Bansilal RamnathAgarwal Charitable Trust's

Vishwakarma Institute of Information Technology, Pune-48

Curriculum for
T.Y. B. Tech.
Electronics & Telecommunication
(2018 pattern)

Department of
Electronics & Telecommunication
Engineering

VISION:

- Excellence in Electronics & Telecommunication Engineering Education

MISSION:

- Provide excellent blend of theory and practical knowledge
- Establish center of excellence in post graduate studies and research
- Prepare engineering professionals with highest ethical values and a sense of responsible citizenship

Program Educational Objectives (PEO):

1. Graduates of the program will become competent electronic engineers suitable for industry.
2. Graduates of the program will apply the mathematical and analytical abilities gained through core courses of Electronics and Communication engineering.
3. Graduates of the program will apply problem solving skills to develop hardware and/or software.
4. Graduates of the program will become responsible citizen.

Program Outcomes (PO):

A graduate of the program will have

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding ofthe engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSO):

Graduates will be able to

1. Apply and demonstrate the usage of hardware and software platforms for variety of applications.

2. Apply different mathematical and statistical methods for analysis and design of signal processing and communication systems.

Graduate attributes:

1. Engineering knowledge
2. Problem Analysis
3. Design/Development of Solutions
4. Investigations of Complex Problems
5. Modern Tool Usage
6. The Engineer and Society
7. Environment and sustainability
8. Ethics
9. Individual and Teamwork
10. Communication
11. Project management and Finance
12. Life –long Learning

Third Year B. Tech. Electronics & Telecommunication Engineering (TYBT) - Semester I
(Semester V of Pattern 2018)
From Academic Year 20-21

Course Code	Course Title	Course Type	Teaching Scheme			Examination Scheme					Total	Credits
			L	T	P	CIE	ISE	SCE	ESE	PR/ OR/ **TW**		
ES31181ET	Design and Analysis of Algorithms	TH	3	-	2	20	30	20	30	25	125	4
ETUA31182	Microcontroller and Applications*	TH	3	-	2	20	30	20	30	25	125	4
ETUA31183	Professional Elective -I*	TH	3	-	-	20	30	20	30	-	100	3
ETUA31184	Wireless Communication and Networks	TH	3	-	-	20	30	20	30	-	100	3
ETUA31185	Power Electronics*	TH	3	-	2	20	30	20	30	25	125	4
ETUA31186	Control Systems	CE	2	-	2	-	-	50	-	25	75	3
M3	Mandatory course	AU	-	-	-	-	-	-	-	-	-	-
	Total	-	17	0	8	100	150	150	150	100	650	21

*Indicates the courses which have Oral/Practical as evaluation head

Professional Elective-I:

ETUA31183A: Operating Systems
ETUA31183B: Information Theory and Coding Techniques
ETUA31183C: Software Engineering
ETUA31183D: Mechatronics Systems

Nomenclature

L	Lectures/week
T	Tutorial/week
P	Practicals/week
CIE	Continuous Internal Evaluation
ISE	In Semester Examination
SCE	Skills and Competency Evaluation
ESE	End Semester Evaluation

Mandatory Course: Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Traditional Knowledge, Online certification course (minimum two weeks); Participation in intercollegiate co-curricular and extra-curricular activities.

BoS Chairman **Dean Academics** **Director**

Third Year B. Tech. Electronics & Telecommunication Engineering (TYBT) - Semester II
(Semester VI of Pattern 2018)
From Academic Year 20-21

Course Code	Course Title	Course Type	Teaching Scheme			Examination Scheme					Total	Credits
			L	T	P	CIE	ISE	SCE	ESE	PR/ OR/ TW		
ETUA32181	Professional Elective-II	TH	3	-	2	20	30	20	30	25	125	4
ETUA32182	Professional Elective – III *	TH	3	-	2	20	30	20	30	25	125	4
ETUA32183	Digital Signal Processing *	TH	3	-	2	20	30	20	30	25	125	4
ES32184ET	Management Information System	TH	3	-	-	20	30	20	30	-	100	3
IOEUA32185	Open Elective -I	TH	3	-	-	20	30	20	30	-	100	3
ETUA32186	Employability Skills in Electronics Design	CE	2	-	2	-	-	50	-	25	75	3
M3	Mandatory Course	AU	-	-	-	-	-	-	-	-	-	-
	Total	-	17	0	8	100	150	150	150	100	650	21

***Indicates the courses which have Oral/Practical as evaluation head**

Professional Elective-II:
ETUA32181A: Internet of Things
ETUA32181B: Computer Network and Security
ETUA32181C: Advanced Processors
ETUA32181D: Biomedical Electronics

Professional Elective – III:
ETUA32182A: Machine Learning
ETUA32182B: Robotics and Applications
ETUA32182C: Digital System Design using Verilog
ETUA32182D: Broadband Communication

Open Elective- I:
IOEUA32185A: Information and Cyber Security
IOEUA32185B: Automotive Electronics
IOEUA32185C: Industrial Engineering
IOEUA32185D: Artificial Neural Network in Engineering
IOEUA32185E: Social Media Analytics

Mandatory Course: Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Traditional Knowledge, Online certification course (minimum two weeks); Participation in intercollegiate co-curricular and extra-curricular activities.

BoS Chairman **Dean Academics** **Director**

Semester – I

ES31181ET: Design and Analysis of Algorithms

Teaching Scheme	Examination Scheme						
Credits: 4	CIE	ISE	SCE	ESE	PR/OR	TW	Total
Lecture (L): 3hrs./week Tutorial (T): - Practical (P): 2hrs/week	20	30	20	30	-	25	125

Prerequisite: Readers/students are expected to know the following concepts:

1. Fundamentals of Computer programming
2. Data Structures

Course Objectives:

- Analyze the asymptotic performance of algorithms.
- Demonstrate a familiarity with major algorithms and data structures.
- To apply algorithmic strategies while solving problems.
- Apply important algorithmic design paradigms and methods of analysis.
- To understand the limitations of Algorithmic power.

Course Outcomes:

After completion of the course, student will be able to

1. Analyze worst-case running times of algorithms based on asymptotic analysis.
2. Analyze a variety of divide and conquer algorithms.
3. Develop greedy algorithms for a given problem.
4. Develop dynamic-programming algorithms for a given problem.
5. Solve problems on backtracking and branch and bound strategy.
6. Understand tractable and intractable problems.

Unit- I : Introduction

Characteristics of algorithm. Analysis of algorithm: Asymptotic analysis of complexity bounds – best, average and worst-case behavior; Performance measurements of Algorithm, Time and space trade-offs, Analysis of recursive algorithms through recurrence relations: Substitution method, Masters' theorem.

Unit- II : Brute Force and Divide-and-Conquer

Brute Force: Computing an String Matching, Closest-Pair and Convex-Hull Problems, Exhaustive Search Travelling Salesman Problem, Divide and Conquer : Binary Search, Merge sort, Quick sort, Heap Sort, Multiplication of Large Integers ,Closest-Pair and Convex, Hull Problems

Unit –III : GREEDY Technique

Greedy Method: General strategy, the principle of optimality, Knapsack problem, Prim's Algorithm, Kruskal's algorithm, Huffman code generation algorithm.

Unit IV: Dynamic Programming

General Strategy, Principle of optimality – Coin changing problem, Computing a Binomial Coefficient – Floyd's algorithm, Multi stage graph, Optimal Binary Search Trees – Knapsack Problem and Memory functions

Unit V: Backtracking, Branch and Bound

Backtracking: 8 Queen problem, Graphs, Coloring Branch and Bound: 0/1 Knapsack. Backtracking and branch and bound general strategy, Optimal BST , 0/1 Knapsack problem example of dynamic programming.

Unit VI : Tractable and Intractable Problems

Computability of Algorithms, Computability classes – P, NP, NP-complete and NP-hard. Cook's theorem, Standard NP-complete problems and Reduction techniques, eg. Vertex cover problem, Travelling salesman prpblem,3SAT problem

Text Books :

1. Horowitz and Sahani, "Fundamentals of Computer Algorithms", 2ND Edition. University Press
2. Gilles Brassard, Paul Bratley, ―Fundamentals of Algorithmics, PHI, ISBN 978-81-203-1131-2

Suggested reference books

1. Algorithm Design, 1ST Edition, Jon Kleinberg and ÉvaTardos, Pearson.
2. "Introduction to Algorithms", 4TH Edition, Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, MIT Press/McGraw-Hill.
3. Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition, Michael T Goodrich and Roberto Tamassia, Wiley.
4. Algorithms -- A Creative Approach, 3rd Edition, UdiManber, Addison-Wesley, Reading, MA.

List of Experiments: (Any 8 from 12)

1. Program to implement Heap sort
2. Program to implement Binary Search using Divide and Conquer
3. Program to implement Quick sort
4. Program to implement minimum and maximum using Divide and Conquer
5. Program to implement Merge sort using Divide and Conquer
6. Program to implement Prim's algorithm using Greedy method
7. Program to implement Kruskal's algorithm using Greedy method
8. Program to implement Knapsack problem using Dynamic Programming
9. Program to implement Graph Traversal: Breadth First Traversal
10. Program to implement Graph Traversal: Depth First Traversal
11. Program to implement 8-Queen's problem using Backtracking
12. Program to implement All Pairs Shortest Path Using Dynamic Programming

ETUA31182: Microcontroller and Applications

Teaching Scheme	Examination Scheme						
Credits: 4	CIE	ISE	SCE	ESE	PR/OR	TW	Total
Lecture (L): 3hrs./week Tutorial (T): - Practical (P): 2hrs/week	20	30	20	30	25	-	125

Prerequisite: Students are expected to know the concepts studied in following courses:

1. Digital Electronics,
2. Semiconductor devices and circuits
3. Fundamentals of programing language

Course Objectives:

- To give an overview of 8 bit architecture
- To justify the use of microcontroller in embedded system.
- To understand architecture and features of 8051 and AVR microcontroller.
- To learn interfacing of real world peripherals inputs (sensors) and output (actuators) with microcontroller.
- To study various hardware and software tools for developing applications
- To develop small application based assignment using Microcontrollers and sensors.

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

1. Describe the CISC architecture based 8051 microcontroller. (BT-2, Understanding)
2. Demonstrate modern engineering tools necessary for simulating, configuring and monitoring embedded system (BT-3, Applying)
3. Implement system with commonly used peripherals with microcontroller. (BT-6 Creating)
4. Demonstrate bus standards used in industrial environment.(BT-3 Applying)
5. Describe the RISC architecture based AVR Microcontroller. (BT-2, Understanding)
6. Develop system using different microcontroller based for embedded applications.(BT-6, Creating)

Unit- I: Introduction to 8051 CISC Microcontrollers (6 Hrs)

Microprocessor & Microcontroller comparison, Harvard & Von Neumann architecture, RISC & CISC comparison, Evolution of microcontrollers, Microcontroller selection criteria for particular application, MCS-51 architecture, family devices & its derivatives. Pin configuration, Port architecture, memory organization, external memory interfacing. Interrupt structure, Timers and its modes, Serial communication and its modes.

Unit- II: 8051 Instruction Set and Programming (6 Hrs)

Addressing modes: Introduction, Instruction syntax, Data types, Subroutines, Immediate addressing, Register addressing, Direct addressing, Indirect addressing, Relative addressing, Indexed addressing, Bit inherent addressing, bit direct addressing. **8051 Instruction set:** Instruction timings. Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction. **Programming environment:** Study of software development tool chain (IDE), hardware debugging tools (timing analysis using logic analyzer), **Sample Programs:** Assembly language programs and C language programs.

Unit –III: 8051 Microcontroller based Real World Interfacing and programming – I (6 Hrs)

Interfacing peripheral devices using GPIO: Generating various delays using Timer/counter and interfacing of LEDs, 7 segment displays, Switches, Relay, Stepper Motor, LCD interfacing, Keyboard Interfacing, ADC0809 and DAC interfacing with 8051. (All programs in C)

Unit IV : 8051 Microcontroller based Real World Interfacing and programming – II (6 Hrs)

Basics of serial communication protocol: Synchronous and Asynchronous Communication, RS232, RS485, SPI, I2C.

Interfacing of devices using protocols: Interfacing of peripherals using UART, Interfacing RTC DS1307 using I2C protocol, Interfacing of memory using SPI protocol.
(All programs in C)

Unit V: Introduction to AVR RISC Microcontroller Architecture and programming (6 Hrs)
Overview of AVR family, AVR Microcontroller architecture, Introduction To 8-bit AVR Microcontroller, AVR register, AVR status register, ROM space and other hardware modules, ATmega32 pin configuration & function of each pins,
Addressing modes of AVR, Data transfer Arithmetic, Logic and Compare, Rotate and Shift, Branch and Call instructions. AVR data types and assembler directives, AVR assembly language programs.
AVR Programming in C :
Data types, I/O programming, logic operations, Intel HEX file, Timer programming in assembly and C, Interrupt programming in assembly and C, Serial Port programming in assembly and C

Unit VI: AVR microcontroller based Real World Interfacing and programming - III (6 Hrs)
Interfacing peripheral devices: Servo motor interfacing, DC motor control using PWM programming, LCD and keyboard interfacing, ADC and temperature sensor LM35 interfacing, RTC interfacing using I2C Protocol.
Implement simple multichannel data acquisition system using AVR/8051. (All programs in C)

Text Books :

1. Mazidi Muhammad Ali; Mazidi Janice Gillispie; McKinlay Rolin D, "The 8051 Microcontroller and Embedded Systems Using Assembly and C", 2nd Edition, Dorling Kindersley.
2. The AVR Microcontroller and Embedded Systems Using Assembly and C, By Muhammad Ali Mazidi, Sarmad Naimi and Sepehr Naimi, Pearson Education.

Reference Books :

1. Programming and Customizing the AVR Microcontroller, By Dhananjay Gadre, McGraw Hill Education
2. Richard Barnett, Sarah Cox , Larry O'Cull, "Embedded C Programming and the AVR Microcontrollers", 2nd edition Thomson publication.
3. Ayala Kenneth J, Gadre Dhananjay V, "8051 Microcontroller and Embedded Systems ", Cengage Learning.

Datasheets (from websites):

1. ATMEL 8051/52 data sheet
   Atmel AT89C51/52 AT89S51/52 Data Sheet www.keil.com › docs › datashts › atmel
2. AVR ATmega32 data sheet
   ATmega32A - 8-bit AVR Microcontrollers - Microchip Technology
   www.microchip.com › wwwproducts › ATmega32A

List of Experiments: Microcontroller and Applications

After completion of this course student should be able to

1. Demonstrate modern engineering tools necessary for simulating, configuring and monitoring embedded system (BT-3, Applying)
2. Design and Built microcontroller based system with peripheral interfacing and programming for real time applications. (BT-6 Creating)

(Any 8 experiments from 1 to 11)
***PBL compulsory**

I. 8051 based practical's (Programs in assembly language)

1. Interfacing of LED's, switches, buzzer, relay with 8051 Microcontroller.

2. Interfacing of 16x2 LCD in 8 bit/4 bit mode with 8051 Microcontroller and display message on it.
3. Interface 4x4 matrix keyboard with 8051 Microcontroller. Display value of pressed switch on LCD.
4. Interface Computer with 8051 Microcontroller using UART communication.
5. Interface stepper Motor with 8051Microcontroller and write program to rotate it in clockwise and anticlockwise direction using different drives (Full step drive, Half step drive and wave drive).
6. Interfacing of ADC PCF8591 with 8051 Microcontroller using IIC protocol read the analog voltage from ADC and display its equivalent digital value on LCD.

II. AVR based practical's (Programs in C language)

7. Interfacing of 16x2 LCD and 4X4 matrix keyboard with AVR Microcontroller board and display message on it and display value of pressed switch on LCD.
9. Interface temperature sensor LM35 with AVR Microcontroller using ADC module and display temperature on LCD.
10. Interface Servo motor with AVR Microcontroller.
11. Generate PWM using AVR Microcontroller and use it for speed control of DC motor

III. Project Based Learning

Implementation of hardware and software for specific application using 8051 or AVR Microcontroller.

ETUA31183: Professional Elective-I

ETUA31183A: Operating Systems

Teaching Scheme	Examination Scheme						
Credits: 3	CIE	ISE	SCE	ESE	PR/OR	TW	Total
Lecture (L): 3hrs./week Tutorial (T): - Practical (P): -	20	30	20	30	-	-	100

Prerequisite: Readers/students are expected to know the following concepts:

1. Basic Computer Concepts
2. Basics of Data structures
3. Knowledge of Programming Language (C/C++)

Course Objectives:

- To understand the services provided by operating system.
- To study process management and scheduling
- To understand various issues in Inter Process Communication (IPC) and the role of OS in IPC.
- To understand different approaches to memory management.
- To understand the working of an OS as a resource manager.

Course Outcomes:

1. Analyze the structure of OS and basic architectural components involved in OS design
2. Recognize the process management policies and scheduling of processes by CPU
3. Evaluate the requirement for process synchronization and coordination handled by operating system
4. Understand the Mutual exclusion, Deadlock detection
5. Describe and analyze the memory management and its allocation policies.
6. Identify the storage management policies with respect to different storage management technologies.

Unit- I: Introduction to Operating System & System Structure

Introduction: Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems

System Structure: OS Services, System Calls, Structure of an OS ,Concept of Virtual Machine, Case study on UNIX and WINDOWS Operating System.

Unit –II: Processes, Threads and Process Scheduling

Processes: Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching.

Thread: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads.

Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non pre-emptive, FCFS, SJF, RR

Unit III: Inter-process Communication:

Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Strict Alternation, Peterson's Solution, The Producer Consumer Problem, Semaphores, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem.

Unit IV: Deadlocks:

Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.

Unit V: Memory Management & Virtual Memory:
Memory Management: Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation – Fixed and variable partition– Internal and External fragmentation and Compaction; Paging: Principle of operation – Page allocation – Hardware support for paging, Protection and sharing, Disadvantages of paging.
Virtual Memory: Basics of Virtual Memory –Page fault, Dirty page/Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU).

Unit VI: Storage Management:
I/O Hardware: I/O devices, Device controllers, Direct memory access Principles of I/O software: Device drivers, Device independent I/O software, Secondary-Storage Structure: Disk structure, Disk scheduling algorithms
File Management: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods, Free-space management.

Text Books:

1. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, Operating System Concepts. Addison-Wesley
2. Stallings W., Operating Systems, Prentice Hall

Reference Books:

1. Andrew Tanenbaum, Modern Operating Systems, Prentice Hall.
2. Harvey M. Deitel, An introduction to operating systems. Addison-Wesley.
3. Douglas Comer, Operating System Design - The XINU Approach. Prentice-Hall.

ETUA31183: Professional Elective-I

ETUA31183B: Information Theory and Coding Techniques (ITCT)

Teaching Scheme	Examination Scheme						
Credits: 3	CIE	ISE	SCE	ESE	PR/OR	TW	Total
Lecture (L): 3hrs./week Tutorial (T): - Practical (P): -	20	30	20	30	-	-	100

Prerequisite: Readers/students are expected to know the following concepts:

1. Basics of Probability
2. Basics of Digital Communication
2. Basics of signals and systems(only in a specific topic of convolution encoders)

Course Objectives:

- To equip students with the basic understanding of the fundamental concept of entropy and information theory.
- To familiarize students with different channel models and their capacity
- To understand types of source coding techniques
- To understand various types of channel coding techniques

Course Outcomes:

1. Apply appropriate source coding techniques for data with known and unknown statistics
2. Calculate the channel capacity of simple noisy channels and interpret the result
3. Design linear block codes using fundamentals of linear algebra
4. Comprehend systematic and nonsystematic cyclic codes and construct the encoder and decoder for practical implementation.
5. Design BCH and RS codes for given specification.
6. Analyze the different representations of convolution encoder to encode the message and decode it with Viterbi decoding.

Unit- I : Information Theory and Source Coding

Introduction **to probability, law of total probability, Bayes theorem**, information theory, Entropy and its properties, Source coding theorem, Huffman coding, Shannon-Fano coding, The Lempel Ziv algorithm (LZW, LZ77), Arithmetic coding ,Run Length Encoding, JPEG, MPEG (as case studies for compression)

Unit –II : Information Capacity and Channel Coding

Discrete memory less channel, Mutual information, Channel capacity, types of channels, Channel coding theorem, Differential entropy and mutual Information for continuous ensembles, Information Capacity theorem, Implications of information capacity theorem

Unit III : Linear Block Codes

Linear Block Codes : Generator matrix, parity check matrix, Syndrome and error detection, Error detection and correction capability, Standard array and syndrome decoding, Encoding and decoding circuit, Single parity check codes, Repetition codes and dual codes, Hamming code, Golay Code, Interleaved code

Unit IV : Cyclic Codes

Galois field, Primitive element & Primitive polynomial, Minimal polynomial and generator polynomial, Description of Cyclic Codes, Generator matrix for systematic cyclic code, Encoding for cyclic code, Syndrome decoding of cyclic codes, Circuit implementation of cyclic code.

Unit V : BCH and RS Codes

Binary BCH code, Generator polynomial for BCH code, Decoding of BCH code, RS codes, generator polynomial for RS code, Decoding of RS codes, Cyclic Hamming code and Golay code, CRC code, FEC and ARQ systems

Unit VI : Convolutional Codes

Introduction of convolution code, State diagram, Polynomial description of convolution code, Generator matrix of convolution code, Tree diagram, Trellis diagram, Sequential decoding and Viterbi decoding, Known good convolution code, Introduction to LDPC and Turbo codes, Introduction and concept of Trellis coded modulation (TCM), Error Probability plane, Bandwidth efficiency plane, Modulation and coding tradeoffs

Applications of coding in recent technologies (Infiniband, PCI express for clock recovery, maintain DC balance) , applications in block chain, stock market, **Ethernet receiver**

Text Books :

1. Ranjan Bose, "Information Theory coding and Cryptography", McGraw-Hill Publication, 2nd Edition
2. J C Moreira, P G Farrell, "Essentials of Error-Control Coding", Wiley Student Edition.

Reference Books :

1. Bernad Sklar, "Digital Communication Fundamentals & applications", Pearson Education. Second Edition.
2. Simon Haykin, "Communication Systems", John Wiley &Sons, Fourth Edition.
3. Shu Lin and Daniel J Cistellojr., "Error control Coding" Pearson, 2nd Edition.
4. Todd Moon, "Error Correction Coding : Mathematical Methods and Algorithms", Wiley Publication
5. Khalid Sayood, "Introduction to Data compression", Morgan Kaufmann Publishers

ETUA31183: Professional Elective-I

ETUA31183C: Software Engineering

Teaching Scheme	Examination Scheme						
Credits: 3	CIE	ISE	SCE	ESE	PR/OR	TW	Total
Lecture (L): 3hrs./week Tutorial (T): - Practical (P): -	20	30	20	30	-	-	100

Prerequisite: Readers/students are expected to know the following concepts:

1. Basics of Programming

Course Objectives:

- To understand the stages in a software engineering
- To know fundamental concepts of software requirements and analysis.
- To understand the various software design methodologies
- To learn various testing of software development
- To understand project management through life cycle of the software project

Course Outcomes:

1. Compare and chose a process model for a software project development.
2. Identify unique features of various software application domains and classify software applications
3. Analyze requirements of a software system.
4. Apply design and quality attributes in software development
5. Design test cases of a software system
6. Identify risk of the project, manage and configure software projects.

Unit- I : Introduction to Software Engineering

Software Engineering Fundamentals: Nature of Software, Software Engineering Principles, Software Process, Software Myths. Process Models: A Generic Process Model, Prescriptive Process Models: The Waterfall, Incremental Process (RAD), Evolutionary Process, Unified Process, Concurrent

Unit II: - Advanced Process Models & Tools

Agile software development: Agile methods, Plan-driven and agile development, Extreme programming Practices, Testing in XP, Pair programming. Introduction to agile tools: JIRA, Kanban, Case Studies: An information system (mental health-care system), wilderness weather system

Unit III: - Software Requirements Engineering& Analysis

Requirements Engineering: User and system requirements, Functional and non-functional requirements, Types & Metrics, A spiral view of the requirements engineering process. Software Requirements Specification (SRS): The software requirements Specification document, The structure of SRS, Ways of writing a SRS, structured & tabular SRS for an insulin pump case study, Requirements elicitation & Analysis: Process, Requirements validation, Requirements management. Case Studies: The information system case study - Mental health care patient management system (MHC-PMS).

Unit IV:-Design Engineering

Design Process & quality, Design Concepts, The design Model, Pattern-based Software Design. Architectural Design :Design Decisions, Views, Patterns, Application Architectures, Modelling Component level Design: component, Designing class based components, conducting component-level

design, User Interface Design: The golden rules, Interface Design steps & Analysis, Design Evaluation, Case Study: Web App Interface Design

Unit V: - Software Implementation & Testing

Structured Coding Techniques, Coding Styles, Coding Standards & Guidelines, Introduction to Software Testing, Principles of Testing, Testing Life Cycle, Phases of Testing, Types of Testing, Verification & Validation, Defect Management, Defect Life Cycle, Bug Reporting, GUI Testing, Test Management and Automation.

Unit VI: - Project Management

Project Management Concepts: The Management Spectrum, People, Product, Process, Project, The W5HH Principle, Project Scheduling: Basic Concepts, Scheduling with time-line charts, Schedule tracking Tools, Project Risk Management : Risk Analysis & Management: Reactive versus Proactive Risk Strategies, Software Risks, Risk Identification, Risk Projection, Risk Refinement, The RMMM plan for case study project, Software Maintenance & Re-engineering

Text Books :

1. Roger Pressman, "Software Engineering: A Practitioner's Approach", Mcgraw Hill
2. Ian Sommerville, "Software Engineering", Addision and Wesley

Reference Books :

1. Rajib Mall, "Fundamentals of Software Engineering, Prentice Hall India

ETUA31183: Professional Elective-I

ETUA31183D :Mechatronics Systems

Teaching Scheme	Examination Scheme						
Credits: 3	CIE	ISE	SCE	ESE	PR/OR	TW	Total
Lecture (L): 3hrs./week Tutorial (T): - Practical (P): -	20	30	20	30	-	-	100

Prerequisite: Readers/students are expected to know the following concepts:

1. Basic Electronics devices and their operations
2. Basic understanding of Operational Amplifier.
3. Understanding of basic mechanical devices.

Course Objectives:

- To give the students a comprehension of Sensors and transducers.
- To give the students a comprehension of Actuators.
- To give the students a comprehension of Instrumentation.
- To make the students able to design and analyze the industrial Mechatronics systems and to achieve the control actions with different Controllers

Course Outcomes:

After completion of this course, students will be able to -

1. Select an appropriate sensor or transducer to meet requirements of an industrial application.
2. Select and design a signal conditioning circuit for given application based on applied sensing method.
3. Select and appropriate actuators to meet system requirements.
4. Design Industrial solutions for complex engineering problems using Programmable Logic controllers.
5. Understand, select and use Smart Materials for an application.
6. Understand the Advances in Automation systems.

Unit I : Sensors and Transducers

Performance terminology - Displacement, Velocity and Motion sensors - Proximity sensors, Force, Pressure, Flow, Level and Temperature sensors – Humidity, pH and Conductivity sensors – Specifications and selection criteria – Inputting data by switches

Unit II : Transmitters, Signal conditioning and Converters

Analog signal conditioning for different sensors – Use of bridge circuits and Instrumentation amplifiers Signal converters V/I, I/V, V/F, F/V, I/P & P/I converters –Design guidelines.

Unit III : Actuators and Final Control elements

Pneumatic and hydraulic actuators- Directional control valves, Pressure control valves, Cylinders, Process control valves - Electrical actuators- Mechanical switches, Solid state switches, Solenoids, DC motors, AC motors and Stepper motors. Drives

Unit IV: Programmable Logic Controllers - Applications and Interfacing :
Introduction of Process Controllers , PID Controllers.

PLC : Architecture – Input / Output processing – Interfacing of Input / Output devices with PLC – Analog Input / Output - Ladder logic programming – Selection of PLC – PLC based automated systems.

Unit V: Smart Materials, Sensors and actuators :
Composite Materials , Smart Material types : smart polymer, smart responsive material, Smart material for active coating, Micro Sensors , Micro Actuators

Unit VI: Advances in Mechatronics and in Industrial Automations:
Digital Factory , Industrial IOT, Virtual Reality in Industrial Automations,Artificial Intelligence in Industrial Automations

Text Books :

1. K. Krishna Swamy, "Process Control"; New Age International Publishers.
2. C.S. Rangan, G.R. Sarma, V.S.V. Mani; " Instrumentation Devices and Systems "; Tata McGraw Hill; 2nd Edition
3. W. Bolton; " Mechatronics, Electronic Control Systems in Mechanical and Electrical Engineering "; Pearson Education; 3rd Edition

Reference Books :

1. Shimon Y. Nof , "Springer Handbook of Automations", Springer.
2. Curtis Johnson, "Process Control Instrumentation Technology"; 8th Edition, Pearson Education.
3. Ernest O. Doebelin; " Measurement System Application and Design "; Mc-Graw Hill; 5th Edition
4. David G. Alciatore, Michael B Histand; " Introduction to Mechatronics and Measurement System "; Tata McGraw Hill

ETUA31184: Wireless Communication and Networks

Teaching Scheme	Examination Scheme						
Credits: 3	CIE	ISE	SCE	ESE	PR/OR	TW	Total
Lecture (L): 3hrs./week Tutorial (T): - Practical (P): -	20	30	20	30	-	-	100

Prerequisite: Readers/students are expected to know the following concepts:

1. Basics of signals and systems
2. Basics of Probability
3. Basics of Digital Communication

Course Objectives:

- To equip students with the basic understanding of the fundamental concept of wireless communication
- To understand the theoretical framework wireless channel modeling, channel capacity and performance analysis of modulation techniques used in wireless communication.
- To understand multiple antenna systems, concept of diversity and importance of error control coding techniques.
- To understand the Multicarrier Modulation and Multiuser systems
- To know the concepts of wireless networking and different wireless technologies and applications

Course Outcomes:

1. Apply the fundamental concepts and to model multipath channel model
2. Evaluate the performance of wireless channel for a given specification of channel and modulation techniques.
3. Analyze the multiple antenna systems and coding techniques.
4. Analyze multicarrier and multiuser system for wireless communication
5. Interpret the layered system required to implement wireless technologies and applications with reference to OSI and TCP/IP model.
6. Interpret IEEE standards used for wireless technologies and applications.

Unit- I : Overview of Wireless Communication

History of wireless communication, current wireless systems, wireless spectrum and standards.
Path loss and shadowing: Radio wave propagation, Transmit and receive signal models, free space path loss, Ray tracing and Empirical path loss models, Outage probability under path loss and shadowing, cell coverage area.
Statistical multipath channel models: Time varying channel impulse response, Narrowband and wideband fading models, Discrete time model and Space-Time channel model

Unit –II : Channel Capacity Modulation & Detection Techniques and Performance analysis

Capacity of AWGN, Capacity of Flat-Fading and Frequency-Selective Fading channels.
Digital modulation and detection: Signal space analysis, Pass band modulation techniques: Amplitude and Phase modulation, Frequency modulation, Pulse shaping, symbol synchronization and carrier phase recovery.
Performance analysis: Error probability analysis of various modulation techniques function representation, Fading, Doppler spread, Intersymbol interference.

Unit III : Antenna systems Diversity and coding for Wireless communication

Realization of independent fading paths, Receiver and Transmitter diversity.

Coding for wireless channels: Overview of code design, introduction to block code, convolutional code, parity check codes etc. Adaptive modulation and coding
Multiple antenna and space time communication: Narrowband MIMO model, MIMO channel capacity, MIMO diversity gain: Beamforming, Space-Time modulation and coding, smart antennas. Equalization

Unit IV : Multicarrier Modulation and Multiuser systems
Data Transmission using Multiple Carriers, Multicarrier Modulation with Overlapping Subchannels, Discrete Implementation of Multicarrier: Orthogonal Frequency Division Multiplexing (OFDM), Matrix Representation of OFDM, Vector Coding, Challenges in Multicarrier Systems.
Multiuser Systems: Multiuser Channels: The Uplink and Downlink, Multiple Access: TDMA, FDMA, CDMA, Space division and Hybrid techniques, Random access, Power control.

Unit V : Wireless Networking
Communication Networks: LANs, MANs and WANs, switching techniques: circuit and packet switching asynchronous transfer mode.
Protocol and TCP/IP suit: Need for a protocol architecture, TCP/IP protocol architecture, OSI model, Internet working.

Unit VI : Wireless Technologies and Applications
Introduction, satellite communications, cellular wireless networks, cordless systems and wireless local loops, Mobile-IP and wireless access protocol, Wireless LAN technology, Wi-Fi and wireless LAN stsndards IEEE 802.11, Bluetooth and IEEE 802.15

Text Books :

1. Wireless Communications, Andrea Goldsmith, Cambridge University Press, 2012
2. Wireless Communications and Networks, William Stallings, Prentice Hall, 2005

Reference Books :

1. T. S. Rappaport. *Wireless Communications: Principles and Practice*, 2nd ed. Prentice Hall, 2002.

ETUA31185: Power Electronics

Teaching Scheme	Examination Scheme						
Credits: 4	CIE	ISE	SCE	ESE	PR/OR	TW	Total
Lecture (L): 3hrs./week Tutorial (T): - Practical (P): 2hrs/week	20	30	20	30	25	-	125

Prerequisite: Readers/students are expected to know the following concepts:

1. Semi-conductor Devices and Circuits
2. Basics of Electrical Engineering

Course Objectives:

- To study characterization of different power devices through its construction, operations and triggering / driving circuits.
- To understand power conversion, its driving and control mechanism
- To analyze different power converters for variety of loads.
- To apply knowledge of devices, converters and load characteristics to select / configure applications

Course Outcomes:

1. Understand characteristics of power semiconductor through semi-conductor fundamentals.
2. Apply engineering mathematics to analyze the performance of different power converter for different loads.
3. Apply the knowledge of power electronics for different applications such as UPS system, DC drives.
4. Design and implement different over voltage / over current protection circuits.
5. Comprehend and present technical literature in the field of power electronics.
6. To Simulate power circuits using P-Sim software

Unit- I : Introduction to Power Devices

Objective and scope of subject. Power Conversion cycle
Construction, Steady state & Switching characteristics of SCR.
SCR ratings: IL, IH, VBO, VBR, dv/dt, di/dt, surge current & rated current.
Gate characteristics, Gate drive requirements,
Construction, Steady state and switching characteristics and ratings of Power MOSFET & IGBT.
Gate drive requirements, gate drive circuits for Power MOSFET / IGBT.

Unit –II : Line Commutated Converters

Concept of line & forced commutation (Class A-E), Single phase Semi & Full converters for R, R-L loads, Performance parameters, Effect of freewheeling diode,
Three phase Semi & Full converters for R load. Simulation of converters using P-Sim software.

Unit III : DC-AC Converters

Single phase bridge inverter for R and R-L load using MOSFET / IGBT, performance parameters. Different PWM techniques, single phase PWM inverters. Three phase Voltage Source Inverter (VSI) for balanced star R load. 120 and 180 degree mode of operation.
Concept of harmonics, reduction techniques.

Unit IV: DC-DC converters & AC Voltage Controller

Working principle of buck and boost converters, control strategies, working with R, RL, highly inductive loads. Performance parameters, 2-quadrant & 4-quadrant (multi-phase) choppers,
SMPS**:-** Types i.e. half bridge, full bridge, fly-back convertors, comparison with LPS
Single-phase full wave AC voltage controller with R and R-L load.
Applications of Choppers and AC voltage controllers

Unit V: Power Electronics Applications

On-line and OFF line UPS with battery.
Electronic ballast: Working, advantages, Characteristics of fluorescent lamps.
Induction heating. DC motor drive: Single phase separately excited DC motor drive.
Simulation of drive circuit using P-sim software.

Unit VI : Resonant Converters & Protection of Power Devices & Circuits

Need for resonant converters, SLR half bridge DC/DC converter in low frequency, Introduction of zero current switching (ZCS) and zero voltage switching (ZVS) resonant converters.
Cooling & heat sinks, over voltage conditions, over voltage protection circuits, over current fault conditions, over current protection.
Electromagnetic interference: Sources, Impacts, minimizing techniques.

Text Books :

1. M. H. Rashid, "Power Electronics circuits devices and applications", PHI 3rd edition, 2004 edition, New Delhi.
2. R. W. Erickson, Fundamentals of Power Electronics, Kluwer Academic Publishers,
3. M.D. Singh, K.B. Khanchandani, " Power Electronics", 2nd edition, TMH, New Delhi.

Reference Books :

1. Dr. P. S. Bimbhra, "Power Electronics", Khanna Publishers, Delhi.
2. Ned Mohan, T. Undeland & W. Robbins, "Power Electronics Converters applications and design" 2nd edition, John Willey & Sons, Singapore.
3. M. S. Jamil Asghar, "Power Electronics", PHI, 2004, New Delhi
4. GE SCR MANUAL, 6th edition, General Electric, New York, USA.
5. P.C. Sen, "Modern Power Electronics", S Chand & Co New Delhi.

Power Electronics (List of Experiments – Perform any EIGHT of following)

0. Introduction to different devices, understand ratings and interpretation of datasheets

1. Characteristics of SCR
   a. Plot V-I characteristics ,b. Observe the effect of gate current
   b. Measure I_H & I_L
2. V-I Characteristics of MOSFET / IGBT
   a. Plot output characteristics
   b. Plot transfer characteristics
3. Single phase Semi converter with R & R-L load
   a. Observe load voltage waveform,
   b. Measurement of firing angle, average o/p voltage across loads,
   c. Verification of theoretical values with practically measured values.
4. Single phase Full Converter with R & R-L load
   a. Observe load voltage waveform,
   b. Measurement of firing angle, average o/p voltage across loads,
   c. Verification of theoretical values with practically measured values.
5. Single-Phase PWM bridge inverter for R load
   Observe output r.m.s. voltage waveforms,

   OR

   Three phase inverter for R - load (120 and 180 degree mode of operation)
   Observe the line voltage and phase voltage waveforms and harmonics.
6. Step down dc chopper using power MOSFET / IGBT.

Measure duty cycle and observe effect on average load voltage for DC chopper.

7. Find load & line regulation of given SMPS.
8. Speed control of DC motor / stepper motor / ac motor (Any One of following)
    a. Speed control of DC motor using armature voltage control / field control method. Measure RPM and plot graph of speed versus armature voltage and field current
    b. Study drive circuit for stepper motor- phase sequencing and micro stepping
    c. Plot speed-torque characteristic of three phase induction motor.
9. To study over voltage / over current protection circuit.
10. Mini Project based on above syllabus (Any one of the following)
    a. SCR/TRIAC based fan regulator,
    b. Light dimmer
    c. 12V to 5V step down converter
    d. 5V to 48 V step up converter
    e. SCR based battery charger

11 Simulation of converter circuits using P-Sim software.

ETUA31186: Control Systems

Teaching Scheme	Examination Scheme						
Credits: 3	CIE	ISE	SCE	ESE	PR/OR	TW	Total
Lecture (L): 3hrs./week Tutorial (T): - Practical (P): 2hrs/week	-	-	50	-	-	25	75

Prerequisite: Readers/students are expected to know the following concepts:

1. Partial Fractions
2. Laplace Transform
3. Matrices

Course Objectives:

- To introduce various types of control system and transfer function of the system.
- To introduce methods for analyzing the time response, the frequency response and the stability of systems.
- To introduce the concept of root locus, Bode plots, Nyquist plots.
- To introduce the state variable analysis method.

Course Outcomes: On completion of the course, student will be able to:

1. Calculate transfer function of the system using various reduction techniques.
2. Determine the (absolute) stability of a closed-loop control system.
3. Perform time domain and frequency domain analysis of control systems using various techniques.
4. Express and solve system equations in state variable form.

Unit- I : Basics of Control Systems

Introduction, Types of Control Systems: Open loop & Closed loop, Feedback Control System, Effect of Feed Back, Signal flow graphs, Concept of Transfer Function, Characteristics Equation, Poles and Zeros, Block Diagram Algebra, Control system Components

Unit –II : Time Domain Analysis

Type and Order of the Control Systems, Types of Standard Inputs , Response of First Order System to Step, Ramp and Parabolic Inputs , Response of Second Order System to Step Input , Time Domain Specifications of Second Order Systems, Steady State Error and Error Coefficients, Effects of addition of Poles and Zeros.
Concept of Stability - Routh Hurwitz Criterion, Root Locus

Unit III : Frequency Domain Analysis

Need of Frequency Domain Analysis , Correlation between Time & Frequency Domain, Frequency Domain Specifications , Bandwidth , , Bode Plot - Construction of Bode Plot , Gain and Phase Margin , Determination of Relative Stability, Nyquist Stability Criterion- Relative Stability Using Nyquist Criterion

Unit IV : State Space Analysis

Concept of State , State Variables and State Model, State Space Representation using State Model, State Transition Matrix and its properties, Concept of Controllability and Observability

Text Books :

1. Katsuhiko Ogata, Modern Control Engineering, Fifth Edition, PHI Learning Private Limited, New Delhi, 2010
2. I.J. Nagrath, M.Gopal, Control Systems Engineering, Fifth Edition, New Age International Publishers, New Delhi, 2007
3. D. Roy choudhary, Modern Control Engineering, First Edition, PHI Learning Private Limited, New Delhi.

Reference Books :

1. Curtis D Johnson, Process Control Instrumentation Technology, Eighth Edition, PHI Private Limited, New Delhi, 2011
2. B.C. Kuo, Digital Control Systems, Second Edition, Oxford University Press, New York, 1992

List of Practicals :

To be performed in Scilab. At least 2-3 system examples should be taken in each experiment.

1. To calculate Transfer function of a system.
2. To perform transient response analysis of second order system.
3. To perform steady sate response analysis of second order system.
4. To study effect of addition of poles and zeros on time response of second order system.
5. To perform stability analysis of LTI system using Root locus.
6. To perform stability analysis of LTI system using Bode Plot.
7. To perform stability analysis of LTI system using Nyquist Plot
8. To design state space model for a transfer function.

Semester – II

ETUA32181: Professional Elective-II

ETUA32181A : Internet of Things

Teaching Scheme	Examination Scheme						
Credits: 4	CIE	ISE	SCE	ESE	PR/OR	TW	Total
Lecture (L): 3hrs./week Tutorial (T): - Practical (P): 2hrs/week	20	30	20	30	-	25	125

Prerequisite: Readers/students are expected to know the following concepts:

1. Basic of Electronics devices and their operations
2. Basic of Sensor and Transducers.
3. Understanding Of basic Wireless Communication networks.

Course Objectives:

- To study fundamental concepts of IoT
- To understand roles of sensors in IoT
- To Learn different protocols used for IoT design
- To be familiar with data handling and analytics tools in IoT

Course Outcomes:

On completion of the course, student will be able to

1. Understand the various concepts, terminologies and architecture of IoT systems.
2. Use sensors and actuators for design of IoT.
3. Understand and apply various protocols for design of IoT systems
4. Use various techniques of data storage and analytics in IoT
5. Understand various applications of IoT
6. Understand Industrial IOT

Unit I : Introduction to IOT

Introduction, Definitions & Characteristics of IoT, History of IoT, IoT Architectures, Physical & Logical Design of IoT, Enabling Technologies in IoT, About Things in IoT, The Identifiers in IoT, About the Internet in IoT, IoT frameworks, IoT and M2M.

Unit II : Wireless Sensor Networks for IOT

Types of Wireless Sensors, Types of Actuators, Examples and Working, RFID Principles and components, **Wireless Sensor Networks**: History and Context, The node, Connecting nodes, Networking Nodes, WSN and IoT.

Unit III : IOT Protocols and Standards

WPAN Technologies for IoT: IEEE 802.15.4, Zigbee, HART, NFC, Z-Wave, BLE, Bacnet, Modbus.

Unit IV: IP based Protocols for IOT

IPv6, 6LowPAN, RPL, REST, AMPQ, CoAP, MQTT.

Unit V: BIG Data

Introduction, Bigdata, Types of data, Characteristics of Big data, Data handling Technologies, Flow of data, Data acquisition, Data Storage, Introduction to Hadoop. Introduction to data Analytics, Types of Data analytics, Statistical Models, Analysis of Variance, Data Dispersion, Contingence and Correlation, Regression Analysis, Precision and Error limits.

Unit VI: IOT Applications :
Home Automation, Smart Cities, Energy, Retail Management, Logistics, Agriculture, Health and Lifestyle, IoT in Environmental Protection.
Industrial IoT

Text Books :

1. 1.Hakima Chaouchi, " The Internet of Things Connecting Objects to the Web" ISBN : 978-1-84821-140-7, Wiley Publications
2. Olivier Hersent, David Boswarthick, and Omar Elloumi, "The Internet of Things: Key Applications and Protocols", WileyPublications
3. http://www.cse.wustl.edu/~jain/cse570-15/ftp/iot_prot/index.html

Reference Books :

1. Internet of Things, Arsheep Bahga and Vijay Madisetti
2. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications
3. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press
4. https://onlinecourses.nptel.ac.in/noc17_cs22/course

Suggested List of the Experimental Projects(Minimum 6 are to be performed):

1. Study& Survey of various development boards for IoT.
2. Study & Survey of various IoT platforms.
3. Interfacing sensors and actuators with Arduino .
4. Build a cloud-ready temperature sensor with the Arduino Uno and the any IoT Platform: This project shows the building of a temperature sensor.
5. Interfacing Sensors and actuators with Raspberry Pi 2.
6. IoT based Stepper Motor Control with Raspberry Pi: The combination of Raspberry Pi and IoT is an exciting one. Raspberry Pi has many general purpose I/O pins and has the ability to control different actuators like stepper motors. In this project, an internet control of stepper motor using Raspberry Pi computer is developed. The connectivity is divided into server side software and client side software.
7. IoT based Web Controlled Home Automation using Raspberry Pi.
8. A Simple IoT Project with the ESP8266 WiFi module: Here is a simple project with ESP8266 wi-fi module. This project collects the temperature and is displayed on the network.
9. Implement a RFID Based IoT Project

Note: A Project based Learning approach will be followed for this course hence the experiments will be small projects to be built by the students.

ETUA32181: Professional Elective-II

ETUA32181B : Computer Networks and Security

Teaching Scheme	Examination Scheme						
Credits: 4	CIE	ISE	SCE	ESE	PR/OR	TW	Total
Lecture (L): 3hrs./week Tutorial (T): - Practical (P): 2hrs/week	20	30	20	30	-	25	125

Prerequisite: Readers/students are expected to know the following concepts:

1. Data Communications, Topology, Networking, Network categories
2. Protocol layering, layers in OSI reference model, TCP / IP protocol suite, and Addressing,
3. Guided and Unguided Transmission media
4. Switching: Circuit switched networks, Packet Switching.

Course Objectives:

- To understand state-of-the-art in network protocols, architectures, and applications
- To provide students with a theoretical and practical base in computer networks issues
- To outline the basic network configurations
- To understand the transmission methods underlying LAN and WAN technologies.
- To understand security issues involved in LAN and Internet.

Course Outcomes: On completion of the course, student will be able to

1. Understand fundamental principles of computer networking
2. Describe switching and routing in the network and their interrelation.
3. Specify services and deficiencies in existing protocols, and use of new protocols.
4. Acquire the basic knowledge of network security.
5. Explain Virtual Private Network and Access Control Server Protocol
6. Identify security threats and understand use of Intrusion Detection and prevention System (IDS/ IPS)

Unit-I: Network Layer Protocol and Addressing

Network Layer Protocol: ARP, RARP, IGMP, IPv4, IPv6, ICMPv4, ICMPv6

IP Addressing: Classful and Classless Addressing

Unit-II: Switching and Routing

Switching: Frame, Hub, Bridge, Collision Domain, Broadcast Domain, Spanning Tree Protocol

Routing: RIP, OSPF, BGP, EIGRP

Unit-III: Protocol and Services

Transport layer: UDP, TCP, SCTP (Connection Oriented and Connectionless Protocol)

Application layer: WWW, HTTP/ HTTPS, SMTP, DNS, DHCP, FTP/ TFTP

Unit-IV: Introduction to Security

Security Basics - Confidentiality, Integrity, Availability

Intrusion Alert: Interruption, Interception, Modification, Fabrication

Introduction to Security Appliances (any three): CISCO, Juniper, etc.

Access Control List (ACL) and NAT

Unit-V: Virtual Private Network and Access Control Server Protocol

VPN: IPsec, SSL

ACS Protocol: Radius, TACACS, AAA

Unit-VI: Security Threats and Intrusion Detection System (IDS/ IPS)

Types of attack: Denial of service (DOS), backdoors and trapdoors, sniffing, spoofing, man in the middle, replay, TCP/IP Hacking, Phishing attacks, Distributed DOS, SQL Injection. Malware : Viruses, Logic bombs

Intruders, Intrusion detection systems (IDS): host based IDS, network based IDS, logical components of IDS, signature based IDS, anomaly based IDS, network IDS components, advantages and disadvantages of NIDS, host based IDS components, advantages and disadvantages of HIDS.

Text Books :

1. Behrouz A. Foruzan, "Data communication and Networking", Tata McGraw-Hill,5th Edition
2. James F. Kurouse& W. Rouse, "Computer Networking: A Top down Approach", 6th Edition, Pearson Education.

Reference Books :

1. CCNA Security 200-300
2. Wayne Tomasi, "Introduction to Data Communication and Networking", 1/e, Pearson Education

List Lab assignments

1. Study of IP Addresses Subnetting and CIDR
2. Installation of Protocol/ Packet Analyzer Tool and analysis of Network Traffic
3. Assignment on LAN & WAN simulation using Network simulator Tool.
4. Installation and configuration of Web Server, FTP server Installation and configuration of Web Server, FTP server
5. Lab assignment on Switching and Routing (based on Spanning Tree Protocol)
6. Lab assignment based on VPN
7. Case studies on Security Threats and Intrusion Detection System (IDS/ IPS)

ETUA32181: Professional Elective-II

ETUA32181C : Advanced Processors

Teaching Scheme	Examination Scheme						
Credits: 4	CIE	ISE	SCE	ESE	PR/OR	TW	Total
Lecture (L): 3hrs./week Tutorial (T): - Practical (P): 2hrs/week	20	30	20	30	-	25	125

Prerequisite: Readers/students are expected to know the following concepts:

1. Digital Electronics,
2. Microntrollers
3. Fundamentals of programing language

Course Objectives:

- To study 32 bit architecture for an application design and implementation
- To impart philosophy of ARM core evolution
- To explore ARM7 and ARM CORTEX architecture and its impact on embedded solutions.
- To use tool chain for ARM based microcontroller software
- To design and implement software components for hardware initialization and programming.
- To impart knowledge of hardware architecture for digital signal processing.

Course Outcomes: On completion of the course, students will be able to:

1. Recognize ARM 7 architecture to provide optimal solution for embedded system.
2. Identify controller features for application functionality.
3. Understand an embedded application with ARM-7 architecture with an experimentation.
4. Distinguish Cortex architecture philosophy and features from its predecessor
5. Develop an embedded application with Cortex M3 architecture.
6. Recognize fundamentals of DSP processor with reference to an application.

Unit- I : ARM7, ARM9, ARM11 Processor

Introduction to ARM processors and its versions, ARM7, ARM9& ARM11 features, advantages &suitability in embedded application, ARM7 data flow model, programmer's model, modes of operations, Instruction set, programming in assembly language

Unit –II : ARM based Microcontroller

ARM7 Based Microcontroller LPC22xx: Features, Architecture (Block Diagram and Its Description), System Control Block (PLL and VPB divider) , Memory Map, GPIO, Pin Connect Block, timer.

Unit III : Application development with ARM7 Based Microcontroller

Interfacing the peripherals to LPC22XX: LED, LCD, GLCD, KEYPAD, GSM and GPS using UART, on-chip ADC using interrupt (VIC), EEPROM using I2C, SDCARD using SPI, on-chip DAC for waveform generation.

Unit IV : ARM CORTEX Processor

Introduction to ARM CORTEX series, improvement over classical series and advantages for embedded system design. CORTEX A, CORTEX M, CORTEX R processors series, versions, features and applications. Need of operating system in developing complex applications in embedded system, desired features of operating system & hardware support from processor, Firmware development using CMSIS standard for ARM Cortex. Survey of CORTEX M3 based controllers, its features and comparison.

Unit V : ARM CORTEX M3 based Microcontroller (6 Hrs)

ARM-CM3 Based Microcontroller LPC1768: Features, Architecture (Block Diagram & Its Description), System Control, Clock & Power Control, GPIO, Pin Connect Block, interfacing with RGB LED, Seven Segment, TFT Display, MOTOR control using PWM.

Unit VI: Digital signal Processors (6 Hrs)

TMS320C67X Functional units, Internal memory, External memory, On chip peripherals, Interrupts,

Instruction set and addressing modes, Fixed point instructions, Floating point instructions, Conditional operations, Parallel operations, Pipeline operations, Code Composer studio, Application programs in C67X.

Text Books :

1. Andrew Sloss, Dominic Symes, Chris Wright, ―ARM System Developer's Guide –Designing and Optimizing System Software‖, ELSEVIER
2. Joseph Yiu, ―The Definitive Guide to the ARM Cortex-M‖, Newness, ELSEVIER
3. Digital Signal Processors: Architecture, Programming and Applications By B. Venkatramani, M Bhaskar McGraw Hill Second Edition

Reference Books :

1. ARM architecture reference manual : - www.arm.com
2. Trevor Martin, An Engineer's Introduction to the LPC2100 series, Hitex (UK) Ltd.
3. Digital Signal Processing A Practical Approach by Emmanuel Ifeachor, Barrie W. Jervis Pearson Second edition.
4. Texas TMS-320 reference manual

List of Experiments: Advanced Processors

(Any 9 experiments from 1 to 10)

I. LPC2148 ARM7 based practicals

1. Interfacing LPC2148 to 16X2 LCD /128X64 dots GLCD
2. Interfacing LPC2148 UART module with GPS/ GSM
3. Interfacing LPC2148 in-built ADC for respective channel on interrupt basis.

II. LPC1768 Cortex based practicals

4. Interfacing LPC1768 to seven segment/ RGB LED.
5. Interfacing LPC1768 to DC motor and control using PWM signal.
6. Interfacing LPC1768 to TFT display.

III. Tiva™ C Series TM4C123G Based practical's

7. Interfacing TIVA TM4C123G to RGB LED.
8. Interfacing TIVA TM4C123G to initialize inbuilt ADC

IV. TMS320C67xx DSP based practicals

9. Write a program to generate sine wave of specific frequency using TMS320C67xx
10. Write a program to convolve two signals using TMS320C67xx.

ETUA32181: Professional Elective-II

ETUA32181D : Biomedical Electronics

Teaching Scheme	Examination Scheme						
Credits: 4	CIE	ISE	SCE	ESE	PR/OR	TW	Total
Lecture (L): 3hrs./week Tutorial (T): - Practical (P): 2hrs/week	20	30	20	30	-	25	125

Prerequisite: Readers/students are expected to know the following concepts:
Basic electronic systems, basics of biology

Course Objectives:

- To understand the basic theory of biomedical signals and study of different sensors used to acquire these signals
- To understand various noise and artifacts in measurement of biomedical signals
- To study Human Physiological Systems from Engineering Perspectives
- To study major health care devices currently used in medical field
- To understand use of bio signals in diagnosis, patient monitoring and physiological investigation
- To apply basic engineering methods in designing and building of innovations in medical field

Course Outcomes: After the completion of this course the students will be able to

1. Understand the basics of biomedical signals, resemble biological process in terms of electronic process.
2. Understand physiology and anatomy of cardiovascular system and method of acquisition and recording of ECG signal
3. Apply knowledge of various EEG patterns for diagnosis of neural disorders.
4. Design a biomedical system for acquisition and processing of ECG signals.
5. Understand the principle and working of various medical devices
6. Understand the application of the electronic systems in biological and medical applications.

Unit- I : Biomedical Signals

Bioelectric Signals and Electrodes: Bio-potentials and their origin: ECG, EEG, EMG, ENG, ERG, EOG, MEG. Classification of biomedical signals, Biomedical Instrumentation System (man-machine interface), biomedical transducers, electrodes and their characteristics. Sources and contamination of noise in bio-signals, Motion artifacts and skin Impedance.

Unit –II : Cardio Vascular System

Cardiovascular system: Coronary and Peripheral Circulation, Electrical Activity of the heart, Lead configurations , ECG data acquisition, ECG recorder, Heart Sounds and Murmurs

Unit III: Central Nervous System

Nervous System, Structure and functions of Neurons, Electrical activity of nerve cell, Synapse, Reflex action and Receptors. Electroencephalogram – Structure of brain, EEG signal acquisition, 10-20 electrode placement, EEG rhythms & waveform - categorization of EEG activity - recording techniques – EEG applications- Epilepsy, sleep disorders, brain computer interface. Use of Fourier Transform in EEG Signal Analysis.

Unit IV : Biomedical Instrumentation: Basics of Instrumentation Amplifier, Isolation amplifier, Right leg drive mechanism, Design of ECG amplifier, Grounding and shielding techniques, filter design for removal of noise and artifacts.

Unit V : Medical devices:

Blood Pressure measurement, Pulse Oximeter, Life saving Devices: Pacemakers and Defibrillators, Bedside Monitors, heart lung machine, artificial kidney.

Unit VI : Biomedical innovations

Case studies: Prostheses (Jaipur Foot factory) , Smart-cane for blind, Bempu wristlet designed for babies, innovations by young entrepreneurs in medical field.

Text Books :

1. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology",4th Edition, Prentice Hall, 2000.
2. R.S.Khandpur, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, 2003, Edition-II.

Reference Books :

1. J.G. Webster, ed., Medical Instrumentation, Houghton Mifflin, 1978.
2. A.M. Cook and J.G. Webster, eds., Therapeutic Medical Devices, Prentice-Hall, 1982.

Biomedical Electronics (Practical minimum 6 to be performed)

1. A study of biomedical transducers available commercially, exploring the detailed characteristics (can use internet search engines for acquiring literature)
2. Design of an ECG amplifier for acquiring ECG signal
3. Study of ECG recorder and acquisition of ECG signals with various lead configurations
4. Study of digitized ECG signal (readily available at http://physionet.org), expected to observe spectrum, and time domain characteristics like peak amplitudes, identify fiducial points (P,Q,R,S,T,U) (usage of MATLAB expected)
5. Study of EEG recorder and acquisition of EEG signals using 10-20 electrode placement system
6. Study of BP measurement system using Sphygmomanometer /and automatic BP machine
7. Design and implementation of Pulse amplifier
8. Study of a defibrillator/pacemaker as per given specifications.
9. Model a biomedical system for measurement of any bio-signal like body temperature/bio-impedance/respiration/any other

Note: Use of Multisim/ORCAD PSpice/Proteus or any SPICE based simulation program can be made for initial design and verification

ETUA32182: Professional Elective-III

ETUA32182A : Machine Learning

Teaching Scheme	Examination Scheme						
Credits: 4	CIE	ISE	SCE	ESE	PR/OR	TW	Total
Lecture (L): 3hrs./week Tutorial (T): - Practical (P): 2hrs/week	20	30	20	30	25	-	125

Prerequisite: Readers/students are expected to know the following concepts:

1. Basics of Statistics and Probability
2. Linear Algebra

Course Objectives:

- Explore supervised and unsupervised learning paradigms of machine learning used for regression and classification.
- To design and analyze various machine learning algorithms using neural networks.
- To explore Deep learning technique and various feature extraction strategies

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

1. Summarize the concepts of model learning.
2. Analyze mathematically the types of regression models and performance metrics.
3. Analyze mathematically the types of classification models and performance metrics.
4. Illustrate the unsupervised learning paradigms.
5. Analyze backpropagation algorithm and make use of artificial neural networks to solve complex regression and classification problems.
6. To implement convolution neural networks in recognition applications.

Unit- I : Introduction to Machine Learning

Defining and understanding Machine Learning, Types of machine learning, Model definition, Parametric and non-parametric modeling, Generalization: Concept of Training, Validation, Testing, Overfitting and Under fitting as applied to models. Concept of Bias and Variance and its importance in machine learning. Feature Engineering and Dimensionality reduction. Applications of Machine Learning

Unit –II : Supervised Learning -Regression

Linear models for regression**:** Linear Basis Function Models, Least squares and Polynomial regression, Partial least squares, Bayesian Linear Regression, Effect of noise in regression.
Principal Component Regression. Error function used in regression, Regularization: Ridge and Lasso regression, Bayesian Regression, Multivariate Regression.

Unit III : Supervised Learning -Classification

Linear Models for Classification, Logistic regression, Linear Discriminant Analysis, Bayesian Classification, Support Vector Machines, Random forest classifiers, Decision Trees, Evaluation of classification performance.

Unit IV : Unsupervised Learning

Principal Components Analysis (Incremental PCA, Sparse PCA, Kernel PCA), Linear Discriminant Analysis, Independent Component Analysis, clustering: k-Means Clustering, Hierarchical Clustering, Density-based Clustering, Gaussian Mixture models, Maximum Likelihood Estimation.

Unit V : Artificial Neural Networks

Biological neuron, Artificial neuron model, Concept of bias and threshold, Activation functions, McCulloch-Pits Neuron Model, Gradient descent algorithm and application of linear neuron for linear regression and classification, Stochastic Gradient Descent, RMS Prop and Adam optimization techniques. Multilayer perceptron (MLP) and back propagation algorithm, Radial Basis Function networks, Applications of MLP in classification and regression

Unit VI : Deep Neural Networks

Challenges in Machine learning: Vanishing Gradient problems, Computational Load, Architecture of ConvNet, Convolution Layer, Pooling Layer, and Applications of CNN's in Computer Vision, Introduction to Recurrent neural networks. Case study using CNN.

Text Books :

1. Alpaydin, Ethem. *Introduction to machine learning*. MIT press, Third Edition.
2. Laurene Fausett , Fundamentals of Neural Networks: Architectures, Algorithms And Applications, Pearson Education, Inc, 2008.
3. Phil Kim, ―MATLAB Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence Press 2017.

Reference Books :

1. Christopher Bishop, "*Pattern Recognition and Machine Learning*", Springer, 2007.
2. Goodfellow, Ian, Yoshua Bengio, Aaron Courville, and Yoshua Bengio. *Deep learning*. Vol. 1. Cambridge: MIT press, 2016.

Prerequisite: Knowledge of Python programming with Scikit Learn, numpy, matplotlib, pandas, seaborn libraries.

1. Write a program for fitting a line for a given data.
2. Write a program for fitting a line for a given data with Machine learning.
3. Write a program to perform regression tasks over a given data using direct functions and evaluate its performance.
4. Write a program to perform classification tasks over a given data using direct functions and evaluate its performance.
5. Write a program to perform classification tasks over a given data using Support Vector Machine and Random forest classifier and evaluate its performance.
6. Implement K means clustering algorithm for a given data.
7. Implement a simple linear regressor with a single neuron model.
8. Implement and test Multi-Layer Perceptron (MLP) trained with back-propagation algorithm.
9. Implement and test Convolutional Neural Network (CNN) for digits recognition.
10. Write a program to perform classification tasks over a given data using Decision Trees and Random forest classifier and evaluate its performance.

Mini Project.
Design and coding of regression/classification problem using ANN/Deep learning.

ETUA32182: Professional Elective-III

ETUA32182B : Robotics and Applications

Teaching Scheme	Examination Scheme						
Credits: 4	CIE	ISE	SCE	ESE	PR/OR	TW	Total
Lecture (L): 3hrs./week Tutorial (T): - Practical (P): 2hrs/week	20	30	20	30	25	-	125

Prerequisite: Readers/students are expected to know the following concepts:
Basics of Power Electronics, control systems, Microcontrollers and operating system

Course Objectives:

- To understand different aspects of robotic systems and its workspace
- To improve the architectural and programming aspects of robotic automation to deliver efficient outcome.
- To aware the student of their understanding from prerequisite subject to invoked new ideas to find real world solutions through robotic automation systems.
- To analyze the system performance simultaneously optimizing same for improvements.

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

1. Understand robot system and their types with peripheral components
2. Use ROS for robot functioning
3. Use SLAM algorithms for robot navigation
4. Design sensory system for robot
5. Use control algorithms for navigation
6. Understand safety and social implications of robotic systems

Unit- I: Introduction to Autonomous Robot Systems and Applications

Robots: Definition, Types of robot: Manual, Semi Auto, Fully Autonomous. Application Workspaces: Under water, ground, Arial, Static, Dynamic, uncertain, Sensor: Contact and Proximity, Position, Velocity, Force, Tactile etc. Vision applications. Robot Actuation Systems: Electric, Hydraulic and Pneumatic; Timing Belts and Bearings, Parameters for selection of actuators Robotics and Automation for Industry 4.0

Unit- II: Introduction to ROSPY programming and Simulation

What is Robot Operating System: Definition, Working with ROS and Python 2.7 stable version, Working with different ROS Module: raspy, code reusability. Unix-based platforms (Ubuntu) Stable Platform, ROS components, ROS concepts, Computation graph and naming conventions, programming and simulating your first robot.

Unit –III: Robot Localization with Environment Mapping ROS

Introduction to SLAM, Different types of SLAM Sensor classification, Characterizing sensor performance, Sensor selection criteria for SLAM (four different criteria), Range Sensors [Contact Type : Touch sensor, Non-contact Type: IR, LiDAR, Ultrasonic, Laser, Vision based], 3D camera, Workspace relative and absolute position sensors, Global Positioning System (GPS), Sensor Networks, RFID, Blue tooth beacons, Case Study : Indoor SLAM System, Outdoor SLAM System

Unit IV: Path Planning Algorithm (AI)

Static workspace PPA: A*, Visibility graph Cell decomposition, Probabilistic Roadmaps methods, Rapidly-exploring random tree D*, JPS, Dynamic PPA, Path Optimization : GA,

Unit V: Mobile Robot Navigation

Open loop- closed loop, and different types of drives, PID controllers, Path retention, Linear and Non-linear controls, Case Study: Unmanned under water vehicles, Unmanned ground vehicles and Unmanned aerial vehicles Applications

Unit VI: Robot Safety and Social Robotics

Safe navigation, subordinate safety, human aware environment, collision avoidance in multi agent system, Human-Robot Interaction basics. Implicit vs explicit interaction.

Text Books :

1. Introduction to Autonomous Mobile Robots, Second Edition, By Roland Siegwart, Illah Reza Nourbakhsh and Davide Scaramuzza, ISBN: 9780262015356472
2. Mobile Robotics, A Practical Introduction, Authors: **Nehmzow**, Ulrich, Springer publisher, ISBN 978-1-4471-0025-6
3. Adaptive Navigation and Motion Planning for Autonomous Mobile Robots: Mobile Robots, Navigation, Path Planning, Visual Tracking and Sensor Integration, Ashraf Aboshosha, ISBN-13: 978-3846530207, LAMBERT publication
4. Path Planning for Autonomous Vehicle, Umar Zakir Abdul Hamid, DOI: 10.5772/intechopen.77593, ISBN: 978-1-78923-992-8, IntechOpen publisher

Reference Books:

1. Mobile Robotics, 1st Edition, by Luc Jaulin, Hardcover ISBN: 9781785480485, Book ISBN: 9780081004814, ISTE Press – Elsevier press
2. Path Planning Algorithms for Mobile Robots, Zeeshan Malik Muhammad, Eizad Amre, Khan Muhammad Umer, ISBN-13: 978-3659585081, Lambert publication
3. Robot Navigation from Nature, **Milford**, Michael John,, ISBN 978-3-540-77520-1, Springer Tracts in Advanced Robotics
4. Mobile Robot Navigation and Localization: Roadmap-based Path Planning and Visibility Sector-based Localization, Jinsuck Kim, ISBN-13: 978-3639088489, VDM Verlag

Practical Assignments:

According to each group PBL selection student performs following activity:

Tools Required: Python Language, Development system, operating system, Robot simulators**,**

1. Selection of real-world scenario where human find problem to perform task which can be solved by introducing autonomous robot system.
2. To design the autonomous robot structure. which can be utilized to accomplish above selected PBL?
3. Identifying different modules required to accomplish the complete task. Student expected to use simulation software / actual hardware to run required automation modules.
4. Integrating the modules to execute complete task.
5. Introducing all required safety measures inside the robotic system.
6. Analysis and optimizing the complete system.
7. Documentation and Publishing the complete PBL work online.

ETUA32182: Professional Elective-III

ETUA32182C : Digital System Design using Verilog

Teaching Scheme	Examination Scheme						
Credits: 4	CIE	ISE	SCE	ESE	PR/OR	TW	Total
Lecture (L): 3hrs./week Tutorial (T): - Practical (P): 2hrs/week	20	30	20	30	25	-	125

Prerequisite: Readers/students are expected to know the following concepts:
Digital Logic Design

Course Objectives:

- Get the knowledge of Verilog Hardware Description Language to design digital circuits.
- Explore features and architectures of various PLDs.
- Learn different modeling styles using Verilog.
- Learn to write test benches and analyze simulation results.
- Distinguish between good and bad coding practices.
- To implement digital designs on PLDs (CPLDs/FPGAs).

Course Outcomes: After the completion of this course the students will be able to

1. Comprehend the basic concepts in the Verilog language.
2. Write efficient Verilog codes using different modeling styles.
3. Describe and differentiate the architectures and features of PLDs like CPLDs and FPGAs.
4. Cognize switch level modeling and user defined primitives.
5. Comprehend the concept of synthesizable codes and write efficient synthesizable codes of different digital circuits.
6. Design complex system like processor.

Unit I : Basic Verilog HDL
Introduction, HDL design flow, Design representation, Modules and Instances, Verilog features, Data types, Operators, Identifiers, Keywords, Writing basic test bench, Modeling examples.

Unit II : Modeling Styles
Dataflow modeling: Continuous assignment, Behavioral modeling: Procedural assignment, Initial and always block, Sequential statements, Loops, Blocking and non-blocking assignments, Generate block, Modeling examples.

Unit III : Programmable Logic Devices
Basic PLDs (PAL, PLA, and PROM), CPLDs (Features and architecture), Spartan-3E FPGA (Features, IOB architecture, and CLB/Slice architecture), Overview of Artix-7 FPGA.

Unit IV: Advanced Verilog topics
Verilog test benches and simulation, User defined primitives: UDP basics, combinational UDP's, Sequential UDP's, guidelines for UDP design, Switch level modeling: Various switch primitives, examples.

Unit V: Logic Synthesis with Verilog
Synthesizable Verilog: Synthesis rules, Functions and tasks in Verilog, Non-synthesizable constructs, Coding styles, Modeling finite state machines, Data path and controller design, Modeling memory and register bank.

Unit VI : Case Study (Pipelined Processor design)
Basics of pipelining, Pipeline modeling, Pipeline implementation of a processor, Verilog modeling of a processor.

Text Book :
Samir Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis", Pearson.

Reference Books and Material :
1. Jayaram Bhasker, "A Verilog HDL Primer", Star Galaxy Publication.
2. Jayaram Bhasker, "Verilog HDL Synthesis: A Practical Primer", Star Galaxy Publication.
3. Spartan-3E FPGA family data sheet.
4. Artix-7 FPGA data sheet.

Digital System Design using Verilog (List of experiments) (Any 8)

To write Verilog design and test code to simulate, synthesize, and implement design on FPGA.

1. 4 bit full adder.
2. 4:1 Multiplexer.
3. 4-bit up/down counter with output displayed on 7-segment display.
4. Basic ALU (any two logical and any two arithmetic operations).
5. Traffic Signal controller.
6. 4 bit shift register.
7. Random Access Memory (RAM).
8. Sequence detector.
9. Parity checker.
10. Modeling using user defined primitive and switch level modeling to implement a given function (Not synthesizable).

ETUA32182: Professional Elective-III

ETUA32182D : Broadband Communication

Teaching Scheme	Examination Scheme						
Credits: 4	CIE	ISE	SCE	ESE	PR/OR	TW	Total
Lecture (L): 3hrs./week Tutorial (T): - Practical (P): 2hrs/week	20	30	20	30	25	-	125

Prerequisite: Readers/students are expected to know the following concepts:

1. Analog Communication
2. Digital Communication

Course Objectives:

- To introduce fundamental theory of radiation and microwaves.
- To understand theory of passive and active components of microwave systems.
- To understand the basics of orbital mechanics and the look angles from ground stations to the satellite.
- Provide in depth understanding of uplink and downlink parameters for bandwidth and power constraint system.

Course Outcomes:

1. Differentiate various performance parameters of radiating elements.
2. Apply the knowledge of waveguide fundamentals in design of transmission lines.
3. Design and set up a system consisting of various passive and active microwave components.
4. Analyze tube based and solid state active devices along with their applications.
5. Identify the challenges related to design the satellite subsystem.
6. Design Satellite Link for Up Linking and Down Linking and evaluate its performance.

Unit I : Fundamental Theory of Radiation and Radiating Elements (6Hrs)

Fundamental equations for free space propagation, Friss transmission equation, Definition of antenna, radiation mechanism and types of antenna, performance parameters such as radiation pattern, directivity, gain, efficiency, half power beam width, bandwidth, polarization, input impedance, radiation efficiency, effective length, effective area, radiation sphere.

Unit II : Transmission lines and Waveguides (6Hrs)

Introduction to Microwaves engineering: History of Microwaves, Microwave Frequency bands. Applications of Microwave. General solution for TEM, TE and TM waves, Parallel plate waveguide, and rectangular waveguide. Wave guide parameters. Introduction to coaxial line, Rectangular waveguide cavity resonators. Strip lines: Structural details, types and applications. (No derivations)

Unit III : Passive Microwave Components (6Hrs)

Construction, working principle and scattering analysis of passive microwave components such as E-plane, H-plane and magic tee. Ferrite composition, characteristics and Faraday rotation principle. Construction, working principle, S-parameters and scattering analysis of isolator, circulator and directional coupler. Construction and operation of gyrator.

Unit IV: Active Microwave Components (6Hrs)

Limitations of conventional tubes, O and M type classification of microwave tubes, re-entrant cavity, velocity modulation. Construction, operation, performance analysis and applications of - Single cavity and two cavity klystron, Cylindrical wave magnetron and Helix traveling wave. Construction, working principle and applications of two terminal microwave devices such as tunnel diode, Gunn Diode, PIN Diode, Schottky Barrier Diode and Varactor Diode.

Unit V: Orbital Mechanics and Launchers (6 Hours)

History of Satellite Communication, Orbital Mechanics, Look angle determination, Orbital perturbations, Orbital determination, Launchers and Launch Vehicles, Orbital effects in communication system performance.

Unit VI: Satellite Communication Link Design (6 Hours)

Introduction, Basic transmission Theory, System Noise Temperature and G/T Ratio, Design of Downlinks, Satellite Systems using Small Earth Stations, Uplink Design, Design of Specified C/N: Combining C/N and C/I values in Satellite Links, System Design Examples.

Text Books :

1. C.A. Balanis, "Antenna Theory - Analysis and Design", John Wiley.
2. Samuel Y. Liao, "Microwave Devices and Circuits", 3rd edition, Pearson
3. Annapurna Das and Sisir K. Das, "Microwave Engineering", Second edition, Tata Mc Graw Hill.
4. Timothy Pratt, Charles Bostian, Jeremy Allnutt "Satellite Communications", John Wiley & Sons.

Reference Books :

1. K. D. Prasad, "Antenna &Wave Propagation", Satya Prakashan, New Delhi.
2. David M. Pozar, "Microwave Engineering", Fourth edition, Wiley.
3. M. Kulkarni, "Microwave and Radar engineering", 3rd edition, Umesh Publication
4. Dennis Roody, "Satellite Communications", McGraw Hill

Course Objectives:

- To introduce fundamental theory of radiation and microwaves.
- To understand theory of passive and active components of microwave systems.
- To understand the basics of orbital mechanics and the look angles from ground stations to the satellite.
- Provide in depth understanding of uplink and downlink parameters for bandwidth and power constraint system.

List of Experiments [Minimum 08]

1. To measure and compare radiation pattern, return loss, impedance, gain, beam width of dipole antenna and folded dipole antenna at microwave frequency.
2. To measure radiation pattern and gain of horn or parabolic antenna at microwave frequency.
3. To measure and plot mode characteristics of reflex klystron.
4. To measure VI characteristics of Gunn Diode and study of PIN modulator.
5. To measure and verify port characteristics of microwave tees (E, H, E-H or magic planes).
6. To measure and verify port characteristics of directional coupler and calculate coupling factor, insertion loss and directivity.
7. To measure and verify port characteristics of isolator and circulator and calculate insertion loss and isolation in dB.
8. Set up an Active Satellite link between Uplink Transmitter and Downlink Receiver using tone signal and demonstrate Link Fail Operation.
9. To transmit and receive three separate signals (Audio, Video, and Tone) simultaneously through satellite Link.

ETUA32183: Digital Signal Processing

Teaching Scheme	Examination Scheme						
Credits: 4 Lecture (L): 3hrs./week Tutorial (T): - Practical (P): 2hrs/week	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	25	-	125

Prerequisite: Readers/students are expected to know the following concepts:
1) Mathematics 2) Signals and Systems

Course Objectives:
- To build an understanding of sampling and aliasing
- To introduce students to transforms for analysis of Discrete time signals and systems.
- To build an understanding of design of FIR and IIR systems and their implementation.
- To build an understanding of multirate systems.

Course Outcomes:
On completion of the course, students will be able to
1. Apply the fundamentals of engineering mathematics for understanding sampling and equivalence between analog and digital domain frequencies.
2. Apply Fourier transform and analyze signals in time and frequency domain.
3. Apply Z transform and analyze discrete time system behavior.
4. Design FIR filters for the given passband and stopband specifications
5. Design IIR filters for the given passband and stopband specifications.
6. Understand the fundamentals of multirate systems and wavelets.

Unit- I: Introduction
Review of Signals and Systems: Types of signals and systems. Basic elements of DSP and its requirements, Advantages of Digital over Analog signal processing. Sampling & Aliasing, DT signals, sampling theorem in time domain, Continuous Time signals and discrete time signals, relation between analog frequency and digital frequency. Representation of signals as vectors, concept of Basis function and orthogonality.Convolution and Correlation, recursive and non-recursive discrete time systems.

Unit –II: Discrete Fourier Transform
DTFT, Definition, Frequency domain sampling, DFT, Properties of DFT, resolution of DFT, circular convolution, Computation of linear convolution using circular convolution, FFT, decimation in time and decimation in frequency using Radix-2 FFT algorithm, Linear filtering using overlap add and overlap save method. Analyze audio signals using FFT. DCT and IDCT.

Unit III: Z transform
Need for transform, relation between Laplace transform and Z transform, between Fourier transform and Z transform, properties of Z transform, Relation between pole locations and time domain behavior, causality and stability considerations for LTI systems, Inverse Z transform, Power series method, partial fraction expansion method, Solution of difference equations.

Unit IV: FIR Filter Design
Ideal filter requirements, Concept of Linear phase in FIR filters. Design of FIR filters using window Method, Gibbs phenomenon, Characteristics and comparison of different window functions, Design of FIR filter using frequency sampling method. FIR filters realization using direct form, cascade form.

Unit V: IIR Filter Design
Design of IIR filters from analog filters, IIR filter design by impulse invariance method, Bilinear transformation method. Warping effect. Characteristics of Butterworth filters, Chebyshev filters. Design

of filters from prototype low pass filter. Butterworth filter design, IIR filter realization using direct form, cascade form and parallel form.

Unit VI: Multirate DSP and Introduction to Wavelets

Concept of Multirate DSP, Sampling rate conversion by a non-integer factor, Design of two stage sampling rate converter. Subband coding of speech signal. Short time Fourier Transform (STFT), continuous wavelet transform (CWT), Introduction to discrete wavelet transform (DWT), Interpretation of DWT, Signal representation with Harr wavelet.

Text Books :

1. John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing: Principles, algorithms and applications" Fourth edition, Pearson Prentice Hall.
2. Ifaeachor E.C., Jervis B. W., "Digital Signal processing : Practical approach", Pearson Publication
3. P. P. Vaidyanathan, "Multirate Systems and Filter Banks", Prentice Hall, 1993.

Reference Books:

1. A. V. Oppenheim, R. W. Schaffer, "Discrete Time Signal Processing", Third edition, Prentice-Hall Signal Processing Series.
2. S. Salivahanan, A. Vallavaraj, C. Gnanpriya, "Digital Signal processing", McGraw Hill.
3. Monson Hayes "Schaums Outline of Digital Signal processing", McGraw Hill.
4. Shaila Apte, "Digital Signal Processing", Second edition, Wiley India.
5. P. Ramesh Babu, "Digital Signal Processing", Fourth edition, Scitech Publications.
6. S. Mallat, "A Wavelet tour of Signal Processing", Academic Press, Second Edition.

List of Experiments:

Write programs using MATLAB / PYTHON to:

1. Compute DFT. Plot the spectrum with different DFT resolution.
2. Compute DCT and IDCT to perform signal compression.
3. Perform linear filtering on the signal using overlap add/save method
4. Design FIR filter using window method.
5. Design Butterworth filter using Bilinear transformation method.
6. Design and implement decimator.
7. Design and implement interpolator.
8. Perform subband coding of signal using multirate signal processing.

ES32184ET: Management Information System

Teaching Scheme	Examination Scheme						
Credits: 3 Lecture (L): 3hrs./week Tutorial (T): - Practical (P): -	CIE	ISE	SCE	ESE	PR/OR	TW	Total
	20	30	20	30	-	-	100

Prerequisite: Readers/students are expected to know the following concepts:

1. Basics terminology of Information Technology / Internet / MS Excel,
2. Engineering Fundamentals
3. Business Process / Supply Chain Life Cycle

Course Objectives:

- To understand types of MIS applications in organizations
- To understand information system and its components, its association in big picture
- To analyze the requirement of users and draft specifications of system
- To study databases and its importance in system and business process
- To develop broad understanding of ethics and code of conduct
- To study process of decision making and its phases

Course Outcomes:

After completion of this course student should be able to

1. Appreciate what a supply chain is and what it does
2. Understand the role of IT in Engineering and business process
3. Describe a business process and link it to information system
4. Apply MIS concepts to reach to decision in the tasks he/she undertake
5. Apply ethical practices in day-to-day life

Unit- I: Information Technology and its Impact

Information Technology - Definition, Data, Information, Knowledge, Dataflow, system, Apps.
IT Capabilities and their impact on Industrial, Educational, Business and Profession.
Telecommunication and Networks – Need, Basics of networking and internet, Concept of cloud and data centers, Video Conferencing and virtual meetings
IT enabled services such as Call Centres, Geographical Information Systems, E Commerce, etc.

Unit- II: Information System Analysis and Design

User requirement analysis, Feasibility study, Software Development / Product development life cycle, systems study and systems design, Resource utilization, implementation, audit, operation, maintenance and modification.

Unit –III: Database Management System

Introduction, Types, Advantages using database models, Basics of data models, Queries, generating a report, Excel as a database for trend analysis.

Unit IV Functional MIS: MIS within functional areas such as Human Resources, Marketing & Sales, Production, Accounting & Finance, Customer Relationships Management (CRM), Product Supply Chain Management systems, Logistic Management, Learning Management System

Unit V: Decision Support System and strategic management:

Decisions support systems, expert systems, office automation systems and knowledge-based systems, Structured decision making, unstructured decision making and semi structured decision making, Setting up Strategy for the organization / situation

Unit VI: Ethical and Social Issues in Information Systems:

Moral dimensions of Information Age, Concept of responsibility, accountability and liability, Professional code of conduct, Information rights: Privacy and freedom, Ethical Dilemma

Text Books :

1. Kenneth C. Laudon & Jane P. Laudon, Essentials of Management Information Systems, Tenth Edition, Pearson Prentice-Hall, 2012. ISBN 978-0132668552
2. Analysis and Design of Information Systems, Rajaraman, Prentice Hall

Reference Books :

1. Management Information Systems, Laudon and Laudon, 7th Edition, Pearson Education
2. Management Information Systems, Davis and Olson, Tata McGraw Hill
3. Decision Support Systems and Intelligent Systems, Turban and Aronson, Pearson Education Asia

IOEUA32185: Open Elective- I

IOEUA32185A: Information and Cyber Security

Teaching Scheme	Examination Scheme						
Credits: 3	CIE	ISE	SCE	ESE	PR/OR	TW	Total
Lecture (L): 3hrs./week Tutorial (T): - Practical (P): -	20	30	20	30	-	-	100

Prerequisite: Readers/students are expected to know the following concepts:
Fundamentals of Computer Networks

Course Objectives:

- To know the need and basic of security
- To learn various types of Cryptographic algorithm algorithm
- To learn various authentication techniques
- To acquire knowledge of protocols employed to provide Confidentiality and integrity
- To understand various threats
- To acquaint with current security scenario

Course Outcomes:

After completion of this course student should be able to

1. Identify the need and basic of security (Knowledge)
2. Summarize various Cryptographic algorithm (Understand)
3. Infer various authentication techniques (Understand)
4. Summarize protocols for confidentiality and integrity (Understand)
5. Identify various threats (Knowledge)
6. Relate with current industry trends (Understand)

Unit- I: Security Basics and Introduction to cryptography
Introduction, Elements of Information Security, Understanding concepts: threat, exploit, privacy, vulnerability and policy, Types of Attacks, Operational Model of Network Security,
Cryptography, Substitution Ciphers, Transposition Ciphers, Stenography applications and limitations.

Unit- II: Symmetric Key Cryptography
Introduction, Encryption Methods: Symmetric, Asymmetric, Block Ciphers and methods of Operations, Data Encryption Standard (DES), Advance Encryption Standard (AES).

Unit –III: Asymmetric Key Cryptography
Public Key Cryptography, RSA Algorithm: Working, Key length, Security, Key Distribution, Deffie-Hellman Key Exchange,
Authentication methods, Message Digest, Kerberos, X.509 Authentication service.
Digital Signatures: Implementation, Algorithms, Standards (DSS), Authentication Protocol

Unit IV: Network Layer Security
IP Security: IPSec protocols, and Operations, AH Protocol, ESP Protocol, ISAKMP Protocol, Oakkey determination Protocol, VPN.
WEB Security:
Introduction, Secure Socket Layer (SSL), SSL Session and Connection, SSL Record Protocol, Change Cipher Spec Protocol, Alert Protocol, Handshake Protocol.
Electronic Mail Security: Introduction, Pretty Good Privacy, MIME, S/MIME, Comparison. Secure Electronic Transaction(SET)

Unit V: Firewall And Intrusion

Introduction, Computer Intrusions. Firewall Introduction, Characteristics and types, Benefits and limitations. Firewall architecture, Trusted Systems, Access Control.
Intrusion detection, IDS:
Need, Methods, Types of IDS, Password Management, Limitations and Challenges.

Unit VI: Introduction to OWASP

Introduction, Top 10 Vulnerabilities, understanding Top 10 Vulnerabilities.

Text Books :

1. Atul Kahate, "Cryptography and Network Security", Mc Graw Hill Publication, 2nd Edition, 2008, ISBN : 978-0-07-064823-4
2. Dr. V.K.Pachgare, "Cryptography and Network Security", PHI, 2nd Edition, 2015

Reference Books :

1. William Stallings, "Cryptography and network security principles and practices", Pearson, 6th Edition, ISBN : 978-93-325-1877-3
2. Forouzan, "Cryptography and Network Security (SIE)", Mc Graw Hill, ISBN,007070208X, 9780070702080
3. www.owasp.org

IOEUA32185B: Automotive Electronics

Teaching Scheme	Examination Scheme						
Credits: 3	CIE	ISE	SCE	ESE	PR/OR	TW	Total
Lecture (L): 3hrs./week Tutorial (T): - Practical (P): -	20	30	20	30	-	-	100

Prerequisite: Readers/students are expected to know the following concepts:
Basics of sensors and actuators, general automotive system, basics of OS

Course Objectives:

- To make familiar about automotive system operations.
- To illustrate need for automation in automotive operations and appropriate electronics for the same.
- To discuss suitability of electronics hardware and software platform for control, compute and communication systems in automotive.
- To discuss control algorithms used in automotive.
- To introduce various communication standards used for intra and inter-cluster communication in automotive electronic system.
- To make awareness of fault diagnosis system in automotive.

Course Outcomes:

After completion of this course student should be able to

1. understand powertrain and transmission mechanism of SI and DI engine.
2. identify need of automation in automotive operations and appropriate electronics for the same.
3. select suitable electronics hardware and software platform for design and development of various control, compute and communicate oriented automotive systems.
4. Understand control theory for automotive systems
5. understand communication and fault diagnostic protocols used in automotive
6. use the techniques, skills, and modern engineering tools necessary for automotive engineering practice

Unit I: Power Train Engineering and fundamentals of Automotive.
Fundamentals of Petrol, diesel and gas engines and electric motors. Basic Automotive System. Alternators and charging, battery technology, Ignition systems. Basic of Hybrid designs (solar power, electric/gasoline, LPG, fuel cells). Basic Transmission systems.

Unit II: Sensors and actuators in Automotive
In-vehicle sensors: Working principles, Characteristics, limitations and use within the automotive context of the following: Temperature sensing e.g. coolant. Position sensing e.g. crankshaft, throttle plate. Pressure sensing e.g. exhaust differential, tyre pressure measurement system. Distance sensing e.g. anti-collision, Velocity sensing e.g. speedometer, anti-skid, Torque sensing e.g. automatic transmission, Vibration sensing e.g. Airbags, Flow sensing and measurement e.g. Fuel injection.
Use of Actuators: Types, working principle, Characteristics, limitations and use within the automotive context of each type.

Unit –III: Electronics processing System in automotive
Interfacing electronics: Operational amplifier circuits, Instrumentation amplifiers, Comparators. Level shifting, Wave-shaping, Filters. Noise mechanisms and reduction.

Electronics control unit: Automotive processors and OS, typical design consideration of ECU.

Unit IV: Automotive Control Systems

Control system approach in Automotive: Analog and Digital control methods. Cruise control, traction control, actuator limiting, wind-up, gain scheduling, adaptive control.

Special Control Schemes: Vehicle braking fundamentals, Antilock systems, Variable assist steering and steering control, Controls for Lighting, Wipers, Air-conditions/Heating, Remote keyless Entry and Anti-theft System. Spark Ignition and Compression Ignition Engines and their electronic controls.

Engine management testing: Engine management system strategies and implementation, Simulation and implementation methods.

Unit V: Automotive Communication Systems

Communication interface with ECUs: Interfacing techniques and interfacing with infotainment gadgets. Automotive Buses: Use of various buses such as CAN, LIN, Flexural, Recent trends in automotive buses (Such as OBDII, MOST, IE, IELLI, D2B, and DSI: Only Comparative study). **Application of Telematics in Automotive:** Global Positioning Systems (GPS) and General Packet Radio Service (GPRS), for use in an automotive environment.

Unit VI: Diagnostics and Safety in Automotive.

Fundamentals of Diagnostics: Basic wiring system and Multiplex wiring system. Preliminary checks and adjustments. Self-Diagnostic system. Fault finding and corrective measures. Electronic transmission checks and Diagnosis. Diagnostic procedures and sequence. On board and off board diagnostics in Automotive.

Safety in Automotive: Safety norms and standards. Passenger comfort and security systems. Electromagnetic environment and Automotive EMC Standards. SAE and IEEE Standards.

Text books:

1. Williams. B. Ribbens, "Understanding Automotive Electronics", 6th Edition, 2003, Elsevier Science, Newness Publication.
2. Robert Bosch, "Automotive Electronics Handbook", John Wiley and Sons, 2004.
3. K.P. Ramchandran, G.K. Vijayraghavan, M.S. Balsundaram, "Mechatronics: Integrated Mechanical and Electronic System", Wiley India, 2010.

Reference Books :

1. Ronald K Jurgen, "Automotive Electronics Handbook", 2nd Edition, **McGraw-Hill**, 1999.
2. James D Halderman, "Automotive Electricity and Electronics", PHI Publication 2005.

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IOEUA32185: Open Elective- I

IOEUA32185C: Industrial Engineering

Teaching Scheme	Examination Scheme						
Credits: 3	CIE	ISE	SCE	ESE	PR/OR	TW	Total
Lecture (L): 3hrs./week Tutorial (T): - Practical (P): -	20	30	20	30	-	-	100

Prerequisite: Readers/students are expected to know the following concepts:

Course Objectives:

- To introduce the concepts, principles and framework of contents of Industrial Engineering.
- To acquaint the students with various productivity enhancement techniques.
- To acquaint the students with different aspects of Production Planning and Control and Facility Design.
- To introduce the concepts of various cost accounting and financial management practices as applied in industries
- To acquaint the students with different aspects of Human Resource activities and Industrial Safety rules.
- To acquaint students with different aspect of simulation modeling for various industrial engineering\applications.

Course Outcomes:

After completion of this course student should be able to

1. Apply the Industrial Engineering concepts to solve industrial problems.
2. Understand, analyze and implement different concepts in method study so as to reduce the cost.
3. Design and Develop different aspects of work system and facilities to improve effectiveness of production processes.
4. Apply Industrial safety standards and financial management practices to take financial decision.
5. Undertake project work based on modeling & simulation area.
6. Understand project planning and its control

Unit I: Introduction to Industrial Engineering and Productivity

Definition and Role of Industrial Engineering, Types of production systems and organization structure, Functions of management. Measurement of productivity: Factors affecting the productivity, Productivity Models and Index (Numerical), Productivity improvement techniques.

Unit II: Methods Study

Work Study: Definition, objective and scope of work-study, Human factors in work-study.

Method Study: Definition, objective and scope of method study, work content, activity recording and exam aids.

Charts to record movements: Operation process charts, flow process charts, travel chart, two-handed chart and multiple activity charts.

Principles of Motion Economy: Classification of movements, SIMO chart, and micro motion study. Definition and installation of the improved method, brief concept about synthetic motion studies. Introduction to Value Engineering and Value Analysis.

Unit –III: Work System Design

Work Measurements: Definition, objectives and uses, Work measurement techniques.

Work Sampling: Need, confidence levels, sample size determinations, random observation, conducting study with the simple problems.

Time Study: Definition, time study equipment, selection of job, steps in time study. Breaking jobs into elements, recording information, Rating and standard rating, standard performance, scales of rating, factors affecting rate of working, allowances and standard time determination.

Introduction to PMTS, MTMand MOST.

Unit IV: Production Planning and Control

Introduction: Types of production systems, Need and functions of PPC, Aggregate production planning. Capacity Planning, ERP: Modules, Master Production Schedule, MRP and MRP-II.

Forecasting Techniques: Causal and time series models, moving average, exponential smoothing, trend and seasonality (Numerical), Demand Control strategies (MTO, MTA, MTS).

Introduction to Supply Chain Management: Basic terminologies.

Unit V: Facility Design

Plant Location: Need and factors influencing plant location, Plant Layout: Objectives, principles, types of plant layouts.

Introduction to Assembly Line Balancing and Layout parameters to evaluate.

Material Handling systems: Objectives, relation with plant layout, principles. Types and purpose of different material handling equipment, Selection of material handling equipment.

Inventory control and Management: Types of inventories, Need of inventories, terminology, costs, Inventory Models: Basic production models, (with and without shortage and discount), ABC, VED Analysis

Unit VI: Engineering Economy, Human Resource and Industrial Safety

Introduction to Costing: Elements of Cost, Break-Even Analysis (Numerical). Introduction to Debit and Credit Note, Financial Statements (Profit and loss account and Balance Sheet), Techniques for Evaluation of capital investments.

Human Resource Development: Functions: Manpower Planning, Recruitment, Selection, Training. Concept of KRA (Key Result Areas), Performance Appraisal (Self, Superior, Peer, 360º). Industrial Safety: Safety Organization, Safety Program

Text books:

1. M Mahajan, Industrial Engineering and Production Management, Dhanpat Rai and Co.
2. O. P. Khanna, Industrial engineering and management, Dhanpat Rai publication
3. Martend Telsang, Industrial Engineering, S. Chand Publication.
4. Banga and Sharma, Industrial Organization& Engineering Economics, Khanna publication

Reference Books :

1. Introduction to Work Study by ILO, ISBN 978-81-204-1718-2, Oxford & IBHPublishing Company, New Delhi, Second Indian Adaptation, 2008.
2. H. B. Maynard, K Jell, Maynard 's Industrial Engineering Hand Book, McGraw Hill Education.
3. Askin, Design and Analysis of Lean Production System, Wiley, India
4. Zandin K.B., Most Work Measurement Systems, ISBN 0824709535, CRCPress,2002

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OEUA32185: Open Elective- I

IOEUA32185D: Artificial Neural Network in Engineering

Teaching Scheme	Examination Scheme						
Credits: 3	CIE	ISE	SCE	ESE	PR/OR	TW	Total
Lecture (L): 3hrs./week Tutorial (T): - Practical (P): -	20	30	20	30	-	-	100

Prerequisite: Readers/students are expected to know the following concepts:

Course Objectives:

- To make students aware of various soft computing techniques in general and Artificial Neural Networks in particular, giving details about its working and analogy with Biological Neural networks.
- To give students ideas about designing and training an Artificial Neural network using different algorithms to solve uinvariate and multivariate time series problems.

Course Outcomes:

After completion of this course student should be able to

1. Understand ANN as AI, soft computing and data driven model and describe its types
2. Compute the Net information given components of neuron
3. Describe various network training algorithms
4. Determine various design related aspects of ANN namely architecture, stopping criteria, performance function, overfitting
5. Describe working of Recurrent networks, Radial basis function networks, Generalized regression neural networks, Self-organizing maps using case studies
6. Design, train, and test 2 or 3 layered Feed forward back propagation neural network for time series and cause effect models

Unit I: Introduction to Artificial Neural Networks

Biological Neural Network, Introduction to Artificial Intelligence, soft computing techniques, Data driven modeling, ANN as AI, Soft computing and data driven technique, Artificial Neuron, ANN- history and general properties, ANN types according to architecture and Neuro-Dynamics, ANN Vs empirical, statistical, physical, physics based models

Unit II: Artificial Neuron

Components of artificial neuron, methods of computing net information, Activation functions (linear, sigmoidal, hyperbolic tangent, hard limiter, soft-lin), perceptron, Multi-layered perceptron (MLP)

Unit –III: Network training

Pre-training procedures- data normalization, network initialization, Types of training-Supervised and un-supervised, Network training using supervised training algorithms – Standard back propagation algorithm or gradient descent algorithm (mathematical treatment), introduction to Network training using conjugate gradient, resilient back propagation, Broydan-Fletcher-Goldfarb-Shanno algorithm, One step secant algorithm, Levernberg-Marquardt algorithm

Unit IV: Important Aspects of ANN design

Network architecture- inputs, outputs, number of hidden layers, number of hidden neurons, stopping criteria, overfitting, validation, testing, De-normalization, Evaluating model performance, data division, performance function

Unit V: Types of ANN

Recurrent networks, Radial basis function networks, Generalized regression neural networks, Self-organizing maps (discuss using case studies of each referring to published papers and literature).

Unit VI: Applications of Feed Forward Back Propagation Neural Networks

Time series (univariate and multivariate) models, cause-effect models, Applications in Civil engineering, Electronics and Telecommunications, Mechanical Engineering, Computer Engineering, design, train and test simple 2 or 3 layered feed forward back propagation ANN for time series and cause effect models. Image Classifications using ANN

Text books:

1. Wasserman, P.D., (1993), " Advanced methods in neural computing", Van Nostrand Reinhold, New York
2. Kosko, B., (1992), "Neural Networks and Fuzzy systems", Prentice Hall, Englewood Cliffs, NJ
3. Bose, N. K., Liang, P. (1998), "Neural Network Fundamentals with Graphs, Algorithms and Applications", Tata McGraw-Hill Publication.

Continuous Evaluation:

1. Calculation of network output for any given ANN with sigmoidal, hyperbolic tangent and linear activation functions
2. Implementing standard backpropagation algorithm manually, Using WEKA or any other software
3. Designing, training, and testing 2-3 layered FFBP ANN using standard backpropagation algorithm for any time series problem (univariate)
4. Evaluating the performance of ANN developed in Experiment 3 by varying number of hidden neurons, activation functions, normalization ranges
5. Designing, training, and testing 2-3 layered FFBP ANN using standard backpropagation algorithm for any time series problem (multi-variate)
6. Evaluating the performance of ANN developed in Experiment 5 by varying number of hidden neurons, activation functions, normalization ranges
7. Designing, training, and testing 2-3 layered FFBP ANN using standard backpropagation algorithm for any cause effect problem
8. Evaluating the performance of ANN developed in Experiment 7 by varying number of hidden neurons, activation functions, normalization ranges
9. Demonstration of MNIST digit classification using ANN..

IOEUA32185: Open Elective- I

IOEUA32185E: Social Media Analytics

Teaching Scheme	Examination Scheme						
Credits: 3	CIE	ISE	SCE	ESE	PR/OR	TW	Total
Lecture (L): 3hrs./week Tutorial (T): - Practical (P): -	20	30	20	30	-	-	100

Prerequisite: Readers/students are expected to know the following concepts:
1.Basic knowledge of Graphs.
2. Data mining.
3. Data Analysis.

Course Objectives:

- To understand foundations of Social Media Analytics.
- To Visualize and understand the data mining aspects in social networks.
- To solve mining problems by different algorithms.
- To understand network measures for social data.
- To understand behavioral part of web applications for Analysis.
- To analyze the data available on any social media applications.

Course Outcomes:

After completion of this course student should be able to

1. Understand the basics of Social Media Analytics.
2. Understand the visualization of social networks and the significance of Data mining in Social media.
3. Demonstrate the algorithms used for text mining.
4. Compare and Apply network measures for social media data.
5. Explain Behavior Analytics techniques used for social media data.
6. Apply social media analytics for Facebook, LinkedIn and Twitter kind of applications.

Unit I: INTRODUCTION TO SOCIAL MEDIA ANALYTICS (SMA) AND TYPES OF ANALYTICS TOOLS

Social media landscape, Need for SMA; SMA in Small organizations; SMA in large organizations; Application of SMA in different areas,

The foundation for analytics, Social media data sources, Defining social media data, data sources in social media channels, Estimated Data sources and Factual Data Sources, Public and Private data, data gathering in social media analytics

Unit II: THE SOCIAL NETWORKS PERSPECTIVE AND ITS VISUALIZATION

The social networks perspective - nodes, ties and influencers, Social network and web data and methods. Graphs and Matrices- Basic measures for individuals and networks.

A Taxonomy of Visualization, The convergence of Visualization, Interaction and Analytics. Data mining in Social Media: Introduction, Motivations for Data mining in Social Media, Data mining methods for Social Media

Unit –III: TEXT MINING IN SOCIAL NETWORKS

Introduction, Keyword search, Classification Algorithms, Clustering Algorithms-Greedy Clustering, Hierarchical clustering, k-means clustering, Transfer Learning in heterogeneous Networks, Sampling of online social networks, Comparison of different algorithms used for mining, tools for text mining.

Unit IV: NETWORK MEASURES

Centrality: Degree Centrality , Eigenvector Centrality, Katz Centrality , PageRank, Betweenness Centrality, Closeness Centrality ,Group Centrality ,Transitivity and Reciprocity, Balance and Status, Similarity: Structural Equivalence, Regular Equivalence

Unit V: BEHAVIOR ANALYTICS

Individual Behavior: Individual Behavior Analysis, Individual Behavior Modeling, Individual Behavior Prediction Collective Behavior: Collective Behavior Analysis, Collective Behavior Modeling, Collective Behavior Prediction

Unit VI: CASE STUDY

Mining Twitter: Overview, Exploring Twitter's API, Analyzing 140 Characters

Mining Facebook: Overview, Exploring Facebook's Social Graph API's, Analyzing Social Graph Connections.

Mining Linked In: Overview, Exploring Linked In API

Text books:

1. Reza Zafarani Mohammad Ali Abbasi Huan Liu, Social Media Mining, Cambridge University Press, ISBN: 10: 1107018854.
2. Charu C. Aggarwal, Social Network Data Analytics, Springer, ISBN: 978-1-4419-8461-6.
3. Matthew Ganis, Avinash Kohirkar Social Media Analytics: Techniques and Insights for Extracting Business Value Out of Social Media,Pearson publications,2016

Reference Books :

1. Marshall Sponder, Social Media Analytics: Effective Tools for Building, Interpreting, and Using Metrics, McGraw Hill Education, 978-0-07-176829-0. 2.
2. Matthew A. Russell, Mining the Social Web, O'Reilly, 2nd Edition, ISBN:10: 1449367615.
3. Jiawei Han University of Illinois at Urbana-Champaign Micheline Kamber, Data Mining: Concepts and Techniques, Morgan Kaufmann, 2nd Edition, ISBN: 13: 978-1-55860-901-3 ISBN: 10: 1-55860-901-6.
4. Bing Liu, Web Data Mining : Exploring Hyperlinks, Contents and Usage Data, Springer, 2nd Edition, ISBN: 978-3-642-19459-7.

ETUA32186: Employability Skills in Electronics Design

Teaching Scheme	Examination Scheme						
Credits: 3	CIE	ISE	SCE	ESE	PR/OR	TW	Total
Lecture (L): 2hrs./week Tutorial (T): - Practical (P): 2hrs/week	-	-	50	-	-	25	75

Prerequisite: Readers/students are expected to know the following concepts:

1) Digital Electronics
2) Power electronics
3) Microcontrollers and application

Course Objectives:

- To impart the skill of applying basic concepts for designing electronic systems.
- To imbibe good design practices for robust design of electronic systems.
- To explore the importance and significance of customer specifications/requirements.
- To impart the knowledge of electronic circuit function verification with an EDA tool.
- To create an interest in the field of electronic design as a prospective career option

Course Outcomes:

- Interpret and summaries the specifications of different power supply requirement
- Select optimal design topologies for data acquisition system.
- Evaluate and decide appropriate components and devices for designing modern data acquisition system
- Design an electronic filters system/sub-system and validate its performance by simulating the same using EDA tools

Unit- I : Linear Power Supplies

Typical specifications, Concept of ideal power supply & Voltage regulation, Rectifier and filter design, Basic shunt regulator design, Series pass transistorized regulator, Variable output voltage regulator, Protection circuits for critical devices in regulator circuits (Short-circuit, over-voltage protection circuits), Heat-sink selection, Three terminal IC regulator, Design examples of IC based power supplies.

Unit II: Switched Mode Power Supply

Advantages of SMPS, General block diagram of SMPS ,Basic concept of switching regulator, Basic topologies, Step down converter, Step up converter, Polarity inverter, Characteristics of components, Switching element, BJT, MOSFET, IGBT, Switching diode, Filter capacitor and inductor, PWM circuit, High frequency transformer design (steps only),Practical topologies of SMPS, Fly back design, Push pull Design, Startup circuit design, PWM control circuit, Isolation circuit, Protection Circuits for SMPS.

Unit III : Data Acquisition System.

Generalized control system, Concept of set point and error, Typical control mechanisms, Role of data acquisition system, Block diagram of Data ,Acquisition System ,Transducers, sensor and actuator, Active and passive transducers and their characteristics, Instrumentation Amplifiers(IA), Characteristics of an ideal IA, Selection criteria of IA, Signal conditioning circuits, different environmental and industrial parameter sensors Interfacing

Design of signal conditioning circuits, Selection criteria for MCU, Overview of Interface devices and storage, RS-232 interface, RTC, I2C EEPROM, LCD, Keyboard interface, DC motor driver, relay driver interface. GUI Development

Unit IV: Filters Design and Case Study

Design of various filter types , Low-pass filter (second order), High-pass filter (second order), Band-pass filter, Band-reject Filter , All-pass filter, State variable filter design, Selection of components , Sensitivity analysis and Applications.

Students will form groups and visits/ interact with different types of manufacturing as well as service industries to gather information regarding various atomizations and debugging techniques used by the industries. Study based on minimizing the distortion, THD, EMI and EMC effect inside the electronic design, ESD, Protection against ESD, Control panel layout, Enclosure Design

Text Book:

1. Practical design of power supplies" , Ron Lenk, John Wiley & Sons, 2005, ISBN: 978-0-08-097138-4
2. "Intuitive Analog Circuit Design A Problem-Solving Approach using Design Case Studies", Marc T. Thompson, Elsevier Inc, 2006,ISBN-10: 0-7506-7786-4
3. "Linear Circuit Design Handbook", Hank Zumbahlen, Elsevier Inc, 2008 , ISBN 978-0-7506-8703-4

Reference Books:

1. "The Circuit Designer's Companion", Peter Wilson, Elsevier Ltd, 2012
2. "Switching Power Supply Design,"3E, Abraham I. Pressman et. al, The McGraw-Hill Companies, 2009
3. "Measurement, Instrumentation, and Sensors Handbook", John G. Webster, CRC Press,1999
4. "Electronic Filter Design Handbook",4E, Arthur Williams, Fred Taylor, McGraw-Hill, 2006

List of Design Assignments:

1. Design of Linear Power Supply
   a) Single Polarity (Variable/Fixed, Display)
   b) Dual Polarity (Variable/Fixed, Display)
   c) Dual Polarity (tracking, display)
2. Design of Switched Mode Power Supply
   a) Single polarity, multiple outputs (Flyback/ Push-pull)
   b) Dual polarity output (Flyback/ Push-pull)
3. Design of Modern Data Acquisition System
   Multi-channel data acquisition systems
4. Design of Active Filter
   a) Second-order LPF/HPF/BRF/BPF
   b) State variable filter design
5. Case Study based on Industry Interaction
   Report submission based on the topic given with Industry Interaction.

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