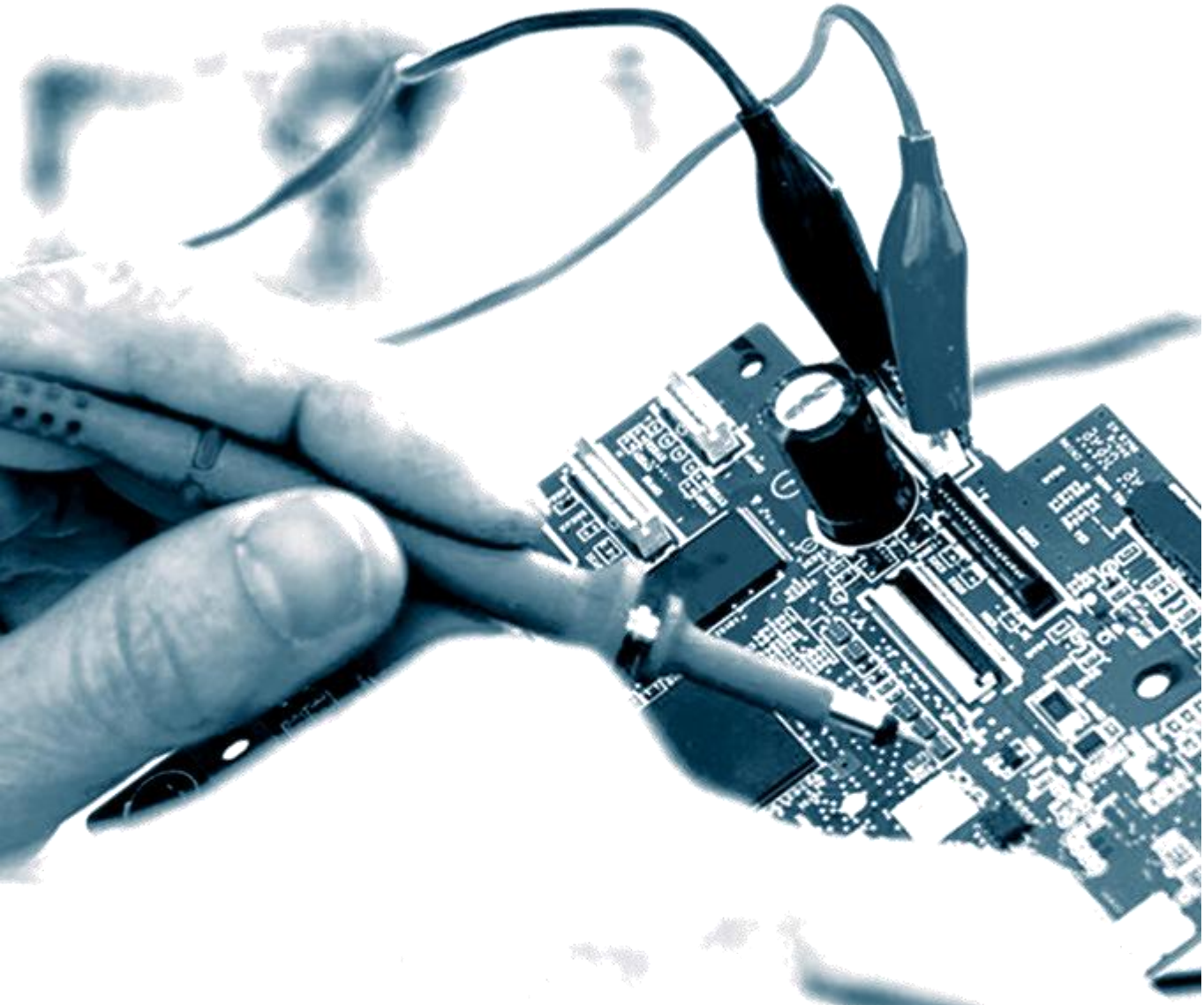

ECSE

EMBEDDED SYSTEMS

First Year (First Semester)

S. No	Course Code	Course Title	Periods			Credits
			L	T	P	
1	18 EM 5101	Advanced Embedded Systems	3	0	2	4
2	18 EM 5102	Advanced Micro Processors and Microcontrollers	3	1	0	4
3	18 EM 5103	Embedded Linux and Drivers	3	1	0	4
4	18 EM 5104	Networking Embedded Systems	3	0	2	4
5		Elective – I	3	0	0	3
6		Elective – II	3	0	0	3
7	18 IE 5149	Seminar	0	0	4	2
		Total	**18**	**2**	**8**	**24**

First Year (Second Semester)

S. No	Course Code	Course Title	Periods			Credits
			L	T	P	
1	18 EM 5205	Digital Signal Processing	3	1	0	4
2	18 EM 5206	FPGA Design	3	0	2	4
3	18 EM 5207	Wireless Networks	3	1	0	4
4	18 EM 5208	Securing Embedded Systems	3	0	2	4
5		Elective –III	3	0	0	3
6		Elective - IV	3	0	0	3
7	18 IE 5250	Term Paper	0	0	4	2
		Total	**18**	**2**	**8**	**24**

Second Year (First & Second Semester)

S. No	Course Code	Course Title	Periods			Credits
			L	T	P	
1	18 IE 6050	Dissertation	0	0	72	36

ELECTIVE COURSES

S.No	Course Code	Course Title	Periods			Credits
			L	T	P	
Elective-1						
1	18 EM 51A1	Digital Image Processing	3	0	0	3
2	18 EM 51A2	Natural Language Processing	3	0	0	3
3	18 EM 51A3	Sensors and Actuators	3	0	0	3
4	18 EM 51A4	Artificial Intelligence	3	0	0	3
Elective-2						
1	18 EM 51B1	Digital Video Processing	3	0	0	3
2	18 EM 51B2	Machine Learning	3	0	0	3
3	18 EM 51B3	Internet of Things	3	0	0	3
4	18 EM 51B4	Digital Instrumentation	3	0	0	3
Elective-3						
1	18 EM 52C1	Digital Audio Processing	3	0	0	3
2	18 EM 52C2	Deep Learning	3	0	0	3
3	18 EM 52C3	Developing IOT Applications	3	0	0	3
4	18 EM 52C4	Wireless Sensor Networks	3	0	0	3
Elective-4						
1	18 EM 52D1	Video and Audio Streaming	3	0	0	3
2	18 EM 52D2	Cloud Computing and Big Data Analytics	3	0	0	3
3	18 EM 52D3	Data Analytics for IOT	3	0	0	3
4	18 EM 52D4	Sensor Network Programming	3	0	0	3

Detailed Syllabus Design – Semester – 1

Course	Advanced Embedded Systems		
Course Code	18EM5101	L-T-P-S	3-0-2-0
Pre-Requisites	NIL	Credits	4

CO No	Course Outcome (CO)	PO/PSO	BTL
CO1	Able to understand embedded systems structure, software development process	PO1, PO2	2
CO2	Able to interface and program different off chip peripherals used in embedded systems and basic	PO1, PO2	2

	communication terminology		
CO3	Able to understand basic communication technologies and RTOS architecture	PO1, PO2	2
CO4	Able to understand various features of RTOS	PO1, PO2	2
CO5 (Only for lab components)	Able to understand basic concepts of embedded system software development and able to develop a prototype for a real time embedded application using project based labs.	PO1, PO2, PO3, PO5	3

Syllabus

Advanced Embedded systems

Moving forward from Processors & Controllers to Embedded systems: Moving on from 8051 & assembly language to Atmega and Programming using C

Introduction to Embedded Systems: Definition, Comparison with Loaded Systems, Challenges of Embedded systems, Application of Embedded Systems. Reading through an Embedded Board, terminology, symbols and notations considering Arduino board.

Hardware fundamentals

Power, coupling and decoupling, Open collector out puts, Tristate outputs, Signal loading related issues, Memories types and selection, Processor types and selection.

General discussion on Atmega 328 Architecture, On chip devices: Timers, Counters, watchdog timer, Pulse width Modulation, Interrupts, Overview on device interfacing with Atmega 328: LCD, Key Pad Stepper motor, A/D Converters,

Introduction to Embedded programming

Languages that can be used to develop firmware. Differences between C and Embedded C especially related to address mapping, Relevance to Header

files included into the embedded C programs in relation to Arduino board. IDE and RTOS: Introduction to IDE and FreeRtos, Downloading and installing Arduino IDE and FreeRTOS, setting environment for development of applications using Arduino board. Sample program

Basic Interfacing: Interfacing through Ports and PINS, Implementing Memory based, and I/O based, and BUS based Addressing, Basic Interfacing: Interrupt based I/O, Interrupt latency.

Measuring time through timers:

Block diagrams, Layout, principal of operation, interfacing with a Micro controller, developing sample application using timers.

Using counters

Block diagrams, Layout, principal of operation, interfacing with a Micro controller, sample application. Pulse with modulation – the primary concepts, use of pulse width modulators for speed control of stepper Motors: Block diagrams, Layout, principal of operation, interfacing with a Micro controller, sample application, Use of pulse width modulators for speed control of DC motors: Block diagrams, Layout, principal of operation, interfacing with a Micro controller, sample application (E4)

Writing on to LCD at function Level: Block diagrams, Layout, principal of operation, interfacing with a Micro controller, developing sample application to write on to LCD). Reading from Matrix Keyboards: Block diagrams, Layout,principal of operation, interfacing with a Micro controller, sample application. (E6) Reading analog inputs (Temperature) through A/D converters: Block diagrams, Layout, principal of operation, interfacing with a Micro controller, sample application.

Reading analog inputs (Flow) through A/D converters

Block diagrams, Layout, principal of operation, interfacing with a Micro controller, sample application.

Reading analog inputs (Humidity) through A/D converters: Block diagrams, Layout, principal of operation, interfacing with a Micro controller, sample application.

Firmware Architectures

Round Robin, Round Robin with Interrupts, Function Queue Scheduling, RTOS architectures, Sample Applications using Embedded Software Architecture

Introduction to RTOS

Task and Task Data, re-entry, semaphores and shared data problem. Scheduling tasks under RTOS: Principles, Sample application, related tasks and scheduling, Introduction to soft and hard real time requirements. Introducing Inter Task communication: Message ques, Pipe and Mail Boxes, Implementation of Inter task communication (E13) using message Queues

Effecting Inter task communication through Mail Boxes

Sample application, related tasks, Effecting Inter task communication through Mail Boxes: Sample application, related tasks. Implementing timing under RTOS: Basic concepts, Sample application and Implementation, Implementing Event handling under RTOS: Basic concepts, Sample application, Sample application that implements event handling under RTOS. Managing memory and power: Using memory through RTOS, Power management using RTOS, Managing power under RTOS

Text books

1. David E Simon, "An embedded Software Premier", Pearson Education, Edition 2007
2. Frank Vahid and Tony Givargis, "Embedded software Division", John Wiley and Sons, 2002 Edition
3. Arduino Technical Documentation

Reference books

1. Raj Kamal, "Embedded Systems - Architecture, programming and design", er and Embedded Systems-Mazidi and Mazidi, 2 Edition

Advanced micro Processors and Controllers

Course	Advanced MicroProcessors and Controllers		
Course Code	18EM5102	L-T-P-S	3-1-0-0
Pre-Requisites	NIL	Credits	4

Co no	CO	PO/PSO	BTL
1	Understand Micro Processors and Micro Controllers, 3 and 5 stag pipelines of ARM	PO1	1
2	Apply instructions set of ARM 7 processor using assembl language	PO2	2
3	Understand the AMBA bus architecture	PO1	1
4	Analyze different advanced ARM cores and their use in SO applications	PO2	2

Syllabus

Introduction to advanced features built into Advanced Micro processors and controllers: Review of the Features supported in Basic Micro Controllers (8051 + Atmega) and Advanced processors and micro controllers, a brief review of the features supported in advanced micro processors and controllers

Introduction to ARM Technologies: Variants of ARM processors and controllers, Advanced ARM processors and controllers

ARM Processor (ARM7): Features, Components, Connectivity, Acorn RISC Machine

– Architecture inheritance – 3 and 5 stage pipeline ARM organizations – Advanced Microcontroller bus architecture- Little Endian Big Endian architecture

ARM Controller (LPC2148): Features, Pin configuration, On Chip Devices: GPIO, Serial communication, A/D Converters: single and Multiple Channels, Interrupts,

Basic Interfacing, GPIO and interfacing devices to the GPIO, Fast GPIO

ARM programming through C++ using IDE-IAR: Overview on KEIL/IAR, installing KEIL/IAR, Drill down using C/C++: Variable declaration, includes, Conditional and Looping instructions, Computational instructions,loops,

Interfacing with LPC2148: Developing application for effecting communication between PC and LPC2148, Interfacing RFID, GSM, Smart card and developing small applications, Implementing application through RTOS: Interrupt processing and inter-task communication

TEXTBOOKS :

1. ARM System on Chip Architecture – Steve Furber – 2nd ed., 2000, Addison Wesley Professional
2. Volume 1: LPC214x User Manual, UM10139, http://www.semiconductors. philips.com
3. John H. Davies, "MSP430 Microcontroller Basics", Newnes (Elsevier Science), 2nd Edition, 2008.

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Embedded Linux and drivers

Course	Embedded Linux and drivers		
Course Code	18EM5103	L-T-P-S	3-1-0-0
Pre-Requisites	NIL	Credits	4

CO No	Course Outcome (CO)	PO/PSO	(BTL)
CO1	Understand the using of Eclipse as IDE	P01/PSO1	1
CO2	Understand the basic concepts of LINUX	P01/PSO1	1
CO3	Students be able to configure and cross compile the same for porting on to controllers	P02/PSO2	2
CO4	Understand the tool chain used for configuring, compiling and porting embedded linux to the target systems	P02/PSO2	2

Syllabus

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

Architecture of Embedded Linux

Linux Kernel Architecture - Porting Linux into controllers, GNU Cross Platform Tool chain Host - target setup and overall architecture: Real Life Embedded Linux Systems - Design and Implementation Methodology - Types of Host/ Target, Development Setups - Types of Host/Target Debug Setups - Generic Architecture of an Embedded Linux System - System Startup - Types of Boot Configurations – System Memory Layout – Processor Architectures - Buses and Interfaces - I/O Storage

Kernel configuration

A Practical Project Workspace - GNU Cross - Platform Development Toolchain - C Library Alternatives - Other Programming Languages

Porting Linux into the target using Eclipse: An Integrated Development Environment – Terminal Emulators - Selecting a Kernel - Configuring the Kernel

- Compiling the Kernel - Installing the Kernel - Basic Root Filesystem Structure
- Libraries - Kernel Modules and Kernel Images – Device Files – Main System Applications - System Initialization

Embedded Storage and drivers : Flash Map, MTD—Memory Technology Device, MTD Architecture, Flash-Mapping Drivers, MTD Block and Character devices, device drivers, Embedded File systems;

Developing other Embedded Drivers: Linux Serial Driver, Ethernet Driver, I2C subsystem on Linux, USB driver, RS485 Driver, CAN driver

TextBooks :

1. Karim Yaghmour, Jon Masters, Gilad Ben - Yossef, and Philippe Gerum, 'Building Embedded Linux Systems 2nd Edition', SPD - O'Reilly Publica-tions, 2008
2. P.Raghavan, AmolLad, Sriram Neelakandan,"Embedded Linux System Design & Development,Auerbach Publications, 2012
3. William von Hagen, 'Ubuntu Linux Bible 3rd Edition', Wiley Publishing Inc., 2010
4. Jonathan Corbet, Alessandro Rubini & Greg K roah Hartman, 'Linux Device Drivers 3 rd Edition', SPD - O'Reilly Publications , 2011
5. Robert Love,"Linux System Programming, SPD- O'Reilly Publica-tions, 2010

Networking of Embedded Systems

Course	Networking Embedded Systems		
Course Code	18EM5104	L-T-P-S	3-0-2-0
Pre-Requisites	NIL	Credits	4

CO No	Expected Course Outcomes (CO)	PO	BTL
CO1	Able to understand and describe serial communication protocols using 8051 and LPC2148 controllers.	PO1	2
CO2	Able to understand and describe I2C and USB communication protocols.	PO2	4
CO3	Able to understand and describe CAN communication protocol	PO2	2
CO4	Able to understand and describe Ethernet communication protocols	PO2	4
CO5	Able to interface the communication protocols SPI, I2C, UART, USB, CAN, Ethernet etc., using ARM LPC2148 development board.	PO3 PO5	5

Syllabus

Introduction to networking peer topeerconnectivity, anyto anyconnectivity, Rs232C review. A small review on essential of communication Networking through RS485: RS485 Standards, balanced Differential Lines, Termination resistors, Topologies, cable length and data rate, Maximum number of devices in a RS485 network, Grounding and Common wires, Connections, Half- duplex- RS485, RS485 converters, Full-duplex-RS485

Networking through USB: Introduction, Speed identification on the bus, USB states, USB bus communication – Packets, Data flow types, Enumeration, descriptors, interfacing PIC 18 with USB, Developing Sample networking of
embedded systems using USB

Meaning, the I2C Bus, Acknowledgments and negative Acknowledgements, addressing, I2C Firmware, Developing Sample networking of embedded systems using I2C

Networking through CAN: Introduction, Frames, bit stuffing, error detection, types of errors, Nominal bit timing, Interfacing PIC controller with CAN, Development of Sample Networking of embedded systems using PIC Micro Controllers

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

TextBooks :

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

Elective – 1

Digital Image Processing

Course	Advanced Embedded Systems		
Course Code	18EM51A1	L-T-P-S	3-0-0-0
Pre-Requisites	NIL	Credits	3

CO No	Course Outcome	PO	BTL
1	Students will be able to understand the fundamentals of Image processing and what are the basic parameters required to handle Image processing	PO2	2
2	Students will be able to understand various types of Transform and the frequency domain analysis They will be able to analyze different frequency domain filters for Image enhancement	PO3	3
3	Application of Image restoration will be understood Analysis of Different types of filters for noise reduction	PO1	4
4	Understanding and application of Image compression and segmentation and how they can be useful for further research Analysis of different parameters of Image segmentation	PO5	4

Syllabus

Introduction

Origin of Digital Image Processing, Fields that uses Digital Image Processing, Fundamental steps in Digital Image Processing, Components of an Image Processing System.

Digital image fundamentals

Elements of Visual perception, Image sampling and Quantization, Basic relationships between Pixels, Linear and Non-linear operations.

Digital image transforms

Image Transforms – The Discrete Fourier Transform, The FFT, Walsh, Hadamard, Discrete Cosine Transform, The Haar Transform, And The Slant Transform,

Image enhancement in spatial domain

Some basic Grey level transformations, histogram processing, enhancementusing Arithmetic/Logic operations, Smoothing Spatial Filters, Sharpening Spatial Filters.

Image enhancement in frequency domain: Introduction to Fourier Transform and the Frequency Domain, Smoothing Frequency Domain Filters, Sharpening Frequency Domain Filters.

Image restoration

Noise models, Restoration in the presence of Noise, only Spatial Filtering, Periodic Noise reduction by Frequency Domain Filtering, Linear, Position-Invariant Degradations, Inverse Filtering, Wiener Filtering, Least mean square Filtering.

Image compression

Fundamentals –Image Compression models –Error Free Compression, Lossy Compression.

Image segmentation

Detection of discontinuities, Thresholding, Edge based Segmentation and Region based Segmentation.

Image representations and description Representation schemes, Boundary Descriptors, Regional Descriptors

TEXTBOOKs :

1. Rafael C Gonzalez, Richard E Woods," Digital Image Processing", Second Edition, Pearson Education Asia, 2002. (Chapter 1, 3, 4, 5, 6, 7, 8, 9)
2. Jorg Arndt, " DSP Algorithms for Programmers"(Chapter 3)
3. Gonzalez. R & Woods B.E.," Digital Image Processing", Addison Wesley Longman Pearson Education, 2000.

Reference books :

1. MilanSonka, Vaclav Hlavac and Roger Boyle, Image Processing Analysis and Machine Vision, Thomson learning, Second Edition, 2001.
2. William J Prati, "Digital Image Processing", John Wiley & sons
3. Tinku Acharya, Ajoy K Ray,"Image Processing Principles and Applications Principles and Applications", Wiley- Inter science.

Natural Language processing

Course	Natural Language Processing		
Course Code	18EM51A2	L-T-P-S	3-0-0-0
Pre-Requisites	NIL	Credits	3

CO#	CO Description	PO	BTL
CO1	Understand the Basic Idea Statistical machine translation, Language models	1, 2	2
CO2	Understand the concepts Parts of Speech and Sentences and Statistical Machine Translation	1, 2	4
CO3	Understand the concepts Speech processing, Syntactic-parsing and Semantic Analysis	1, 2	4
CO4	Understand and analyze the concepts Information Extraction (IE)	1, 2	4

Syllabus

Introduction

overview, Statistical machine translation, Language models and their role in speech processing, The problem of ambiguity, NLP tasks in syntax, semantics, and pragmatics. Words: Structure, Semantics

Arts of Speech and Sentences

Basicideas in compositional semantics, Classical Parsing (Bottom up, top down,

Dynamic Programming: CYK parser). Sentences

Parsing using Probabilistic Context Free Grammars and EM based approaches for learning PCFG parameters.

N-gram Language Models and Information Theory: The role of language models. Simple N-gram models, Entropy, relative entropy, cross entropy, Statistical estimation and smoothing for language models.

Statistical Machine Translation (MT) Alignment Models: Statistical Alignment Models and Expectation Maximization (EM) EM and its use in statistical MT alignment models, EM algorithm.

Speech processing

Part of Speech Tagging and Sequence Labelling, Lexical syntax. Hidden Markov Models (Forward and Viterbi algorithms and EM training). N-gram models.

Syntactic-parsing

Grammar formalisms, treebanks. Efficient parsing for context-free grammars (CFGs), Statistical parsing, probabilistic CFGs (PCFGs, Top-down and bottom-up parsing, empty constituents, left recursion.

Modern Statistical Parsers Search methods in parsing: Agenda-based chart, A*, "best-first" parsing, Dependency parsing, Discriminative parsing.

Semantic Analysis

Lexical semantics and word-sense disambiguation. Discourse: Reference resolution and phenomena, syntactic and semantic constraints on Reference, pronoun resolution algorithm, text coherence, discourse structure. Labelling and parsing of semantics. Sy

Information Extraction (IE)

Named entity recognition and relation extraction, sequence labelling, Information sources, rule-based methods, evaluation (recall, precision.

Machine Translation (MT): Basic issues in MT. Rule based Techniques, Statistical Machine translation (SMT), word alignment, phrase-based translation, and synchronous grammars,

Additional topics

Advanced Language Modelling (including LDA), other applications like summarization.

TEXTBOOKS :

1. Daniel Jurafsky and James H. Martin "An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", Second Edition.
2. Bird, S., Klein, E., Loper, E. (2009). Natural Language Processing with Python. Sebastopol, CA: O'Reilly Media.

Reference Books :

1. James A.. Natural language Understanding 2e, Pearson Education, 1994
2. Bharati A., Sangal R., Chaitanya V.. Natural language processing: a Panin-ian perspective, PHI, 2000
3. Siddiqui T., Tiwary U. S.. Natural language processing and Information retrieval, OUP, 2008.
4. Manning, Christopher D.; Hinrich Schuetze; Foundations of Statistical Natural Language Processing Cambridge, MIT Press, 1999.
5. Kiraz, George Anton; Computational Nonlinear Morphology: With Emphasis on Semitic Languages Cambridge University Press, 2001, 171 pages

Sensors and Actuators

Course	Sensors and Actuators		
Course Code	18EM51A3	L-T-P-S	3-0-0-0
Pre-Requisites	NIL	Credits	3

CO No	Course Outcome (CO)	PO/PSO	BTL
CO1	To make the students understand the operating principles, signal conditioning, and A/D conversion	PSO1	1
CO2	The students must be able to trace of the Analog signal flow from the sensors till the time the data is received at the controller side.	PSO1, PSO4	2
CO3	The students must be able to trace of the Analog signal flow from controller till the time the actual control is exercised	PSO4	2
CO4	The students must be able to trace of the Digital signal flow from the digital sensors till the time the data is received at the controller side.	PSO5	2

Syllabus

Introduction to Sensors and Actuators

Role of sensors and actuators, sensors and Actuators in Automobile Systems, Sensors and Actuators in feedback control system, Importance of estimation in sensing, Innovative Sensor technologies, Application scenarios, Analog and digital transducers and Actuators Component interconnection. Signal modification conditioning, Importance of Impedance Matching in Component Interconnection, Impendence matching methods

Analog Sensors

Principle of operation. Transduction concept, signal amplification, timing, scaling, range calibration, interfacing considering Temperature sensors, Humidity sensors, LDR, stepper motor, Level sensor, pressure, Piezo Vibration sensor, and Flow sensor, Potentiometers, differential transformers, tachometers, piezoelectric devices, gyros, Keyboards

Analog Actuators

Principle of operation. Transduction concept, signal amplification, timing, scaling, range calibration, interfacing considering Stepper Motors, PieZo Actuator, Solenoid Valve, relay systems, Ultrasonic Motor Actuator

Digital Sensors

Principle of operation. Transduction concept, signal amplification, timing, scaling, range calibration, interfacing considering Temperature sensors, Humidity sensors, LDR, Level sensor, pressure, and Flow sensor

Digital Actuators

Principle of operation. Transduction concept, signal amplification, timing,scaling, range calibration, interfacing considering DC, servo Motors, PieZo Actuator, Solenoid Valve, relay systems, Ultrasonic Motor Actuator

TextBookS :

1. Sensors and actuators, Engineering System for instrumentation, 2nd Edition, Clarence W d Selva, CRC Press
2. Data Sheets downloaded from different WEB sites

Artificial Intelligence

Course	Artificial Intelligence		
Course Code	18EM51A4	L-T-P-S	3-0-0-0
Pre-Requisites	NIL	Credits	3

CO No	Course Outcome (CO)	PO	BTL
CO1	To make the students understand Artificial Intelligence foundations and its applications	PO1	2
CO2	The students must be able to understand local and adversarial search techniques.	PO2	2
CO3	The students must be able to analyse knowledge and reasoning models.	PO5	3
CO4	The students must be able to analyse handling uncertainty using different models.	PO5	3

Syllabus

Introduction to AI: Intelligent Agents, Solving problems by searching, problem-solving agents, well defined problems and solutions with examples.

Applications of AI: ANN, Fuzzy Systems, NLP. Introduction to Expert systems.
Uninformed search strategies: BFS, DFS, Iterative deepening, bidirectional search. Heuristic Search Techniques: Greedy BFS, A*, memory bounded, heuristic functions.

Local & Adversarial search: Optimization problems, hill climbing search, simulated annealing, local beam search, genetic algorithms. Online search agents and unknown environments. Optimal decisions in games, alpha-beta pruning, cutting of search, forward pruning, stochastic games, partially observable games. Constraint satisfaction problems:-Inference in CSPs, back tracking search foe CSPs, Local search for CSPs.

Knowledge and reasoning: knowledge based agents, Logic, propositional logics and horn clauses, first order logic, Inference in first order logic, Propositional versus first order inference, unification and lifting, forward & backward chaining, resolution.

Handling Uncertainty: Quantifying uncertainty, basic probability notation, Bayes theorem, Probabilistic reasoning, representation of conditional distributions, probabilistic reasoning overtime, hidden Markov model, and Kalman filters.

TextBooks :

1. Russel and Norvig, 'Artificial Intelligence', third edition, Pearson Education, PHI, (2015)
2. Elaine Rich & Kevin Knight, 'Artificial Intelligence', 3nd Edition, Tata McGraw Hill Edition, Reprint(2008)

REFERENCE Books :

1. Patrick Henry Winston, 'Artificial Intelligence', Pearson Education (2003)
2. G. Luger, W. A. Stubblefield, "Artificial Intelligence", Third Edition, Addi-son-Wesley,(2007)
3. William F. Clocks in, Christopher S. Mellish-Programming in Prolog- Spring-er (2003)

Elective – 2

Digital video processing

Course	Digital Video Processing		
Course Code	18EM51B1	L-T-P-S	3-0-0-0
Pre-Requisites	NIL	Credits	3

CO No	Course Outcome (CO)	PO	BTL
CO1	To make the students describe the video processing principles	PO1	2
CO2	The students must be able to trace the optical flow and optimization methods	PO2	2
CO3	The students must be able to analyze 3D motion estimation and segmentation	PO5	3
CO4	The students must be able to analyze motion compensated filtering	PO5	3

Syllabus

Representation of Digital Video

Basics of Video: Analog Video, Digital Video, Digital Video Processing, Time Varying image formation models: 3D motion models, Geometric image formation, Photometric image formation, Photometric effects of 3D motion, Spatio temporal sampling: Sampling for analog and digital sampling, Sampling on 3D Structures, Reconstruction from samples.

2D Motion and Estimation

Optical Flow Methods: 2D motion, 2D Motion Estimation, Methods using optical flow equation, PEL Recursive Methods: Displaced frame difference, Gradient based optimization, Steepest decent based algorithms, Wiener estimation based algorithms, Bayesian Methods: Optimization methods, Basics of MAP motion estimation, MAP motion estimation algorithms.

3D Motion Estimation and Segmentation

Methods using point correspondences: Modeling the projected displacement field, methods based on the orthographic model, methods based on the perspective model, case of 3D planar surfaces,

Motion Segmentation

Direct methods, Optical flow segmentation, Simultaneous estimation and segmentation, Stereo and motion tracking: Motion and structure from stereo, Motion tracking – 2D and 3D.

Video Filtering

Motion Compensated Filtering

Spatio temporal Fourier Spectrum, Sub Nyquist spatio temporal sampling, filtering along motion trajectories, Applications: motion compensated noise filtering, motion compensated reconstruction filtering, Noise Filtering: Intraframe filtering, Motion adaptive filtering, Motion compensated filtering.

Video Compression and Digital Video Systems

The H.261 Standard, The MPEG-1 Standard, The MPEG-2 Standard, Software and Hardware Implementations, Video Conferencing, interactive video andmultimedia, Digital Television, Low bitrate video and videophone.

TEXTBOOK :

1. Digital Video Processing by A M Tekalp, Prentice Hall.

Machine Learning

Course	Machine Learning		
Course Code	18EM51B2	L-T-P-S	3-0-0-0
Pre-Requisites	NIL	Credits	3

CO No	CO Description	PO	BTL
CO1	Understand the Basic Idea of Machine Learning, its Goals and Decision Trees	1, 2	2
CO2	Understand the concepts of decision tree , Bayesian learning models	1, 2	4
CO3	Understand the concepts of artificial neural networks	1, 2	4
CO4	Understand the concepts of Genetic algorithms, learning rule sets and analytical learning.	1, 2	4

Syllabus Design

Introduction and Decision Trees

Introduction to Learning problems. Designing a Learning System: Choosing Training Experience, Choosing target Function, Choosing a Representation for the Target function, choosing a Function Approximation Algorithm, the final Design.

Perspectives and Issues in Machine Learning

Issues in Machine Learning. Decision Tree Learning: Introduction, Decision Tree Representation, Appropriate Problems for Decision Tree Learning. The Basic Decision Tree Learning Algorithm: Which attribute is the Best classifier, an illustrative example, Hypothesis Space Search in Decision Tree Learning?

Inductive Bias in Decision Tree Learning

Restriction Biases and preference Biases, why prefer short Hypotheses. Issues in Decision Tree Learning: Avoiding Over fitting the Data, Incorporating Continuous-valued Attributes, Alternative Measures for Selecting Attributes, Handling Training Examples with Missing Attribute Values, Handling Attributes with Differing Costs.

Bayesian Learning

Introduction, Bayes Theorem. Bayes Theorem and Concept Learning: Brute-Force Bayes Concept Learning, MAP Hypothesis and Consistent Learners. Maximum Likelihood and Least-squared Error Hypotheses, Maximum Likelihood Hypothesis for predicting probabilities: Gradient Search to Maximize Likelihood in a Neural Net. Minimum Description Length Principle,

Bayes Optimal Classifier, Gibbs Algorithm, Naive Bayes Classifier, and An Example: Learning to classify Text.

Bayesian Belief Networks

Conditional Independence, Representation, Inference, Learning Bayesian Belied Networks, Gradient Ascent Training of a Bayesian Networks, Learning the structure of Bayesian Networks. The EM Algorithm: Estimate Means of K Gaussians, General Statement of EM Algorithm, Derivation of the K Means Algorithm

Artificial Neural Networks

Introduction, Neural Network Representations, Appropriate Problems for Neural Network Learning, Perceptron, and Multi-Layer Networks and BACK PROPAGATION Algorithm, Remarks on the BACK PROPAGATION Algorithm, Advanced Topics in Artificial Neural Networks.

Genetic Algorithms

Motivation, Genetic Algorithms, An illustrative Example, Hypothesis Space Search, Genetic programming, Models of Evolution and Learning, Parallelizing Genetic Algorithm

Learning Sets of Rules

Introduction, Sequential Covering Algorithms, Learning Rule Sets: Summary, Learning First-Order Rules, Learning Sets of First-order Rules: FOIL, Induction as Inverted Deduction, Inverting Resolution.

Introduction to Analytical Learning

Inductive and Analytical Learning Problems, and Learning with Perfect Domain Theories: PROLOG-EBG, Remarks on Explanation Based Learning, Explanation Based Learning of

TextBooks :

1. Tom M.Mitchell ,"Machine Learning", McGraw Hill,1997
2. Stephen Marsland, "Machine Learning an Algorithmic Perspective", CRC Press,(2009). nd
3. Chun, J Wesley, Core Python Programming, 2 Edition, Pearson, 2007 Reprint 2010.
4. Programming Python by Mark Lutz, O'Reilly.

REFERENCE Books :

1. Ethem Alpadin, "Introduction to Machine Learning", The MIT Press, (2010)

Internet Of Things

Course	Internet of Things		
Course Code	18EM51B3	L-T-P-S	3-0-0-0
Pre-Requisites	NIL	Credits	3

CO No	Course Outcome (CO)	PO/PSO	BTL
CO1	Understand functional blocks and functioning of IOT devices	PO1	1
CO2	Understand Communication models and protocols that are used for development of the IOT based Systems	PO2	2
CO3	Understand different networking topologies used for the development of IOT based Networks	PO1	2
CO4	Understand various IOT design Components, Analyse various protocols for IoT	PO2	2

Detailed Syllabus

Introduction to IOT

Definition, Characteristics, things in IOT, Challenges of IOT based Systems, IOT Device: Building Blocks, Raspberry Pi as an IOT device, Raspberry PI components, Porting LINUX on Raspberry PI, Raspberry PI frequently used commands, Raspberry PI interfaces: Serial, SPI and I2C, Other IOT devices

IOT Communication model and Protocols: Link Layer: 802.3 Ethernet, 802.11 WiFi, 802.16 WiMax, 802.15.4 LR-WPAN, 2G/3G/4G Mobile Communication,

Network/Internet Layer: IPv4, IPv6, IPv6 Low power, Transport Layer: TCP, UDP, Application Layer:HTTP, CaAP, WebSocket, MQTT, XMPP, DDS, AMQP

IOT Design Components: Function Blocks, Communication Models, Communication API

IOT Enabling Technologies

Wireless sensor networks, Cloud Computing, Big data Analytics, Embedded Systems, Communication protocols

IoT Topologies and deployment models

IOT Deployment components (Devices, resources, controller service, database, web services (stateless/Stateful, Unidirectional / Bi Directional, Request-response/Full duplex, TCP Connections, Header Overhead , Scalability), Analysis Components, Applications, Communication Topologies: Level-1, Level-2, Level-3, Level-4, Level-5, Level-6

TextBook :

1. Arshdeep Bahga and Vijay Madisetti,, Internet of Things - A Hands-on Ap-proach, Universities Press, 2015, ISBN: 9788173719547 .

REFERENCE Books :

2. Wolfram Donat "Learn Raspberry Pi programming in python", Apress (2014), ISBN – 9781430264255
3. Matt Richardson & Shawn Wallace, Getting Started with Raspberry Pi, O'Reilly (SPD), 2014, ISBN: 9789350239759.
4. "Learning Python", Fifth Edition by Mark Lutz, Published by O'Reilly Media, ISBN: 978-1-449-35573-9.

Digital Instrumentation

Course	Digital Instrumentation		
Course Code	18EM51B4	L-T-P-S	3-0-0-0
Pre-Requisites	NIL	Credits	3

CO No	Expected Course Outcomes (CO)	PO	BTL
CO1	To make the students understand the operating principles of Data acquisition systems and Data acquisition interface requirements	PO1 & PO6	2
CO2	The students must be able to understand the communication protocols and Instrument communication	PO2 & PO6	3
CO3	The students must be able to realize the importance of Virtual instrumentation and implementation of Virtual instrumentation.	PO2	3
CO4	The students must be able to Configure programmable instrumentation.	PO2 & PO5	4

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

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

Virtual instrumentation basics: Block diagram, role, and Architecture for VI— tool bar, Graphical system design &programming using, Virtual Instrumentation for test, control design-modular programming: conceptual and program approaches for creation of panels, icons, Loops, Arrays, clusters, plotting data structures, strings and File, I/O- Instrument Drivers

Configuring programmable instrumentation: Microprocessor based system design –Peripheral Interfaces systems and instrument communication standards –Data acquisition with processor and with VI – Virtual Instrumentation Software and hardware simulation of I/O communication blocks-peripheral interface, ADC/DAC – Digital I/O – Counter, Timer-servo motor control, PID control.

Text Books

1. Mathivanan, "PC based Instrumentation Concepts and practice", Prentice-Hall India, 2009
2. Jovitha Jerome," Virtual Instrumentation using Labview" PHI,2010.
3. Gregory J. Pottie / William J. Kaiser, Principles of Embedded Networked Systems Design,
1. CAMBRIDGE UNIVERSITY PRESS (CUP),2016
4. Jonathan W Valvano, "Embedded Microcomputer systems", Brooks/ Cole, Thomson, 2010.

References

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

Seminar

Detailed Syllabus

Any Chosen topic in technology, emerging research area

Detailed Syllabus design Semester – 2

Digital Signal Processing

Course	Digital Signal Processing		
Course Code	18EM5205	L-T-P-S	3-0-2-0
Pre-Requisites	NIL	Credits	4

CO No	Course Outcome (CO)	PO/PSO	BTL
CO1	students understand the basic concepts related to digital signal processing	PO2	2
CO2	students understand various issues related to programmable Analog and digital DSP devices	PO2	2
CO3	students understand various issues related to programmable DSP processors	PO2	2
CO4	students understand various issues related to Interfacing peripherals to programmable DSP devices	PO2	2
CO5	Ability to design and implementation of a) Convolution b) DFT & IDFT c) FFT e) FIR and IIR filters f) ALU.	PO2	4

Detailed Syllabus Design

Introduction To Digital Signal Processing

Introduction, A Digital signal- processing system, The sampling process, Discrete time sequences. Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), linear time- invariant systems, Digital filters, Decimation and interpolation

Computational Accuracy in DSP Implementations

Number formats for signals and coefficients in DSP systems, Dynamic Range and Precision, Sources of erroring DSP implementations, A/D Conversion errors, DSP Computational errors, D/A Conversion Errors, Compensating filter.

Programmable DSP Devices: Basic features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Speed Issues, Features for External interfacing.

Programmable Digital Signal Processors

Commercial Digital signal-processing Devices, Data Addressing modes of TMS320C54XX DSPs, Data Addressing modes of TMS320C54XX Processors, Memory space of TMS320C54XX Processors, Program Control, TMS320C54XX instructions and Programming, On-Chip Peripherals, Interrupts of TMS320C54XX processors, Pipeline Operation of TMS320C54XX Processors.

Analog Devices Family of DSP Devices

Analog Devices Family of DSP Devices- ALU and MAC block diagram, Shifter Instruction, Base Architecture of ADSP2100, ADSP-2181 high performance Processor. Introduction to Blackfin Processor – The Blackfin Processor, Introduction to Micro Signal Architecture, Overview of Hardware Processing Units and Register files, Address Arithmetic Unit, Control Unit, Bus Architecture and Memory, Basic Peripherals.

Interfacing Memory And I/O Peripherals to Programmable DSP Devices
Memory space organization, External bus interfacing signals, Memory interface, Parallel I/O interface, Programmed I/O, Interrupts and I/O, Direct memory access (DMA).

TextBooks :

1. Digital Signal Processing – Avtar Singh and S. Srinivasan, Thomson Publications, 2004.
2. A Practical Approach to Digital Signal Processing – K Padmanabhan, R. Vijayarajeswaran, Ananthi.S, New Age International, 2006/2009.
3. Embedded Signal Processing with the Micro Signal Architecture Publisher: Woon-Seng Gan, Sen M. Kuo, Wiley-IEEE Press, 2007.

REFERENCE Books :

1. Digital Signal Processors, Architecture, Programming and Applications – B. Venkataramani and M. Bhaskar, 2002, TMH.
2. Digital Signal Processing – Jonatham Stein, 2005, John Wiley.
3. DSP Processor Fundamentals, Architecture & Features- Lapsley et al. 2000, S. Chand & Co. Digital Signal Processing Applications Using the ADSP-2100 Family by The Applications Engineering Staff of Analog De-vices, DSP Division, Edited by Amy Mar, PHI.
4. The Scientist and Engineering's Guide to Digital Signal Processing by Ste-ven W. Smith, Ph.D., California Technical Publishing, ISBN 0- 9660176-3-3, 1997.
5. Embedded Media Processing by David J. Katz and Rick Gentile of Analog Devices, Newnes, and ISBN 0750679123, 2005.

FPGA Design

Course	FPGA Design		
Course Code	18EM5206	L-T-P-S	3-0-2-0
Pre-Requisites	NIL	Credits	4

CO No	Course Outcome (CO)	PO/PSO	(BTL)
CO1	Understand basic concepts of Verilog programming	P01	2
CO2	Understand the combinational and sequential logic circuits and analyse them through test benches using Verilog HDL	P01	2
CO3	Understand FPGA based embedded processors architectures	P01	2
CO4	Understand signal conditioning and serial communication protocols	P01	2
CO5 (Only for lab components)	Ability to design and implementation of a) Multiplexers b) Demultiplexers c)Encoder and Decoder e)ALU f) Counters.	P03	2

Syllabus

Introduction to Programmable Logic Devices: Various IC technologies, mask ROM, ROM, EPROM, EEPROM, Programmable Logic Devices – PLA, PAL and CPLD

Introduction to Verilog Programming Language: Front end design tools for FPGA and design flow, RT Level Design, Verilog HDL, Basic elements of Verilog HDL and Different modeling styles

Combinational circuit Description: Verilog HDL models of combinational circuits such as Adder, Multiplexer, De-multiplexer, Encoder, Decoder, Code converters, Comparators, Parity generators and implementation of Boolean functions, Test-benches

Sequential Circuit Design: Verilog Models of sequential circuits such as level and edge triggered D flip flop, T flip flop and J K flip flop, shift registers, counters, memories, ALU.

Field Programmable Gate Arrays SRAM Programmable FPGAs - Introduction, Programming Technologies: such as anti-Fuse, SRAM Programmed FPGA. Device Architecture, Programmable Logic Block Architectures, Programmable Interconnects, and Programmable I/O blocks in FPGAs, Xilinx XC4000

Text Books

1. Fundamentals of digital logic with Verilog design by Stephen Brown and Zvonko Vranesic, McGra Hill, 3 ed
2. Field Programmable Gate Array Technology by Stephen M. Trimberger, Springer International Edition.

Reference Books

1. Zainalabedin Navabi, Verilog Digital System Design RT Level Synthesis, Testbench and Verification Second Edition McGraw-Hill Publications
2. Digital Design Using Field Programmable Gate Arrays by Pak K. Chan/ Samiha Mourad, Pearson Low Price Edition.

Wireless networks

Course	Wireless Networks		
Course Code	18EM5207	L-T-P-S	3-1-0-0
Pre-Requisites	NIL	Credits	4

CO No	Course Outcome (CO)	PO/PSO	BTL
CO1	Able to understand Transmission fundamentals and communications networks and application protocol architecture	PO1	2
CO2	Able to understand and analyse signal encoding techniques, spectrum and different wireless networks	PO1	2
CO3	Able to understand and analyse various principles of cellular wireless networks	PO1	2
CO4	Able to understand wireless protocols and applications of IEEE802.11 architecture and standards	PO1	2

Detailed Syllabus

Introduction

The Global Cellular Network, Broadband, Transmission Fundamentals: Wireless Signals for Conveying Information, Analog and Digital Data Transmission, Channel Capacity, and Transmission Media, Multiplexing, Communication Networks: LANs, MANs, WANs, Switching Techniques, Circuit Switching, Packet Switching, Asynchronous Transfer mode.

The TCP/IP Suite

The Need for Protocol Architecture. The TCP/IP Protocol Architecture, The OSI Protocol Architecture, internetworking

Wireless communication technology: Antennas and Propagation: Antennas. Propagation Modes, Line-of-Sight Transmission, Fading in the Mobile Environment

Signal Encoding Techniques

Signal Encoding Criteria. Digital Data, Analog Signals. Analog Data, Analog Signals. Analog Data, Digital signals.

Spread Spectrum

The Concept of Spread Spectrum. Frequency Hopping Spread Spectrum, Direct Sequence Spread Spectrum. Code Division Multiple Access. Generation of Spreading Sequences, Coding and Error Control,

Cellular wireless networking

Principles of Cellular Networks. First Generation Analog networking, Second Generation TDMA and CDMA based systems, Third Generation GSM Systems.

IEEE 802.11 Wireless LAN Standards:

IEEE 802 Protocol Architecture, IEEE 802.11 Architecture and Services, IEEE 802.11 Medium Access Control, IEEE 802.11 Physical Layers.

Bluetooth

Overview. Radio Specifications, Baseband Specification, Link Manager Specification, Logical Link Control, Adaptation protocol. Mobile IP and Wireless Access Protocol: Mobile IP, Wireless Application Protocol. Cordless Systems and Wireless Local Loop: Cordless Systems, Wireless Local Loop, IEEE 802.16 Fixed Broadband Wireless Access Standards.

Wireless Networking

Overview, Infrared LANs, Spread Spectrum LANs, Narrowband Microwave LANs

TextBooks :

1. WilliamStallings, "Wireless Communications and Networks", Pearson Education, 2005
2. Jochen Schiller, "Mobile Communications", Second Edition, Pearson Educa tion, 2001.

REFERENCE Books :

1. Kaveh Pahlavan, Prasanth Krishnamoorthy, "Principles of Wireless Networks", First edition, Pearson Education, 2001.
2. Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, "Principles of Mobile Computing", Springer, 2001.

Securing Embedded Systems

Course	Securing Embedded Systems		
Course Code	18EM5208	L-T-P-S	3-0-2-0
Pre-Requisites	NIL	Credits	4

CO No	Course Outcome (CO)	PO/PSO	(BTL)
CO1	Understand basic foundations of Cryptography	P01/PSO1	2
CO2	Understand in detail different encryption and decryption algorithms	P02/PSO1	2
CO3	Understand different attacking and counter attacking that can be enforced on embedded systems	P05/PSO1	2
CO4	Ability to develop applications that ensure securing the embedded systems	P05/PSO1	2
CO5 (Only for lab components)	Ability to develop application programs in C/Python program to implement a) Multiplicative Inverse b) Logical Operations to implement Substitution techniques a) Play fair Cipher b) Hill Cipher	P03/PSO1	2

Detailed Syllabus Design

Introduction to Cryptography

Ciphering, types of cypher, Theory of Ciphers, Public and private Key Management: Key lengths, Generating Keys, Transferring, Verification, Updating, Storing, and Backup, destroying keys

Encryption and Decryption Algorithms

DEA, TDEA, RSA, Block Cipher Algorithms: RC2, BLOW FISH, RC5, Digital Signature and Algorithms: Meaning, creation, storage and distribution, Algorithms: DSA and Its variants, Digital Certificates: Meaning, Creation. Distribution, Algorithms

Securing Embedded Systems

Vulnerabilities, Classification of attacks, Attacking: Timing, Fault Injection, Power Analysis, electromagnetic emanation, crypto servers, Counter Attacking: Methods that can be employed for counter attacking Timing, Fault Injection, Power Analysis, electromagnetic emanation based attacks, Sample applications and developments

TEXT Books :

1. Applied Cryptography, 7/e, Bruce SCHNEIER John Wiley & Sons Inc.
2. Cryptography and Network Security, William Stallings, PHI.
3. Introduction to cryptography with coding Theory, 7/e, Wade Trappe, C. Washington, PEA.

REFERENCE Books :

1. Cryptography and Information Security, V.K. Pachghare, PHI.
2. Cryptography and Network Security, Forouzan, TMH, 2007.
3. Cryptography and Network Security, 2/e, Kahate , TMH.
4. Modern Cryptography, Wenbo Mao, PEA
5. Securing the embedded systems from side channels, PhD thesis, K. Subba Rao, KL University

Elective – 3

Digital Audio Processing

Course	Digital Audio Processing		
Course Code	18EM52C1	L-T-P-S	3-0-0-0
Pre-Requisites	NIL	Credits	3

CO No	Course Outcome (CO)	PO	BTL
CO1	To make the students understand the operating principles, quantization, and A/D conversion	PO2	1
CO2	The students must be able to view the comparison of digital signal processors and multiprocessor systems	PO2	2
CO3	The students must be able to trace equalizers and room simulators	PO5	3
CO4	The students must be able to analyse compressing of audio files.	PO5	3

Detailed Syllabus Design

Introduction and Quantization

Digital Transmission Systems, Storage media, Audio components at home,
Signal quantization, Dither, Spectrum shaping of quantization – noise shaping,
Number representation.

A to D converters, D to A converters, Digital Signal Processors – Fixed point DSP, Floating point DSP, Digital audio interfaces, signal processor systems, Multiprocessor systems – Connection via serial links, Connection via parallel links, Connections via standard bus systems, scalable audio systems.

Equalizers and Room Simulation

Recursive audio filters- Design, parametric filter structures and Quantization effects, Non recursive audio filters – Fast convolution, Fast convolution of Long sequences, Filter design by frequency sampling, Multi complementary filter bank, Ando's investigations, Gerzon algorithms, Subsequent Reverberation – Schroeder Algorithm, General feedback systems, Approximation of roomimpulse response.

Static Curve, Dynamic behaviour, Implementation – Limiter, Compressor, Expander, Noise Gate, Combination System; Realization Aspects, Synchronous conversion,

Asynchronous conversion, Interpolation methods – Polynomial Interpolation, Lagrange Interpolation, Spline Interpolation.

Compressing Audio files

Lossless data compression, Lossy data compression, Psychoacoustics –
Critical bands and Absolute Threshold, Masking, ISO-MPEG1 audio coding,
Dynamic bit allocation and coding.

TEXTBOOK :

1. Digital Audio Signal Processing by Udo Zolzer, Wiley Publications.

Deep Learning

Course	Deep Learning		
Course Code	19EM52C2	L-T-P-S	3-0-0-0
Pre-Requisites	NIL	Credits	3

CO No	Course Outcome (CO)	PO	BTL
CO1	To make the students understand deep learning mathematical foundations	PO1	2
CO2	The students must be able to understand deep feedforward networks.	PO2	2
CO3	The students must be able to analyzeoptimization for deep training models.	PO5	3
CO4	The students must be able to sequential modelling techniques.	PO5	3

Detailed Syllabus Design

Introduction

Deep learning, moving from machine learning to Deep Learning Mathematical foundations: linear algebra, probability and information theory, Numerical computation.

Deep learning Foundations

deep feedforward networks, regularization for deep learning, optimization for training deep models, convolutional networks,

Sequential Modelling: recurrent and recursive nets, practical methodology for deep networks, applications of deep learning, Expert Systems

TextBooks :

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville. Deep Learning
2. Tensor Flow for Deep Learning – 2018, BY REZA ZADEH , BHARATH RAMSUNDAR

Developing Internet of Things Applications

Course	Developing Internet of Things Applications		
Course Code	18EM52C3	L-T-P-S	3-0-0-0
Pre-Requisites	NIL	Credits	3

CO No	Course Outcome (CO)	PO/PSO	Blooms Taxonomy Level (BTL)
CO 1	Ability describe the Raspberry PI board architecture and components	PO1	2
CO 2	Ability to design IOT based Applications	PO2	6
CO 3	Ability to develop IOT applications using Python	PO2	6
CO 4	Ability setup environment required for developing applications using Python and Raspberry PI board	PO1	4

Detailed Syllabus

Introduction to IOT Applications

Home Automation: Cities: Environment:, Energy: Retail: Logistics: Agriculture: Industry: Health and Lifestyle:

Introduction to Raspberry Board

Architecture and Hardware specifications

Preparing Raspberry Board for application development: Installing OS on raspberry Pi, Setting up the board to work with Python as the programming language, Retrieving the board's assigned IP address, Connecting to the board's operating system, Installing and upgrading the necessary libraries to interact with the board, Installing pip and additional libraries, Invoking the Python interpreter

Programming using Python

Installing Python, Python Data Types & Data Structures, Numbers Strings Lists, Tuples, Dictionaries, Type Conversion, Control Flow: if, for, while, range, break/continue, pass. Functions, Modules, Packages, File Handling, Date/ Time Operations, Classes, Python Packages of Internet Of Things-JSON, XML, HTTPLib & URLLib, SMTPLib.

Requirement specification, Process specification, domain model specification, information model specification, Services Speciation, level specification, functional view specification, operational view specification, device and component integration, application development.

Development of IOT based Smart Lighting Systems

Deployment design, developing mode and state services, developing sterilizers, developing views for rest services, Developing URL patterns for rest services, Developing Main application, developing controller and integrated schematic for IOT home lighting system

TextBook :

1. Arshdeep Bahga and Vijay Madisetti,, Internet of Things - A Hands-on Approach, Universities Press, 2015, ISBN: 9788173719547 .

REFERENCE Books :

1. Wolfram Donat "Learn Raspberry Pi programming in python", Apress (2014), ISBN – 9781430264255
2. Matt Richardson & Shawn Wallace, Getting Started with Raspberry Pi, O'Reilly (SPD), 2014, ISBN: 9789350239759.
3. "Learning Python", Fifth Edition by Mark Lutz, Published by O'Reilly
4. Media, ISBN: 978-1-449-35573-9.

Wireless sensor networks

Course	Wireless Sensor Networks		
Course Code	18EM52C4	L-T-P-S	3-0-0-0
Pre-Requisites	NIL	Credits	3

CO No	Expected Course Outcomes (CO)	**PO**	**BTL**
CO1	To make the students understand the issues in Ad Hoc Wireless Networks and design challenges in Wireless sensor networks.	PO1 & PO6	2
CO2	The students must be able to understand the Node Architectures, Energy Consumption of Sensor Nodes and Issues in Designing a Routing Protocol	PO2 & PO5	3
CO3	The students must be able to realize the importance of WSNs Gateways and Quality of service.	PO2	2
CO4	The students must be able to understand the importance of MAC Protocols for Sensor Networks	PO2 & PO6	4

Detailed Syllabus

Ad Hoc Wireless Networks

Applications of Ad Hoc Wireless Networks, Issues in Ad Hoc Wireless Networks: Medium Access Scheme, Routing, Multicasting Transport Layer Protocols, Quality of Service Provisioning, Self-Organization, Security Addressing , Service Discovery, Energy management, Scalability, Deployment Considerations, Ad Hoc Wireless Internet: Comparison with Adhoc wireless networks, Challenges for WSNs, Difference between sensor networks and Traditional sensor networks ,Types of Applications, Enabling Technologies for Wireless Sensor NetworksSingle Node Architectures , Hardware Components , Energy Consumption of Sensor Nodes, Issues in Designing a Multicast Routing Protocol.

Data Dissemination

Flooding and Gossiping, Data gathering, Sensor Network Scenarios,– Optimization Goals, Figures of Meri –

Design Principles for building WSNs Gateways

Need for gateway, WSN to Internet Communication, Internet to WSN Communication, WSN Tunneling.

MAC Protocols for Sensor Networks

Location Discovery, Quality of Sensor Networks, Evolving Standards, Low duty cycle andwake up concepts- The IEEE802.15.4 MAC Protocols: Energy Efficiency, Geographic Routing. Mobile nodes Gossiping and Agent based Unicast Forwarding, Energy Efficient Unicast, Broadcast, Multicast, Geographic Routing,

TextBooks :

1. Holger Karl and Andreas Wiilig, "Protocols and Architectures for Wireless Sensor Networks" John Wiley & Sons Limited 2008.
2. I.F Akyildiz and Weillian, "A Survey on Sensor Networks", IEEE Communication Magazine, August 2007.

REFERENCE Books :

1. Wilson, "Sensor Technology hand TextBook :," Elsevier publications 2005.
2. Anna Hac "Wireless Sensor Networks Design," John Wiley& Sons Limited Publications 2003.
3. C.Siva Ram Murthy and B.S.Manoj "Ad Hoc Wireless Networks," Pearson Edition 2005

Elective – 4

Video and Audio Streaming

Course	Video and Audio Streaming		
Course Code	18EM52D1	L-T-P-S	3-0-0-0
Pre-Requisites	NIL	Credits	3

CO No	Course Outcomes (CO)	PO	BTL
CO1	Students will be able to understand the architectures of streaming media and applications.	PO6,PO5	2
CO2	Ability to understand the principle and process of different video encoding techniques	PO6,PO5	3
CO3	Ability to understand the audio encoding principles and different file formats associated with audio streaming	PO6,PO5	3
CO4	Ability to understand various stream serving domains and content distribution	PO6,PO5	3

Detailed Syllabus

Introduction to streaming Media: Applications, Architectures, Bandwidth, bytes and Bits, Proprietary Code architectures

Video Encoding

Introduction, capture, compression, encoding enhancements, encoding products, File limitations

Audio Encoding

Introduction, capture, Encoding, Audio formats, file formats

Stream Serving

introduction, streaming, webcasting, On demand serving, inserting advertisements, play lists, logging and statistics, proprietary server architectures, server deployment

Content distribution: introduction, delivery networks, corporate intranets, satellite delivery, quality of delivery, Applications of streaming media

TextBook :

1. The technology of video and audio streaming, David Auster berry, Focal press, 2013 Editio

Cloud Computing and Big Data Analytics

	Cloud Computing and Big Data Analytics		
Course Code	18EM52D2	L-T-P-S	3-0-0-0
Pre-Requisites	NIL	Credits	3

CO No	Expected Course Outcomes (CO)	PO	BTL
CO1	Ability to understand the basics of cloud computing, Cloud Computing architectures and deployment models	PO1, PO2, PO3, PO5	2
CO2	Ability to understand various service models and the way the modules are implemented in open stack	PO1, PO2, PO3, PO5	3
CO3	Ability to understand basics aspects of big data that emanate out of data collected through sensors, and storing the same in clouds	PO1, PO2, PO3, PO5	2

CO4	Ability to conduct Analytics using the data stored in the clouds and through use of "R" Language	PO1, PO2, PO3, PO5	4

Detailed Syllabus

Introduction to Cloud Computing

meaning of Cloud Computing, variations of cloud computing from other models, Essential Characteristics, Cloud computing Architectures, Technological Influences. Cloud Computing Architecture, the three deployment models IaaS, PaaS, SaaS, and Types of clouds (Public, Private and Hybrid)

CLOUD INFRASTRUCTURE

Architectural Design of Compute and Storage Clouds – Layered Cloud Architecture Development – Design Challenges - Inter Cloud Resource Management – Resource Provisioning and Platform Deployment – Global Exchange of Cloud Resources.

Service Models (XaaS)

Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS); Deployment Models: Public cloud, Private cloud, Hybrid cloud, Community cloud.

Establishing and using a private cloud

Network topology, HW-SE specification, Installing open stack, configuring open stack availing services through open stacks, establishing virtual networks

Infrastructure as a Service (IaaS): Introduction to IaaS, IaaS definition, Introduction to virtualization, Different approaches to virtualization, Hypervisors, Machine Image, and Virtual Machine (VM). Resource Virtualization: Server, Storage, Network, Virtual Machine (resource) provisioning and manageability, Storage as a service, Examples Applications: Amazon EC2, Google Drive, One drive, drop box. Developing applications Using IaaS.

Introduction to big data and Analytics:– Sources of data through embedded systems: Video, audio, spectral, transactional, WEB Data, Different kinds of data Structures - Current Analytical Architecture - Drivers of Big Data. Big Data Overview, State of the Practice of Analytics, Big Data Analytics in

Industry Verticals. Data analytics lifecycle Discovery - Data Preparation - Model Planning – Model Building - Communicate Results - Operationalize Case Study

Data Collection though embedded systems: RS232C, RS485, I2C, CAN, USB, Ethernet and transmission of the same through internet to be stored in a remote server

Initial Analysis of the Data using R:

Introduction to R: Graphical User Interface, data import and Export: Attributes and data types, Descriptive statistics,

Exploratory Data Analysis: visualization before Analysis, dirty data, visualizing a single variable, examine multiple variables, data exploration Vs Presentation,

Statistical methods for evaluation: Hypothesis testing, difference of means, Ranking tests, Sampling, ANOVA, Introduction to HADOOP and Map reduce and the uses of the same for effecting the data analytics.

TextBooks :

1. Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data by EMC Education Services 2014
2. David Dietrich, Barry Heller, Beibei Yang, "Data Science and Big Data Analytics", EMC Education Series, John Wiley, ISBN: 978-1-118-87613-8, 2015.
3. Peter Bühlmann,Petros Drineas, Michael Kane, Mark van der Laan, "Handbook of Big Data", CRC Press, 2016.

REFERENCE Books :

1 .Kris Jamsa, Cloud Computing, Jones & Bartlett,2012

2. Russell Dean Vines and Ronald L. Krutz ,Cloud Security: A Comprehensive Guide To Secure Cloud Computing, Wiley India Pvt Ltd, 2010

3. Barrie Sosinsky, Cloud Computing Bible, Wiley India,2011

1.Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.

1. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practi-cal Approach", TMH, 2009.

6. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud" O'Reilly, 2009.
7. MapReduce Design Patterns, Author: Donald Miner, Publisher: O'Reilly (2012), ISBN-13:- 9789350239810
8. Agile data science: building data analytics applications with Hadoop- Rus-sell Journey-O'Reilly Media-2013
9. An Introduction to Applied Multivariate Analysis withR-Brian Everett, Torstein Hothorn-Springer-2011

Internet of things

Course	Data Analytics for Internet of Things		
Course Code	19EM52D3	L-T-P-S	3-0-0-0
Pre-Requisites	NIL	Credits	3

CO No	Expected Course Outcomes (CO)	PO	BTL
CO1	Ability to understand the basics of cloud computing, Cloud Computing architectures and deployment models	PO1, PO2, PO3, PO5	2
CO2	Ability to understand various service models and the way the modules are implemented in open stack	PO1, PO2, PO3, PO5	3
CO3	Ability to understand basics aspects of big data that emanate out of data collected through sensors, and storing the same in clouds	PO1, PO2, PO3, PO5	2
CO4	Ability to conduct Analytics using the data stored in the clouds and through use of "R" Language	PO1, PO2, PO3, PO5	4

Introduction to data emanation from ES and IOT devices Devices, Data Flow, Data Storage

Overview of Computing Paradigm

Recent trends in Computing: Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing. Evolution of cloud computing: Business driver for adopting cloud computing.

Introduction to Cloud Computing

Cloud Computing (NIST Model): Introduction to Cloud Computing, History of Cloud Computing, Cloud service providers; Properties, Characteristics & Disadvantages: Pros and Cons of Cloud Computing, Benefits of Cloud Computing, Cloud computing vs. Cluster computing vs. Grid computing; Role of Open Standards.

Computing Architecture

Cloud computing stack, Comparison with traditional computing architecture (client/server), Services provided at various levels, Role of Networks in Cloud computing, Protocols used, Role of Web services;

Service Models (XaaS)

Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS); Deployment Models: Public cloud, Private cloud, Hybrid cloud, Community cloud.

Embellishing And Using A Private Cloud

Network topology, HW-SE specification, Installing open stack, configuring open stack availing services through open stacks, establishing virtual networks

Infrastructure As A Service (Iaas)

Introduction to IaaS, IaaS definition, Introduction to virtualization, Different approaches to virtualization, Hypervisors, Machine Image, and Virtual Machine (VM). Resource Virtualization: Server, Storage, Network, Virtual Machine (resource) provisioning and

manageability, Storage as a service, Examples Applications: Amazon EC2, Google Drive, One drive, drop box. Developing applications that use IaaS.

Introduction To Big Data And Analytics Sources of data through embedded systems

Video, audio, spectral, transactional, WEB Data, Different kinds of data Structures - Current Analytical Architecture - Drivers of Big Data. Big Data Overview, State of the Practice of Analytics, Big Data Analytics in Industry Verticals. Data analytics lifecycle Discovery - Data Preparation - Model Planning – Model Building - Communicate Results - Operationalize Case Study

Overview on data capturing through IOT devices, transmission of the same through different stages, and storage of the same in Clouds.

Initial Analysis of the Data using R

Introduction to R: Graphical User Interface, data import and Export: Attributes and data types, Descriptive statistics,

Exploratory Data Analysis

visualization before Analysis, dirty data, visualizing a single variable, examine multiple variables, data exploration Vs Presentation,

Statistical methods for evaluation

Hypothesis testing, difference of means, Ranking tests, Sampling, ANOVA, Introduction to HADOOP and Map reduce and the uses of the same for effecting the data analytics.

TEXTBOOKs:

1 Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data by EMC Education Services 2014

2. David Dietrich, Barry Heller, Beibei Yang, “Data Science and Big Data Ana-lytics”, EMC Education Series, John Wiley, ISBN: 978-1-118-87613-8, 2015.
3. Peter Bühlmann, Petros Drineas, Michael Kane, Mark van der Laan, “Hand-book of Big Data”, CRC Press, 2016.

REFERENCE Books :

1. Kris Jamsa, Cloud Computing, Jones & Bartlett,2012

2. Russell Dean Vines and Ronald L. Krutz ,Cloud Security: A Comprehensive Guide To Secure Cloud Computing, Wiley India Pvt Ltd, 2010
3. Barrie Sosinsky, Cloud Computing Bible, Wiley India,2011
4. Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
5. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", TMH, 2009.
6. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud" O'Reilly, 2009.
7. MapReduce Design Patterns, Author: Donald Miner, Publisher: O'Reilly (2012), ISBN-13:- 9789350239810
8. Agile data science: building data analytics applications with Hadoop- Russell Journey- O'Reilly Media-2013
9. An Introduction to Applied Multivariate Analysis with R -Brian Everett, Torstein Hothorn-Springer-2011
10. Statistical Modeling and Analysis for Database Marketing: Effective Techniques for Mining Big Data-Bruce Ratner-Chapman and Hall/CRC-2003

Sensor network programming

Course	Sensor Network Programming		
Course Code	18EM52D4	L-T-P-S	3-0-0-0
Pre-Requisites	NIL	Credits	3

CO No	Course Outcomes (CO)	PO	BTL
CO1	Students will be able to understand the sensor network and tools for sensor network.	PO1,PO6	2
CO2	Ability to analyse industry standards with Zigbee devices and Sensor programming concepts with TinyOS.	PO6,PO5	4
CO3	Ability to program and study different sensor network abstractions in real world scenario.	PO6,PO5	4
CO4	Ability to understand and apply different simulators for developing sensor networks	PO6,PO5	4

Detailed Syllabus Design

Introduction: Foundational Information, Next-Generation Sensor Networked Tiny Devices, Sensor Network Software Performance Driven Network Software Programming, Unique Characteristics of Programming Environments for Sensor Networks, Introduction to TinyOS and NesC, Future Demands on Sensor-Based Software. Wireless Sensor Networks: Sensor Network Applications, Characteristics of Sensor Networks, Nature of Data in Sensor Networks.

Standards for Building Wireless Sensor Network Applica-tions

802.XX Industry Frequency and Data Rates, ZigBee Devices and Components, ZigBee Application Development, Dissemination and Evaluation for Real-Time Environment, Motivation and Background, Software Micro framework Requirements

Sensor Network Implementation

Sensor Programming, Programming Challenges, Sensing the World, Level / Server Level / Client Level Programming Tools, Tiny Operating System (TinyOS): Components of TinyOS, Introduction to NesC, Event Driven Programming. Programming in NesC, A Simple Program

Real-World Sensing Requirements

Sensor Deployment Abstraction, Sensor Network Abstraction, Data Aggregation, Collaboration, Group Abstractions, Programming Beyond Individual Nodes

Simulators for developing Sensor Networks

Introduction, Currently Available Simulators, Simulation Design, Implementation Details, Experimental Results, MATLAB Simulation of Airport Baggage-Handling System: Introduction, proposed Architecture

TextBooks :

1. Fundamentals of Sensor Network Programming: Applications and Technology Hardcover Dec 2010 by S. Sitharama Iyengar , Nandan Parameshwaran, Vir V. Phoha.
2. Fundamentals of Sensor Network Programming: Applications and Technology S. Sitharama Iyengar, Nandan Parameshwaran,Vir V. Phoha, N. Balakrishnan, Chuka D. Okoye ISBN: 978-0-470-87614-5

REFERENCE Book :

1. Developing a Wireless Sensor Network Programming Language Application Guide Using Memsic Devices and LabVIEW 5.0 Structure design Semes-ter-3 and Semester-4

Term Paper

Syllabus

1. Choose the problem
2. Literature Survey
3. Conduct Literature Review
4. Find the gaps
5. Investigate and Innovate new solutions or enhancement of the existing solu-tions
6. Experiment and prove results

Detailed Syllabus design Semester–3 and Semester–4 Disseretation

Detailed Syllabus Design

1. Choose an application in the specialisation area
2. Draft Requirements that include platform specific, technology specific, operational and functional
3. Install and operate the platform required for development of the projects
4. Conduct Analysis
5. Conduct Design
6. Develop the application
7. Test the application
8. Install the application
9. Demonstrate the running of the application
10. Develop project report in standard format