNaimi, SepehrNaimi, "AVR Microcontroller and Embedded Systems using Assembly and C", Pearson Education 2014.

REFERENCES:

1. Trevor Martin, "The Insider's Guide to The Philips ARM7-Based Microcontrollers",
2. "An Engineer's Introduction to The LPC2100 Series" Hitex (UK) Ltd.,

ONLINE RESOURCES:

1. www.Nuvoton .com/websites on Advanced ARM Cortex Processors

OUTCOMES:

Upon completion of the course, the students should be able to

1. Describe the programmer's model of ARM processor and create and test assembly level programming.
2. Analyze various types of coprocessors and design suitable co-processor interface to ARM processor.
3. Identify the architectural support of ARM for operating system and analyze the function of memory management unit of ARM.
4. Students will develop more understanding on the concepts ARM Architecture, programming and application development.
5. The learning process delivers insight into various embedded processors of RISC architecture /computational processors with improved design strategies.

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	--	2	1	-	-	-	-	-	2	1	-
CO2	2	1	1	-	2	1	-	-	-	-	-	2	1	-
CO3	2	1	1	-	2	1	-	-	-	-	-	2	1	-
CO4	2	1	1	-	2	1	-	-	-	-	-	2	1	-
CO5	2	1	1	-	2	1	-	-	-	-	-	2	1	-

SEMESTER - II

24PESPC204 SDG NO. 4	INTERNET OF THINGS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To Study about Internet of Things technologies and its role in real time applications
- To familiarize the accessories and communication techniques for IOT
- To familiarize the different platforms and Attributes for IOT
- To understand the concepts of data analysis methods for IOT
- To familiarize the different case studies for IOT

UNIT I INTRODUCTION TO INTERNET OF THINGS 9

Overview, Technology drivers , Business drivers,Typical IoT applications , Trends and implications.

UNIT II IOT ARCHITECTURE 9

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 TECHNOLOGY FOR IOT 9

Protocols : NFC, RFID, Zigbee MIPI, M-PHY, UniPro, SPMI, SPI, M-PCIe Wired vs. Wireless communication, 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.

UNIT IV DATA ANALYTICS FOR IOT 9

Services/Attributes: Big-Data Analytics and Visualization, Dependability, Security, Maintainability. Data analytics for IoT: A framework for data-driven decision making , Descriptive, Predictive and Prescriptive Analytics , Business Intelligence and Artificial Intelligence Importance of impact and open innovation in data-driven decision making.

UNIT V CASE STUDIES 9

Home Automation, smart cities, Smart Grid, Electric vehicle charging, Environment, Agriculture, Productivity Applications

TOTAL: 45 PERIODS

TEXT BOOKS:

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.

REFERENCES:

1. Adrian McEwen and Hakim Cassimally, "Designing the Internet of Things", John Wiley and sons, 2014
2. Lingyang Song/Dusit Niyato/ Zhu Han/ Ekram Hossain," Wireless Device-to-Device Communications and Networks, CAMBRIDGE UNIVERSITY PRESS, 2015
3. OvidiuVermesan and Peter Friess (Editors), "Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems", River Publishers Series in Communication, 2013
4. Vijay Madisetti , ArshdeepBahga, "Internet of Things (A Hands on-Approach)", 2014 22.

WEB REFERENCES:

1. https://nptel.ac.in/courses/106/105/106105166/
2. https://nptel.ac.in/courses/106/105/106105195/
3. https://swayam.gov.in/nd1_noc19_cs65/preview

ONLINE RESOURCES:

1. https://www.coursera.org/specializations/internet-of-things
2. https://www.skillshare.com/browse/iot

OUTCOMES:

Upon completion of the course, the student should be able to

1. Students will develop more understanding on the concepts of IOT and its present developments.
2. Students will study about different IOT technologies.
3. Students will acquire knowledge about different platforms and Infrastructure for IOT.

4. Students will learn the art of implementing IOT for smart applications and control.
5. Students will acquire exposure to different case studies.

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	3	3	3	-	-	-	-	3	2	2
CO2	3	2	3	2	3	3	3	-	-	-	-	3	3	3
CO3	3	2	3	2	2	3	3	-	-	-	-	3	2	3
CO4	3	2	2	3	2	2	2	-	-	-	-	3	2	2
CO5	3	2	2	2	2	3	3	-	-	-	-	3	3	2

SEMESTER - II

24PESPL201 SDG NO. 4	EMBEDDED SYSTEM LAB - II	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- The students will learn design with simulators/ programming environments
- The students will learn design with simulators/experiments,
- The students will learn design in programming processor boards, processor interfacing/ designing digital controllers

LIST OF EXPERIMENTS

1. Programming ARM processor: ARM7 / ARM9/ARM Cortex Study on in circuit Emulators, cross compilers, debuggers
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
3. Programming with Raspberry Pi Microcontroller Board: Study on in circuit Emulators, cross compilers, debuggers
4. I/O Programming with Arduino, Raspberry Pi Microcontroller Boards I/O Interfacing: Timers/ Interrupts/ Serial port programming/PWM Generation/ Motor Control/ADC/DAC/ LCD/RTC Interfacing/ Sensor Interfacing

5. Programming with DSP processors
6. Software & Modelling tools Study on MEMS Tools, Study on process Controller modelling, PLC/SCADA/PCB one type CAD Tool.
7. Programming & Simulation in GUI Simulators /Tools/others Graphical User interface simulations & modelling of instrumentation & controllers
8. Study of one type of Real Time Operating Systems (RTOS)
9. Programming & Simulation in Python Simulators/Tools/others
10. Programming with wired/wireless communication protocol/Network Simulators

LIST OF EQUIPMENT FOR A BATCH

1. Microcontrollers with peripherals; IDE, Board Support Software Tools /Keil/uCOS Compiler/others.
2. ARM processor: ARM7 /ARM9/ARM Cortex Microcpontrollers with peripherals; Board Support Software Tools, peripherals with interface.
3. Raspberry Pi Boards with peripherals; IDE, Board Support Software Tools /Compiler/others.
4. Compilers & Platforms with VXWorks/ Keil/ Android/Tiny OS/ Linux Support/any RTOS.
5. Programming in Python Platform
6. Learning Communication Protocols & Support Software Tools for BUS & network communication.
7. Simulation Tools as Labview.
8. Programming Compilers & Platforms on freeware.

OUTCOMES:

Upon completion of the course, the student should be able to

1. Design ,modelling & simulation of Combinational, Sequential, Synchronous, Asynchronous circuits with simulators/experiments.
2. Design in programming processor boards, processor interfacing/ designing reprogrammable system.
3. Design with experiments, in programming suites/ simulators/Tool Bench.
4. Apply the programming knowledge for designing embedded system applications.
5. Learning Communication Protocols & Experimenting with Support Software Tools for communicate on interfaces.

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	3	2	3	-	-	-	-	3	3	3
CO2	3	2	3	2	3	3	3	-	-	-	-	3	3	3
CO3	3	3	3	3	2	3	3	-	-	-	-	3	3	3
CO4	3	2	2	3	2	3	3	-	-	-	-	3	3	3
CO5	3	3	2	3	3	2	3	-	-	-	-	3	3	3

SEMESTER - II

24PESTE201 SDG NO. 4 & 9	INNOVATIVE DESIGN PROJECT - II	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To encourage in identifying problems with social relevance
- To think of an innovative solution for the problem
- To design and conduct suitable experiment with modern tool
- To develop a cost effective prototype of the innovative design
- To understand the practical aspects and associated challenges in implementing the design

METHODOLOGY:

1. Student should do it individually.
2. Student should submit / present his/her ideas to the Faculty-in-Charge for approval.
3. Student should submit proposal with system/ technical details and cost implications.
4. Student should periodically demonstrate his/her progress.

EVALUATION:

Evaluation will be based on:

1. The social relevance of the work.
2. The utility of the system developed.
3. The Level of proof of concept.
4. Industry support if obtained.etc.

WEB REFERENCES:

1. https://www.mathworks.com/academia/books.html
2. http://www.mathcs.emory.edu/~cheung/Courses/455/Syllabus/A3-NS/Book/Introduction-to- Network-Simulator-NS2-2012.pdf

ONLINE REFERENCES:

1. http://www.jgyan.com/ns2/
2. https://matlabacademy.mathworks.com/

OUTCOMES:

Upon completion of the course, the student should be able to

1. The student would be able to identify socially relevant issues and apply his/her knowledge to evolve feasible solutions.
2. The student would be able to comprehensively record and report the measured data, write reports, communicate research ideas and do oral presentations effectively.

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	1	1	1	2	1	3	2	3	3
CO2	3	3	3	3	3	1	1	1	2	1	3	2	3	3

SEMESTER - III

24PESPJ301 SDG NO. 4 & 9	PROJECT WORK PHASE - I	L	T	P	C
		0	0	12	6

OBJECTIVES:

- To identify a specific problem for the current need of the society and collecting information related to the same through detailed review of literature.
- To develop the methodology to solve the identified problem.

SYLLABUS:

The student individually works on a specific topic approved by the head of the division under the guidance of a faculty member who is familiar in this area of interest. The student can select any topic which is relevant to the area of engineering design. The topic may be theoretical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

TOTAL: 180 PERIODS

OUTCOMES :

Upon completion of the course, the students should be able to

1. Conceptualize the societal needs and acquire exposure to product development.
2. Get familiarized with respect to design standards, design calculations and analysis in designing any mechanical component or system.
3. Get clear idea of their area of work and they will be in a position to carry out the remaining phase II work in a systematic way.

CO-PO & PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	3	2	3	3	3	3	3	3	3	3
CO2	2	2	3	1	3	3	3	3	3	3	3	3	3	3
CO3	3	1	-	-	3	-	2	3	3	3	1	3	3	3

SEMESTER - IV

24PESPJ401 SDG NO. 4 & 9	PROJECT WORK PHASE - II	L	T	P	C
		0	0	24	12

OBJECTIVES:

- To solve the identified problem based on the formulated methodology.
- To develop skills to analyze and discuss the test results, and make conclusions

SYLLABUS:

The student should continue the phase I work on the selected topic as per the formulated methodology under the same supervisor. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report should be prepared and submitted to the head of the department. The students will be evaluated based on the report submitted and the viva-voce examination by a panel of examiners including one external examiner

TOTAL: 180 PERIODS

OUTCOMES :

Upon completion of the course, the students should be able to

1. Develop project related to societal needs and acquire knowledge regarding product development.
2. Get familiarized with respect to design standards, design calculations and analysis in designing any mechanical component or system.
3. Take up any challenging practical problem in the field of engineering design and find better solutions to it.

CO-PO & PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	3	2	3	3	3	3	3	3	3	3
CO2	2	2	3	1	3	3	3	3	3	3	3	3	3	3
CO3	3	1	-	-	3	-	2	3	3	3	1	3	3	3

PROFESSIONAL ELECTIVES - I

24PESEL201 SDG NO. 4	MEMS TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To teach the students properties of materials, microstructure and fabrication methods
- To teach the design and modelling of Electrostatic sensors and actuators
- To teach the characterizing thermal sensors and actuators through design and modeling
- To teach the fundamentals of piezoelectric sensors and actuators through exposure to different MEMS and NEMS devices
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I MICRO-FABRICATION, MATERIALS AND ELECTRO -MECHANICAL CONCEPTS 9

Overview of micro fabrication – Silicon and other material based fabrication processes – Concepts: Conductivity of semiconductors-Crystal planes and orientation-stress and strain-flexural beam bending analysis-torsional deflections-Intrinsic stress- resonant frequency and quality factor.

UNIT II ELECTROSTATIC SENSORS AND ACTUATION 9

Principle, material, design and fabrication of parallel plate capacitors as electrostatic sensors and actuators-Applications.

UNIT III THERMAL SENSING AND ACTUATION 9

Principle, material, design and fabrication of thermal couples, thermal bimorph sensors, thermal resistor sensors-Applications.

UNIT IV PIEZOELECTRIC SENSING AND ACTUATION 9

Piezoelectric effect-cantilever piezoelectric actuator model-properties of piezoelectric materials-Applications.

UNIT V CASE STUDIES 9

Piezo resistive sensors, Magnetic actuation, Microfluidics applications, Medical applications, Optical MEMS.-NEMS Devices.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Chang Liu, "Foundations of MEMS", Pearson International Edition, 2006.
2. Marc Madou, "Fundamentals of microfabrication", CRC Press, 1997.

REFERENCES:

1. Boston, "Micromachined Transducers Sourcebook", WCB McGraw Hill, 1998.
2. M.H.Bao "Micromechanical transducers : Pressure sensors, accelerometers and gyroscopes", Elsevier, Newyork, 2000.

WEB REFERENCES:

1. https://nptel.ac.in/courses/117105082/
2. https://www.mooc-list.com/tags/mems
3. https://swayam.gov.in/nd1_noc20_ee52/preview

ONLINE RESOURCES:

1. https://www.edx.org/course/micro-and-nanofabrication-mems
2. https://www.coursera.org/lecture/sensor-manufacturing-process-control/2-mems-construction-0tHJV

OUTCOMES:

Upon completion of the course, the student should be able to

- Understand basics of microfabrication, develop models and simulate electrostatic and electromagnetic sensors and actuators
- Understand material properties important for MEMS system performance, analyze dynamics of resonant micromechanical structures
- The learning process delivers insight on the design of micro sensors, embedded sensors & actuators in power aware systems like grid.
- Understand the design process and validation for MEMS devices and systems, and learn the state of the art in optical microsystems
- Improved Employability and entrepreneurship capacity due to knowledge upgradation on recent trends in embedded systems design.

CO - PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	2	2	3	2	-	-	-	-	3	3	3
CO2	3	2	2	2	2	3	2	-	-	-	-	3	2	2
CO3	3	2	3	2	2	3	2	-	-	-	-	3	2	2
CO4	3	2	3	3	2	3	3	-	-	-	-	3	2	2
CO5	3	3	3	3	3	2	2	-	-	-	-	3	3	3

PROFESSIONAL ELECTIVES - I

24PESEL202 SDG NO. 4	ADVANCED COMPUTER ARCHITECTURE AND PARALLEL PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To educate the students to the fundamentals of parallel processing
- To teach the fundamentals of network topologies for multiprocessors
- To introduce different pipeline designs
- To introduce features of parallel processors , memory technologies, OS for multiprogrammed computer
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I THEORY OF PARALLELISM 9

Parallel Computer models – the state of computing-introduction to parallel processing- parallelism in uniprocessor & Multiprocessors,-parallel architectural classification schemes-speedup performance laws- -Program and Network Properties-H/W-S/W Parallelism.

UNIT II SYSTEM INTERCONNECT ARCHITECTURES 9

System interconnect Architectures-Network Properties and routing-Static Interconnection Networks-Dynamic Interconnection Networks-Multiprocessor System Interconnects-interprocessor communication network-Structure of Parallel Computers; Hierarchical bus systems-Crossbar switch and multiport memory-multistage and combining network.

UNIT III PIPELINING AND SUPERSCALAR TECHNOLOGIES 9

Pipeline principle and implementation-classification of pipeline processor-

introduction of arithmetic, instruction, processor pipelining-pipeline mechanisms-hazards.

UNIT IV HARDWARE TECHNOLOGIES 9

Introduction to features of advanced embedded processors through Basic Comparative study: of Architectures -addressing modes -instruction types-performance of- Parallel and scalable architectures, Multiprocessor and SIMD, MIMD computers, RISC, CISC, Superscalar, VLIW , Vector, Systolic processors of their unique features -Scalable, Multithreaded and dataflow Architectures-interPE communication-interconnection networks- Array & vector processors, vector instruction types performance modeling-design of vectorising compiler- case Architecture of Itanium processor, Pentium Processor, SPARC Processor.

UNIT V OS ISSUES FOR MULTI PROCESSOR 9

Introduction-Need for Preemptive OS – Synchronising and Scheduling in Multiprocessor OS-, UsualOs scheduling Techniques, threads – Classification of multiprocessor OS – Software requirements of multiprocessor OS, Distributed scheduler – PVM – PT Threads in shared memory systems.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Kai Hwang "Advanced Computer Architecture".Tata McGraw Hill 2000
2. Rajiv Chopra, 'Advanced Computer architecture" S Chand , 2010
3. John L. Hennessy, David A. Petterson, "Computer Architecture: A Quantitative Approach", 4thEdition, Elsevier, 2007
4. DezsoSima, Terence Fountain, Peter Kacsuk, "Advanced computer Architecture – A designSpace Approach". Pearson Education,2003.
5. Sajjan G. Shiva "Advanced Computer Architecture", Taylor & Francis, 2008.

REFERENCES:

1. Rajaraman, C.Siva Ram Murthy, "Parallel Computers- Architecture and Programming", PrenticeHall India, 2008
2. Carl Homacher, ZvonkoVranesic, Sefwat Zaky, "Computer Organisation", 5th Edition, TMH, 2002.29
3. David E. Culler, Jaswinder Pal Singh with Anoop Gupta "Parallel Computer Architecture" ,Elsevier,2004.
4. John P. Shen. "Modern processor design Fundamentals of super scalar processors", TataMcGraw Hill 2003.

WEB RESOURCES:

1. https://swayam.gov.in/nd1_noc19_cs62/preview
2. https://nptel.ac.in/courses/106105163/
3. https://nptel.ac.in/courses/106103068/

OUTCOMES:

Upon completion of the course, the student should be able to:

1. An ability to understand the operations of multiprocessor and multicomputer systems.
2. Understand the various advanced processor technology, pipelining and scalable architectures.
3. Know the working of superscalar pipeline, cache memory organization.
4. Understand the principles of multithreading, multi thread architecture, static and dynamic dataflow.
5. Improve Employability and entrepreneurship capacity due to knowledge upgradation on recent trends in embedded systems design.

CO – PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	1	1	1	-	-	-	-	-	1	2	1
CO2	3	3	3	3	3	1	-	-	-	-	-	1	2	1
CO3	2	3	3	3	2	1	-	-	-	-	-	1	2	1
CO4	3	3	3	2	3	1	-	-	-	-	-	1	2	2
CO5	2	2	2	2	1	1	-	-	-	-	-	1	2	2

PROFESSIONAL ELECTIVES - I

24PESEL203 SDG NO. 4	DIGITAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart the working of fundamental building blocks of a digital data acquisition system.
- To introduce various digital data communication modules and protocols
- To introduce programming skills in virtual instrumentation platform
- To teach microprocessor based system design and provide hands on experience in interfacing systems using virtual instrumentation concepts.
- To discuss various case studies on real time data acquisition systems.

UNIT I DATA ACQUISITION SYSTEMS 9

Overview of A/D converter, types and characteristics – Sampling, Errors. Objective – Building blocks of Automation systems -Calibration, Resolution, Data acquisition interface requirements.–Counters – Modes of operation-Frequency, Period, Time interval measurements, Prescaler, Heterodyne converter for frequency measurement, Single and Multi-channel Data Acquisition systems-Digital storage Oscilloscope-digital display interface.

UNIT II INSTRUMENT COMMUNICATION 9

Introduction, Modem standards, Data transmission systems- Time Division Multiplexing (TDM) – Digital Modulation Basic requirements of Instrument Bus Communications standards, interrupt and data handshaking , serial bus-basics, Message transfer, - RS-232, USB, RS-422, Ethernet Bus- CAN standards interfaces .General considerations -advantages and disadvantages-Instrumentation network design ,advantages and limitations ,general considerations, architecture, model, and system configuration of : HART network, Mod Bus, Fieldbus.

UNIT III VIRTUAL INSTRUMENTATION BASICS 9

Block diagram, role, and Architecture for VI–– toolbar, Graphical system design & programming Using GUI – Virtual Instrumentation for test, control design-modular programming-conceptual and prog approaches for creation of panels, icons-Loops-Arrays-clusters-plotting data-structures-strings and File I/O- Instrument Drivers

UNIT IV CONFIGURING PROGRAMMABLE INSTRUMENTATION 9

Microprocessor based system design –Peripheral Interfaces systems and instrument communication standards –Data acquisition with processor and with VI – Virtual Instrumentation Software and hardware simulation of I/O communication blocks-peripheral interface – ADC/DAC – Digital I/O – Counter.

UNIT V CASE STUDIES 9

Processor based DAS, Data loggers, VI based process measurements like temperature, pressure and level development system- DSO interface -digital controller for colour video display. Relays/Solenoids, Timer-servo motor control-PID control./ LCD graphics Interface/storage interface.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Mathivanan, "PC based Instrumentation Concepts and practice", Prentice-Hall India, 2009
2. Jovitha Jerome,"Virtual Instrumentation using Labview"PHI, 2010.

3. Gregory J. Pottie / William J. Kaiser, Principles Of Embedded Networked Systems Design, Cambridge University Press (CUP),2016
4. Jonathan W Valvano, "Embedded Microcomputer systems", Brooks/Cole, Thomson, 2010.

REFERENCES:

1. Cory L.Clark, "Labview Digital Signal Processing & Digital Communication", TMcH,2005
2. Lisa K. wells & Jeffrey Travis, "Lab VIEW for everyone", Prentice Hall, New Jersey,1997.
3. H S Kalsi, "Electronic Instrumentation" Second Edition, Tata McGraw-Hill,2006.
4. K.Padmanabhan, S.Ananthi, "A Treatise on Instrumentation Engineering" , I K Publish,2011
5. Gary Johnson, "LabVIEW Graphical Programming", Second edition, McG Hill,Newyork, 1997.

OUTCOMES:

Upon completion of the course, the student should be able to

1. Analyse the working of building blocks of a digital data acquisition system.
2. Understand and apply various digital data communication modules and protocols.
3. Apply programming skills for framing simple loops, arrays and clusters in virtual instrumentation platforms.
4. Interface the given microprocessor for a real time application and also generate programs for interfacing systems using virtual instrumentation concepts.
5. Learn various case studies on real time data acquisition systems.

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	2	1	1	1	-	-	1	1	1	2	2
CO2	2	1	1	1	1	-	-	-	-	-	1	1	2	2
CO3	1	2	2	2	3	-	-	-	-	-	1	2	2	2
CO4	2	2	2	2	3	1	-	-	-	-	1	2	2	2
CO5	1	2	2	2	3	1	1	1	2	2	1	2	2	2

PROFESSIONAL ELECTIVES - I

24PESEL204 SDG NO. 4	VLSI ARCHITECTURE AND DESIGN METHODOLOGIES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To discuss to the students on the fundamentals building blocks of a VLSI architecture
- To teach the analog VLSI design principles
- To study on working of programmable logic devices
- To teach principles of ASIC designs
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I CMOS DESIGN **9**

Overview of digital VLSI design methodologies - Logic design with CMOS transmission gate circuits-Clocked CMOS-dynamic CMOS circuits, Bi-CMOS circuits- CMOS IC technology - Stick diagram for all basic gates, Layout diagram for Inverter.

UNIT II ANALOG VLSI DESIGN **9**

Introduction to analog VLSI- Design of 2 stage and 3 stage Op Amp -High Speed and High frequency Op Amps-Super MOS-Analog primitive cells.

UNIT III PROGRAMMABLE LOGIC DEVICES **9**

Generic Architecture of FPGA – Functional blocks - I/O blocks – Interconnects - Programming Techniques - Anti fuse – SRAM-EPROM and EEPROM technology – Spartan VI: Functional Block Diagram and features - Cyclone V: Functional Block Diagram and features.

UNIT IV ASIC CONSTRUCTION, FLOOR PLANNING, PLACEMENT AND ROUTING **9**

System partitioning - Partitioning methods- floor planning – placement and routing - global routing - detailed routing - detailed routing - special routing-circuit extraction – Design Rule checker.

UNIT V VERILOG HDL **9**

Introduction to Verilog HDL, hierarchical modeling concepts, modules and port definitions, gate level modeling, data flow modeling, behavioral modeling, task & functions, Verilog Simulation and synthesis, Verilog coding for Carry Look ahead adder, Multiplier, ALU, Shift Registers using structural

modeling – Multiplexer, Sequence detector Traffic light controller using behavioural modeling.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. M.J.S Smith, "Application Specific integrated circuits", Pearson Education, 5th Reprint, 2008.
2. Kamran Eshraghian, Douglas A. Pucknell and Sholeh Eshraghian, "Essentials of VLSI circuits and system", Prentice Hall India, 2005.
3. Wayne Wolf, “Modern VLSI design”, Pearson Education, 3rd Edition, 2007.

REFERENCES:

1. Mohamed Ismail, TerriFiez, "AnalogVLSI Signal and information Processing", McGraw Hill International Editions, 1994.
2. SamirPalnitkar, "Verilog HDL, A Design guide to Digital and Synthesis", Pearson, 2nd Edition, 2005.

WEB RESOURCES:

1. www.nptelvideos.in/2012/12/digital-vlsi-system-design.html
2. www.nptelvideos.in/2012/12/vlsi-design.html
3. swayam.gov.in/nd1_noc20_ee29/preview

OUTCOMES:

Upon completion of the course, the student should be able to

1. Design CMOS Transistor level circuit for the given logic.
2. Explain the VLSI design aspects of operational amplifier.
3. Distinguish different FPGA Architectures.
4. Explain the concepts of ASIC.
5. Write the Verilog coding for digital circuits.

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	2	1	-	-	-	-	-	1	1	1
CO2	2	2	1	1	2	1	-	-	-	-	-	1	2	2
CO3	2	1	1	1	2	1	-	-	-	-	-	1	1	1
CO4	2	2	1	1	2	1	-	-	-	-	-	1	1	1
CO5	2	2	1	2	2	1	-	-	-	-	-	1	2	2

PROFESSIONAL ELECTIVES - I

24PESEL205 SDG NO. 4	ROBOTICS AND CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To discuss to the students on the fundamentals of basic terminologies
- To teach the basics and design of kinematics
- To study on working of differential motion and path planning
- To teach principles of dynamic modelling
- 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 AND TERMINOLOGIES 9

Definition - Classification - History - Robots components - Degrees of freedom - Robot joints coordinates- Reference frames - workspace-Robot languages-actuators - sensors- Position, velocity and acceleration sensors -Torque sensors-tactile and touch sensors - proximity and range sensors –social issues.

UNIT II KINEMATICS 9

Mechanism-matrix representation-homogeneous transformation-DH representation – Inverse kinematics-solution and programming-degeneracy and dexterity.

UNIT III DIFFERENTIAL MOTION AND PATH PLANNING 9

Jacobian-differential motion of frames-Interpretation-calculation of Jacobian-Inverse Jacobian- Robot Path planning.

UNIT IV DYNAMIC MODELLING 9

Lagrangian mechanics- Two - DOF manipulator- Lagrange-Euler formulation – Newton Euler formulation – Inverse dynamics.

UNIT V ROBOT CONTROL SYSTEM 9

Linear control schemes- joint actuators- decentralized PID control- computed torque control– force control- hybrid position force control- Impedance/ Torque control.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. R.K. Mittal and I J Nagrath, “Robotics and Control”, Tata McGraw Hill, 4th Reprint, 2003.

2. Saeed B. Niku, ''Introduction to Robotics '', Pearson Education,2002
3. K.S.Fu, R.C.Gonzalez and C.S.G.Lee, ''Robotics Control, Sensing, Vision and Intelligence", Tata McGraw Hill, 2nd Reprint,2008.

REFERENCES:

1. R.D.Klafter, TA Chmielewski and Michael Negin, "Robotic Engineering, An Integrated approach", Prentice Hall of India, 2003.
2. Reza N.Jazar, “Theory of Applied Robotics Kinematics, Dynamics and Control”, Springer, 1st Indian Reprint, 2010.

OUTCOMES:

Upon completion of the course, the student should be able to

1. Define the basic robot terminologies.
2. Discuss the concepts of kinematics and Jacobians in robot control.
3. Explain the basis of robot dynamics.
4. Discuss the path planning and robot control techniques.
5. Explain the basics of robot control systems.

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	2	1	2	-	-	-	2	2	2	2
CO2	3	2	3	2	1	2	2	-	-	-	2	3	2	1
CO3	2	2	1	2	2	2	2	-	-	-	3	3	2	1
CO4	2	2	2	3	2	2	2	-	-	-	3	2	2	2
CO5	2	3	2	1	2	2	2	-	-	-	3	2	2	2

PROFESSIONAL ELECTIVES - I

24PESEL206 SDG NO. 4	DISTRIBUTED EMBEDDED COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To expose the students to the fundamentals of Network communication technologies and distributed computing
- To study on Java based Networking and distributed computing
- To know the fundamentals of distributed computing
- To understand the concepts of security in computing

- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I DISTRIBUTED SYSTEM **9**

Introduction- Communication in distribution system-Client/Server Model-Synchronization in distributed system.

UNIT II EMBEDDED JAVA **9**

Overview of JAVA – Programs- Multithreaded programming- APPLET programming- I/O streaming- RMI- Introduction to Embedded JAVA.

UNIT III DISTRIBUTED COMPUTING **9**

Definition- Model of distributed computation- Distributed shared memory-Authentication in distributed system

UNIT IV SECURITY IN COMPUTING **9**

Security meaning- Threads in networks- Network security control- Firewall-Authentication- E-mail security- Security in web services- Case studies

UNIT V WEB BASED HOME AUTOMATION **9**

Components of Distributed Embedded - Protocols & Standards - Hardware/Software selection for Distributed Embedded – case study: Web based Home Automation.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Andrew S. Tanenbaum, "Distributed operating systems", Pearson 2013
2. E Balagurusamy," Programming with JAVA", Mc Graw Hill 2013

REFERENCES:

1. Ajay D Kshemkalyani,Mukesh Singhal, "Distributed Computing" – Principles, Algorithm and systems, Cambridge university press 2008
2. Charles P. Pfleeger, "Security in Computing", Pearson 2009.

OUTCOMES:

Upon completion of the course, the student should be able to

1. Apply knowledge from undergraduate engineering and other disciplines to identify, formulate, solve novel advanced electronics engineering along with soft computing problems that require advanced knowledge within the field.

2. Understand and integrate new knowledge within the field and advanced technical knowledge in multiple contexts.
3. Analyse and design the security in computing.
4. Design web based home automation systems.
5. Improved Employability and entrepreneurship capacity due to knowledge upgradation on recent trends in embedded systems design.

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	2	1	2	-	-	-	2	2	2	2
CO2	3	2	3	2	1	2	2	-	-	-	2	3	2	1
CO3	2	2	1	2	2	2	2	-	-	-	3	3	2	1
CO4	2	2	2	3	2	2	2	-	-	-	3	2	2	2
CO5	2	3	2	1	2	2	2	-	-	-	3	2	2	2

PROFESSIONAL ELECTIVES - I

24PESEL207 SDG NO. 4	CRYPTOGRAPHY AND NETWORK SECURITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To expose the students to the fundamentals of data security
- To teach the fundamentals of mathematical aspects in creating Encryption keys
- To teach the fundamentals of Security in data & wireless communication.
- To teach the fundamentals of Secured system operation
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I SYMMETRIC CIPHERS **9**

Overview – classical Encryption Techniques – Block Ciphers and the Data Encryption standard – Introduction to Finite Fields – Advanced Encryption standard – Contemporary, Symmetric Ciphers – Confidentiality using Symmetric Encryption.

UNIT II PUBLIC-KEY ENCRYPTION AND HASH FUNCTIONS 9

Introduction to Number Theory – Public-Key Cryptography and RSA – Key Management – Diffie- Hellman Key Exchange – Elliptic Curve Cryptography – Message Authentication and Hash Functions – Hash Algorithms – Digital Signatures and Authentication Protocols.

UNIT III NETWORK SECURITY PRACTICE 9

Authentication Applications – Kerberos – X.509 Authentication Service – Electronic mail Security –Pretty Good Privacy – S/MIME – IP Security architecture – Authentication Header – Encapsulating Security Payload – Key Management.

UNIT IV SYSTEM SECURITY 9

Intruders – Intrusion Detection – Password Management – Malicious Software – Firewalls – Firewall Design Principles – Trusted Systems.

UNIT V WIRELESS SECURITY 9

Introduction to Wireless LAN Security Standards – Wireless LAN Security Factors and Issues.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. William Stallings, "Cryptography And Network Security – Principles And Practices", Pearson Education, 3rd Edition, 2003.
2. Atul Kahate, "Cryptography and Network Security", Tata McGraw Hill, 2003.
3. Natalia Olifer and Victor Olifer,"Computer Networks principles. Technologies and protocols for network design", Wiley, 2015
4. Bruce Schneier, "Applied Cryptography", John Wiley and Sons Inc, 2001.

REFERENCES:

1. Stewart S. Miller, "Wi-Fi Security", McGraw Hill, 2003.
2. Charles B. Pfleeger, Shari Lawrence Pfleeger, "Security In Computing", 3rd Edition, Pearson Education, 2003.
3. Mai, "Modern Cryptography: Theory and Practice", First Edition, Pearson Education, 2003.

WEB RESOURCES:

1. swayam.gov.in/nd1_noc20_cs21/preview
2. www.nptel.ac.in/courses/106105031

OUTCOMES:

Upon completion of the course, the student should be able to

1. Identify the major types of threats to information security and the associated attacks, understand how security policies, standards and practices are developed.
2. Describe the major types of cryptographic algorithms and typical applications, write code to encrypt and decrypt information using some of the standard algorithms.
3. To be exposed to original research in network security and master information security governance, and related legal and regulatory issues
4. The learning process delivers insight onto role of security aspects during data transfer and communication in systems like grid.
5. Improved Employability and entrepreneurship capacity due to knowledge upgradation on recent trends in embedded systems design.

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	2	1	-	-	-	-	-	2	2	1
CO2	2	2	2	1	2	2	-	-	-	-	-	2	2	2
CO3	2	1	1	1	1	1	-	-	-	-	-	2	2	2
CO4	1	2	2	1	2	2	-	-	-	-	-	1	1	1
CO5	1	1	1	1	1	2	-	-	-	-	-	1	2	1

PROFESSIONAL ELECTIVES - II

24PESEL301 SDG NO. 4	EMBEDDED LINUX	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To expose the students to the fundamentals of Linux Operating system, its basic commands and shell programming
- To teach the history of embedded Linux, various distributions and basics of GNU Cross Platform Tool Chain
- To study on different Host-Target setup, debug and various memory device, file systems and performance tuning
- To introduce the concept of configuring kernel using the cross-platform tool chain
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I FUNDAMENTALS OF LINUX 9

Basic Linux System Concepts: Working with Files and Directories - Introduction to Linux File system -Working with Partitions and File systems - Understanding Linux Permissions; Using Command Line Tools: Executing Commands from the Command Line - Getting to a Shell - Popular Command-Line Commands - Working with the Bash Shell.

UNIT II VARIOUS DISTRIBUTIONS AND CROSS PLATFORM TOOL CHAIN 9

Introduction - History of Embedded Linux - Embedded Linux versus Desktop Linux – Commercial Embedded Linux Distribution - Choosing a distribution - Embedded Linux Distributions – Architecture of Embedded Linux - Linux Kernel Architecture - Porting Roadmap - GNU Cross Platform Toolchain.

UNIT III HOST-TARGET SETUP AND OVERALL ARCHITECTURE 9

Real Life Embedded Linux Systems - Design and Implementation Methodology - Types of Host / Target Development Setups - Types of Host / Target Debug Setups - Generic Architecture of an Embedded Linux System - System Startup - Types of Boot Configurations - System Memory Layout – Processor Architectures - Buses and Interfaces - I/O – Storage.

UNIT IV KERNEL CONFIGURATION 9

A Practical Project Workspace - GNU Cross-Platform Development Toolchain -

C Library Alternatives- Other Programming Languages - Eclipse: An Integrated Development Environment – Terminal Emulators - Selecting a Kernel - Configuring the Kernel - Compiling the Kernel - Installing the Kernel - Basic Root Filesystem Structure - Libraries - Kernel Modules and Kernel Images - Device Files – Main System Applications - System Initialization.

UNIT V LINUX DRIVERS 9

Introduction in to basics on Linux drivers, introduction to GNU cross platform Toolchain- Case study on programming one serial driver for developing application using Linux Driver.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Karim Yaghmour, Jon Masters, Gilad Ben-Yossef, and Philippe Gerum, "Building Embedded Linux Systems"2nd Edition, SPD -O'Reilly Publications, 2008.
2. P.Raghavan,Amol Lad,Sriram Neelakandan,"EmbeddedLinux System Design & Development", Auerbach Publications, 2012.
3. William von Hagen, "Ubuntu Linux Bible" 3rd Edition', Wiley Publishing Inc., 2010.

REFERENCES:

1. Jonathan Corbet, Alessandro Rubini & Greg Kroah-Hartman, "Linux Device Drivers 3rd Edition", SPD -O'Reilly Publications, 2011
2. Robert Love,"Linux System Programming, SPD -O'Reilly Publications, 2010.

OUTCOMES:

Upon completion of the course, the student should be able to

1. To use Linux desktop and GNU tool chain with Eclipse IDE.
2. Cross compile Linux kernel and port it to target board.
3. Add applications and write customized application for the Linux kernel in the target board.
4. Students will study about distributions and cross platform tool chain.
5. Improved Employability and entrepreneurship capacity due to knowledge upgradation on recent trends in embedded systems design.

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	1	2	-	-	-	-	-	2	2	2
CO2	2	2	2	2	2	2	-	-	-	-	-	2	2	2
CO3	2	2	2	2	2	1	-	-	-	-	-	2	2	2
CO4	1	1	2	1	1	1	-	-	-	-	-	1	1	1
CO5	2	2	2	1	1	1	-	-	-	-	-	1	2	2

PROFESSIONAL ELECTIVES - II

24PESEL302 SDG NO. 4	ADVANCED DIGITAL SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To expose the students to the fundamentals of digital signal processing in frequency domain & its application.
- To teach the fundamentals of digital signal processing in time-frequency domain & its application.
- To compare Architectures & features of Programmable DSP processors & develop logical functions of DSP Processors.
- To discuss on Application development with commercial family of DS Processors.
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills.

UNIT I FUNDAMENTALS OF DSP 9

Frequency interpretation, sampling theorem, aliasing, discrete-time systems, constant-coefficient difference equation. Digital filters: FIR filter design – rectangular, Hamming, Hamming windowing technique. IIR filter design – Butterworth filter, bilinear transformation method, frequency transformation. Fundamentals of multi rate processing – decimation and interpolation.

UNIT II TRANSFORMS AND PROPERTIES 9

Discrete Fourier transform (DFT): - properties, Fast Fourier transform (FFT), DIT-FFT, and DIF-FFT. Wavelet transforms: Introduction, wavelet coefficients –

orthonormal wavelets and their relationship to filter banks, multi-resolution analysis, and Haar and Daubechies wavelet.

UNIT III ADAPTIVE FILTERS **9**

Wiener filters – an introduction. Adaptive filters: Fundamentals of adaptive filters, FIR adaptive filter –steepest descent algorithm, LMS algorithm, NLMS, applications – channel equalization. Adaptive recursive filters – exponentially weighted RLS algorithm.

UNIT IV ARCHITECTURE OF COMMERCIAL DIGITAL SIGNAL PROCESSORS **9**

Introduction to commercial digital signal processors, Categorization of DSP processor – Fixed point and floating point, Architecture and instruction set of the TI TMS 320 C54xx and TMS 320 C6xxx DSP processors, On-chip and On-board peripherals – memory (Cache, Flash, SDRAM), codec, multichannel buffered I/O serial ports (McBSPs), interrupts, direct memory access (DMA), timers and general purpose I/Os.

UNIT V INTERFACING I/O PERIPHERALS FOR DSP BASED APPLICATIONS **9**

Introduction, External Bus Interfacing Signals, Memory Interface, I/O Interface, Programmed I/O, Interrupts, Design of Filter, FFT Algorithm, Application for Serial Interfacing, DSP based Power Meter, Position control , CODEC Interface .

TOTAL: 45 PERIODS

TEXT BOOKS:

1. John. G. Proakis, Dimitris G. Manolakis, "Digital signal processing", Pearson Edu, 2002.
2. Sen M.Kuo,Woon-Seng S.Gan, "Digital Signal Processors" Pearson Edu, 2012.
3. Ifeachor E. C., Jervis B. W,"Digital Signal Processing: A practical approach", Pearson-Education, PHI/ 2002.
4. Shaila D. Apte, "Digital Signal Processing", Second Edition, Wiley, 2016.
5. Robert J.Schilling,Sandra L.Harris,"Introd. To Digital Signal Processing with Matlab", Cengage, 2014.

REFERENCES:

1. Steven A. Tretter, "Communication System Design Using DSP Algorithms with Laboratory Experiments for the TMS320C6713™ DSK", Springer, 2008.

2. RulphChassaing and Donald Reay, "Digital Signal Processing and Applications with the TMS320C6713 and TMS320C6416 DSK", John Wiley & Sons, Inc., Hoboken, New Jersey, 2008.
3. K.P. Soman and K.L. Ramchandran, "Insight into WAVELETS from theory to practice", Eastern Economy Edition, 2008.
4. B Venkataramani and M Bhaskar "Digital Signal Processors", TMH, 2nd, 2010.
5. Vinay K.Ingle,John G.Proakis,"DSP-A Matlab Based Approach",Cengage Learning, 2010.

WEB RESOURCES:

1. swayam.gov.in/nd1_noc19_ee50
2. www.nptel.ac.in/courses/117101001
3. www.nptelvideos.in/2012/12/advanced-digital-signal

OUTCOMES:

Upon completion of the course, the student should be able to

1. Students will learn the essential advanced topics in DSP that are necessary for successful Postgraduate level research.
2. Students will have the ability to solve various types of practical problems in DSP.
3. Comprehend the DFTs and FFTs, design and Analyze the digital filters, comprehend the Finite word length effects in Fixed point DSP Systems.
4. The conceptual aspects of Signal processing Transforms are introduced.
5. The comparison on commercially available DSP Processors helps to understand system design through processor interface.

CO – PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	1	2	-	-	-	-	-	2	2	2
CO2	2	2	2	2	2	2	-	-	-	-	-	2	2	2
CO3	2	2	2	2	2	1	-	-	-	-	-	2	2	2
CO4	1	1	2	1	1	1	-	-	-	-	-	1	1	1
CO5	2	2	2	1	1	1	-	-	-	-	-	1	2	2

PROFESSIONAL ELECTIVES - II

24PESEL303 SDG NO. 4	PYTHON PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Students will learn the grammar of Python programming language
- Students will understand and be able to use the basic programming principles such as data types, variables, conditionals, loops, recursion and function calls
- Students will learn how to use basic data structures such as List, Dictionary and be able to manipulate text files and images
- Students will understand the process and will acquire skills necessary to effectively attempt a programming problem and implement it with a specific programming language - Python
- 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 PYTHON 9

Introduction to Python language – Using the interpreter – Python data types and functions – Working with Data – List, Dictionary and Set – Processing Primitives – List comprehensions – File Handling – Object model including Variables, Reference counting, Copying, and Type checking – Error handling.

UNIT II PROGRAM ORGANIZATION AND FUNCTIONS 9

Organize Large programs into functions – Python functions including scoping rules and documentation strings – Modules and Libraries – Organize programs into modules – System administration, Text processing, Sub processes, Binary data handling, XML parsing and Database Access – Installing third-party libraries.

UNIT III CLASSES AND OBJECTS 9

Introduction to Object-oriented programming – Basic principles of Object-oriented programming in Python – Class definition, Inheritance, Composition, Operator overloading and Object creation – Python special modules – Python Object System – Object representation, Attribute binding, Memory management, and Special properties of classes including properties, slots and private attributes.

UNIT IV TESTING, DEBUGGING, AND SOFTWARE DEVELOPMENT PRACTICE **9**

Python Software development – Use of documentation string – Program testing using doc test and unit test modules – Effective use of assertions – Python debugger and profiler – Iterators and Generators to set up data processing pipelines – An effective technique for addressing common system programming problems (e.g. processing large data files, handling infinite data streams, etc.)

UNIT V TEXT I/O HANDLING **9**

Text generation, Template strings and Unicode-packages – Python Integration Primer – Network programming – Accessing C code – Survey on how Python interacts with other language programs.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Mark Lutz, "Learning Python, Powerful OOPs", O'reilly, 2011
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Intr Programming in Python", Pearson, 2016.s
3. Mark J.Guzdial, Barbara Ericson, "Introduction to Computing & Programming in Python", 4th Edition Pearson,2015.

REFERENCES:

1. Budd, Timothy. "Exploring Python. McGraw-Hill science", 2009.
2. Guttag, John. "Introduction to Computation and Programming Using Python". MIT Press, 2013.
3. Zelle, John M. "Python Programming: An Introduction to Computer Science". 1st ed. Franklin Beedle& Associates, 2003

WEB REFERENCE:

1. https://www.youtube.com/watch?v=_uQrJ0TkZlc&t=793s

OUTCOMES:

Upon completion of the course, the student should be able to

1. Students will be able to develop skill in system administration and network programming by learning Python.
2. Students will also learn how to effectively use Python's very powerful processing primitives, modeling etc.
3. Improved Employability and entrepreneurship capacity due to knowledge upgradation on recent trends in embedded systems design.

4. Students able to understand the concepts of testing, debugging and software development practice.
5. Students are able to get exposure on text input and output handling.

CO – PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	1	1	3	2	-	-	-	-	2	2	2	2
CO2	2	2	2	2	2	2	-	-	-	-	1	2	2	1
CO3	2	2	1	2	2	2	-	-	-	-	1	2	2	2
CO4	3	2	2	3	2	2	-	-	-	-	1	2	2	2
CO5	1	2	2	1	2	2	-	-	-	-	1	3	2	2

PROFESSIONAL ELECTIVES - II

24PESEL304 SDG NO. 4	EMBEDDED PRODUCT DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide the basic concepts of product design, product features and its architecture
- To introduce the possible approaches for product development
- To understand the concepts of industrial design strategies
- To explore the stages of electronic product development
- To study about the embedded product design

UNIT I CONCEPTS OF PRODUCT DEVELOPMENT 9

Need for PD- Generic product Development Process Phases- Product Development Process Flows- Product Development organization structures- Strategic importance of Product Planning process – Product Specifications- Target Specifications-Plan and establish product specifications - integration of customer, designer, material supplier and process planner, Competitor and customer – Understanding customer and behaviour analysis. Concept Generation, Five Step Method-Basics of Concept selection- Creative thinking –creativity and problem solving- creative thinking methods- generating design concepts-systematic methods for designing –functional decomposition – physical decomposition

UNIT II INTRODUCTION TO APPROACHES IN PRODUCT DEVELOPMENT 9

Product development management - establishing the architecture - creation - Product Architecture changes - variety – component standardization , clustering -geometric layout development - Fundamental and incidental interactions - related system level design issues - secondary systems - architecture of the chunks - creating detailed interface specifications-Portfolio Architecture competitive benchmarking- Approach for the benchmarking process-Design for manufacturing - Industrial Design-Robust Design – Prototype basics - Principles of prototyping - Planning for prototypes-Economic & Cost Analysis -Testing Methodologies- Product Branding

UNIT III INDUSTRIAL DESIGN STRATEGIES 9

Role of Integrating CAE, CAD, CAM tools for Simulating product performance and manufacturing processes electronically- Basics on reverse engineering – Reverse engineering strategies – Finding reusable software components – Recycling real-time embedded software based approach and its logical basics-Incorporating reverse engineering for consumer product development –case study on DeskJet Printer

UNIT IV ELECTRONIC PRODUCT DEVELOPMENT STAGES 9

Product Development Stages-Embedded product modeling- Linear, Iterative, Prototyping, Spiral - Selection of Sensor, Voltage Supply, Power supply protection, Grounding and noise elimination methods, Thermal protection with heat management – PCB design steps – Software design and testing method – documentation.

UNIT V EMBEDDED PRODUCTS DESIGN 9

Creating general Embedded System Architecture (with Case study example: Mobile Phone / DeskJet Printer./ Robonoid as a product) -Architectural Structures- Criteria in selection of Hardware Software Components, processors, input/output interfaces & connectors, ADC System ,Memory, choosing Bus Communication Standards, Criteria in selection of Embedded OS/Device Drivers, Need for Developing with IDE, Translation & Debugging Tools & Application Software, Performance Testing, Costing, Benchmarking, Documentation.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Anita Goyal, Karl T Ulrich, Steven D Eppinger, "Product Design and Development", McGraw –Hill International Edns.1999/ Tata McGrawEducation, ISBN-10-007-14679-9

2. R.G. Kaduskar and V.B. Baru, " Electronic Product Design", Wiley, 2014
3. George E.Dieter, Linda C.Schmidt, "Engineering Design", McGraw-Hill International Edition,4th Edition, 2009, ISBN 978-007-127189-9
4. Stephen Armstrong, "Engineering and Product Development Management ; The Holistic Approach", CAMBRIDGE UNIVERSITY PRESS (CUP),2014

REFERENCES:

1. Rajkamal, "Embedded system-Architecture, Programming, Design", TMH,2011.
2. KEVIN OTTO & KRISTIN WOOD, "Product Design and Development", 4th Edition,2009, Product Design Techniques in Reverse Engineering and New Product Development, , Pearson Education (LPE),2001./ISBN 9788177588217
3. Yousef Haik, T. M. M. Shahin, "Engineering Design Process", 2nd Edition Reprint, Cengage Learning, 2010, ISBN 0495668141
4. Clive L.Dym, Patrick Little, "Engineering Design: A Project-based Introduction", 3rd Edition, John Wiley & Sons, 2009, ISBN 978-0-470-22596-7

ONLINE RESOURCES

1. https://barrgroup.com/embedded-systems/consulting-services/product-development
2. http://logicproindia.com/index.php/products/
3. https://www.arm.com/resources/education/online-courses
4. https://openlabpro.com/design-platforms/

OUTCOMES:

Upon completion of the course, the student should be able to

1. understand the integration of customer requirements in product design.
2. Apply structural approach to concept generation, creativity, selection and testing.
3. Understand various aspects of design such as industrial design, design of Consumer specific product and product architecture.
4. Understand various aspects of its Reverse Engineering manufacture, economic analysis.
5. To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills.

CO – PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	3	2	2	1	2	1	1	3	2	3
CO2	3	2	3	2	3	2	2	1	2	1	2	3	1	3
CO3	3	2	3	2	3	2	2	1	3	1	1	3	2	3
CO4	3	2	3	2	3	2	2	1	3	1	2	3	2	3
CO5	3	2	3	2	3	2	2	1	3	1	1	3	1	3

PROFESSIONAL ELECTIVES - II

24PESEL305 SDG NO. 4	AUTOMOTIVE EMBEDDED SYSTEM	L	T	P	C
		3	0	0	3

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
- To teach logics of automation & commercial techniques for vehicle communication
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I BASICS OF ELECTRONIC ENGINE CONTROL SYSTEMS 9

Motivation, concept for electronic engine controls and management-Standards; introduction to fuel economy- automobile sensors-volumetric, thermal, air-fuel ratio, solenoid, hall effect-exhaust gas oxygen sensors, Oxidizing catalytic efficiency, emission limits and vehicle performance; advantages of using Electronic engine controls – open and closed loop fuel control; Block diagram of Electronic ignition system and Architecture of a EMS with multi point fuel injection system, Direct injection; programmed ignition-actuators interface to the ECU; starter motors and circuits - sensors interface to the ECU; Actuators and their characteristics – exhaust gas recirculation.

UNIT II FUEL CELL FOR AUTOMOTIVE POWER 9

Fuel cell-Introduction-Proton exchange membrane FC (PEM), Solid oxide fuel cell (SOFC)-properties of fuel cells for vehicles-power system of an automobile

with fuel cell based drive, and their characteristics.

UNIT III VEHICLE MANAGEMENT SYSTEMS 9

Electronic Engine Control-engine mapping,air/fuel ratio spark timing control strategy, fuel control,electronic ignition-Vehicle cruise control- speed control-anti-locking braking system-electronic suspension - electronic steering , wiper control ; Vehicle system schematic for interfacing with EMS,ECU. Energy Management system for electric vehicles- for sensors, accelerators, brake-Batterymanagement, Electric Vehicles-Electrical loads, power management system-electrically assisted power steering system.

UNIT IV AUTOMOTIVE TELEMATICS 9

Role of Bluetooth, CAN, LIN and flex ray communication protocols in automotive applications;Multiplexed vehicle system architecture for signal and data / parameter exchange between EMS,ECUs with other vehicle system components and other control systems; Realizing bus interfaces for diagnostics, dashboard display ,multimedia electronics- Introduction to Society of Automotive Engineers(SAE). J1850 message with (IFR) in frame response in protocol-Local Interconnect n/w [LIN], Bluetooth.

UNIT V ELECTRONIC DIAGNOSTICS FOR VEHICLES 9

System diagnostic standards and regulation requirements –On board diagnosis of vehicles electronic units & electric units-Speedometer, oil and temperature gauges, and audio system.

TOTAL: 45 PERIODS

TEXT BOOKS:

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 CellVehicles",Cengage ,2012
5. Electronic Engine Control technology – Ronald K Jurgen Chilton's guide to Fuel Injection –Ford

REFERENCES:

1. Tom Denton, "Automotive Electricals / Electronics System and Components", 3rd Edition, 2004.

2. Uwe Kiencke, Lars Nielsen, "Automotive Control Systems: For Engine, Driveline, and Vehicle",Springer; 1st edition, March 30, 2000.
3. Automotive Electricals Electronics System and Components, Robert Bosch Gmbh, 4thEdition,2004.
4. Automotive Hand Book, Robert Bosch, Bently Publishers, 1997.
5. Jurgen, R., Automotive Electronics Hand Book.

OUTCOMES:

Upon completion of the course, the student should be able to

1. Design and develop automotive embedded systems.
2. Analyze various embedded products used in the automotive industry.
3. Evaluate the opportunities involving technology, a product or a service required for developing a startup idea used for automotive applications.
4. Understand the diagnostics techniques for electric vehicles.
5. Improved Employability and entrepreneurship capacity due to knowledge upgradation on recent trends in embedded systems design.

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	2	2	1	-	-	-	-	3	2	2
CO2	1	2	2	1	1	1	1	-	-	-	-	2	2	1
CO3	3	3	3	2	2	2	2	-	-	-	-	3	2	2
CO4	2	1	1	1	1	2	1	-	-	-	1	2	2	1
CO5	2	2	2	1	1	1	2	-	-	-	-	2	2	2

PROFESSIONAL ELECTIVES - II

24PESEL306 SDG NO. 4	MACHINE LEARNING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To expose the students to the fundamentals of Machine learning
- To impart the fundamentals of unsupervised learning clustering
- To teach the fundamentals of reinforcement learning.
- To teach the fundamentals of machine learning for IOT applications.
- To design industry applications using machine learning algorithms

UNIT I SUPERVISED LEARNING BASIC METHODS 9

Distance-based methods, Nearest-Neighbours, Decision Trees, Naive Bayes Linear models: Linear Regression, Logistic Regression, Generalized Linear Models Support Vector Machines, Nonlinearity and Kernel Methods beyond Binary Classification.

UNIT II UNSUPERVISED LEARNING CLUSTERING 9

K-means/Kernel K-means Dimensionality Reduction: PCA and kernel PCA Matrix Factorization and Matrix Completion Generative Models (mixture models and latent factor models) Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests).

UNIT III REINFORCEMENT LEARNING 9

Need and specific features of reinforcement learning-Markov decision-Montecorlo prediction-Case study: Next best offer, Dynamic pricing. -Inference in Graphical Models, Introduction to Bayesian Learning and Inference.

UNIT IV MACHINE LEARNING FOR IOT APPLICATIONS 9

Recent trends in various learning techniques of machine learning and classification methods for IOT applications, Introduction to Various models for IOT applications.

UNIT V MACHINE LEARNING APPLICATIONS ACROSS INDUSTRIES 9

Machine Learning Applications across Industries (Healthcare, Manufacturing, Hospitality)-Study on Cloud Based ML offerings.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Kevin Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.
2. Trevor Hastie, Robert Tibshirani, Jerome H. Friedman, "The Elements of Statistical Learning", 2ndEdition, Springer, 2009.

REFERENCES:

1. Shai Shalev-Shwartz , Shai Ben-David, "Understanding Machine Learning: From Theory to Algorithms", Cambridge University Press, 2014.
2. Mehryar Mohri, Afshin Rostamizadeh, "Foundations of Machine learning",The MIT press, Cambridge, 2018.

OUTCOMES:

Upon completion of the course, the student should be able to:

1. Understand the concept of how to learn patterns and concepts from data.
2. Explore unsupervised learning paradigms of machine learning.
3. Understand the specific features of reinforcement learning.
4. Analyze Machine learning in IOT applications.
5. Analyze Machine learning applications across industries.

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	2	3	-	-	-	-	-	1	2	3	2
CO2	2	1	1	1	3	-	-	-	-	-	1	2	3	2
CO3	2	2	2	2	3	-	-	-	-	-	1	2	3	2
CO4	2	2	2	2	3	2	2	-	2	2	1	2	3	2
CO5	2	2	2	2	3	2	2	-	2	2	1	2	3	2

PROFESSIONAL ELECTIVES - II

24PESEL307 SDG NO. 4	ADVANCED EMBEDDED SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To expose the students to the fundamentals of embedded cyber physical modeling
- To teach the fundamentals of system modelling with hardware and software partitioning
- To teach the fundamentals of hardware and software co synthesis
- To teach the fundamentals of concurrent process models and hardware software co-design .
- To get the knowledge of analysis and verification of cyber physical modeling

UNIT I INTRODUCTION TO EMBEDDED CYBER PHYSICAL MODELING **9**

Introduction – Modeling Dynamic Behaviors – Continuous Dynamics – Newtonian Mechanics, Actor Models, Properties of system, Feedback Control – Discrete Dynamics – Discrete systems, The notion of state, Finite-State Machines, Extended State Machines, Non determinism, Behaviors and Traces – Hybrid systems – Modal Models, Classes of Hybrid systems.

UNIT II SYSTEM MODELLING WITH HARDWARE/ SOFTWARE PARTITIONING 9

Embedded systems Hardware/Software Co-Design - System Specification and modeling , Single-processor Architectures &Multi-Processor Architectures, comparison of Co Design Approaches, Models of Computation, Requirements for Embedded System Specification, Hardware/Software Partitioning Problem, Hardware/Software Cost Estimation, Generation of Partitioning by Graphical modeling, Formulation of the HW/SW scheduling, Optimization.

UNIT III HARDWARE/SOFTWARE CO-SYNTHESIS 9

The Co-Synthesis Problem, State - Transition Graph, Refinement and Controller Generation, Distributed System Co-Synthesis.

UNIT IV CONCURRENT PROCESS MODELS AND HARDWARE SOFTWARE CO-DESIGN 9

Modes of operation - Finite state machines models - HCFSL and state charts language – state machine models - Concurrent process model - Concurrent process communication - Synchronization among process - Implementation-Data Flow model - Automation synthesis - Hardware software co-simulation - IP cores - Design Process Model.

UNIT V ANALYSIS AND VERIFICATION OF CYBER PHYSICAL MODELING9

Invariants and Temporal Logic – Invariants, Linear Temporal Logic, Equivalence and Refinement –Models as specifications, Type Equivalence and Refinement, Language Equivalence and Containment, Simulation, Bisimulation.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Edward Ashford Lee and Sanjit Arunkumar Seshia, “Introduction to Embedded Systems - A Cyber-Physical Systems Approach”, 2nd Edition, MIT Press, 2016.
2. David. E. Simon, "An Embedded Software Primer", Pearson Education, 2001.
3. Tammy Noergaard, "Embedded System Architecture, A comprehensive Guide for Engineers and Programmers", Elsevier, 2006
4. Raj Kamal, "Embedded Systems - Architecture, Programming and Design”, Tata McGraw Hill, 2006.

REFERENCES:

1. Frank Vahid and Tony Gwargie, "Embedded System Design", John Wiley & Sons, 2002.

2. Jorgen Staunstrup, Wayne Wolf, "Hardware/Software Co-Design: Principles and Practice", Kluwer Academic Pub, 1997.
3. Giovanni De Micheli, Rolf Ernst Morgon, "Reading in Hardware/Software Co - Design", Kaufmann Publishers, 2001.

OUTCOMES:

Upon completion of the course, the student should be able to:

1. Describe the concepts of embedded cyber physical modeling.
2. Explain the system modeling and partitioning of hardware and software.
3. Analyze the hardware & software co-synthesis and concurrent design process models.
4. Understand the concepts of concurrent process models and hardware software co-design.
5. Understand the analysis and verification of cyber physical modeling.

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	2	3	-	-	-	-	-	1	2	3	2
CO2	2	1	1	1	3	-	-	-	-	-	1	2	3	2
CO3	2	2	2	2	3	-	-	-	-	-	1	2	3	2
CO4	2	2	2	2	3	2	2	-	2	2	1	2	3	2
CO5	2	2	2	2	3	2	2	-	2	2	1	2	3	2

PROFESSIONAL ELECTIVES - III

24PESEL308 SDG NO. 4	RECONFIGURABLE PROCESSOR AND SOC DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the Reconfigurable Processor technologies
- To familiarize the need and role of Reconfigurable Processor for embedded system applications
- To impart the knowledge of Reconfigurable embedded Processor for real time applications
- To discuss about the concepts of reconfigurable SOC processors
- To understand the applications of reconfigurable processors with some examples

UNIT I INTRODUCTION TO RECONFIGURABLE PROCESSOR 9

Introduction to reconfigurable processor- Reconfigurable Computing- Programming elements and Programming Tools for Reconfigurable Processors, ASIC design flow- Hardware/Software Codesign- FPAA Architecture overview- recent trends in Reconfigurable Processor & SoC.

UNIT II PROGRAMMABLE LOGIC DEVICES CPLD 9

Introduction to Programmable logic devices, SPLDs, CPLD building blocks- Architectures and features of Altera:MAX 7000, MAX V- Xilinx XC 9500, CoolRunner-II.

UNIT III PROGRAMMABLE LOGIC DEVICES FPGA 9

FPGA architecture overview- Challenges of FPGA processor design- Opportunities of FPGA processor design- Designing SoftCore Processors – Designing Hardcore Processors –hardware/software co simulation- FPGA to multi core embedded computing- FPGA based on-board computer system.

UNIT IV RECONFIGURABLE SOC PROCESSORS 9

SoC Overview –Architecture and applications of Xilinx Virtex II pro ,Zynq-7000, Altera Excalibur, Cyclone V -Triscend A7, E5- Atmel FPSLIC- Multicore SoCs.

UNIT V RECONFIGURABLE PROCESSOR AND SOC APPLICATIONS 9

Reconfigurable processor based DC motor control- digital filter design- mobile phone development- High Speed Data Acquisition -Image Processing application-controller implementation for mobile robot.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Nurmi, Jari (Ed.), "Processor Design System-On-Chip Computing for ASICs and FPGAs", Springer, 2007.
2. Ian Grout ,"Digital system design with FPGAs and CPLDs", Elsevier, 2008.

REFERENCES:

1. Joao Cardoso, Michael Hübner, "Reconfigurable Computing: From FPGAs to Hardware/Software Codesign" Springer, 2011.
2. Ron Sass and Anderew G.Schmidt, " Embedded System design with platform FPGAs: Principles and Practices", Elsevier, 2010.
3. Steve Kilts, "Advanced FPGA Design: Architecture, Implementation, and Optimization" , Willey, 2007

OUTCOMES:

Upon completion of the course, the student should be able to

1. Understand Adaptability, in its complete strength, present in reconfigurable processors, which makes it an important IP in modern System-on-Chips (SoCs).
2. Platform across embedded, general-purpose, and high-performance application domains during the last decade.
3. Acquire knowledge about reconfigurable SOC processors and its importance.
4. Design embedded systems for specific applications using reconfigurable processors.
5. Improved Employability and entrepreneurship capacity due to knowledge upgradation on recent trends in embedded systems design.

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	1	3	2	-	1	-	1	2	2	2
CO2	3	2	1	2	3	1	2	-	1	-	1	2	2	1
CO3	2	2	2	3	1	1	1	-	2	-	2	2	2	1
CO4	2	2	3	1	2	2	1	-	3	-	2	1	2	2
CO5	2	2	2	1	1	2	3	-	3	-	2	1	2	2

PROFESSIONAL ELECTIVES - III

24PESEL309 SDG NO. 4	EMBEDDED WIRELESS SENSOR NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To discuss the overview of wireless sensor networks
- To familiarize the architecture of different networks
- To get knowledge about various physical layer and mac protocols
- To acquire knowledge about different types of smart sensors used for designing the embedded system
- To know about the implementation of protocols on WSN in various applications

UNIT I OVERVIEW OF WIRELESS SENSOR NETWORKS 9

Challenges for Wireless Sensor Networks - Characteristics requirements - Required mechanisms, Difference between mobile ad-hoc and sensor networks- Enabling Technologies for Wireless Sensor Networks.Single-Node Architecture - Hardware Components - Energy Consumption Sensor Nodes Operating Systems and Execution Environments - Sensor node Examples: EYES, MICA, MICAZ motes.

UNIT II NETWORK ARCHITECTURE 9

Sensor Network Scenarios – Optimization goals and Figure of Merit – Design principles for WSNs – Gateway concepts.

UNIT III PHYSICAL LAYER AND MAC PROTOCOLS 9

Wireless Channel and communication fundamentals – Physical layer and transceiver design considerations in WSN – Fundamentals of MAC Protocols- Low duty cycle protocols and wakeup concepts – Contention based protocols - Schedule based protocols – IEEE 802.15.4 MAC protocol.

UNIT IV SMART SENSORS 9

Introduction to Smart Sensors – Signal Conditioning Circuits – Architecture of Smart Sensors Humidity Sensors – Soil Moisture Sensors– Temperature Sensors – Color Sensors – LevelSensors.

UNIT V APPLICATIONS AND PROTOCOL IMPLEMENTATION ON WSN 9

Home control - Medical Applications - Civil and Environmental Engineering applications – Wildfire monitoring - Habitat monitoring. Embedding LEACH

protocol on ARM7 TDM microcontroller using embedded C language - Embedding Cryptographic algorithms on ARM 7 TDM microcontroller using embedded C language – FPGA based customizable event driven architecture.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Feng Zhao & Leonidas J. Guibas, "Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.
2. KazemSohraby, Daniel Minoli, & TaiebZnati, "Wireless Sensor Networks-Technology, Protocols and Applications", John Wiley, 2012.
3. Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2003.

REFERENCES:

1. Bhaskar Krishnamachari, "Networking Wireless Sensors", Cambridge Press, 2005.
2. Mohammad Ilyas and Imad Mahgaob, "Handbook of Sensor Networks: Compact Wireless and Wired Sensing Systems", CRC Press, 2005.

OUTCOMES:

Upon completion of the course, the students should be able to

1. Explain the basics of wireless sensor networks.
2. Discuss about the sensor network components, architecture and design principles of WSN.
3. Explain the need of Physical layer design challenges and MAC Protocols.
4. Design the Smart Sensors and Applications of WSN.
5. Improved Employability and entrepreneurship capacity due to knowledge upgradation on recent trends in embedded systems design.

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	1	2	-	-	-	2	-	2	2	1
CO2	2	2	2	1	1	2	-	-	-	2	-	2	2	1
CO3	2	2	2	2	1	1	-	-	-	2	-	2	2	1
CO4	2	2	2	1	1	2	-	-	-	-	-	2	2	1
CO5	2	1	1	1	2	2	-	-	-	-	-	2	2	1

PROFESSIONAL ELECTIVES - III

24PESEL310 SDG NO. 4	PROTOCOLS AND ARCHITECTURES FOR WIRELESS SENSOR NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To discuss the architecture of wireless sensor networks
- To familiarize about physical layers
- To get knowledge about various Mac and link protocols
- To acquire knowledge about different types of routing protocols
- To know about the implementation of infrastructure establishment

UNIT I ARCHITECTURE **9**

Challenges for Wireless Sensor Network-Single node architecture - Energy consumption of sensor nodes-Some examples of sensor nodes-Sensor network scenarios-Optimization goals and figure of merit-Gateway concepts.

UNIT II PHYSICAL LAYER **9**

Frequency allocation - Modulation and Demodulation-Wave propagation effects and noise - Channel models-Energy usage profiles-Choice of modulation scheme-Dynamic modulation scaling.

UNIT III MAC AND LINK PROTOCOLS **9**

Fundamentals of MAC protocols-Low duty cycle protocol and wakeup concepts-Contention based protocols-Schedule based protocols-IEEE 802.15.4 MAC protocols-Error control protocols.

UNIT IV ROUTING PROTOCOLS **9**

Gossiping and agent based unicast forwarding – Energy efficient unicast – Broad cast and multicast – Geographic routing – Mobile nodes.

UNIT V INFRASTRUCTURE ESTABLISHMENT **9**

Topology control – clustering – Time synchronization – Localization and positioning sensor – Tasking and control – Medical and health care – Environmental disaster monitoring.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Holger Karl & Andreas Willig, "Protocols And Architectures for Wireless Sensor Networks", John Wiley, 2005.
2. Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003.

3. Bhaskar Krishnamachari, "Networking Wireless Sensors", Cambridge Press, 2005.

REFERENCES:

1. Mohammad IlyasAndImadMahgaob, "Handbook of Sensor Networks: Compact Wireless and Wired Sensing Systems", CRC Press, 2005.
2. Wayne Tomasi, "Introduction to Data Communication and Networking", Pearson Education, 2007.

OUTCOMES:

Upon completion of the course, the student should be able to

1. Understand the architecture of wireless sensor networks.
2. Discuss about different physical layers.
3. Explain the MAC and link protocols.
4. Knowledge about link protocols used for wireless sensor networks.
5. Improved Employability and entrepreneurship capacity due to knowledge upgradation on recent trends in embedded systems design.

CO – PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	2	-	1	-	2	-	2	1	2
CO2	2	1	-	-	-	2	-	1	-	2	-	2	1	2
CO3	2	1	-	-	-	2	-	1	-	2	-	2	1	2
CO4	2	1	-	-	-	2	1	1	-	2	-	2	1	2
CO5	2	1	-	-	-	2	2	1	-	2	-	2	1	2

PROFESSIONAL ELECTIVES - III

24PESEL311 SDG NO. 4	DIGITAL IMAGE PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- The fundamentals of image processing
- The techniques involved in image enhancement
- The low and high-level features for image analysis
- The fundamentals and significance of image compression
- The hardware for image processing applications

UNIT I FUNDAMENTALS OF IMAGE PROCESSING 9

Introduction to image processing systems, sampling and quantization, color fundamentals and models, image operations – arithmetic, geometric and morphological. Multi-resolution analysis –image pyramids

UNIT II IMAGE ENHANCEMENT 9

Spatial domain; Gray-level transformations – histogram processing – spatial filtering, smoothing and sharpening. Frequency domain: filtering in frequency domain – DFT, FFT, DCT – smoothing and sharpening filters – Homomorphic filtering. Image enhancement for remote sensing images and medical images.

UNIT III IMAGE SEGMENTATION AND FEATURE ANALYSIS 9

Detection of discontinuities – edge operators – edge linking and boundary detection, thresholding –feature analysis and extraction – region based segmentation – morphological watersheds – shape skeletonization, phase congruency. Number plate detection using segmentation algorithm.

UNIT IV IMAGE COMPRESSION 9

Image compression: fundamentals – models – elements of information theory – error free compression – lossy compression – compression standards. Applications of image compression techniques in video and image transmission.

UNIT V EMBEDDED IMAGE PROCESSING 9

Introduction to embedded image processing. ASIC vs FPGA - memory requirement, power consumption, parallelism. Design issues in VLSI implementation of Image processing algorithms -interfacing. Hardware implementation of image processing algorithms: Segmentation and compression.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Rafael C. Gonzalez and Richard E. Woods, "Digital Image processing", 2nd edition, Pearson Education, 2003.
2. Anil K. Jain, "Fundamentals of digital image processing", Pearson education, 2003.
3. Milan Sonka, Vaclav Hlavac and Roger Boyle, "Image processing, analysis and machine vision", 2nd Edition, Thomson learning, 2001.

REFERENCES:

1. Mark Nixon and Alberto Aguado, "Feature extraction & Image processing for computer vision", 3rd Edition, Academic press, 2012
2. Donald G. Bailey, "Design for Embedded Image processing on FPGAs" John Wiley and Sons, 2011.

WEB RESOURCES:

1. https://nptel.ac.in/courses/117105079/
2. https://swayam.gov.in/nd1_noc19_ee55/preview

OUTCOMES:

Upon completion of the course, the student should able to

1. Understand Fundamentals of image processing.
2. Know the techniques involved in image enhancement.
3. Explain image segmentation and feature analysis.
4. Understand the techniques of image compression and their real-time applications.
5. The implementation of image processing applications using software and hardware.

CO – PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	2	-	-	-	-	-	1	3	2
CO2	3	3	3	3	3	2	-	-	-	-	-	1	3	2
CO3	3	3	3	3	3	2	-	-	-	-	-	1	3	2
CO4	3	2	3	3	3	2	-	-	-	-	-	1	3	2
CO5	2	3	3	3	3	2	-	-	-	-	-	1	3	3

PROFESSIONAL ELECTIVES - III

24PESEL312 SDG NO. 4	SOFT COMPUTING AND OPTIMIZATION TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the fundamental concepts of soft computing, artificial neural networks and optimization techniques
- To familiarize with recent advancements in Artificial neural networks techniques
- To expose fundamentals of fuzzy logic and neuro fuzzy systems
- To familiarize with recent advancements in optimization techniques from fundamental
- To design improved embedded systems with advanced optimization techniques

UNIT I INTRODUCTION TO SOFT COMPUTING AND NEURAL NETWORKS **9**

Introduction to soft computing: soft computing vs hard computing – various types of soft computing techniques, from conventional AI to computational intelligence, applications of soft computing. Fundamentals of neural network: biological neuron, artificial neuron, activation function, single layer perceptron – limitations. Multi-layer perceptron – back propagation algorithm.

UNIT II ARTIFICIAL NEURAL NETWORKS **9**

Radial basis function networks – reinforcement learning. Hopfield / recurrent network – configuration – stability constraints, associative memory and characteristics, limitations and applications. Hopfield vs Boltzmann machine. Advances in neural networks – convolution neural networks. Familiarization of Neural network toolbox.

UNIT III FUZZY LOGIC AND NEURO FUZZY SYSTEM **9**

Fundamentals of fuzzy set theory: fuzzy sets, operations on fuzzy sets, scalar cardinality, union and intersection, complement, equilibrium points, aggregation, projection, composition. Fuzzy membership functions. Fundamentals of neuro-fuzzy systems – ANFIS. Introduction to ANFIS Toolbox.

UNIT IV INTRODUCTION TO OPTIMIZATION TECHNIQUES **9**

Classification of optimization problems – classical optimization techniques. Linear programming – simplex algorithm. Non-linear programming – steepest

descent method, augmented Lagrange multiplier method – equality constrained problems.

UNIT V ADVANCED OPTIMIZATION TECHNIQUES 9

Simple hill climbing algorithm, Steepest ascent hill climbing – algorithm and features. Simulated annealing – algorithm and features. Genetic algorithm: working principle, fitness function. Familiarization with Optimization Toolbox.

Note: Classroom discussions and tutorials can include the following guidelines for improved teaching /learning process: Discussions/Practice on Workbench: on role of Fuzzy, Neural ,Genetic algorithms and Concepts in design of intelligent systems.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Laurene V. Fausett, "Fundamentals of neural networks, architecture, algorithms and applications", Pearson Education, 2008.
2. Jyh-Shing Roger Jang, Chuen-Tsai Sun, EijiMizutani, "Neuro-Fuzzy and soft computing", Prentice Hall of India, 2003.
3. Simon Haykin, "Neural Networks – A comprehensive foundation", Pearson Education, 2005.

REFERENCES:

1. David E. Goldberg, "Genetic algorithms in search, optimization and machine learning", Pearson Education, 2009.
2. Singiresu S. Rao, "Engineering Optimization – Theory and Practice", 4th edition, John Wiley & Sons, 2009.
3. Thomas Weise, "Global Optimization algorithms – Theory and applications", self-published, 2009.

OUTCOMES:

Upon completion of the course, the student should be able to

1. Comprehend the fundamentals of artificial neural network.
2. Design fuzzy systems and optimization techniques.
3. Understand the significance of various optimization algorithms applied to engineering problems.
4. Be capable of developing ANN-based models.
5. Be capable of choosing appropriate optimization techniques for engineering applications.

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	2	1	-	-	-	-	-	1	2	3	2
CO2	2	1	1	1	3	-	-	-	-	-	1	2	3	2
CO3	2	2	2	2	3	-	-	-	-	-	1	2	3	2
CO4	2	2	2	2	3	-	-	-	-	-	1	2	3	2
CO5	2	2	2	2	3	-	-	-	-	-	1	2	3	2

PROFESSIONAL ELECTIVES - III

24PESEL313 SDG NO. 4	ANALYSIS AND MODELING OF DIGITAL SYSTEM USING VHDL	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To expose the students to the fundamentals of VHDL programming
- To teach the fundamentals of composite data types and basic modelling constructs
- To teach how to write programs subprograms
- To teach the fundamentals of signals, components and configurations
- To get the knowledge of abstract data types and files

UNIT I VHDL FUNDAMENTALS 9

Fundamental Concepts – Modeling Digital Systems – Domains and Levels of Modeling – Modeling Languages – VHDL Modeling concepts – Scalar Data Types and Operations – Constants and variables – Scalar Types – Type Classification – Attributes and Scalar types – Expressions and operators – Sequential Statements – If statements – Case statements – Null Statements – Loop statements – Assertion and Report statements.

UNIT II COMPOSITE DATA TYPES AND BASIC MODELING CONSTRUCTS 9

Arrays – Unconstrained Array types – Array Operations and Referencing – Records – Basic Modeling Constructs –Entity Declarations – Architecture Bodies – Behavioral Descriptions – Structural Descriptions – Design Processing. Case Study: A pipelined Multiplier Accumulator.

UNIT III SUBPROGRAMS AND PACKAGES 9

Procedures – Procedure Parameters – Concurrent Procedure Call Statements –

functions – Overloading – Visibility of Declarations – Packages and Use Clauses – Package declarations – Package bodies – Use Clauses – The predefined – Aliases - Aliases for data objects – Aliases for Non-Data Items.

UNIT IV SIGNALS, COMPONENTS AND CONFIGURATIONS 9

Basic Resolved signals – IEEE Std_Logic_1164 Resolved subtypes – Resolved signal parameters – Generic Constants – Parameterizing behavior – Parameterizing structure – Components and Configurations – Components –Configuring component Instances – Configuration Specification – Generate Statements – generating iterative structure –Conditionally generating structures – Configuration of generate Statements. Case Study: The DLX Computer System.

UNIT V ADTS AND FILES. 9

Access Types – Linked Data structures – Abstract Data Types using Packages – Files and Input/Output – Files – The Package Textio – Verilog. Case Study: Queuing Networks.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Peter J.Ashenden, "The Designer's Guide to VHDL", Morgan Kaufmann Publishers, San Francisco, Second Edition, 2001.

REFERENCES:

1. Zainalabedin Navabi, "VHDL Analysis and Modeling of Digital Systems", Mc Graw Hill International Editions, 2nd Edition, 1998.
2. James M.Lee, "Verilog Quick start", Kluwer Academic Publishers, 2nd Edition, 1999.

OUTCOMES:

Upon completion of the course, the student should be able to

1. Understand the basics of VHDL programming.
2. Develop programs using VHDL for various applications.
3. Understand the use of packages and develop subprograms.
4. Know about signals, components and configurations.
5. Get knowledge about Abstract Data Types files and its usages.

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	2	1	2	-	-	-	2	2	2	2
CO2	2	2	3	2	2	1	2	-	-	-	3	2	2	2
CO3	2	2	1	2	3	2	2	-	-	-	2	2	2	2
CO4	3	2	2	3	3	2	2	-	-	-	2	2	2	1
CO5	2	3	2	1	2	2	2	-	-	-	2	2	2	2

PROFESSIONAL ELECTIVES - III

24PESEL314 SDG NO. 4	BLUETOOTH TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide an insight into the bluetooth technology
- To familiarize with the steps required for bluetooth radio and networking
- To design connection establishment procedure
- To understand about the hardware for bluetooth implementation
- To design bluetooth communication for different applications

UNIT I INTRODUCTION **9**

Introduction to Wireless technologies: WAP services, serial and parallel Communication, Asynchronous and synchronous communication, EDM, TFM, Spread spectrum technology. Introduction to Bluetooth: Specification, core protocols, cable replacement protocol.

UNIT II BLUETOOTH RADIO AND NETWORKING **9**

Bluetooth Radio: Type of Antenna, Antenna Parameters, Frequency hopping Bluetooth Networking: Wireless networking, Wireless network types, devices roles and states, adhoc network, scatter net.

UNIT III CONNECTION ESTABLISHMENT PROCEDURE **9**

Connection establishment procedure, notable aspects of connection establishment, Mode of connection, Bluetooth Security, Security architecture, Security level of services, profile and usage model: Generic access profile(GAP), SDA, serial profile, Secondary Bluetooth profile.

UNIT IV HARDWARE **9**

Hardware: Bluetooth implementation, Baseband overview, packet format, Transmission buffers, Protocol implementation: link manager protocol, logical link control Adaptation protocol, Host control interface, protocol interaction with layers

UNIT V APPLICATIONS **9**

Programming with Java: Java Programming, J2ME architecture, Javax, Bluetooth package interface, classes, exceptions, Javax. obex package: interfaces, classes, Bluetooth services overview of IRDA, Home RF, Wireless LANs, JINI.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. C.S.R.Prabhu and A.P.Reddi, "Bluetooth Technology", Prentice Hall of India, 2004.

REFERENCES:

1. Charles. Pfleeger, "Security in computing", Prentice Hall, 2003.
2. Andreas F.Molisch, "Wideband wireless Digital Communication", Prentice Hall PTR, 2001.
3. George.V.Toulouse, "Adaptive Antennas for wireless Communication", IEEE Press, 2001.

WEB RESOURCES:

1. https://nptel.ac.in/content/storage2/courses/106105080/pdf/M5L8.pdf
2. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/106105193/lec35.pdf
3. https://www.classcentral.com/course/edx-real-time-bluetooth-networks-shape-the-world-6494

OUTCOMES:

Upon completion of the course, the student should be able to

1. Understand the concept of bluetooth technology.
2. Analyse bluetooth radio and networking.
3. Understand connection establishment procedure.
4. Get knowledge about hardware required for bluetooth technology.
5. Design a bluetooth communication for different applications.

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	2	1	-	-	-	-	-	1	3	1
CO2	2	2	2	2	2	1	-	-	-	-	-	1	2	1
CO3	3	3	2	2	2	1	-	-	-	-	-	1	2	1
CO4	3	2	3	3	3	2	-	-	-	-	-	1	2	2
CO5	3	3	3	3	3	3	-	-	-	-	-	2	2	2

PROFESSIONAL ELECTIVES - IV

24PESEL315 SDG NO. 4	WIRELESS AND MOBILE COMMUNICATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To expose the students to the fundamentals of wireless communication technologies
- To teach the fundamentals of wireless mobile network protocols
- To study on wireless network topologies
- To introduce network routing protocols
- To study the basis for classification of commercial family of wireless communication technologies

UNIT I INTRODUCTION **9**

Wireless Transmission – signal propagation – Free space and two ray models – spread spectrum – Satellite Networks – Capacity Allocation – FDMA –TDMA-SDMA – DAMA

UNIT II MOBILE NETWORKS **9**

Cellular Wireless Networks – GSM – Architecture – Protocols – Connection Establishment – Frequency Allocation – Handover – Security – GPRA.

UNIT III WIRELESS NETWORKS **9**

Wireless LAN – IEEE 802.11 Standard-Architecture – Services – Hiper LAN, Bluetooth

UNIT IV ROUTING **9**

Mobile IP- SIP – DHCP – AdHoc Networks – Proactive and Reactive Routing Protocols – Multicast Routing - WSN routing – LEACH- SPIN- PEGASIS.

UNIT V TRANSPORT AND APPLICATION LAYERS **9**

TCP over Adhoc Networks – WAP – Architecture – WWW Programming Model – WDP – WTLS – WTP – WSP – WAE – WTA Architecture – WML – WML scripts.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Kaveh Pahlavan, Prasanth Krishnamoorthy, "Principles of Wireless Networks" PHI/Pearson Education, 2003
2. C. Siva Ram Murthy and B.S. Manoj, "AdHoc Wireless Networks: Architectures and protocols", Prentice Hall PTR, 2004
3. Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, " Principles of Mobile computing", Springer, New york, 2003.
4. C.K.Toh, " AdHoc mobile wireless networks", Prentice Hall, Inc, 2002.

REFERENCES:

1. Charles E. Perkins, "Adhoc Networking", Addison-Wesley, 2001.
2. Jochen Schiller, "Mobile communications", PHI/Pearson Education, Second Edition, 2003.
3. William Stallings, "Wireless communications and Networks", PHI/Pearson Education, 2002.

WEB RESOURCES:

1. www.nptel.ac.in/courses/117102062
2. nptel.ac.in/courses/117104099
3. swayam.gov.in/nd1_noc19_ee48/preview

OUTCOMES:

Upon completion of the course, the student should be able to

1. Knowledge of basic and advanced theories on wireless communications systems in physical, link and network layer.
2. Ability to understand, model, and design mobile networks.
3. Ability to understand and apply mathematical model in wireless communications.
4. Wireless communication transceiver algorithm design.
5. Mobile system design methodology, link level simulation for wireless communications.

CO – PO, PSO MAPPING :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	2	2	1	-	-	-	-	-	-	2	1	1
CO2	1	1	2	1	1	-	-	-	-	-	-	1	1	2
CO3	1	1	1	1	1	-	-	-	-	-	-	2	1	2
CO4	2	2	1	2	2	-	-	-	-	-	-	1	1	1
CO5	2	2	2	2	2	-	-	-	-	-	-	1	1	2

PROFESSIONAL ELECTIVES - IV

24PESEL316 SDG NO. 4	ELECTRIC VEHICLES AND POWER MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concept of electrical vehicles and its operations
- To understand the need for energy storage in hybrid vehicles
- To provide knowledge about various possible energy storage technologies that can be used in electric vehicles
- To get knowledge about control of DC and AC drives
- To understand the need and concept of alternative energy storage systems

UNIT I ELECTRIC VEHICLES AND VEHICLE MECHANICS 9

Electric Vehicles (EV), Hybrid Electric Vehicles (HEV), Engine ratings, Comparisons of EV with internal combustion Engine vehicles, Fundamentals of vehicle mechanics

UNIT II ARCHITECTURE OF EV's AND POWER TRAIN COMPONENTS 9

Architecture of EV's and HEV's – Plug-n Hybrid Electric Vehicles (PHEV)- Power train components and sizing, Gears, Clutches, Transmission and Brakes

UNIT III CONTROL OF DC AND AC DRIVES 9

DC/DC chopper based four quadrant operations of DC drives – Inverter based V/f Operation (motoring and braking) of induction motor drive system – Induction motor and permanent motor based vector control operation –

Switched reluctance motor (SRM) drives

UNIT IV BATTERY ENERGY STORAGE SYSTEM 9

Battery Basics, Different types, Battery Parameters, Battery modeling, Traction Batteries.

UNIT V ALTERNATIVE ENERGY STORAGE SYSTEMS 9

Fuel cell – Characteristics- Types – hydrogen Storage Systems and Fuel cell EV – Ultra capacitors

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Iqbal Hussain, "Electric and Hybrid Vehicles: Design Fundamentals, Second Edition" CRC Press, Taylor & Francis Group, Second Edition (2011).
2 Ali Emadi, Mehrdad Ehsani, John M.Miller, "Vehicular Electric Power Systems", Special Indian Edition, Marcel dekker, Inc 2010.

REFERENCES:

1. Chakrabarti A "Energy Engineering and Management"
2. GKP, " Coal India Limited Management Trainee Electrical Engineering 2017"
3. K V Sharma and P Venkataseshaiah "Energy Management and Conservation".
4. John Lowry and James Larminie, "Electric Vehicle Technology Explained"
5. Mehrdad Ehsani and Yimin Gao, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory and Design", Second Edition (Power Electronics and Applications Series)

ONLINE RESOURCES

1. https://nptel.ac.in/courses/108103009/
2. https://www.hindawi.com/journals/acisc/2018/2846748/
3. https://www.energy.gov/eere/electricvehicles/electric-vehicle-basics
4. https://www.iedconline.org/clientuploads/Downloads/edrp/IEDC_Electric_Vehicle_Industry.pdf

OUTCOMES:

Upon completion of the course, the student should be able to

1. Knowledge of basic and advanced theories on electric vehicles and vehicle mechanics.
2. Ability to understand architecture of electric vehicle and power train components.
3. Ability to understand control of AC and DC drives.

4. Understand possible energy storage for electric vehicles.
5. Knowledge of alternative energy storage systems design.

CO – PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	3	2	3	3	3	2	3	2	3	3	3	3
CO2	3	1	3	2	3	3	3	2	3	2	3	3	3	3
CO3	3	1	3	2	3	3	3	2	3	2	3	3	3	3
CO4	3	1	3	2	3	3	3	2	3	2	3	3	3	3
CO5	3	1	3	2	3	3	3	2	3	2	3	3	3	3

PROFESSIONAL ELECTIVES - IV

24PESEL317 SDG NO. 4	SMART GRID	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To get knowledge in the concepts of smart grids
- To Study about Smart Grid technologies and its advancements
- To understand the design of different smart meters and advanced metering infrastructure
- To familiarize the power quality management issues in Smart Grid
- To familiarize the high performance computing for Smart Grid applications

UNIT I INTRODUCTION TO SMART GRID 9

Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid, National and International Initiatives in Smart Grid.

UNIT II SMART GRID TECHNOLOGIES 9

Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation ,Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and control, Distribution systems: DMS, Volt/ Var control, Fault Detection, Isolation and service restoration, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers, Plug in Hybrid Electric Vehicles (PHEV).

UNIT III SMART METERS AND ADVANCED METERING INFRASTRUCTURE 9

Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit(PMU), Intelligent Electronic Devices (IED) & their application for monitoring & protection.

UNIT IV POWER QUALITY MANAGEMENT IN SMART GRID 9

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

UNIT V HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS 9

Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), IP based Protocols, Basics of Web Service and CLOUD Computing to make Smart Grids smarter, Cyber Security for Smart Grid.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Stuart Borlase "Smart Grid :Infrastructure, Technology and Solutions", CRC Press 2012.
2 Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", Wiley 2012.

REFERENCES:

1. Vehbi C. Güngör, DilanSahin, TaskinKocak, Salih Ergüt, Concettina Buccella, Carlo Cecati, and Gerhard P. Hancke, "Smart Grid Technologies: Communication Technologies and Standards" IEEE Transactions On Industrial Informatics, Vol. 7, No. 4, November 2011.
2. Xi Fang, Satyajayant Misra, Guoliang Xue, and Dejun Yang "Smart Grid – The New and Improved Power Grid: A Survey", IEEE Transaction on Smart Grids, vol. 14, 2012.

ONLINE RESOURCES

1. https://www.smartgrid.gov/
2. https://www.edx.org/professional-certificate/delftx-smart-grids-integration-and-modeling
3. https://www.ctc-n.org/technologies/smart-grid
4. https://www.mdpi.com/2571-5577/3/1/5/htm

OUTCOMES:

Upon completion of the course, the student should be able to:

1. Develop more understanding on the concepts of Smart Grid and its present developments.
2. Study about different Smart Grid technologies.
3. Acquire knowledge about different smart meters and advanced metering infrastructure.
4. Understand power quality management in Smart Grids.
5. Develop more understanding on LAN, WAN and Cloud Computing for Smart Grid applications.

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	3	1	-	-	3	1	-	3	3	3
CO2	3	3	3	3	3	3	3	1	3	1	3	3	3	3
CO3	3	3	3	3	3	3	3	1	3	1	3	3	3	3
CO4	3	3	3	3	3	3	3	1	3	1	3	3	3	3
CO5	3	3	3	3	3	3	3	1	3	1	3	3	3	3

PROFESSIONAL ELECTIVES - IV

24PESEL318 SDG NO. 4	EMBEDDED NETWORKING AND AUTOMATION OF ELECTRICAL SYSTEM	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To expose the students to the fundamentals of wired embedded networking techniques
- To expose the students to the fundamentals of wireless embedded networking
- To study on design of automation in instrumentation
- To introduce design of Programmable measurement & control of electrical Devices & grid
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

UNIT I EMBEDDED PROCESS COMMUNICATION WITH INSTRUMENT BUS 9

Embedded Networking: Introduction – Cluster of Instruments in System: introduction to bus protocols, connectors, Bus Architecture & Interfacing of external instruments to – RS 232C, RS – 422, RS 485 and USB standards – embedded Ethernet – MOD bus and CAN bus.

UNIT II WIRELESS EMBEDDED NETWORKING 9

Wireless sensor networks – Introduction – Sensor node architecture – Commercially available sensor nodes -Network Topology –Localization –Time Synchronization - Energy efficient MAC protocols – SMAC –Energy efficient and robust routing – Data Centric routing Applications of sensor networks; Applications - Home Control - Building Automation - Industrial Automation.

UNIT III BUILDING SYSTEM AUTOMATION 9

Concept of UC Based & PC based data acquisition – Concept of Virtual Instrumentation -Programming Environment to build a Virtual Instrumentation, Building system automation with graphical user interface programming-Programmable Logic Controllers-introduction-Ladder & Functional Block programming-Case study on Temperature control, Valve sequencing control.

UNIT IV MEASUREMENT AND EMBEDDED CONTROL OF ELECTRICAL APPARATUS 9

Sensor Types & Characteristics: Sensing Voltage, Current, flux, Torque, Position, Proximity, Force, Data acquisition & Display system- Signal conditioning circuit design- computers/ embedded processor interfacing circuit -design automation and protection of electrical appliances –processor based digital controllers for switching Actuators: Servo motors, Stepper motors, Relays.

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 for substation automation, extended control feeder automation, Performance measure and response time, SCADA Data Models, need, sources, interface.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. "Control and automation of electrical power distribution systems", James Northcote-Green, Robert Wilson, CRC, Taylor and Francis, 2006

2. Krzysztof Iniewski, "Smart Grid , Infrastructure & Networking", TMcGH,2012
3. Robert Faludi, "Building Wireless Sensor Networks", O'Reilly,2011
4. W.Bolton, "Programmable Logic Controllers", 5th Ed,Elseiver,2010.
5. Shih-Lin Wu, Yu-Chee Tseng, "Wireless Ad Hoc Networking, PAN, LAN, SAN", Aurebach Pub,2012.

REFERENCES:

1. Jan Axelson, "Embedded Ethernet and Internet Complete", Penram publications.
2. Bhaskar Krishnamachari, "Networking wireless sensors", Cambridge press 2005.
3. Robert H. Bishop, "Learning with Lab-View", Preticee Hall, 2009.
4. Sanjay Gupta, "Virtual Instrumentation, LABVIEW", TMH, New Delhi, 2003.
5. Ernest O. Doeblin and Dhanesh N Manik, " Measrement Systems – Application and Design", 5th Edn, TMH, 2007.

OUTCOMES:

Upon completion of the course, the student should be able to

1. Understand about embedded process communication with instruments.
2. Design wireless embedded networking for different applications.
3. Design automation for building systems.
4. Understand about the concepts Measurement And Embedded Control Of Electrical Apparatus.
5. Understand and design Communication For Large Electrical System Automation.

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	2	-	-	-	-	-	-	1	2	3	2
CO2	2	1	1	1	-	-	-	-	-	-	1	2	3	2
CO3	2	2	1	1	-	-	-	-	-	-	1	2	3	2
CO4	2	2	2	2	3	2	2	-	2	2	1	2	3	2
CO5	2	2	2	2	3	2	2	-	2	2	1	2	3	2

PROFESSIONAL ELECTIVES - IV

24PESEL319 SDG NO. 4	NANO ELECTRONICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the properties of electron and its implication for electronics
- To teach the importance and the issues of Nanoscale CMOS technology
- To introduce the characteristics and applications of Nano electronic devices, Nano fabrication methods and techniques
- To teach the circuits and architectural features of Nano memory devices
- 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 NANO ELECTRONICS 9

Particles, waves, Wave mechanics, schrodinger equation, free and confined electrons, particle statistics and density of states. Electron transport in semiconductors and nanostructures, Quantum dots, Quantum Well, Quantum wire , materials and its properties, Ballistic electron transport, 1D transport , Spin electronics- Electrical and Electronics Applications of Nanotechnology.

UNIT II NANOSCALE CMOS 9

Survey of modern electronics and trends towards nano electronics CMOS scaling, challenges and limits, static power, device variability, interconnect - CNT-FET, HEMT, pHEMT FinFET, FerroFET nanoscale CMOS circuit design and analysis.

UNIT III NANOELECTRONIC STRUCTURE AND DEVICES 9

Resonant-tunneling diodes- Resonant Tunneling Transistor-Single-electron transfer devices-Potential effect transistors- Quantum-dot cellular automata, Nano Photonic Devices-Molecular electronic devices -Nano-electromechanical system devices.

UNIT IV NANOELECTRONIC MEMORIES 9

Nano tube for memories- Nano RAM- Nanoscale DRAM, SRAM, Tunnel magnetoresistance-Giant magneto resistance- design and applications.

UNIT V FABRICATION TECHNIQUES 9

Clean room standards-Microfabrication-nanofabrication-nanofabrication issues- E-beam lithography- X-ray and ion-beam lithography-nanoimprint

lithography- Scanning probe lithography- dip-pen nanolithography- Nano-characterization techniques.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Hagelstein, Peter L., Stephen D. Senturia and Terry P. Orlando, "Introduction to Applied Quantum and Statistical Physics.", New York, NY: Wiley, 2004.
2. Rainer Waser, "Nanoelectronics and Information Technology", Wiley 2005
3. Michael A. Nielsen and Isaac L. Chuang, "Quantum Computation and Quantum Information", Cambridge University Press, 2000.

REFERENCES:

1. Adrian Ionesu and Kaustav Banerjee eds. "Emerging Nano electronics: Life with and after CMOS", Vol I, II, and III, Kluwer Academic, 2005.
2. Kiyoo Itoh Masashi Horiguchi, Hitoshi Tanaka," Ultra Low voltage nano scale memories", Spl Indian Edition, Springer.
3. George W. Hanson, "Fundamental of Nano electronics", Pearson education

WEB REFERENCE:

1. https://nptel.ac.in/courses/118102003/

OUTCOMES:

Upon completion of the course, the student should be able to

1. Understand basic and advanced concepts of Nano electronic devices, sensors and transducers and their applications in nanotechnology.
2. Understand the concepts of a quantum well, quantum transport and tunnelling effects.
3. Understand the impact of Nano electronics onto information technology, communication and computer science.
4. Design integrated circuits (microchip) using state-of-the-art CMOS technology.
5. The learning process delivers insight into categorizing various Nano configurations.

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	1	1	1	-	-	-	2	3	2	1
CO2	3	2	2	2	2	2	1	-	-	-	2	2	2	2
CO3	2	2	2	1	1	2	3	-	-	-	2	2	2	2
CO4	2	2	3	2	2	2	2	-	-	-	2	3	2	3
CO5	1	2	1	2	2	2	2	-	-	-	3	3	1	3

PROFESSIONAL ELECTIVES - IV

24PESEL320 SDG NO. 4	PROGRAMMING IN MATLAB AND LABVIEW	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide an insight into MATLAB
- To familiarize with the steps required programming in MATLAB environment
- To design plots and develop Simulink models
- To understand about the LABVIEW platform
- To understand structures, graphs, file I/O and instrument control for LABVIEW

UNIT I INTRODUCTION TO MATLAB 9

Matlab environment–types of files-constants and variables- Matrices and Vectors, matrix manipulations – Cell Array – Structure Array -Strings – function Script files - Input and Output statements – File input and output – Opening & Closing – Writing & Reading data from files.

UNIT II PROGRAMMING IN MATLAB 9

Arithmetic, Relational and logical operators - Control statements IF, SWITCH CASE, BREAK, CONTINUE –FOR loop – While loop – Matlab Debugger – polynomials.

UNIT III PLOTTING AND SIMULINK 9

Basic 2D plots – modifying line styles – markers and colors – grids – placing text on a plot – Various / Special MatLab 2D plot types – Semilogx – Semilogy – Log Log – Polar – Comet –Multiple Plots-Subplots- Simulink-Simulink

Modelling, Simulating a Model, Data Import/Export, State Space Modeling, Creating Sub-Systems.

UNIT IV INTRODUCTION TO LABVIEW 9

Introduction to Virtual Instrumentation, advantages, architecture of a Virtual Instrument, block diagram, front panel, VIs, loading and saving VIs, debugging techniques, creating sub VIs, loops, shift registers, case structure, flat sequence.

UNIT V STRUCTURES, GRAPHS, FILE I/O AND INSTRUMENT CONTROL 9

Formula node, expression node charts, arrays, clusters and graphs, string, file input output, data acquisition in Labview, instrument control in labview.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Raj kumar Bansal, Ashok kumar Goel, Manoj kumar Sharma, "Matlab and its applications in engineering", Pearson Education, 1st edition, 2009.

REFERENCES:

1. Stephen J.Chapmen, "Matlab Programming for Engineers", Thomson learning, 4th Edition, 2008.
2. Rudra Pratap, "Getting Started with MATLAB", Oxford University press, 2nd Edition, 1999.
3. Jeffrey Travis, Jim Kring, "Labview for Everyone: Graphical Programming Made Easy and Fun", 3rd Edition, 2009

OUTCOMES:

Upon completion of the course, the student should be able to

1. Understand the MATLAB and its programming.
2. Design MATLAB programs for various applications.
3. Develop programs using Simulink and create different plots.
4. Get knowledge about LABVIEW platform.
5. Design programs using LABVIEW software for different applications.

CO – PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	2	-	-	-	-	-	-	1	2	3	2
CO2	2	1	1	1	-	-	-	-	-	-	1	2	3	2
CO3	2	2	1	1	-	-	-	-	-	-	1	2	3	2
CO4	2	2	2	2	3	2	2	-	2	2	1	2	3	2
CO5	2	2	2	2	3	2	2	-	2	2	1	2	3	2

PROFESSIONAL ELECTIVES - IV

24PESEL321 SDG NO. 4	EMBEDDED CONTROL SYSTEMS DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide a clear understanding on the basic concept of embedded control system
- To impart the fundamentals of Real time operating system
- To improve the software and hardware design interface, SPI, RTC interfacing and programming.
- To design and develop a software for embedded control applications and also learn about interfacing using C & C++
- To analyze the real time applications of embedded controller

UNIT I EMBEDDED SYSTEM ORGANIZATION 9

Embedded computing – characteristics of embedded computing applications – embedded system design challenges; Build process for Real-time Embedded system – Selection of processor; Memory; I/O devices-Rs-485, MODEM, Bus Communication system using I2C, CAN, USB buses, 8 bit –ISA, EISA bus;

UNIT II REAL-TIME OPERATING SYSTEM 9

Introduction to RTOS; RTOS- Inter Process communication, Interrupt driven Input and Output -Non maskable interrupt, Software interrupt; Thread – Single, Multithread concept; Multitasking Semaphores.

UNIT III INTERFACE WITH COMMUNICATION PROTOCOL 9

Design methodologies and tools – design flows – designing hardware and

software Interface. – system integration; SPI, High speed data acquisition and interface-SPI read/write protocol.

UNIT IV RTC INTERFACING AND PROGRAMMING 9

Design of Software for Embedded Control Software abstraction using Mealy-Moore FSM controller - Layered software development -Basic concepts of developing device driver – SCI – Software - interfacing & porting using standard C & C++ ; Functional and performance Debugging with benchmarking Real-time system software – Survey on basics of contemporary RTOS – VX Works, UC/OS-II.

UNIT V CASE STUDIES WITH EMBEDDED CONTROLLER 9

Programmable interface with A/D & D/A interface; Digital voltmeter, control-Robot system; PWM motor speed controller, serial communication interface.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Wayne Wolf, "Computers as Components: Principles of Embedded Computer Systems Design", Morgan Kaufmann Publishers, Second Edition, 2008.
2. Raj Kamal, "Embedded Systems- Architecture, Programming and Design", Tata McGrawHill, 2006.
3. Arnold S.Berger, "Embedded Systems Design: An Introduction to Processes, Tools and Techniques", CMP Books, 2002.

REFERENCES:

1. Muhammad Ali Mazidi, Rolin D. Mckinlay, Danny Causey, "PIC Microcontroller and Embedded Systems- Using Assembly and C for PIC18", Pearson Education, 2008.
2. Daniel W. Lewis, "Fundamentals of Embedded Software", Prentice Hall India, 2004.

OUTCOMES:

Upon completion of the course, the student should be able to

1. Understand the basic concept of embedded system such as memory, I/O devices, and bus communication system.
2. Design real time embedded systems using the concepts of RTOS.
3. Explain and design of software for embedded control.
4. Implement the real-time operating system principle.
5. Design simple A/D and D/A interface circuits.

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	2	-	-	-	-	-	-	1	2	3	2
CO2	2	1	1	1	-	-	-	-	-	-	1	2	3	2
CO3	2	2	1	1	-	-	-	-	-	-	1	2	3	2
CO4	2	2	2	2	3	2	2	-	2	2	1	2	3	2
CO5	2	2	2	2	3	2	2	-	2	2	1	2	3	2

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RESPONSIBLE CONSUMPTION AND PRODUCTION will help in healing our planet.

CLIMATE ACTION will reduce global warming and we will have abundant,

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