RAJALAKSHMI ENGINEERING COLLEGE
(AN AUTONOMOUS INSTITUTION AFFILIATED TO ANNA UNIVERSITY)
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

DEPARTMENT VISION AND MISSION

VISION

To be an international centre in education, research and the application of knowledge, to benefit the society globally in the field of Electrical and Electronics Engineering

MISSION

- To impart high quality technical education and develop Electrical and Electronics Engineers with a sound theoretical combined with practical skills in all the areas concerning the discipline.
- To inculcate innovative research capabilities and exemplary professional conduct to lead and to use technology for the progress of our country.

M.E. EMBEDDED SYSTEM TECHNOLOGIES

Program Outcomes (POs)

PO1 : An ability to independently carry out research / investigation and development work to solve practical problems

PO2 : An ability to write and present a substantial technical report/ document

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

PO4 : To acquire expertise in Embedded System Technology, for imparting domain knowledge in Electrical circuits, electronic devices, information technology and communication engineering to develop inter-process communication techniques based on hardware– software approaches for real time process automations

PO5 : An ability to analyze and interpret data with the knowledge of embedded systems, to design and test relevant components required for applications in multidisciplinary domains, to become globally employable professionals or entrepreneurs.

PO6 : To enhance teaching & research contributions in embedded system technology with an ability to fabricate hardware and software systems and processes, in tune with the latest developments and Industry requirements, particularly in electrical and allied fields.

M.E. EMBEDDED SYSTEM TECHNOLOGIES
REGULATION – 2019 (Batch - 2020-2022)
CHOICE BASED CREDIT SYSTEM
CURRICULUM AND SYLLABUS

SEMESTER I

SL.NO	COURSE CODE	COURSE TITLE	PERIODS / WEEK					CATEGORY
			L	T	P	TOTAL	CREDITS	
1	MH19106	Applied Mathematics for Electrical Engineers	3	1	0	4	4	BS
2	ET19101	Real Time Systems	3	0	0	3	3	PC
3	ET19102	Advanced Digital Systems	3	0	0	3	3	PC
4	ET19103	Design of Microcontroller Based Systems	3	0	0	3	3	PC
5	ET19104	Design of Embedded Systems	3	0	0	3	3	PC
6	PG19101	Research Methodology and IPR (Common to all)	3	0	0	3	3	MC
7	AC19101	English for Research Paper Writing	3	0	0	3	0	AC
8	ET19111	Embedded System Laboratory I	0	0	4	4	2	PC
		TOTAL	**21**	**1**	**4**	**26**	**21**	

SEMESTER II

SL.NO	COURSE CODE	COURSE TITLE	PERIODS / WEEK					CATEGORY
			L	T	P	TOTAL	CREDITS	
1	ET19201	VLSI Architecture and Design Methodologies	3	0	0	3	3	PC
2	ET19202	Wireless and Mobile Communication	3	0	0	3	3	PC
3	ET19203	Software for Embedded Systems	3	0	0	3	3	PC
4	ET19P2X	Professional Elective- I	3	0	0	3	3	PE
5	ET19P2X	Professional Elective- II	3	0	0	3	3	PE
6	AC19201	Constitution of India	3	0	0	3	0	AC
7	ET19211	Embedded System Laboratory II	0	0	4	4	2	PC
		TOTAL	**18**	**0**	**4**	**22**	**17**	

SEMESTER III

SL.NO	COURSE CODE	COURSE TITLE	PERIODS / WEEK					CATEGORY
			L	T	P	TOTAL	CREDITS	
1	ET19301	Embedded Networking	3	1	0	4	4	PC
2	ET19P3X	Professional Elective–III	3	0	0	3	3	PE
3	ET19P3X	Professional Elective–IV	3	0	0	3	3	PE
4	********	Open Elective	3	0	0	3	3	OE
5	ET19311	Project Work (Phase I)	0	0	12	12	6	EEC
6	ET19312	IOT Applications for Embedded Systems	0	0	4	4	2	EEC
		TOTAL	**12**	**1**	**16**	**29**	**21**	

SEMESTER IV

SL.NO	COURSE CODE	COURSE TITLE	PERIODS / WEEK					CATEGORY
			L	T	P	TOTAL	CREDITS	
1	ET19411	Project Work (Phase II)	0	0	24	24	12	EEC
		TOTAL	**0**	**0**	**24**	**24**	**12**	

TOTAL NUMBER OF CREDITS = 71

PROFESSIONAL ELECTIVES
SEMESTER II

PROFESSIONAL ELECTIVE I

S.No	CODE	COURSE TITLE	CONTACT	L	T	P	C
1	ET19P21	Digital Instrumentation	3	3	0	0	3
2	ET19P22	Real Time Operating Systems	3	3	0	0	3
3	ET19P23	Parallel Processing Architecture	3	3	0	0	3
4	ET19P2A	Embedded Linux	3	3	0	0	3
5	ET19P2B	Open-Source Software	3	3	0	0	3

PROFESSIONAL ELECTIVE II

S.No	CODE	COURSE TITLE	CONTACT	L	T	P	C
1	ET19P24	Design of Embedded Control Systems	3	3	0	0	3
2	ET19P25	Programming with VHDL	3	3	0	0	3
3	ET19P26	Adhoc Networks	3	3	0	0	3
4	ET19P2C	Advanced Digital Signal Processing	3	3	0	0	3
5	ET19P2D	Digital Image Processing System	3	3	0	0	3

SEMESTER III

PROFESSIONAL ELECTIVE III

S.No	CODE	COURSE TITLE	CONTACT	L	T	P	C
1	ET19P31	Robotics and Automation	3	3	0	0	3
2	ET19P32	Soft Computing Techniques	3	3	0	0	3
3	ET19P33	RISC Processor Architecture and Programming	3	3	0	0	3
4	ET19P3A	IoT for Smart Systems	3	3	0	0	3
5	ET19P3B	Machine Learning	3	3	0	0	3

PROFESSIONAL ELECTIVE IV

S.No	CODE	COURSE TITLE	CONTACT	L	T	P	C
1	ET19P34	Advanced Embedded Systems	3	3	0	0	3
2	ET19P35	Pervasive Devices and Technology	3	3	0	0	3
3	ET19P36	Cryptography and Network Security	3	3	0	0	3
4	ET19P3C	Embedded Product Development	3	3	0	0	3
5	ET19P3D	Automotive Embedded System	3	3	0	0	3

AUDIT COURSES - I & II

SEMESTER I							
S.No	**CODE**	**COURSE TITLE**	**CONTACT**	L	T	P	C
THEORY							
	AC19101	English for Research Paper Writing	3	3	0	0	0
SEMESTER II							
S.No	**CODE**	**COURSE TITLE**	**CONTACT**	L	T	P	C
	AC19201	Constitution of India	3	3	0	0	0

OPEN ELECTIVES

S.No	**CODE**	**COURSE TITLE**	**CONTACT**	L	T	P	C
THEORY							
1	CP19O31	Business Analytics	3	3	0	0	3
2	ED19O31	Industrial Safety	3	3	0	0	3
3	ED19O32	Operations Research	3	3	0	0	3
4	PG19O31	Cost Management of Engineering Projects (Common to all)	3	3	0	0	3
5	ED19O33	Composite Materials	3	3	0	0	3
6	PG19O33	Waste to Energy (Common to all)	3	3	0	0	3

CREDIT DISTRIBUTION

CATEGORY	**I**	**II**	**III**	**IV**	**Total**
BS	4				4
PC	14	11	4		29
PE		6	6		12
EEC			8	12	20
MC	3				3
OE			3		3
					71

SYLLABUS

SEMESTER I

Subject Code	Subject Name	Category	L	T	P	C
MH 19106	APPLIED MATHEMATICS FOR ELECTRICAL ENGINEERS	BS	3	1	0	4

Objectives:

- To develop the ability to apply the concepts of Matrix theory and Linear programming in Electrical Engineering problems.
- To achieve an understanding of the basic concepts of one-dimensional random variables and apply in electrical engineering problems.
- To familiarize the students in calculus of variations and solve problems using Fourier transforms associated with engineering applications.

UNIT-I	**MATRIX THEORY**	**12**

The Cholesky decomposition - generalized eigen vectors, 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 – problems with constraints - direct methods: Ritz and Kantorovich methods.

UNIT-III	**ONE DIMENSIONAL RANDOM VARIABLES**	**12**

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 – 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 – Eigen value problems and orthogonal functions – Regular Sturm-Liouville systems –Generalized Fourier series.

Total Contact Hours	**:**	**60**

Course Outcomes:

On completion of the course, students will be able to

- Analyze and solve system of equations using the techniques of matrix decomposition and least square sense.
- Use the concept of MGF and probability distribution for solving problems that arise from time to time.
- Make decisions using the principles of optimality on the problems of dimensionality.
- Use Calculus of variations to solve variation problems arising in Engineering applications
- Use generalized Fourier series in solving problems in Sturm-Liouville systems.

Reference Books(s) / Web links:

1	Richard Bronson, "Matrix Operation", Schaum's outline series, 2nd Edition, McGraw Hill,2011.
2	Gupta, A.S., Calculus of Variations with Applications, Prentice Hall of India Pvt. Ltd., New Delhi.
3	Grewal, B.S., Higher Engineering Mathematics, 42nd edition, Khanna Publishers, 2012.
4	O'Neil, P.V., Advanced Engineering Mathematics, Thomson Asia Pvt. Ltd., Singapore.
5	Johnson R. A. and Gupta C. B., "Miller & Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 7th Edition, 2007.
6	Oliver C. Ibe, "Fundamentals of Applied Probability and Random Processes, Academic Press, (An imprint of Elsevier), 2010.
7	Elsgolts, L., Differential Equations and the Calculus of Variations, MIR Publishers, Moscow.
8	Andrews L.C. and Phillips R.L., Mathematical Techniques for Engineers and Scientists, Prentice Hall of India Pvt.Ltd., New Delhi.

9	Taha, H.A., "Operations Research, An introduction"**,** 10th edition, Pearson education, New Delhi, 2010

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	1	2	1	2
CO2	3	-	1	1	2	2
CO3	3	-	1	2	2	1
CO4	3	-	1	1	1	1
CO5	3	-	2	2	2	2
AVG	**3**	**-**	**1.2**	**1.6**	**1.6**	**1.6**

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
ET19101	**REAL TIME SYSTEMS**	**PC**	**3**	**0**	**0**	**3**

Objectives:

- To expose the students to the fundamentals of Real Time systems
- To teach the fundamentals of Scheduling and features of programming languages
- To study the data management system for real time
- To introduce the fundamentals of real time communication
- To teach the different algorithms and techniques used for real time systems

UNIT-I	**INTRODUCTION**	9

Introduction – Issues in Real Time Computing – Structure of a Real Time System – Task classes – Performance Measures for Real Time Systems – Estimating Program Run Times – Task Assignment and Scheduling – Classical uniprocessor scheduling algorithms – Uniprocessor scheduling of IRIS tasks – Task assignment – Mode changes and Fault Tolerant Scheduling.

UNIT-II	**PROGRAMMING LANGUAGES AND TOOLS**	9

Programming Languages and Tools – Desired language characteristics – Data typing – Control structures – Facilitating Hierarchical Decomposition, Packages, Runtime (Exception) Error handling – Overloading and Generics – Multitasking – Low level programming – Task Scheduling – Timing Specifications – Programming Environments – Run – time support.

UNIT-III	**REAL TIME DATABASES**	9

Real time Databases – Basic Definition, Real time Vs General Purpose Databases, Main Memory Databases, Transaction priorities, Transaction Aborts, Concurrency control issues, Disk Scheduling Algorithms, Two – phase Approach to improve Predictability – Maintaining Serialization Consistency – Databases for Hard Real Time Systems.

UNIT-IV	**COMMUNICATION**	9

Real – Time Communication – Communications media, Network Topologies Protocols, Fault Tolerant Routing. Fault Tolerance Techniques – Fault Types – Fault Detection. Fault Error containment Redundancy – Data Diversity – Reversal Checks – Integrated Failure handling.

UNIT-V	**EVALUATION TECHNIQUES**	9

Reliability Evaluation Techniques – Obtaining parameter values, Reliability models for Hardware Redundancy – Software error models. Clock Synchronization – Clock, A Nonfault – Tolerant Synchronization Algorithm – Impact of faults – Fault Tolerant Synchronization in Hardware – Fault Tolerant Synchronization in software

Total Contact Hours	**:**	**45**

Course Outcomes: At the end of the course the student will be able to:

- realise the process delivers insight into scheduling and computational processes with improved design strategies.
- realise the process delivers insight into disciplining various embedded design strategies
- improve Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in real-time systems design.

●	improve Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in real-time systems design.
●	analyse the process delivers insight into automated process with improved design strategies.
Reference Books(s):	
1	C.M. Krishna, Kang G. Shin, "Real – Time Systems", McGraw – Hill International Editions, 1997.
2	Rajib Mall, "Real-time systems: theory and practice", Pearson Education, 2007
3	Stuart Bennett, "Real Time Computer Control – An Introduction", Prentice Hall of India, 1998.
4	S.T. Allworth and R.N.Zobel, "Introduction to real time software design", Macmillan,1987

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	3	3	3
CO2	3	2	2	3	2	3
CO3	3	2	2	3	2	3
CO4	3	2	2	3	3	3
CO5	3	2	2	3	3	3
AVG	**3**	**2**	**2**	**3**	**2.6**	**3**

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
ET19102	**ADVANCED DIGITAL SYSTEMS**	**PC**	**3**	**0**	**0**	**3**

Objectives:

- To expose the students to the fundamentals of sequential system design, modelling
- To teach the fundamentals of Asynchronous circuits, switching errors
- To study on Fault identification in digital switching circuits
- To introduce logics for design of Programmable Devices
- To comparatively study the classification of commercial family of Programmable Devices

UNIT-I	**SEQUENTIAL CIRCUIT DESIGN**	9

Analysis of Clocked Synchronous Sequential Networks (CSSN) Modelling of CSSN – State Stable Assignment and Reduction – Design of CSSN – Design of Iterative Circuits – ASM Chart – ASM Realization.

UNIT-II	**ASYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN**	9

Analysis of Asynchronous Sequential Circuit (ASC) – Flow Table Reduction – Races in ASC – State Assignment Problem and the Transition Table – Design of ASC – Static and Dynamic Hazards – Essential Hazards – Data Synchronizers – Designing Vending Machine Controller – Mixed Operating Mode Asynchronous Circuits

UNIT-III	**FAULT DIAGNOSIS AND TESTABILITY ALGORITHMS**	9

Fault Table Method – Path Sensitization Method – Boolean Difference Method – Kohavi Algorithm – Tolerance Techniques – The Compact Algorithm – Practical PLA's – Fault in PLA – Test Generation – Masking Cycle – DFT Schemes – Built-in Self-Test.

UNIT-IV	**SYNCHRONOUS DESIGN USING PROGRAMMABLE DEVICES**	9

Programming Techniques -Re-Programmable Devices Architecture- Function blocks, I/O blocks, Interconnects, Realize combinational, Arithmetic, Sequential Circuit with Programmable Array Logic; Architecture and application of Field Programmable Logic Sequence.

UNIT-V	**ARCHITECTURES AND PROGRAMMING PROGRAMMABLE LOGIC DEVICES**	9

Architecture with EPLD, PEEL – Realization State machine using PLD – FPGA-Aptix Field Programmable Interconnect – Xilinx FPGA – Xilinx 2000 – Xilinx 4000 family. VHDL based Designing with PLD-ROM, PAL, PLA, Sequential PLDs, Case study –Keypad Scanner

	Total Contact Hours	**: 45**

Course Outcomes: At the end of the course the student will be able to:

- analyze the process delivers insight into incorporating switching logics, with improved design strategies.
- synthesize the Error free circuitry design of computation logics of processors.
- obtain the processor scheduling algorithms of real time system

●	improve Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in digital design for embedded systems.
●	determine the process delivers insight into involving the capacities of a controllable of processes with improved design strategies.

Reference Books(s):

1	Donald G. Givone, "Digital principles and Design", Tata McGraw Hill 2002.
2	Stephen Brown and Zvonk Vranesic, "Fundamentals of Digital Logic with VHDL Design", Tata McGraw Hill, 2002
3	Charles H. Roth Jr., "Digital Systems design using VHDL", Cengage Learning, 2010.
4	Mark Zwolinski, "Digital System Design with VHDL", Pearson Education, 2004
5	Parag K Lala, "Digital System design using PLD", BS Publications, 2003
6	John M Yarbrough, "Digital Logic applications and Design", Thomson Learning,2001
7	Nripendra N Biswas, "Logic Design Theory", Prentice Hall of India, 2001
8	Charles H. Roth Jr., "Fundamentals of Logic design", Thomson Learning, 2004.
9	John V.Oldfeild, Richard C.Dorf, "Field Programmable Gate Arrays", Wiley India Edition, 2008

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3			2		3
CO2	3					3
CO3	2				2	3
CO4	3		3	3		3
CO5	3	2	3	3	2	3
AVG	**2.8**	**2**	**3**	**2.67**	**2**	**3**

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
ET19103	**DESIGN OF MICROCONTROLLER BASED SYSTEMS**	**PC**	**3**	**0**	**0**	**3**

Objectives:

●	To teach the students to the fundamentals of microcontroller-based system design.
●	To teach I/O and RTOS role on microcontroller.
●	To impart knowledge on PIC Microcontroller based system design.
●	To understand the Microchip PIC 8bit peripheral system design.
●	To study experiences for microcontroller-based applications.

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 – RTOS for 8051 – RTOS Lite – Full RTOS – Task creation and run – LCD digital clock/thermometer using Full RTOS

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, MP-LAB, MICRO C Pro.

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 – sensor Interfacing- Generation of Gate signals for converters and Inverters – Motor Control – Controlling DC/ AC appliances – Measurement of frequency – Standalone Data

Acquisition System.			
	Total Contact Hours	**:**	**45**

Course Outcomes:
At the end of the course the student will be able to:

●	analyze the process delivers insight into involving the capacities of a programmable microcontroller for system interface.
●	design the automation of processes with improved design strategies.
●	design on memory management, application development in PIC processor.
●	design, development and programming on software tools in micro controllers with peripheral interfaces.
●	improve Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design.

Reference Book (s):

1	Muhammad Ali Mazidi, Rolin D. Mckinlay, Danny Causey ' PIC Microcontroller and Embedded Systems using Assembly and C for PIC18', Pearson Education 2008
2	John Iovine, 'PIC Microcontroller Project Book', McGraw Hill 2000
3	I Scott Mackenzie and Raphael C.W. Phan, "The Micro controller", Pearson, Fourth edition 2012
4	Myke Predko, "Programming and customizing the 8051 microcontrollers", Tata McGraw Hill 2001.
5	Muhammad Ali Mazidi, Janice G. Mazidi and Rolin D. McKinlay, 'The 8051 Microcontroller and Embedded Systems' Prentice Hall, 2005.
6	Rajkamal,". Microcontrollers-Architecture, Programming, Interfacing & System Design", 2nd Edition, Pearson, 2012.

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3		3	3	3	3
CO2	3		3	3	3	3
CO3	3		3	3	3	3
CO4	3		3	3	3	3
CO5	3		3	3	3	3
AVG	**3**		**3**	**3**	**3**	**3**

Subject Code	**Subject Name (Theory course)**	**Category**	**L**	**T**	**P**	**C**
ET19104	**DESIGN OF EMBEDDED SYSTEMS**	**PC**	**3**	**0**	**0**	**3**

Objectives:

●	To provide a clear understanding on the basic concepts, building blocks of Embedded System
●	To teach the fundamentals of System design with Partitioning
●	To introduce on Embedded Process development Environment
●	To study on Basic tool features for target configuration
	To introduce different EDLC Phases &Testing of embedded system

UNIT-I	**EMBEDDED DESIGN WITH MICROCONTROLLERS**	9

Product specification – Hardware / Software partitioning – Detailed hardware and software design – Integration – Product testing – Microprocessor Vs Micro Controller – Performance tools – Bench marking – RTOS Micro Controller -issues in selection of processors

UNIT-II	**PARTITIONING DECISION**	9

Hardware / Software duality – Hardware-Software portioning- coding for Hardware- software development – ASIC revolution – Managing the Risk – Co-verification – execution environment– Memory organization –memory enhancement – Firmware-speed and code density -System startup

UNIT-III	**FUNCTIONALITIES FOR SYSTEM DESIGN**	9

Timers, Watchdog timers – RAM, Flash Memory basic toolset – Integration of Hardware & Firmware- InSystem

Programming, In-Application Programming, IDE-Target Configuration- Host based debugging – Remote debugging – ROM emulators – Logic analyzer		
UNIT-IV	**IN CIRCUIT EMULATORS**	9
Bullet proof run control – Real time trace – Hardware break points – Overlay memory – Timing constraints – Usage issues – Triggers.		
UNIT-V	**EMBEDDED DESIGN LIFE CYCLE & TESTING**	9
Objective, Need, different Phases & Modelling of the EDLC. Choice of Target Architectures for Embedded Application Development-for Control Dominated-Data Dominated Systems- Software & Hardware Design– reduction of risks & costs – Performance – Unit testing – Regression testing – Choosing test cases – Functional tests – Coverage tests – Testing embedded software – Performance testing – Maintenance.		
	Total Contact Hours : 45	

Course Outcomes:
At the end of the course the student will be able to:

●	Explain the basic concepts, building blocks of microcontroller-based design of Embedded System
●	Apply fundamentals hardware/ software partitioning in embedded System design
●	Discuss debugging techniques and Embedded Process Development Environment
●	Enumerate Different tools for hardware debugging and basic tool features for target configuration
●	Elucidate different phases of EDLC and embedded architecture for data- dominated and control-dominated application development, PCB design, Testing of embedded system

Reference Book (s):

1	Arnold S. Berger – "Embedded System Design", CMP books, USA 2002.
2	Elicia White," Making Embedded Systems", O'Reilly Series, SPD,2011
3	Arkin, R.C., Behaviour-based Robotics, The MIT Press, 1998.
4	Lyla B Das," Embedded Systems-An Integrated Approach", Pearson2013
5	James K.Peckol, "Embedded system Design",JohnWiley&Sons,2010
6	Rajkamal," Embedded Systems", TMH, 2009.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	3	2	3	3
CO2	3	1	2		3	
CO3	2	1	1		1	
CO4	2	1	2		1	
CO5	2	1	2	2	3	3
AVG	**2.2**	**1**	**2**	**2**	**2.2**	**3**

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
PG19101	**RESEARCH METHODOLOGY AND IPR**	**MC**	**3**	**0**	**0**	**3**

Objectives:

●	To inculcate the importance of research methodology and Intellectual Property Rights. The main objective of the IPR is to make the students aware of their rights for the protection of their invention done in their project work.
●	To get registration of patents in our country and foreign countries of invention, designs and thesis or theory written. To get knowledge of patents, copy right, trademarks and designs.

UNIT-I	**RESEARCH METHODOLOGY**	
	Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.	9
UNIT-II	**REVIEW OF LITERATURE AND TECHNICAL WRITING**	
	Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal,	9

	a presentation and assessment by a review committee.	
UNIT-III	**INTELLECTUAL PROPERTY RIGHTS**	
	Nature of Intellectual Property: Patents, Designs, Trade and Copyright, copyright registration in India Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under Patent Cooperation Treaty.	**9**
UNIT-IV	**PATENT RIGHTS AND RECENT DEVELOPMENTS IN IPR**	
	Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.	9
UNIT-V	**INDUSTRIAL DESIGNS AND GEOGRAPHICAL INDICATIONS**	
	Industrial designs and IC Layout design, Registrations of designs, conditions and procedures of industrial designs- Cancellation of Registration, International convention of design- types and functions. Semiconductor Integrated circuits and layout design Act- Geographical indications- potential benefits of Geographical Indications.	9
	Total Contact Hours :	**45**

Course Outcomes:	
●	Student can understand the research problem formulation and analyze research related information.
●	Understanding that when IPR would take such important place in growth of individuals & nation.
●	Understand the importance of copyright and industrial designs.
●	Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.
●	The students once they complete their academic projects, they get awareness of acquiring the patent and copyright for their innovative works.
Text Book (s):	
1	Neeraj Pandey and Khushdeep Dharni, Intellectual Property Rights, First edition, PHI learning Pvt. Ltd., Delhi, 2014.
2	Uma Sekaran and Roger Bougie, Research methods for Business, 5th Edition, Wiley India, New Delhi, 2012.
3	Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students" ,2nd edition, Juta Academic, 2001.
4	Ramakrishna B & Anilkumar H S, Fundamentals of Intellectual Property Rights, Ist edition, Notion Press, 2017.
Reference Books(s) / Web links:	
1	William G Zikmund, Barry J Babin, Jon C.Carr, Atanu Adhikari,Mitch Griffin, Business Research methods, A South Asian Perspective, 8th Edition, Cengage Learning, New Delhi, 2012.

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3				
CO2	3					
CO3	3					
CO4	3				2	
CO5	3					2
AVG	**3**	**3**	**0**	**0**	**2**	**2**

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
AC19101	**ENGLISH FOR RESEARCH PAPER WRITING**	AC	**3**	**0**	**0**	**0**

Objectives:	
●	Express technical ideas in writing
●	Plan and organize the research paper

●	Understand the structure and familiarize the mechanics of organized writing	
●	Improvise academic English and acquire research writing skills	
UNIT-I	**INTRODUCTION TO RESEARCH PAPER WRITING**	**9**
Research – Types of Research - Selecting the Primary resources - Categorizing secondary sources - Discovering a researchable area and topic – Need Analysis - Research Question- Focusing on the Research Problem- Developing Research Design – Framing the Hypothesis – Identifying the Scope of the Research - Writing – General and Academic Writing.		
UNIT-II	**LANGUAGE OF WRITING**	**9**
Active reading – text mining – use of academic words – jargons – ambiguities – use of expression – use of tense - proper voices – third person narration – phraseology – use of foreign words – use of quotes – interpreting quotes.		
UNIT-III	**THE FORMAT OF WRITING**	**9**
Types of Journals - different formats and styles - IEEE format - Structure – Margins - Text Formatting - Heading and Title - Running Head with Page Numbers -Tables and illustrations - Paper and Printing - Paragraphs - Highlighting – Quotation – Footnotes		
UNIT-IV	**ORGANISING A RESEARCH PAPER**	**9**
Title- Abstract – Introduction – Literature review - Methodology - Results –Discussion –Conclusion - Appendices - Summarising - Citation and Bibliography.		
UNIT-V	**PUBLISHING PAPER**	**9**
Finding the Prospective publication or Journal - analyzing the credits - Reviewing - Revising – Plagiarism Check - Proof reading - Preparing the Manuscript- Submitting - Resubmitting - Follow up – Publishing.		
	Total Contact Hours : 45	
Course Outcomes: On completion of course students will be able to		
●	Understand the basic structure of research work	
●	Apply proper use of language in writing paper	
●	Comprehend different formats of journal paper	
●	Learn the process of writing a research paper	
●	Know the process of publishing journal paper	
Reference Books / Web links:		
1	Adrian Wallwork: "English for Writing Research Papers", Springer Science Business Media, Second Edition, LLC 2011	
2	Stephen Howe and Kristina Henrikssion: "Phrasebook for Writing Papers and Research in English", The Whole World Company Press, Cambridge, Fourth edition 2007	
3	The Modern Language Association of America: "MLA Handbook for Writers of Research Papers" 8th Edition, The Modern Language Association of America, 2016	
4	Rowena Murray: The Handbook of Academic Writing: A Fresh Approach, Sarah Moore Open University Press, 2006	
5	Stephen Bailey: Academic Writing: A Practical Guide for Students RoutledgeFalmer: 2003	
6	Joseph M. Moxley: Publish, Don't Perish: The Scholar's Guide to Academic Writing and Publishing, Praeger Publishers, 1992	

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	2	1	1	2
CO2	1	3	2	-	2	1
CO3	2	3	2	1	2	2
CO4	2	3	2	1	3	1
CO5	1	2	1	1	2	1
AVG	**1.6**	**2.6**	**1.8**	**1**	**2**	**1.4**

Subject Code	Subject Name (Laboratory Course)	Category	L	T	P	C
ET19111	EMBEDDED SYSTEM LABORATORY I	PC	0	0	4	2

Objectives:

- To impart knowledge on programming with 8-bit Microcontrollers for both assembly and C programming
- To provide knowledge on programming with PIC Microcontrollers for both assembly and C programming
- To impart knowledge on I/O programming
- To inculcate knowledge on CAD tools for the implementation of Combinational, Sequential Circuits
- To introduce the TCP/IP protocol stack

List of Experiments

1	Programming with 8-bit Microcontrollers Both Assembly and C programming
2	Programming I/O Programming/ Timers/ Interrupts/ Serial port programming/PWM Generation/ Motor Control/ADC/DAC/ LCD/ RTC Interfacing/ Sensor Interfacing
3	Programming with 8 bit PIC/AVR Microcontrollers Both Assembly and C programming
4	Programming Microcontrollers I/O Programming/ Timers/ Interrupts/ Serial port programming/PWM Generation/ Motor Control/ADC/DAC/ LCD/ RTC Interfacing/ Sensor Interfacing
5	Programming with 16-bit processors Both Assembly and C programming
6	Programming I/O Programming/ Timers/ Interrupts/ Serial port programming/PWM Generation/ Motor Control/ADC/DAC/ LCD/ RTC Interfacing/ Sensor Interfacing
7	Design with CAD tool- Design and Implementation of Combinational, Sequential Circuits in CAD simulators
8	Study on in-circuit Emulators, Cross compilers, debuggers
9	Simulation & Programming of sensor interface & measurement with using programming environments (MATLAB/LabVIEW/Simulation Tools)
10	Programming of TCP/IP protocol stack

Total Contact Hours	**:**	**60**

Course Outcomes: At the end of the course the student will be able to:

- understand the programming with 8-bit Microcontrollers for both assembly and C programming
- understand the programming with PIC Microcontrollers for both assembly and C programming
- comprehend the I/O programming
- synthesize combinational, Sequential Circuits using CAD tools
- understand the TCP/IP protocol stack

References

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

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3		3	2	2
CO2	3	3		3	2	2
CO3	3	3				
CO4	3	3		3		3
CO5	3		3			
AVG	**3**	**3**	**3**	**3**	**2**	**2.33**

SEMESTER II

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
ET19201	VLSI ARCHITECTURE AND DESIGN METHODOLOGIES	PC	3	0	0	3

Objectives:

- To give an insight to the students about the significance of CMOS technology
- To teach the importance and architectural features of programmable logic devices.
- To introduce the ASIC construction and design algorithms
- To teach the basic analog VLSI design techniques.
- To study the Logic synthesis and simulation of digital system with Verilog HDL.

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- Layout diagram, Stick diagram-IC fabrications – Trends in IC technology.

UNIT-II PROGRAMABLE LOGIC DEVICES 12

Programming Techniques-Anti fuse-SRAM-EPROM and EEPROM technology – Re-Programmable Devices Architecture- Function blocks, I/O blocks, Interconnects, Xilinx-XC9500, Cool Runner – XC-4000, XC5200, SPARTAN, Virtex – Altera MAX 7000.

UNIT-III BASIC CONSTRUCTION, FLOOR PLANNING, PLACEMENT AND ROUTING 6

System partition – FPGA partitioning – Partitioning methods- floor planning – placement-physical design flow – global routing – detailed routing – special routing- circuit extraction – DRC.

UNIT-IV ANALOG VLSI DESIGN 6

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

UNIT-V LOGIC SYNTHESIS AND SIMULATION 12

Overview of digital design with Verilog HDL, hierarchical modelling concepts, modules and port definitions, gate level modelling, data flow modelling, behavioral modelling, task & functions, Verilog and logic synthesis-simulation-Design examples, Ripple carry Adders, Carry Look ahead adders, Multiplier, ALU, Shift Registers, Multiplexer, Comparator, Test Bench

Total Contact Hours : 45

Course Outcomes: At the end of the course the student will be able to:

- analyze the process delivers insight into developing design logic/arithmetic functionalities of various embedded design strategies.
- analyze the computational arithmetic/logic functionalities evolvable in processors.
- determine the ASIC construction and design algorithms specific process.
- write the program for logic separation and simulation of digital system with Verilog HDL
- improve employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design.

Reference Books(s):

1. M.J.S Smith, “Application Specific integrated circuits”, Addition Wesley Longman Inc.1997.
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 “ Prentice Hall India,2006.
4. Mohamed Ismail, Terri Fiez, “Analog VLSI Signal and information Processing”, McGraw Hill International Editions,1994.
5. Samir Palnitkar, “VeriLog HDL, A Design guide to Digital and Synthesis” 2nd Ed, Pearson,2005

6	John P. Uyemera "Chip design for submicron VLSI CMOS layout and simulation ", Cengage Learning India Edition", 2011.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1				3	2	2
CO2		3	3	3	2	2
CO3	3	3				
CO4	3	3	3	3		3
CO5			3		3	3
AVG	**3**	**3**	**3**	**3**	**2.33**	**2.5**

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
ET19202	**WIRELESS AND MOBILE COMMUNICATION**	**PC**	**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 – spread spectrum – Satellite Networks – Capacity Allocation – FAMA – DAMA – MAC

UNIT-II	**MOBILE NETWORKS**	9

Cellular Wireless Networks – GSM – Architecture – Protocols – Connection Establishment – Frequency Allocation – Routing – Handover – Security – GPRS

UNIT-III	**WIRELESS NETWORKS**	9

Wireless LAN – IEEE 802.11 Standard-Architecture – Services – AdHoc Network – Hiper Lan – Blue Tooth, Zigbee, 6LowPAN

UNIT-IV	**ROUTING**	9

Mobile IP – DHCP – AdHoc Networks – Proactive and Reactive Routing Protocols – Multicast Routing

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 Contact Hours	**:**	**45**

Course Outcomes:

At the end of the course the student will be able to:

- deliver insight into categorizing various embedded & communication protocols for networking of distributed static & mobile systems.
- evaluate the wireless network routing protocols
- analyze the current and future cellular mobile communication systems
- determine the appropriate wireless standard for mobile routing
- provide improved employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design

Reference Books(s):

1	Kaveh Pahlavan, Prasanth Krishnamoorthy, "Principles of Wireless Networks" PHI/Pearson Education, 2003
2	Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, "Principles of Mobile computing", Springer, Newyork, 2003
3	C.K.Toh, " AdHoc mobile wireless networks", Prentice Hall, Inc, 2002.

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

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	3	2	2
CO2	2	2	3	2	1	1
CO3	3	2	2	3		2
CO4	2	2	1	3	1	2
CO5	3	2	2	3	3	3
AVG	**2.6**	**2**	**1.8**	**2.8**	**1.75**	**2**

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
ET19203	**SOFTWARE FOR EMBEDDED SYSTEMS**	**PC**	**3**	**0**	**0**	**3**

Objectives:

- To expose the students to the fundamentals of embedded Programming
- To Introduce the GNU C Programming Tool Chain in Linux.
- To study the basic concepts of embedded C and Embedded OS
- To introduce time driven architecture, Serial Interface with a case study.
- To introduce the concept of embedded Java for Web Enabling of systems.

UNIT-I	**EMBEDDED PROGRAMMING**	9

C and Assembly – Programming Style – Declarations and Expressions – Arrays, Qualifiers and Reading Numbers – Decision and Control Statements – Programming Process – More Control Statements – Variable Scope and Functions - 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 Make utility – 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 AND EMBEDDED OS**	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. 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.

UNIT-IV	**TIME-DRIVEN MULTI-STATE ARCHITECTURE AND HARDWARE**	9

Multi-State systems and function sequences: Implementing multi-state (Timed) system – Implementing a Multi-state (Input/Timed) system. Using the Serial Interface: RS232 – The Basic RS-232 Protocol – Asynchronous data transmission and baud rates – Flow control – Software architecture – Using on-chip UART for RS-232 communication – Memory requirements – The serial menu architecture – Examples. Case study: Intruder alarm system.

UNIT-V	**EMBEDDED JAVA**	9

Introduction to Embedded Java and J2ME – Smart Card basics – Java card technology overview – Java card objects – Java card applets – working with APDUs – Web Technology for Embedded Systems.

	Total Contact Hours	**: 45**

Course Outcomes:
At the end of the course the student will be able to:

- analyze the process delivers insight into various programming languages.
- design the compatible embedded process development with improved design & programming skills.

●	synthesize the GNU C Programming Tool Chain in Linux
●	design the time driven architecture for serial Interface with a case study
●	improve entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design
Reference Books(s):	
1	Steve Oualline, 'Practical C Programming 3rd Edition', O'Reilly Media, Inc, 2006.
2	Stephen Kochan, "Programming in C", 3rd Edition, Sams Publishing, 2009.
3	Michael J Pont, "Embedded C", Pearson Education, 2007.
4	Zhiqun Chen, 'Java Card Technology for Smart Cards: Architecture and Programmer's Guide', Addison Wesley Professional, 2000.
5	Brian Kernighan and Dennis Ritchie," C Programming Language" second edition, prentice hall, 2015
6	Elecia White, "Making Embedded Systems", O'Reilly Media, Inc, First edition, 2011

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1		2	3	3	3
CO2	1		2	3	3	3
CO3	1		2	3	3	3
CO4	1		2	3	3	3
CO5	1		2	3	3	3
AVG	**1**		**2**	**3**	**3**	**3**

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
ET19P2X	**PROFESSIONAL ELECTIVE- I**	**PE**	**3**	**0**	**0**	**3**

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
ET19P2X	**PROFESSIONAL ELECTIVE- II**	**PE**	**3**	**0**	**0**	**3**

Subject Code	Subject Name	Category	L	T	P	C
AC19201	**CONSTITUTION OF INDIA**	AC	**3**	**0**	**0**	**0**

Objectives:	
●	To inculcate the values enshrined in the Indian constitution.
●	To create a sense of responsible and active citizenship.
●	To know about Constitutional and Non- Constitutional bodies
●	To understand the relationships, exist between union and states
●	To understand sacrifices made by the freedom fighters.

UNIT-I	**INTRODUCTION**	**9**
Historical Background - Constituent Assembly of India - Philosophical foundations of the Indian Constitution - Features - Basic Structure – Preamble.		
UNIT-II	**UNION GOVERNMENT - EXECUTIVE, LEGISLATURE AND JUDICIARY**	**9**
Union and its territory - Citizenship - Fundamental Rights - Directive Principles of State Policy (DPSP) - Fundamental Duties. President - Vice President - Prime Minister - Central Council of Ministers - Cabinet Committees - Parliament: Committees, Forums and Groups - Supreme Court.		
UNIT-III	**STATE GOVERNMENT & UNION TERRITORIES: STATE GOVERNMENT EXECUTIVE, LEGISLATURE AND JUDICIARY**	**9**
Governor - Chief Minister - State Council of Ministers - State Legislature - High Court - Subordinate Courts - Panchayati Raj – Municipalities-Union Territories - Scheduled and Tribal Areas.		

UNIT-IV	RELATIONS BETWEEN UNION AND STATES	9
Relations between Union and States - Services under Union and States. Cooperative Societies - Scheduled and Tribal Areas - Finance, Property, Contracts and Suits - Trade and Commerce within Indian Territory – Tribunals.		
UNIT-V	**CONSTITUTIONAL BODIES AND AMENDMENTS**	**9**
Introduction to Constitutional & Non-Constitutional Bodies-Elections - Special Provisions relating to certain classes - Languages - Emergency Provisions - Miscellaneous - Amendment of the Constitution - Temporary, Transitional and Special Provisions - Short title, date of commencement, Authoritative text in Hindi and Repeals. Schedules of the Constitution of India - Appendices in the Constitution of India.		
	Contact Hours : 45	

Course Outcomes:

On completion of the course students will be able to

- Appreciate the philosophical foundations of the Indian Constitution.
- Understand the functions of the Indian government.
- Understand and abide the rules of the Indian constitution
- Gain knowledge on functions of state Government and Local bodies.
- Gain Knowledge on constitution functions and role of constitutional bodies and amendments of constitution.

Text Books:

1	M Lakshmikanth "Indian Polity", McGraw Hill Education, 5th edition 2017.
2	Durga Das Basu, "Introduction to the Constitution of India ", Lexis Nexis, New Delhi., 21st edition, 2013.

Reference Books / Web links:

1	Sharma, Brij Kishore, "Introduction to the Constitution of India", Prentice Hall of India, New Delhi, 7th edition, 2015.
2	Subhash Kashyap, "Our Constitution: An Introduction to India's Constitution and Constitutional Law", National Book Trust India, 1994.
3	Mahendra Prasad Singh and Himanshu Roy, "Indian Political System", Pearson India, 4th edition, 2017.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1				
CO2	1	1				
CO3	1	1				
CO4	1	1				
CO5	1	1				
AVG	**1**	**1**	**0**	**0**	**0**	**0**

Subject Code	Subject Name (Laboratory Course)	Category	L	T	P	C
ET19211	**EMBEDDED SYSTEM LABORATORY II**	PC	0	0	4	2

Objectives:

- To impart knowledge on simulators/experiments in programming processor boards, processor interfacing/ designing digital controllers
- To provide knowledge on Arithmetic, Logic programs, Filters, Signal analysis with simulators/experiments in programming processor boards, processor interfacing/ Tools
- To impart knowledge in various tools & software domains using PLC/CAD
- To inculcate knowledge in various tools & software domains using Linux support/any RTOS
- To introduce the Support Software Tools for communication interfaces

List of Experiments

1	Programming with ARM Processors Both Assembly and C programming, I/O Programming /Timers/ Interrupts /ADC/DAC/ LCD /RTC Interfacing/ Sensor Interfacing/i/o device control
2	Programming with Fixed Point & Floating-Point DSP Processors Both Assembly /C programming/CCS Compilers -Programming with DSP processors for Correlation, Convolution, Arithmetic adder, Multiplier, Design of Filters – FIR based, IIR based

3	Design using Xilinx/Altera CPLD Design and Implementation of simple Combinational/Sequential Circuits
4	Design using Xilinx/Altera FPGA Design and Implementation of simple Combinational/Sequential Circuits
5	Interfacing: Motor Control/ADC/DAC/LCD / RTC Interfacing/ Sensor Interfacing
6	Study of one type of Real Time Operating Systems (RTOS) with ARM Processor/Microcontroller
7	Network Simulators Communication Topology of network using NS2/simulators
8	Study on Embedded wireless network Topology
9	Simulation & Programming on DSP/Image Processing using programming environments
	Total Contact Hours : 60

Course Outcomes:

At the end of the course the student will be able to:

●	design with simulators/experiments, in programming processor boards, processor interfacing/ designing digital controllers.
●	learn design & simulation of Arithmetic, Logic programs, Filters, Signal analysis with simulators/experiments, in programming processor boards, processor interfacing/ Tools.
●	learn programming, compiling in various tools & software domains using PLC/CAD.
●	learn programming, compiling in various tools & software domains using Linux support/any RTOS.
●	Learn Communication Protocols & Experimenting with Support Software Tools for communication interfaces.

References

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

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3		3	3		3
CO2	3		3	3		3
CO3	2		3	3		3
CO4	2		3	3		2
CO5	2		3	3		2
AVG	**2.4**		**3**	**3**	**0**	**2.6**

SEMESTER III

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
ET19301	EMBEDDED NETWORKING	PC	3	1	0	4

Objectives:

- To give an insight to the students about the Serial communication protocols
- To teach the importance of parallel communication protocols
- To introduce the Application Development using USB and CAN bus for PIC microcontrollers
- To teach the Application Development using USB and CAN bus for PIC microcontrollers
- To study the Application development using Embedded Ethernet for Rabbit processors and Wireless sensor network communication protocols

UNIT-I	EMBEDDED COMMUNICATION PROTOCOLS	12

Embedded Networking: Introduction – Serial/Parallel Communication – Serial communication protocols -RS232 standard – RS485 – Synchronous Serial Protocols -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I^2C) – PC Parallel port programming -ISA/PCI Bus protocols – Firewire

UNIT-II	USB AND CAN BUS	12

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

UNIT-III	ETHERNET BASICS	12

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

UNIT-IV	EMBEDDED ETHERNET	12

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

UNIT-V	WIRELESS EMBEDDED NETWORKING	12

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

Total Contact Hours	:	60

Course Outcomes:

At the end of the course the student will be able to:

- analyze the process delivers insight onto design of automation, communication systems through wired, wireless technology for monitoring and control of grid
- evaluate the process delivers insight onto role of various communication standards applicable in automation
- data transfer and communication in systems like large industrial processes
- synthesize the instrument-based internet protocol for CAN bus systems
- design attributes of functional units of network processes synthesize the sensor network communication protocols

Reference Books(s):

1. Frank Vahid, Givargis ‘Embedded Systems Design: A Unified Hardware/Software Introduction’, Wiley Publications
2. Jan Axelson, ‘Parallel Port Complete’, Penram publications
3. Dogan Ibrahim, ‘Advanced PIC microcontroller projects in C’, Elsevier 2008

4	Jan Axelson 'Embedded Ethernet and Internet Complete', Penram publications
5	Bhaskar Krishnamachari, 'Networking wireless sensors', Cambridge press 2005

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3			3	3	2
CO2	3			3	3	2
CO3	3			3	3	2
CO4	3			3	3	2
CO5	3			3	3	2
AVG	**3**		**0**	**3**	**3**	**2**

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
ET19P3X	**PROFESSIONAL ELECTIVE- III**	**PE**	**3**	**0**	**0**	**3**

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
ET19P3X	**PROFESSIONAL ELECTIVE- IV**	**PE**	**3**	**0**	**0**	**3**

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
*******	**OPEN ELECTIVE**	**OE**	**3**	**0**	**0**	**3**

Subject Code	Subject Name	Category	L	T	P	C
ET19311	**PROJECT WORK (PHASE I)**	**EEC**	**0**	**0**	**12**	**6**

Course Objectives:

- To develop the ability to solve a specific problem right from the identification from the extensive literature review till the successful solution of the same.
- To train the student in preparing comprehensive project report

Students work on a topic approved by the head of the department and prepares a comprehensive project report after completing the work to the satisfaction. The progress of the project is evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department. A project report has to be submitted at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

Total Contact Hours	**:**	**180**

Course Outcomes:

●	On Completion of the Phase-I project work, the students will be in a position to take up their Phase-II project work and find the solution by formulating the proper methodology.

Subject Code	Subject Name (Laboratory Course)	Category	L	T	P	C
ET19312	**IOT APPLICATIONS FOR EMBEDDED SYSTEMS**	**PC**	**0**	**0**	**4**	**2**

Objectives:

●	To implement the basic concepts of ARDUINO.
●	To develop applications using ARDUINO.
●	To understand fundamentals of programming such as variables, conditional and iterative Execution, methods etc.
●	To develop applications using IoT concepts.
●	To implement features of IoT to solve real world problems.

List of Experiments

1	Interfacing and configuration of LED using digital pin of ARDUINO

2	Interfacing and configuration of Buzzer using digital pin of ARDUINO
3	Interfacing and configuration of switches using digital pin of ARDUINO
4	Interfacing of potentiometers using analog pin of ARDUINO
5	Interfacing of moisture, light, flame, temperature & humidity, IR, PIR, Gas, Piezo Vibration, and Sound sensor with ARDUINO
6	Interfacing of Actuators with ARDUINO
7	Interfacing of GSM with ARDUINO
8	IoT using ARDUINO
9	Smart Irrigation System using IoT
10	Introduction to IoT using Raspberry Pi (interfacing with basic sensors and actuators
	Total Contact Hours : 60

Course Outcomes:

At the end of the course the student will be able to:

- apply the concepts of data acquisition system.
- discuss different programming structures to represent real world problems.
- acquire the concepts of Graphical User Interfaces.
- design various ways of algorithms to solve the problems
- Explain the principles of the internet of things.

References

1	Mohamammad Ali Mazidi & Mazidi ' 8051 Microcontroller and Embedded Systems', Pearson Education
2	Mohammad Ali Mazidi, Rolind Mckinley and Danny Causey, 'PIC Microcontroller and Embedded Systems' Pearson Education
3	Simon Monk," Make Action-with Arduino and Raspberry Pi, SPD ,2016.
4	Wesley J.Chun, "Core Python Applications Programming,3rd ed,Pearson,2016

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3					3
CO2	3					3
CO3	3					3

Subject Code	Subject Name	Category	L	T	P	C
ET19411	**PROJECT WORK (PHASE II)**	**EEC**	**0**	**0**	**24**	**12**

Objectives:

CO4	3		3	3		3
CO5	2					3
AVG	**2.8**		**3**	**3**	**0**	**3**

• To develop their own innovative prototype/algorithm for Embedded related application. • To train the students in preparing the project reports and to face reviews and viva voce examination.
Students work on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report has to be submitted at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

	Total Contact Hours	**:**	**360**

Course Outcomes:

●	On Completion of the project work students will be in a position to take up any challenging practical problems and find the solution by formulating the proper methodology.

PROFESSIONAL ELECTIVES
SEMESTER I

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
ET19P21	**DIGITAL INSTRUMENTATION**	**PE**	**3**	**0**	**0**	**3**

Objectives:

●	To discuss to the students on the fundamentals building blocks of a digital instrument
●	To teach the digital data communication techniques
●	To study on bus communication standards and working principles
●	To teach Graphical programming using GUI for instrument building
●	To discuss the case studies on industrial process measurements.

UNIT-I	**DATA ACQUISITION SYSTEMS**	9

Overview of A/D converter, types and characteristics – Sampling, Errors. Objective – Building blocks of Automation systems –Counters – Modes of operation- Frequency, Period, Time interval measurements, Prescaler, Heterodyne converter for frequency measurement, Single and Multi-channel Data Acquisition systems.

UNIT-II	**INTERFACING AND DATA TRANSMISSION**	9

Data transmission systems – 8086 Microprocessor based system design – Peripheral Interfaces– Time Division Multiplexing (TDM) – Digital Modulation – Pulse Modulation – Pulse Code Format – Interface systems and standards – Communications.

UNIT-III	**INSTRUMENTATION BUS**	9

Introduction, Modem standards, Basic requirements of Instrument Bus standards, Bus communication, interrupt and data handshaking, Interoperability, interchangeability for RS- 232, USB, RS-422, RS-485.

UNIT-IV	**VIRTUAL INSTRUMENTATION**	9

Block diagram and Architecture – Data flow techniques – Graphical programming using GUI – Real time Embedded system –Intelligent controller – Software and hardware simulation of I/O communication blocks-peripheral interface – ADC/DAC – Digital I/O – Counter, Timer.

UNIT-V	**CASE STUDIES**	9

PC based DAS, Data loggers, PC based industrial process measurements like flow, temperature, pressure and level development system, CRT interface and controller with monochrome and colour video display.

	Total Contact Hours	**:**	**45**

Course Outcomes:
At the end of the course the student will be able to:

●	understand the fundamentals building blocks of a digital instrument.
●	understand the different methods of Data Transmission System.
●	acquire the concept of various instrumentation Bus.
●	acquire detail knowledge on building blocks of a "Virtual Instrumentation System.
●	acquire detail knowledge on industrial process measurements.

Reference Books(s):	
1	A.J. Bouwens, "Digital Instrumentation" , TATA McGraw-Hill Edition, 1998.
2	N. Mathivanan, "Microprocessors, PC Hardware and Interfacing", Prentice-Hall India, 2005.
3	H S Kalsi, "Electronic Instrumentation" Second Edition, Tata McGraw-Hill,2006.
4	Joseph J. Carr, "Elements of Electronic Instrumentation and Measurement" Third Edition, Pearson Education, 2003.
5	Buchanan, "Computer busses", Arnold, London,2000.
6	Jonathan W Valvano, "Embedded Microcomputer systems", Asia Pvt. Ltd., Brooks/Cole, Thomson, 2001.

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	1	1	3	3	3
CO2	3	1	1	3	3	3
CO3	2	1	1	3	3	3
CO4	3	2	2	2	2	3
CO5	3	3	3	3	3	3
AVG	**2.8**	**1.6**	**1.6**	**2.8**	**2.8**	**3**

Subject Code	**Subject Name (Theory course)**	**Category**	**L**	**T**	**P**	**C**
ET19P22	**REAL TIME OPERATING SYSTEMS**	**PE**	**3**	**0**	**0**	**3**

Objectives:

●	To expose the students to the fundamentals of interaction of OS with a computer and User computation.
●	To teach the fundamental concepts of how process are created and controlled with OS.
●	To study on programming logic of modeling Process based on range of OS features.
●	To compare types and Functionalities in commercial OS.
●	To discuss the application development using RTOS.

UNIT-I	**REVIEW OF OPERATING SYSTEMS**	9

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

UNIT-II	**OVERVIEW OF RTOS**	9

RTOS Task and Task state –Multithreaded Premptive scheduler- Process Synchronization-Message queues– Mail boxes -pipes – Critical section – Semaphores – Classical synchronization 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 – Polled Loop Systems – RTOS Porting to a Target – Comparison and Basic study of various RTOS like – VX works – Linux supportive RTOS – C Executive.

UNIT-V	**RTOS APPLICATION DOMAINS**	9

Case studies-RTOS for Image Processing – Embedded RTOS for Network communication- RTOS for fault-Tolerant Applications – RTOS for Control Systems.

	Total Contact Hours	**:**	**45**

Course Outcomes:

At the end of the course the student will be able to:

●	Understanding Operating System structures and types.
●	Insight into scheduling, disciplining of various processes execution.
●	Provide knowledge on various RTOS support modelling
●	Understanding commercial RTOS Suite features to work on real time processes design.
●	Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in RTOS and embedded automation design.

Reference Books(s):

1	Silberschatz, Galvin, Gagne: "Operating System Concepts ",6th ed, John Wiley,2003
2	D.M.Dhamdhere, "Operating Systems, A Concept-Based Approch" ,TMH,2008
3	Raj Kamal, "Embedded Systems- Architecture, Programming and Design" Tata McGraw Hill, 2006.
4	Herma K., "Real Time Systems – Design for distributed Embedded Applications", Kluwer Academic, 1997.
5	Charles Crowley, "Operating Systems-A Design Oriented approach" McGraw Hill 1997.
6	C.M. Krishna, Kang, G.Shin, "Real Time Systems", McGraw Hill, 1997.
7	Karim Yaghmour, Building Embedded Linux System",O'reilly Pub,2003
8	Mukesh Sighal and N G Shi "Advanced Concepts in Operating System", McGraw Hill,2000

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1				3		
CO2	2	2	2			
CO3			2		3	
CO4		3	2	3		
CO5	3	3		3		
AVG	**2.5**	**2.66**	**2**	**3**	**3**	**0**

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
ET19P23	**PARALLEL PROCESSING ARCHITECTURE**	**PE**	**3**	**0**	**0**	**3**

Objectives:

●	To expose the students to the fundamentals of interaction of OS with a computer and User computation.
●	To teach the fundamental Parallel Processing.
●	To study on networking for memory
●	To compare types and Functionalities in commercial OS
●	To discuss the parallel model's development using software

UNIT-I	**THEORY OF PARALLELISM**	9

Parallel Computer models – the state of computing-introduction to parallel processing- parallelism in uniprocessors& Multiprocessors, -parallel architectural classification schemes-speedup performance laws-issues in H/W-S/W parallelism

UNIT-II	**PARTITIONING AND SCHEDULING**	9

Program partitioning and scheduling, Program flow mechanisms, System interconnect architectures, Principles of scalable performance – performance matrices and measures, Parallel processing applications, speedup performance laws, scalability analysis and approaches.

UNIT-III	**HARDWARE TECHNOLOGIES**	9

Basic Comparative study features of advanced embedded processors: of Architectures – addressing modes -instruction types-performance of- Parallel and scalable architectures, Multiprocessors -SIMD, MIMD computers, Superscalar, Array & vector processors, Systolic processors of their unique features – Memory Management- performance and issues

UNIT-IV	**PIPELINING AND MULTITHREADED ARCHITECTURE TECHNOLOGIES**	9

Pipeline principle and implementation-classification of pipeline processor-introduction of arithmetic, instruction, processor pipelining-pipeline mechanisms-hazards-Introduction to multithreaded Architecture-Cluster computing

UNIT-V	**SOFTWARE AND PARALLEL PROCESSING**	9

Parallel models, Languages and compilers, Parallel program development and environments, UNIX, MACH and

OSF/1 for parallel computers.				
		Total Contact Hours	**:**	**45**
Course Outcomes: At the end of the course the student will be able to:				
●	realize the fundamentals of interaction of OS with a computer and User computation.			
●	analyse the fundamentals of Parallel Processing.			
●	design a network for memory organization			
●	compare and analyse functionalities in commercial OS			
●	analyse the parallel models development using software			
Reference Books(s):				
1	Kai Hwang "Advanced Computer Architecture". McGraw Hill International 2001.			
2	Dezso Sima, Terence Fountain, Peter Kacsuk, "Advanced computer Architecture – A design Space Approach". Pearson Education,2003.			
3	Carl Homacher, Zvonko Vranesic, Sefwat Zaky, "Computer Organisation", 5th Edition, TMH, 2002.			
4	David E. Culler, Jaswinder Pal Singh with Anoop Gupta "Parallel Computer Architecture" ,Elsevier, 2004.			
5	John P. Shen. "Modern processor design Fundamentals of super scalar processors", Tata McGraw Hill 2003.			
6	Sajjan G. Shiva "Advanced Computer Architecture", Taylor & Francis, 2008.			
7	V.Rajaraman, C.Siva Ram Murthy, "Parallel Computers- Architecture and Programming", Prentice Hall India, 2008.			
8	John L. Hennessy, David A. Petterson, "Computer Architecture: A Quantitative Approach", 4th Edition, Elsevier, 2007.			
9	Harry F. Jordan Gita Alaghaband, "Fundamentals of Parallel Processing". Pearson Education, 2003.			
10	Richard Y. Kain, "Advanced computer architecture – A system Design Approach", PHI, 2003.			

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	3	3	2	
CO2		3	3			
CO3		3	3			
CO4		2	3			
CO5		3			3	
AVG	**3**	**2.8**	**3**	**3**	**2.5**	**0**

Subject Code	**Subject Name (Theory course)**	**Category**	**L**	**T**	**P**	**C**
ET19P2A	**EMBEDDED LINUX**	**PE**	**3**	**0**	**0**	**3**

Objectives:		
●	To impart knowledge about Linux Operating System	
●	To expose the students to the fundamentals of Linux Operating system and its basic commands.	
●	To Teach about the various Linux distributions and running them on a typical Embedded Board.	
●	To demystify the details of various Embedded Boards and programming them.	
●	To give an introduction to Linux Device Drivers.	
UNIT-I	**LINUX FUNDAMENTALS**	9
Introduction to Linux: A brief History – Features and Advantages of Linux – System and Software Features – Linux's Copyright – The Design Philosophy of Linux – Differences between Linux and Other Operating Systems – Hardware Requirements – Source of Linux Information – Obtaining and Installing Linux: Distributions of Linux – Installing Linux. Working with Linux: Logging in and Logging Out – Linux File System – Directory and File Commands – Other Useful Linux Commands – File Access Permissions – Pipes and Filters – Text Editors – Working with GNOME.		
UNIT-II	**CROSS-DEVELOPMENT TOOLCHAIN**	9
History of Embedded Linux – Embedded Linux Vs Desktop Linux – Types of Hosts – Types of Host/Target Development Setups – Types of Host/Target Debug Setups – Types of Boot Configurations – System Memory Layout. User space – Architecture of Embedded Linux – Linux Kernel Architecture – Linux Start-Up Sequence. GNU Cross		

Platform Toolchain.		
UNIT-III	**RUNNING LINUX ON EMBEDDED BOARDS**	9
Embedded Boards and their Features – Exploring Embedded Linux System: Different Raspberry Pi Boards and their comparison – Embedded Linux Introduction – Managing Linux Systems – Using Git for Version Control – Using Desktop Virtualization. Programming on the Raspberry Pi: Scripting Languages – Dynamically Compiled Languages – C and C++ on the Rpi – Overview of Object- Oriented Programming – Interfacing to the Linux OS – Improving the Performance of Python.		
UNIT-IV	**CROSS-COMPILATION AND INTERFACING TO THE RASPBERRY PI BUSSES**	9
Cross-Compilation and the Eclipse IDE: Setting Up a Cross-Compilation Toolchain – Cross- Compilation Using Eclipse – Building Linux. Interfacing to the Raspberry Pi Busses: Introduction to Bus Communication – I2C – SPI – UART – Logic-Level Translation		
UNIT-V	**INTRODUCTION TO LINUX DEVICE DRIVERS**	9
Device Driver Basics: User Space and Kernel Space – Driver Skeletons – Errors and Message Printing – Module Parameters – Building First Module. Character Device Drivers: Concept behind Major and Minor – Introduction to Device File Operations – Allocating and Registering a Character Device – Writing File Operations.		
	Total Contact Hours : 45	

Course Outcomes:

At the end of this course, students will have the following knowledge and skills

●	Thorough understanding of Linux and its commands
●	Differentiate Embedded Linux from its Desktop counterpart and its internals
●	Successfully run Linux on an Embedded Board, Use Eclipse IDE for Cross- compilation
●	Able to write a simple device driver in Linux
●	Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded linux skills.

Reference Books(s):

1	Karim Yaghmour, Jon Masters, Gilad Ben-Yossef, and Philippe Gerum, "Building Embedded Linux Systems", O'Reilly Media Inc., 2008.
2	P. Raghavan, Amol Lad and Sriram Neelakandan, "Embedded Linux System Design and Development", Auerbach Publications, Taylor & Francis Group, 2006.
3	Derek Molloy, "Exploring Raspberry Pi: Interfacing to the Real World with Embedded Linux", John Wiley & Sons, Inc., 2016.
4	John Madieu, "Linux Device Drivers Development: Develop customized drivers for embedded Linux", Packt Publishing, 2017.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3			3	3	
CO2		2		3	3	
CO3	3		3	3	3	3
CO4				3	3	
CO5	3		3		3	3
AVG	**3**	**2**	**3**	**3**	**3**	**3**

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
ET19P2B	**OPEN-SOURCE SOFTWARE**	**PE**	**3**	**0**	**0**	**3**

Objectives:

●	To introduce and define open-source software
●	To identify and discuss various software licensing models
●	Understand the motivation, theory, strengths and weaknesses of open-source software.
●	Become familiar with Linux, MySQL, PHP, Python, Apache and other Tools and technologies
●	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**	9
Open-Source Terminologies: Open-Source Software, Freeware, Shareware, Proprietary Software - Introduction to Open sources - Need of Open Sources - Advantages of Open Sources - Application of Open Sources. Open-source operating systems: LINUX: Introduction - General Overview - Kernel Mode and user mode - Process - Advanced Concepts - Scheduling - Personalities- Cloning - Signals - Development with Linux.		
UNIT-II	**OPEN-SOURCE DATABASE**	9
MySQL: Introduction - Setting up account - Starting, terminating and writing your own SQL programs - Record selection Technology - Working with strings - Date and Time - Sorting Query Results - Generating Summary - Working with metadata - Using sequences - MySQL and Web.		
UNIT-III	**OPEN-SOURCE PROGRAMMING LANGUAGES**	9
PHP: Introduction - Programming in web environment - variables - constants - data types - operators - Statements - Functions - Arrays - OOP - String Manipulation and regular expression - File handling and data storage - PHP and SQL database - PHP and LDAP - PHP Connectivity - Sending and receiving E-mails - Debugging and error handling - Security - Templates.		
UNIT-IV	**SOFTWARE DEVELOPMENT USING OPEN-SOURCE SYSTEMS**	9
Introduction, Objectives, Overview of Open-Source System, Open source tools, Open source components, Open source methodology, Open Source Software Development Models, The FOSS Philosophy, Social and Cultural Impacts		
UNIT-V	**OPEN-SOURCE WEB SERVER, TOOLS AND TECHNOLOGIES**	9
General Overview of Web Server - Case Study: Apache Web server - Working with Web Server - Configuring and using Apache Web services - Case Study: Apache Tomcat - Open-Source IDE - Modelling Tools - Mozilla Firefox - Wikipedia - Eclipse		
	Total Contact Hours : 45	

Course Outcomes:

At the end of this course, students will have the following knowledge and skills

●	clear understanding about the terms, tools used for Open-source software
●	Able to use programming Languages in the open-source category for application development.
●	Able to gain improved employability and entrepreneurship capacity
●	Able to develop solutions to problems using open-source tools available
●	Able to get an insight into the recent trends in embedded system design

Reference Books(s):

1	Remy Card, Eric Dumas and Frank Mevel, “The Linux Kernel Book”, Wiley Publications, 2003
2	Richard Blum "PHP, MySQL & JavaScript All - in - One for Dummies", Wiley, 2018
3	Kevin Tatroe, Peter MacIntyre and Rasmus Lerdorf, “Programming PHP: Creating Dynamic Web Pages”, 3rd edition, O’Reilly, 2013
4	Wesley J. Chun, “Core Phython Programming”, Prentice Hall, 2001
5	Martin C. Brown, “Perl: The Complete Reference”, 2nd Edition, Tata McGraw- Hill Publishing Company Limited, Indian Reprint 2009.
6	Steven Holzner, “PHP: The Complete Reference”, 2nd Edition, Tata McGraw- Hill Publishing Company Limited, Indian Reprint 2009.
7	Vikram Vaswani, “MYSQL: The Complete Reference”, 2nd Edition, Tata McGraw-Hill Publishing Company Limited, Indian Reprint 2009

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3					
CO2	3		2		2	
CO3	3					
CO4		3	2		2	
CO5				2		

AVG	**3**	**3**	**2**	**2**	**2**	**0**

PROFESSIONAL ELECTIVE II

Subject Code	**Subject Name (Theory course)**	**Category**	**L**	**T**	**P**	**C**
ET19P24	**DESIGN OF EMBEDDED CONTROL SYSTEMS**	**PE**	**3**	**0**	**0**	**3**

Objectives:

- To expose the students to the fundamentals of Embedded System Blocks
- To teach the fundamental RTOS.
- To study on interfacing for processor communication
- To compare types and Functionalities in commercial software tools
- To discuss the Applications development using interfacing

UNIT-I **EMBEDDED SYSTEM ORGANIZATION** 9

Embedded computing – characteristics of embedded computing applications – embedded system design challenges; Build process of Real time Embedded system – Selection of processor; Memory; I/O devices-Rs-485, MODEM, Bus Communication system using I^2C, 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, RTC interfacing and programming

UNIT-IV **DESIGN OF SOFTWARE FOR EMBEDDED CONTROL** 9

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 – VXWorks, 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 Contact Hours : 45

Course Outcomes:

At the end of the course the student will be able to:

- analyze the blocks of Embedded System
- Realize the working of RTOS.
- design an interfacing system for processor communication
- analyze and compare commercial software tools for real time application
- develop an application using interfacing logic

Reference Books(s):

1	Steven F. Barrett, Daniel J. Pack, "Embedded Systems – Design and Applications with the 68HC 12 and HCS12", Pearson Education, 2008
2	Raj Kamal, "Embedded Systems- Architecture, Programming and Design" Tata McGraw Hill, 2006
3	Micheal Khevi, "The M68HC11 Microcontroller application in control, Instrumentation & Communication", PH New Jersy, 1997
4	Chattopadhyay, "Embedded System Design",PHI Learning, 2011
5	Muhammad Ali Mazidi, Rolin D. Mckinlay, Danny Causey, "PIC Microcontroller and Embedded Systems- Using Assembly and C for PIC18", Pearson Education,2008
6	Daniel W. Lewis, "Fundamentals of Embedded Software", Prentice Hall India, 2004.
7	Jack R Smith "Programming the PIC microcontroller with Mbasic" Elsevier, 2007

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1			3	2	3
CO2	1			3	2	3
CO3	1			3	2	3
CO4	1	2		3	2	3
CO5	2	3	3	3	2	3
AVG	**1.2**	**2.5**	**3**	**3**	**2**	**3**

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
ET19P25	**PROGRAMMING WITH VHDL**	**PE**	**3**	**0**	**0**	**3**

Objectives:

- To give an insight to the students about the significance of VHDL Programming
- To teach the importance and architectural modelling of programmable logic devices
- To introduce the construction and design programming
- To teach the basic VLSI design configurations
- To study the Logic synthesis and simulation of digital system with PLD

UNIT-I	**VHDL FUNDAMENTALS**	9

Fundamental concepts- Modeling digital system-Domain and levels of modeling- modeling languages-VHDL modeling concepts-Scalar Data types and operations- constants and Variable-Scalar Types- Type Classification-Attributes and scalar types-expression and operators-Sequential statements.

UNIT-II	**DATA TYPES AND BASIC MODELING CONSTRUCTS**	9

Arrays- unconstrained array types-array operations and referencing- records – Access Types-Abstract Date types- -basic modeling constructs-entity declarations-Architecture bodies-behavioral description-structural descriptions-design Processing, case study: A pipelined Multiplier accumulator.

UNIT-III	**SUBPROGRAMS, PACKAGES AND FILES**	9

Procedures-Procedure parameters- Concurrent procedure call statements –Functions –Overloading –visibility of Declarations-packages and use clauses- Package declarations-package bodies-use clauses-Predefined Aliases-Aliases for Data objects-Aliases for Non-Data items-Files- I/O-Files. Case study: A bit vector arithmetic Package.

UNIT-IV	**SIGNALS, COMPONENTS, CONFIGURATIONS**	9

Basic Resolved Signals-IEEE std_Logic_1164 resolved subtypes- resolved Signal Parameters – Generic Constants-Parameterizing behavior- Parameterizing structure-components and configurations-Generate Statements-Generating Iterative Structure-Conditionally generating structure-Configuration of generate statements

UNIT-V	**DESIGN WITH PROGRAMMABLE LOGIC DEVICES**	9

Realization of -Micro controller CPU. – Memories- I/O Devices-Vending Machine design, synthesis, simulation and testing

Total Contact Hours	**:**	**45**

Course Outcomes:

At the end of the course the student will be able to:

- model complex digital systems at several level of abstractions; behavioral and structural, synthesis and rapid system prototyping
- develop and simulate register-level models of hierarchical digital systems
- develop a formal test bench from informal system requirements
- design and model complex digital system independently or in a team
- analyze and simulate digital system with PLD

Reference Books(s):

1 Peter J.Ashenden, “The Designer’s guide to VHDL”, Morgan Kaufmann publishers, San Francisco, Second

	Edition, May 2001
2	Zainalabedin navabi, "VHDL Analysis and modeling of Digital Systems", McGraw Hill international Editions, Second Editions, 1998
3	Charles H Roth, Jr. "Digital system Design using VHDL", Thomson ,2006
4	Douglas Perry, "VHDL Programming by Example", Tata McGraw Hill,4th Edition 2002
5	Navabi.Z., "VHDL Analysis and Modeling of Digital Systems", McGraw International, 1998
6	Peter J Ashenden, "The Designers Guide to VHDL", Harcourt India Pvt Ltd, 2002
7	Skahill. K, "VHDL for Programmable Logic", Pearson education, 1996
8	Mark Zwolinski, "Digital System Design with VHDL", Pearson Education, 2004

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3			3	3	3
CO2	3			3	3	3
CO3	3			3	3	3
CO4	3			3	3	3
CO5	3			3	3	2
AVG	**3**			**3**	**3**	**2.8**

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
ET19P26	**ADHOC NETWORKS**	**PE**	**3**	**0**	**0**	**3**

Objectives:

- To expose the students to the fundamentals of wireless communication technologies.
- To teach the fundamentals of wireless network routing protocols
- To study on wireless issues in network layers topologies
- To introduce energy management in network routing protocols
- To study the basis of performance metrics for N/W communication technologies

UNIT-I	**WIRELESS LAN, PAN, WAN AND MAN**	9

Characteristics of wireless channel, Fundamentals of WLANs, IEEE 802.11 standard, HIPERLAN Standard, First-, Second-, and third- generation cellular systems, WLL, Wireless ATM, IEEE 802.16 standard, HIPERACCESS, AdHoc Wireless Internet.

UNIT-II	**MAC, ROUTING AND MULTICAST ROUTING PROTOCOLS**	9

MAC Protocols: Design issues, goals and classification, Contention –based protocols with reservation and scheduling mechanisms, Protocols using directional antennas. Routing protocols: Design issues and classification, Table-driven, On-demand and Hybrid routing protocols, Routing protocols with efficient flooding mechanisms, Hierarchical and power-aware routing protocols. Multicast Routing Protocols: Design issues and operation, Architecture reference model, classification, Tree-based and Mesh-based protocols, Energy-efficient multicasting.

UNIT-III	**TRANSPORT LAYER AND SECURITY PROTOCOLS**	9

Transport layer Protocol: Design issues, goals and classification, TCP over AdHoc wireless Networks, Security, Security requirements, Issues and challenges in security provisioning, Network security attacks, Security routing. Quality of Service: Issues and challenges in providing QoS, Classification of QoS solutions, MAC layer solutions, Network layer solutions, QoS frameworks.

UNIT-IV	**ENERGY MANAGEMENT**	9

Need, classification of battery management schemes, Transmission power management schemes, System power management schemes. Wireless Sensor Networks: Architecture, Data dissemination, Date gathering, MAC protocols, location discovery, Quality of a sensor network.

UNIT-V	**PERFORMANCE ANALYSIS**	9

ABR beaconing, Performance parameters, Route-discovery time, End-to-end delay performance, Communication throughput performance, Packet loss performance, Route reconfiguration/repair time, TCP/IP based applications

Total Contact Hours	**:**	**45**

Course Outcomes: At the end of the course the student will be able to:	
●	analyze the fundamentals of wireless communication technologies.
●	analyze the fundamentals of wireless network routing protocols
●	determine the wireless issues in network layers topologies
●	apply energy management concepts in network routing protocols
●	evaluate the performance metrics for N/W communication technologies
Reference Books(s):	
1	C. Siva Ram Murthy and B.S. Manoj, AdHoc Wireless Networks: Architectures and protocols, Prentice Hall PTR, 2004
2	C.-K.Toh, AdHoc Mobile Wireless Networks: Protocols and Systems, Prentice Hall PTR, 2001
3	Mohammad Ilyas, The Handbook of AdHoc Wireless Networks, CRC press, 2002
4	Charles E. Perkins, AdHoc Networking, Addison – Wesley, 2000
5	Stefano Basagni, Marco Conti, Silvia Giordano and Ivan Stojmenovic, Mobile AdHoc Networking, Wiley – IEEE press, 2004

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	3	1	2	2	2
CO2	3	3	2	3	2	3
CO3	3	3	3	3	3	3
CO4	3	3	3	3	3	3
CO5	2	3		3	2	2
AVG	**2.6**	**3**	**2.25**	**2.8**	**2.4**	**2.6**

Subject Code	**Subject Name (Theory course)**	**Category**	**L**	**T**	**P**	**C**
ET19P2C	**ADVANCED DIGITAL SIGNAL PROCESSING**	**PE**	**3**	**0**	**0**	**3**

Objectives:	
●	To expose 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 teach the fundamentals of audio signal processing & its application
●	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	**INTRODUCTION TO DIGITAL SIGNAL PROCESSING**	9

Introduction to Digital Signal Processing System- Discrete Time Sequences- Time-Invariant & Time-variant Systems, Decimation and Interpolation- The Sampling Process – Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT)- Basics of Digital Filters- FIR Filters, IIR Filters -adaptive filter based on LMS.

UNIT-II	**WAVELET TRANSFORM**	9

Introduction to continuous wavelet transform- discrete wavelet transform -orthogonal wavelet decomposition- Multiresolution Analysis-Wavelet function-DWT, bases, orthogonal Basis-Scaling function, Wavelet coefficients- Multirate signal processing and their relationship to filter banks- Digital filtering interpolation(i) Decomposition filters, (ii) reconstruction, the signal- Example MRA- Haar & Daubechies wavelet.

UNIT-III	**AUDIO SIGNAL PROCESSING**	9

Introduction to Speech and Audio Processing – Speech Signal Processing- Pitch-period estimation, all-pole and all-zero filters- convolution – autoregressive model, autocorrelation estimation, General structure of speech coders; Requirements of speech codecs –quality, LPC model of speech production- LPC encoders and decoders-Power spectral density, periodogram, Spectral measures of audio signal.

UNIT-IV	**ARCHITECTURES OF COMMERCIAL DIGITAL SIGNAL PROCESSORS**	9

Introduction, categorization of DSP Processors-one case example Architecture Processor for Fixed Point (Blackfin),

Floating Point & Speech Processor- Basics of Architecture – study of functional variations of Computational building blocks (with comparison onto their MAC, Bus Architecture, I/O interface, application).		
UNIT-V	**IMPLEMENTATION OF DSP BASED SYSTEMS**	9
Introduction- Interfacing processor- Memory Interface-I/O Interface-Mapping of DSP algorithm onto hardware - Design of Filter-FFT Algorithm- Application with DSP based Interfacing- Power Meter; DSP as motor control		
	Total Contact Hours : 45	

Course Outcomes:
At the end of the course the student will be able to:

●	The concepts of Time and frequency analysis of Signal Transforms based on signal types.
●	The fundamentals of Time-Frequency Transforms are introduced
●	Analyze the quality and properties of speech based on DSP
●	Study features through comparison on commercially available DSProcessors
●	Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in signal processing for embedded systems design.

Reference Books(s):

1	John G. Proaks, Dimitris G. Manolakis, "Digital Signal Processing", 4th edition, Pearson Education, 2007.
2	Vinay K.Ingle,John G.Proakis,"Digital Signal Processing Using MATLAB: A Problem Solving Companion", 1st edition, Cengage Learning, 2017
3	Taan S.Elali,"Discrete Systems and Digital Signal Processing with Matlab",CRC Press2009.
4	Sen M.Kuo and Woon-Seng S.Gan, Digital Signal Processors-Architectures, implementation and applications", Pearson Education 2008.
5	Avatar Sing, S. Srinivasan, "Digital Signal Processing- Implementation using DSP Microprocessors with Examples from TMS320C54xx", Thomson India,2004.
6	Ashok Ambardar, "Digital Signal Processing: A Modern Introduction", Thomson India edition, 2007.
7	Lars Wanhammer, "DSP Integrated Circuits", Academic press, 1999, NewYork.
8	Raghuveer M.Rao and Ajit S. Bapardikar, Wavelet transforms- Introduction to theory and applications, Pearson Education, 2000.

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	3	3	2	2	
CO2		3	3			
CO3		3	3			
CO4		3	3			
CO5		3			2	
AVG	**2**	**3**	**3**	**2**	**2**	**0**

Subject Code	**Subject Name (Theory course)**	**Category**	**L**	**T**	**P**	**C**
ET19P2D	**DIGITAL IMAGE PROCESSING SYSTEM**	**PE**	**3**	**0**	**0**	**3**

Objectives: The objectives of this course to impart knowledge in

●	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 Contact Hours : 45	

Course Outcomes:

At the end of the course students will be able to

●	understand the fundamentals of image processing.
●	understand the techniques involved in image enhancement, segmentation and compression.
●	analyze their real-time applications
●	implement image processing applications using software and hardware.
●	develop real time solutions for applications

Reference Books(s):

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, ValclavHalavac and Roger Boyle, "Image processing, analysis and machine vision", 2nd Edition, Thomson learning, 2001
4	Mark Nixon and Alberto Aguado,"Feature extraction & Image processing for computer vision",3rd Edition, Academic press, 2012
5	Donald G. Bailey, "Design for Embedded Image processing on FPGAs" John Wiley and Sons, 2011.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3				
CO2	3	3				
CO3		3	2			2
CO4		3		3	3	2
CO5		3		3	3	2
AVG	**3**	**3**	**2**	**3**	**3**	**2**

PROFESSIONAL ELECTIVE III

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
ET19P31	**ROBOTICS AND AUTOMATION**	**PE**	**3**	**0**	**0**	**3**

Objectives:

●	To teach the need of embedded system technology for robot building
●	To study the Various Parts of Robots and Fields of Robotics.
●	To study the Various Kinematics and Inverse Kinematics of Robots.
●	To study the trajectory planning for robot.
●	To study the control of robots for some specific applications.

UNIT-I	INTRODUCTION TO ROBOTICS	9
Overview of Robotics & Automation – Different Types of Robotics – Various Generations of Robots- Asimov's Laws of Robotics –Selection of Robots-Role and design of embedded system for robotics and automation –Recent trends.		
UNIT-II	**POWER SOURCES AND SENSORS**	9
Hydraulic, Pneumatic and Electric Drives – Determination Of HP Of Motor And Gearing Ratio –Variable Speed Arrangements – Path Determination – Micro Machines In Robotics – Machine Vision – Ranging – Laser – Acoustic – Magnetic, Fiber Optic And Tactile Sensors-smart sensors.		
UNIT-III	**MANIPULATORS, ACTUATORS AND GRIPPERS**	9
Construction Of Manipulators – Manipulator Dynamics and Force Control – Electronic and Pneumatic Manipulator Control Circuits – End Effectors – Various Types of Grippers – Design Considerations.		
UNIT-IV	**KINEMATICS AND PATH PLANNING**	9
Solution Of Inverse Kinematics Problem – Multiple Solution Jacobian Work Envelop – Hill Climbing Techniques – path planning algorithms- Robot Programming Languages- Simulation and modeling		
UNIT-V	**CASE STUDIES**	9
Robot Cell Design -Intelligent Robot- Humanoid Robot -Multiple Robots –Robots in healthcare applications- Machine Interface – Robots in Manufacturing and Non- Manufacturing Applications- Self balancing robots- Micro/nano robots.		
	Total Contact Hours : 45	

Course Outcomes: At the end of the course the student will be able to:

- select suitable embedded boards for robots
- understand the concepts of robotics & automation and Working of Robot
- analyze the function of Sensors and actuators in the Robot
- Write a program to use a Robot for a Typical Application
- apply knowledge upgradation on Embedded system-based robot development

Reference Books(s):

1. Mikell P. Weiss G.M., Nagel R.N., Odraj N.G., "Industrial Robotics", Mc Graw-Hill Singapore, 1996.
2. Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers, Chennai, 1998.
3. Deb. S.R., "Robotics Technology and Flexible Automation", John Wiley, USA 1992.
4. Klafter R.D., Chimielewski T.A., Negin M., "Robotic Engineering – An Integrated Approach", Prentice Hall Of India, New Delhi, 1994.
5. Mc Kerrow P.J. "Introduction to Robotics", Addison Wesley, USA, 1991.
6. Issac Asimov "Robot", Ballantine Books, New York, 1986.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3		3	
CO2	3		3		3	
CO3	3		3	2	3	
CO4	3		3	2	3	
CO5	3		3		3	3
Average	**3**	**2**	**3**	**2**	**3**	**3**

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
ET19P32	**SOFT COMPUTING TECHNIQUES**	**PE**	**3**	**0**	**0**	**3**

Objectives:

- To expose the concepts of feed forward neural networks.
- To provide adequate knowledge about feedback neural networks.
- To teach about the concept of fuzziness involved in various systems.
- To expose the ideas about genetic algorithm
- To provide adequate knowledge about of FLC and NN toolbox

UNIT-I	INTRODUCTION AND ARTIFICIAL NEURAL NETWORKS	9

Introduction of soft computing – soft computing vs. hard computing- various types of soft computing techniques- applications of soft computing-Neuron- Nerve structure and synapse-Artificial Neuron and its model- activation functions- Neural network architecture- single layer and multilayer feed forward networks- McCulloch Pitts neuron model- perceptron model- Adaline and Madaline- multilayer perception model- back propagation learning methods- effect of learning rule coefficient -back propagation algorithm- factors affecting back propagation training- applications.		
UNIT-II	**ARTIFICIAL NEURAL NETWORKS**	9
Counter propagation network- architecture- functioning & characteristics of counter- Propagation network-Hopfield/ Recurrent network- configuration- stability constraints-associative memory-and characteristics- limitations and applications- Hopfield v/s Boltzman machine- Adaptive Resonance Theory- Architecture- classifications- Implementation and training-Associative Memory.		
UNIT-III	**FUZZY LOGIC SYSTEM**	9
Introduction to crisp sets and fuzzy sets- basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modeling and control- Fuzzification- inferencing and defuzzification- Fuzzy knowledge and rule bases-Fuzzy modeling and control schemes for nonlinear systems. Self-organizing fuzzy logic control- Fuzzy logic control for nonlinear time delay system.		
UNIT-IV	**GENETIC ALGORITHM**	9
Basic concept of Genetic algorithm and detail algorithmic steps-adjustment of free Parameters-Solution of typical control problems using genetic algorithm- Concept on some other search techniques like tabu search and ant colony search techniques for solving optimization problems.		
UNIT-V	**APPLICATIONS**	9
GA application to power system optimization problem- Case studies: Identification and control of linear and nonlinear dynamic systems using Matlab- Neural Network toolbox. Stability analysis of Neural Network interconnection systems- Implementation of fuzzy logic controller using Matlab fuzzy logic toolbox-Stability analysis of fuzzy control systems.		
	Total Contact Hours : 45	

Course Outcomes:

At the end of the course the student will be able to:

●	analyse the basic ANN architectures, algorithms and their limitations.
●	verify the different operations on the fuzzy sets.
●	develop the ANN based models and control schemes for non-linear system.
●	expertise in the use of different ANN structures and online training algorithm.
●	model fuzzy logic control of non-linear systems

Reference Books(s):

1	Laurene V. Fausett, Fundamentals of Neural Networks: Architectures, Algorithms And Applications, Pearson Education, 1993
2	Timothy J. Ross, "Fuzzy Logic with Engineering Applications" 3rd Edition, Wiley India, 2011
3	Zimmermann H.J. "Fuzzy set theory and its applications" Springer international edition, 2011
4	David E.Goldberg, "Genetic Algorithms in Search, Optimization, and Machine Learning", Pearson Education, 2009
5	W.T.Miller, R.S.Sutton and P.J.Webrose, "Neural Networks for Control", MIT Press, 1996

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3		2	3	2	3
CO2	3		2	3	2	3
CO3	3		2	3	2	3
CO4	3		2	3	2	3

CO5	3		2	3	2	3
AVG	**3**		**2**	**3**	**2**	**3**

Subject Code	**Subject Name (Theory course)**	**Category**	**L**	**T**	**P**	**C**
ET19P33	**RISC PROCESSOR ARCHITECTURE AND PROGRAMMING**	**PE**	**3**	**0**	**0**	**3**

Objectives:

- To teach the architecture of 8 bit RISC processor
- To teach the architecture and programming of 16 bit RISC processor
- To teach the implementation of DSP in ARM processor
- To discuss on memory management in RISC processor
- To teach the application development with ARM processor

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 DSP on ARM –FIR Filter – IIR Filter – Discrete Fourier transform – Exception Handling – Interrupts – Interrupt handling schemes- Firmware and bootloader – Example: Standalone – Embedded Operating Systems – Fundamental Components – Example Simple little Operating System

UNIT-IV	**MEMORY PROTECTION AND MANAGEMENT**	9

Protected Regions-Initializing MPU, Cache and Write Buffer-MPU to MMU-Virtual Memory-Page Tables-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.

Total Contact Hours	**:**	**45**

Course Outcomes:

At the end of the course the student will be able to:

- Analyse different blocks of 8 bit RISC processor
- Develop the program using 16 bit RISC processor
- Implement DSP using ARM processor
- Analyse memory management concepts in RISC processor
- Develop an application using ARM processor

Reference Books(s):

1	Steve Furber, 'ARM system on chip architecture', Pearson Education India, 2014
2	Andrew N. Sloss, Dominic Symes, Chris Wright, John Rayfield 'ARM System Developer's Guide Designing and Optimizing System Software', Elsevier 2007
3	Trevor Martin, 'The Insider's Guide To The Philips ARM7-Based Microcontrollers, An Engineer's Introduction To The LPC2100 Series' Hitex (UK) Ltd
4	Dananjay V. Gadre 'Programming and Customizing the AVR microcontroller', McGraw Hill 2001
5	William Hohl, ' ARM Assebly Language' Fundamentals and Techniques.
6	ARM Architecture Reference Manual
7	LPC213x User Manual

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**

CO1	3	3	3		2	3
CO2	3	3	3	3	2	3
CO3	3	3	3	3		
CO4	3	3				
CO5	3	3		3		3
AVG	**3**	**3**	**3**	**3**	**2**	**3**

Subject Code	**Subject Name (Theory course)**	**Category**	**L**	**T**	**P**	**C**
ET19P3A	**IOT FOR SMART SYSTEMS**	**PE**	**3**	**0**	**0**	**3**

Objectives:

- To Study about Internet of Things technologies and its role in real time applications.
- To introduce the infrastructure required for IoT
- To provide insight about the embedded processor and sensors required for IoT
- To familiarize the accessories and communication techniques for IoT.
- To familiarize the different platforms and Attributes for IoT

UNIT-I **INTRODUCTION TO INTERNET OF THINGS** 9

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

UNIT-II **IOT ARCHITECTURE** 9

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

UNIT-III **PROTOCOLS AND WIRELESS TECHNOLOGIES FOR IOT** 9

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

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

UNIT-IV **EMBEDDED PROCESSORS FOR IOT** 9

Services/Attributes: Big-Data Analytics for IOT, Dependability, Interoperability, Security, Maintainability. Embedded processors for IOT: Introduction to Python programming -Building IOT with RASPERRY PI and Arduino.

UNIT-V **CASE STUDIES** 9

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

Total Contact Hours : 45

Course Outcomes: At the end of the course the student will be able to:

- understand on the concepts of IoT and its present developments.
- analyze different IoT technologies
- use different platforms and infrastructures available for IoT
- understand the big data analytic and its importance
- implement IoT solutions for smart applications

Reference Books(s):

1 Arshdeep Bahga and Vijai Madisetti : A Hands-on Approach “Internet of Things”,Universities Press 2015.

2 Oliver Hersent , David Boswarthick and Omar Elloumi “ The Internet of Things”, Wiley,2016.

3 Samuel Greengard, “ The Internet of Things”, The MIT press, 2015

4 Adrian McEwen and Hakim Cassimally “Designing the Internet of Things “Wiley,2014.

5 Jean- Philippe Vasseur, Adam Dunkels, “Interconnecting Smart Objects with IP: The Next Internet” Morgan Kuffmann Publishers, 2010.

6	Adrian McEwen and Hakim Cassimally, "Designing the Internet of Things", John Wiley and sons, 2014
7	Lingyang Song/Dusit Niyato/ Zhu Han/ Ekram Hossain," Wireless Device-to-Device Communications and Networks, CAMBRIDGE UNIVERSITY PRESS,2015
8	OvidiuVermesan and Peter Friess (Editors), "Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems", River Publishers Series in Communication, 2013
9	Vijay Madisetti , ArshdeepBahga, "Internet of Things (A Hands on-Approach)", 2014
10	Zach Shelby, Carsten Bormann, "6LoWPAN: The Wireless Embedded Internet", John Wiley and sons, 2009
11	Lars T.Berger and Krzysztof Iniewski, "Smart Grid applications, communications and security", Wiley, 2015
12	Janaka Ekanayake, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama and Nick Jenkins, " Smart Grid Technology and Applications", Wiley, 2015.
13	Upena Dalal,"Wireless Communications & Networks,Oxford,2015

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3		3	3		
CO2	3	3		3		
CO3	3		3	3		
CO4		3	3	3	3	
CO5		3	3	3	3	2
AVG	**3**	**3**	**3**	**3**	**3**	**2**

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
ET19P3B	**MACHINE LEARNING**	**PE**	**3**	**0**	**0**	**3**

Objectives: To educate the students

- On several fundamental concepts and methods for machine learning.
- get acquaint with basic learning algorithms and techniques and their applications.
- Acquire knowledge in processing, analyzing and handling data sets.
- Demonstrate typical applications of various clustering-based learning algorithms
- To familiarize the different platforms and Attributes for machine learning

UNIT-I	**INTRODUCTION TO MACHINE LEARNING**	9

Objectives of machine learning – Human learning/ Machine learning – Types of Machine learning: - Supervised Learning – Unsupervised learning – Reinforcement Learning – Evolutionary Learning – Regression – Classification – The Machine Learning Process: - Data Collection and Preparation – Feature Selection – Algorithm Choice – Parameter and Model Selection – Training – Evaluation.

UNIT-II	**DATA PREPROCESSING**	9

Data quality – Data preprocessing: - Data Cleaning: – Handling missing data and noisy data – ata integration: - Redundancy and correlation analysis – Data Reduction: - Dimensionality reduction (Linear Discriminant Analysis – Principal Components Analysis – Factor Analysis –Independent Components Analysis) – Numerosity Reduction – Data Compression – Data Normalization and Data Discretization.

UNIT-III	**SUPERVISED LEARNING**	9

Linearly separable and nonlinearly separable populations – Multi Layer Perceptron – Back propagation Learning Algorithm – Radial Basis Function Network – Support Vector Machines: - Kernels – Risk and Loss Functions – Support Vector Machine Algorithm – Multi Class Classification – Support Vector Regression.

UNIT-IV	**CLUSTERING AND UNSUPERVISED LEARNING**	9

Introduction – Clustering: - Partitioning Methods: - K-means algorithm – Hierarchical clustering – Fuzzy Clustering – Clustering High-Dimensional Data: - Problems – Challenges – Subspace Clustering – Biclustering – Self Organizing Map (SOM) – SOM algorithm.

UNIT-V	**BAYESIAN LEARNING**	9

Probability based clustering – The Expectation Maximization Algorithm – Bayesian Classification – Bayesian

Networks – Learning Bayesian Networks – Hidden Markov Models.			
	Total Contact Hours	**:**	**45**

Course Outcomes:
At the end of the course the student will be able to

●	understand the basic theory underlying machine learning.
●	use the different types of machine learning algorithms along with their strengths and weaknesses.
●	formulate machine learning problems corresponding to different applications.
●	apply machine learning algorithms to solve problems of moderate complexity.
●	read current research publications related to machine learning and understand the issues raised by current research.

Reference Books(s):

1	Stephen Marsland, Machine Learning: An Algorithmic Perspective, CRC Press, 2011.
2	Ian H. Witten, Eibe Frank, Mark A. Hall, Data Mining: Practical Machine Learning Tools and Techniques, Elsevier, 2011
3	Jiawei Han, MichelineKamber, Jian Pei, Data Mining: Concepts and Techniques: Concepts and Techniques, Elsevier, 2011.
4	Ferdinand van der Heijden, Robert Duin, Dick de Ridder, David M. J. Tax, Classification, Parameter Estimation and State Estimation: An Engineering Approach Using MATLAB, John Wiley & Sons, 2005.

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1		3		3		2
CO2	3	3				
CO3	3	3			2	
CO4	3	3				2
CO5	3	3		3		
AVG	**3**	**3**		**3**	**2**	**2**

PROFESSIONAL ELECTIVE –IV

Subject Code	**Subject Name (Theory course)**	**Category**	**L**	**T**	**P**	**C**
ET19P34	**ADVANCED EMBEDDED SYSTEMS**	**PE**	**3**	**0**	**0**	**3**

Objectives:

●	To study the Fundamentals on design attributes of functional units of a Processor.
●	To discuss on Hardware software partitioning in system design.
●	To impart knowledge on intra & Inter processor Communications.
●	To discuss strategies for processor Communications.
●	To provide knowledge on Co-Designs.

UNIT-I	**INTRODUCTION TO EMBEDDED HARDWARE AND SOFTWARE**	9

Terminology - Gates - Timing diagram - Memory - Microprocessor buses - Direct memory access - Interrupts - Built interrupts - Interrupt's basis - Shared data problems - Interrupt latency - Embedded system evolution trends - Interrupt routines in an RTOS environment.

UNIT-II	**SYSTEM MODELLING WITH HARDWARE / SOFTWARE P A R T I T I O N I N G**	9

Embedded systems, Hardware/Software Co-Design, Co-Design for System Specification and modelling- 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 modelling, Formulation of the HW/SW scheduling, Optimization.

UNIT-III	**HARDWARE/SOFTWARE CO-SYNTHESIS**	9

Co-Synthesis Problem, State-Transition Graph, Refinement and Controller Generation, Distributed System Co-Synthesis.		
UNIT-IV	**MEMORY AND INTERFACING**	9
Memory: Memory write ability and storage performance – Memory types – composing memory - Advance RAM interfacing communication basic – Microprocessor interfacing I/O addressing - Interrupts – Direct memory access – Arbitration multilevel bus architecture – Serial protocol - Parallel protocols – Wireless protocols – Digital camera example.		
UNIT-V	**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 among process –Synchronization among process – Implementation – Data Flow model. Design technology - Automation synthesis - Hardware software co-simulation – IP cores - Design Process Model. Case studies of design using UML: elevator, microwave oven, train controller		
	Total Contact Hours : 45	

Course Outcomes: At the end of the course the student will be able to:

- Obtain the design attributes of functional units of a Processor.
- Analyze the Hardware software partitioning in system design.
- Evaluate the intra & Inter processor Communications.
- Determine the various embedded networking protocols, memory in processors.
- Analyze and highlight the importance of various embedded development strategies.

Reference Books(s):

1	David. E. Simon, “An Embedded Software Primer”, Pearson Education, 2001.
2	Tammy Noergaard, ”Embedded System Architecture, A comprehensive Guide for Engineers and Programmers”, Elsevier, 2006
3	Frank Vahid and Tony Gwargie, “Embedded System Design”, John Wiley & sons, 2002.
4	Steve Heath, “Embedded System Design”, Elsevier, Second Edition, 2004.
5	Marilyn Wolf, "Computers as Components, Third Edition: Principles of Embedded Computing System Design", May 2012
6	Jorgen Staunstrup, Wayne Wolf, “Harware/Software Co-Design:Principles and Practice”,Kluwer Academic Pub, 1997.
7	Giovanni De Micheli, Rolf Ernst Morgon, “Reading in Hardware/Software Co-Design” Kaufmann Publishers, 2001.
8	Raj Kamal, “Embedded Systems- Architecture, Programming and Design” Tata McGraw Hill, 2006.
9	David. E. Simon, “An Embedded Software Primer”, Pearson Education, 2001.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2			2	2	2
CO2	3			3	3	3
CO3	2			3	3	3
CO4	2		3	3	3	3
CO5	2		3	3	3	3
AVG	**2.2**		**3**	**2.8**	**2.8**	**2.8**

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
ET19P35	**PERVASIVE DEVICES AND TECHNOLOGY**	**PE**	**3**	**0**	**0**	**3**

Objectives:

- To impart knowledge on the fundamentals of wireless sensor technology
- To understand the infrastructure of WSN processor and its functions.
- To know the challenges in Network communication.
- To learn the interconnectivity of networks.
- To study the classification of commercial family of wireless technology

UNIT-I	OVERVIEW OF WIRELESS SENSOR NETWORKS	9
Challenges for Wireless Sensor Networks- Characteristic requirements for WSN –Challenges for WSNs – WSN vs. Adhoc Networks – Sensor node architecture – Commercially available sensor nodes – Imote, IRIS, Mica Mote, TelosB,-Physical layer and transceiver design considerations in WSNs, introduction to fundamentals of MAC protocols- Low duty cycle protocols and wakeup concepts – Contention- based protocol – Schedule-based protocols – the IEEE 802.15.4 MAC protocol – Energy usage profile, Choice of modulation scheme, Dynamic modulation scaling, Antenna considerations-Applications of sensor networks.		
UNIT-II	**ISSUES IN 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 - Examples of Operating Systems - TinyOS, 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	**PERVASIVE NETWORKING & COMPUTING**	9
Introduction, Networking Infrastructure and Architecture of PERV NET, Mobility management, service discovery, disconnected operation, Dynamic configuration, auto registration, content-based routing, Backbone Technology: Electrical Backbone Networks – Optical Backbone Networks – Wireless Backbone Networks – Wireless Access Technology Pervasive Web Application architecture – Access from PCs and PDAs – Access via WAP.		
UNIT-IV	**PERVASIVE DEVICES**	9
Introduction with Case study of – PDA – Mobile Phone: Elements – Mobile Information Architecture – Mobile Phone Design – Android Overview – The Stack – Android User Interface – Preferences, the File System, the Options Menu and Intents.		
UNIT-V	**EMERGING WIRELESS TECHNOLOGIES**	9
Evolution and Deployment of Cellular Telephone Systems – 1G, 2G, 2.5G, 3G, 4G. Introduction to wireless LAN, Wireless PAN, Wireless MAN, Broadband Satellite and Microware Systems – Emerging Wireless Technologies – IEEE 802.20 Mobile Broadband Wireless Access.		
	Total Contact Hours : 45	

Course Outcomes:

At the end of the course the student will be able to:

- determine the appropriate model of WSN.
- obtain the knowledge of WSN to solve any engineering problem related to WSN.
- analyze the Wireless Backbone Networks.
- evaluate the secure solutions for identified WSN.
- analyze the various emerging wireless technology.

Reference Books(s):

1	Debashis saha, Amitava ukherjee ,"Networking Infrastructure for Pervasive Computing, Springer International edition, 2011.
2	Mullet, "Introduction to wireless telecommunications systems and networks", cengage learning, 2010
3	Frank Adelstein, Sandeep K S Gupta, Golden G Richard III, Loren Schwiebert, "Fundamentals of mobile and pervasive computing, TMH, 2007.
4	Brian Fling,"Mobile Design & Development, O'Reilly, 2011.
5	Marko Gargenta,"Learning Android", O'Reilly,2011.
6	Holger Karl & Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks" , John Wiley, 2005.
7	Feng Zhao & Leonidas J. Guibas, "Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007
8	Kazem Sohraby, Daniel Minoli and Taieb Znati, "Wireless Sensor Networks Technology, Protocols , and Applications", John Wiley & Sons, 2007.'
9	C.Britton Rorabaugh, "Simulating Wireless Communication Systems-Practical Models in C++", Pearson Edu,2006.
10	Mohammad Ilyas And Imad Mahgaob" , Handbook Of Sensor Networks: Compact Wireless And Wired Sensing Systems", CRC Press,2005.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2		3	3	3	3
CO2	2		3	3	3	3
CO3	2		3	3	3	3
CO4	2		3	3	3	3
CO5	2		3	3	3	3
AVG	**2**		**3**	**3**	**3**	**3**

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
ET19P36	**CRYPTOGRAPHY AND NETWORK SECURITY**	**PE**	**3**	**0**	**0**	**3**

Objectives:

- To provide practical survey of principles and practices of Cryptography and network security.
- To understand the basic issues to be addressed by network security capability.
- To impart knowledge on the principles of number theory and the practice of network security and cryptographic algorithms.
- To learn different encryption and decryption schemas.
- To provide basic concepts about system security and attacks.

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 Contact Hours : 45

Course Outcomes: At the end of the course the student will be able to:

- evaluate the security of commercial security products organizational policies and software design.
- analyze the construction of the security within the software design or software deployment.
- evaluate the Speaking cogently about security using the terms of art.
- determine the Making of data transmission security by the process of Authentication.
- analyse the security among the systems by making the firewall and security standards efficient

Reference Books(s):

1 William Stallings, "Cryptography and Network security Principles and Practices", 7th edition, Pearson/PHI, 2017.

2 Wade Trappe, Lawrence C Washington, "Introduction to Cryptography with coding theory", 2nd ed, Pearson, 2007.

3 W. Mao, "Modern Cryptography – Theory and Practice", Pearson Education, Second Edition, 2007.

4 Charles P. Pfleeger, Shari Lawrence Pfleeger – Security in computing Third Edition – Prentice Hall of India 2006.

5 Forouzan, "Cryptography And Network Security", McGraw Hill Education, 3th edition, 2015.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2		3	3	3	3
CO2	2		3	3	3	3
CO3	2		3	3	3	3
CO4	2		3	3	3	3
CO5	2		3	3	3	3
AVG	**2**		**3**	**3**	**3**	**3**

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
ET19P3C	**EMBEDDED PRODUCT DEVELOPMENT**	**PE**	**3**	**0**	**0**	**3**

Objectives:

- Aims at providing the basic concepts of product design, product features & its architecture
- Creative thinking in developing automation into consumer products of market value
- To know the techniques & procedures that are practiced in Industry for Product manufacture
- Developing an embedded product with hardware-software components.
- Need for knowing role of IDE Tools, reverse engineering.

UNIT-I **CONCEPTS OF PRODUCT DEVELOPMENT** 9

Need for PD- Generic product Development Phases- Product Development Process Flows- Product Planning –Product Specifications-Understanding customer and behavior analysis. Basics of Concept Generation-Five Step Method-Concept selection- Creative thinking methods and problem solving- design concepts-systematic methods for designing –functional decomposition – physical decomposition –Product Architecture–changes – variety – component standardization – Bill of materials-example case study on Conceptual Design of Digital Printer as a product.

UNIT-II **INTERFACES FOR PRODUCT DEVELOPMENT** 9

Product development management – establishing the architecture – clustering -geometric layout development – Fundamental and incidental interactions – architecture of the chunks – creating detailed interface specifications-Portfolio Architecture- Producibility-quality assurance-value addition- advertisement-Benchmarking – competitive benchmarking- product performance analysis

UNIT-III **APPROACHES FOR NEW PRODUCT DEVELOPMENT** 9

Idea Generation -Brainstorming Methods – Osborne's Checklist-Conjoint Analysis -Delphi Technique- Six Thinking Hats -TRIZ – Idea generation ,TRIZ Process Methodology -Failure Modes and Effects Analysis- SWOT Analysis-Concept Development & Testing- Risk Management Process- Force Field Analysis- Decision Tree Analysis- KANO Model Methodology- Quality Functional Deployment- Product Life Cycle-v- KANO Model- Gantt Charts- Critical Path Analysis & PERT- Reverse Engineering Methodology- Reverse Engineering of Electronic Components- Finding reusable software components- reverse engineering for consumer product development – ethical aspects in reverse engineering.

UNIT-IV **INDUSTRIAL DESIGN** 9

Integrate process design – Industrial Design – Managing costs- need for Involving CAE, CAD, CAM tools -Prototype basics – Rapid Prototyping – Prototyping Techniques ,- Planning for prototypes- Economic & Cost Analysis – Understanding and representing tasks-baseline project planning – accelerating the project-project execution -Testing-Product Development Testing -Exploratory , Assessment , Validation Tests- Design for X- Industrial Design Management - -Lean Manufacturing- Just In Time (JIT) –Kaizen-Kanban-Re-engineering

UNIT-V **DEVELOPING EMBEDDED PRODUCT** 9

Creating Embedded System Architecture (with atleast one Case study example: Mobile Phone /Adaptive Cruise Controller/ Robonoid about) -Architectural Structures- Criteria in selection of Hardware & Software Components, product design by modeling, Performance, Testing.

Total Contact Hours : 45

Course Outcomes:

At the end of the course the student will be able to:

- Identify the recent trends in embedded systems design with understand the integration of customer requirements in product design

●	apply structural approach to concept generation, creativity, selection and testing so that student can have a basic knowledge in the common features a product has and how to incorporate them suitably in developing it as an commercial grade product.
●	understand various aspects of design such as industrial design, design of Consumer specific product, its Reverse Engineering manufacture, economic analysis through product architecture
●	observe the success strategies practiced by Industries in New Product Development
●	Involve in Miniproject/Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability& entrepreneurship skills
Reference Books(s):	
1	Anita Goyal, Karl T Ulrich, Steven D Eppinger, "Product Design and Development ", 4th Edition,2009, Tata McGraw-Hill Education, ISBN-10-007-14679-9
2	George E.Dieter, Linda C.Schmidt, "Engineering Design", McGraw-Hill International Edition,4th Edition, 2009, ISBN 978-007-127189-9
3	I.Komninos, D. Milossis, N. Komninos, Product Life Cycle Management A Guide to New Product Development, 1991
4	Kevin Otto, Kristin Wood, "Product Design", Indian Reprint 2004, Pearson Education, ISBN 9788177588217
5	Katheryn, A. Ingle, Reverse Engineering, McGraw-Hill, 1994

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	3	3	
CO2		3	3			
CO3		3	3			
CO4		3	3			
CO5		3		2		
AVG	**3**	**3**	**3**	**2.5**	**3**	**0**

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
ET19P3D	**AUTOMOTIVE EMBEDDED SYSTEM**	**PE**	**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 management systems
●	To teach logics of automation & commercial techniques for vehicle communication
●	To introduce the embedded systems concepts for E-vehicle system development.

UNIT-I	**BASIC OF ELECTRONIC ENGINE CONTROL SYSTEMS**	9

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

UNIT-II	**SENSORS AND ACTUATORS FOR AUTOMOTIVES**	9

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

UNIT-III	**VEHICLE MANAGEMENT SYSTEMS**	9

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

UNIT-IV	**ONBOARD DIAGONSTICS AND TELEMATICS**	9

On board diagnosis of vehicles -System diagnostic standards and regulation requirements Vehicle communication protocols Bluetooth, CAN, LIN, FLEXRAY, MOST, KWP2000 and recent trends in vehicle communications-

Navigation- Connected Cars technology – Tracking- Security for data communication- dashboard display and Virtual Instrumentation, multimedia electronics- Role of IOT in Automotive systems			
UNIT-V	**ELECTRIC VEHICLES**		9
Electric vehicles –Components- Plug in Electrical vehicle- Charging station – Aggregators- Fuel cells/Solar powered vehicles- Autonomous vehicles- BMS and Controller.			
	Total Contact Hours	**:**	**45**

Course Outcomes:

At the end of the course the student will be able to:

●	deliver insight into the significance of the role of embedded system for automotive applications.
●	understand the need, selection of sensors and actuators and interfacing with ECU
●	apply the Embedded concepts for vehicle management and control systems.
●	understand the need of Electrical vehicle and able to apply the embedded system technology for various aspects of Evs
●	improve Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design and its application in automotive systems.

Reference Books(s):

1	William B. Ribbens ,"Understanding Automotive Electronics", Elseiver,2012
2	Ali Emedi, Mehrded ehsani, John M Miller , "Vehicular Electric power system- land, Sea, Air and Space Vehicles" Marcel Decker, 2004.
3	L.Vlacic,M.Parent,F.Harahima,"Intelligent Vehicle Technologies", SAE International,2001.
4	Jack Erjavec, Jeff Arias," Alternate Fuel Technology-Electric , Hybrid& Fuel Cell Vehicles", Cengage ,2012
5	Electronic Engine Control technology – Ronald K Jurgen Chilton's guide to Fuel Injection – Ford
6	Automotive Electricals / Electronics System and Components, Tom Denton, 3 rd Edition, 2004.
7	Uwe Kiencke, Lars Nielsen, "Automotive Control Systems: For Engine, Driveline, and Vehicle", Springer; 1 edition, March 30, 2000 .
8	Automotive Electricals Electronics System and Components, Robert Bosch Gmbh, 4 th Edition, 2004.
9	Automotive Hand Book, Robert Bosch, Bently Publishers, 1997.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3		3	
CO2	3	3		2	3	
CO3	3	3	3	2	3	
CO4		3	3			
CO5	3	3	3			3
AVG	**3**	**3**	**3**	**2**	**3**	**3**