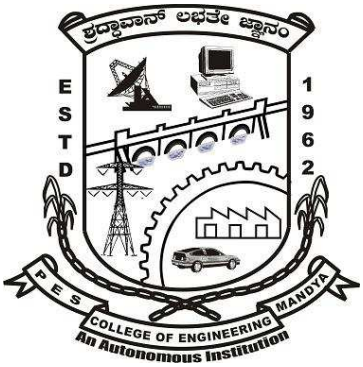
Scheme & Syllabus
of
M.Tech in Computer Engineering
(With effect from 2017-2018 Academic year)

I & II Semester

ಪಠ್ಯಕ್ರಮ

(ಶೈಕ್ಷಣಿಕವರ್ಷ 2017–18)

Out Come Based Education
ಫಲಿತಾಂಶ ಆಧಾರಿತ ಶಿಕ್ಷಣ



P.E.S. College of Engineering, Mandya - 571 401, Karnataka

(An Autonomous Institution under VTU, Belagavi)
Grant -in- Aid Institution
(Government of Karnataka)
Accredited by NBA, New Delhi
Approved by AICTE, New Delhi.

ಪಿ.ಇ.ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ

ಮಂಡ್ಯ–571 401, ಕರ್ನಾಟಕ
(ವಿ.ಟಿ.ಯು, ಬೆಳಗಾವಿ ಅಡಿಯಲ್ಲಿನ ಸ್ವಾಯತ್ತ ಸಂಸ್ಥೆ)

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P.E.S.COLLEGE OF ENGINEERING,

MANDYA-571401, (KARNATAKA)

(An Autonomous Institution under VTU, Belagavi)

PES College of Engineering, Mandya

The vision of the Institute is:

"PESCE shall be a leading institution imparting quality engineering and management education developing creative and socially responsible professionals."

Institute Mission in pursuance of its vision is:

- Provide state of the art infrastructure, motivate the faculty to be proficient in their field of specialization and adopt best teaching-learning practices.
  (Required to be a leading institution)
- Impart engineering and managerial skills through competent and committed faculty using outcome based educational curriculum.
  (Required to provide quality engineering and management education)
- Inculcate professional ethics, leadership qualities and entrepreneurial skills to meet the societal needs.
  (Required to produce socially responsible professionals)
- Promote research, product development and industry-institution interaction.
  (Required to produce creative professionals)

Quality Policy

"Highly committed in providing quality, concurrent technical education and continuously striving to meet expectations of stake holders".

Core Values

Professionalism

Empathy

Synergy

Commitment

Ethics

Preface

PES College of Engineering, Mandya, started in the year 1962, has become autonomous in the academic year 2008-09. Since, then it has been doing the academic and examination activities successfully. The college is running 8 Postgraduate programs. It consists of 6 M.Tech programs, which are affiliated to VTU. Other postgraduate programs are MBA and MCA.

India has recently become a Permanent Member by signing the Washington Accord. The accord was signed by the National Board of Accreditation (NBA) on behalf of India on 13th June 2014. It enables not only the mobility of our degree globally but also establishes equivalence to our degrees with that of the member nations such as Taiwan, Hong Kong, Ireland, Korea, Malaysia, New Zealand, Russia, Singapore, South Africa, Turkey, Australia, Canada and Japan are among 16 signatories to the international agreement besides the US and the UK. Implementation of Outcome Based Education (OBE), has been the core issue for enabling the equivalence and of Indian degrees and their mobility across the countries.

Our higher educational institution has adopted Credit Based semester structure with OBE scheme and grading system.

The credit based OBE semester system provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching.

The OBE, emphasize setting clear standards for observable, measurable outcomes of programs in stages. There lies a is shift in thinking, teaching and learning processes moving towards Students Centric from Teacher Centric education. OBE standards focusing on mathematics, language, science, attitudes, social skills, and moral values.

The key features which may be used to judge if a system has implemented an outcomes-based education systems is mainly Standards-based assessments that determines whether students have achieved the stated standard. Assessments may take any form, so long as the process actually measure whether the student knows the required information or can perform the required task. Outcome based education is a commitment that all students of all groups will ultimately reach the same minimum standards. Outcome Based Education is a method or means which begins with the end in mind and constantly emphasizes continuous improvement.

In order to increase the Industry/Corporate readiness, many Soft Skills and Personality Development modules have been added to the existing curriculum of 2015-16. Lab components are added with each course.

(Sri. B.Dinesh Prabhu)
Deputy Dean (Academic)
Associate Professor
Dept. of Automobile Engg.

(Dr. P S Puttaswamy)
Dean (Academic)
Professor
Dept. of Electrical & Electronics Engg

Department of Computer Science & Engineering

The Vision of the department is:

"The Department of Computer Science and Engineering shall create professionally competent and socially responsible engineers capable of working in global environment.*"*

The mission of the C S & E department is:

DM1: Enforce best practices in teaching-learning, with dedicated faculty and supportive infrastructure to impart the knowledge in emerging technologies.

DM2: Improve Industry-Institute relationship for mutual benefit.

DM3: Inculcate ethical values, communication and entrepreneurial skills.

DM4: Sensitize social, legal, environmental and cultural diversity issues through professional training and balanced curriculum.

About the Department The Department of Computer Science and Engineering was established in 1983. The department offers B.E. program with an intake of 120 students, M.Tech. in Computer Science and Engineering with 18 students, M.Tech. in Computer Engineering with 24 students and also Ph.D. programme. Currently the strength of teaching faculty is 32 and that of non teaching staff is 14. The teacher - student ratio is 1:16. The department has a research centre under VTU and University of Mysore, with 2 research guides and 8 research students. During the last five years, the department has published 85 technical papers in international/national journals/conferences. So far, the department has organized four international and 8 national conferences. The department is equipped with all the required infrastructure, laboratories, class rooms, departmental library. The departments wish to achieve the mission of developing and nourishing computer science engineers through well-trained, committed and experienced faculty members. Faculty members of the departments are involved in research activities in different fields such as Image Processing, Pattern Recognition, Data Mining, Wireless Networks, Big Data Analytics and Computer Vision.

Short Term Goals:

1. Strengthening of Infrastructure
2. Faculty development programmes
3. Encourage academic excellence
4. Project proposals to raise funded projects

Mid Term Goals:

1. Establishing centre of excellence
2. Conducting international conference
3. Establish industry-institute interaction

Long Term Goals:

1. Patents filing
2. Establishing new laboratories

Credit pattern

Programme: M.Tech Computer Science & Engineering

Core Courses	I Semester	16 credits
	II Semester	12 credits
Elective Course	I Semester	08 credits
	II Semester	12 credits
Seminar	III Semester	02 credits
Lab	I Semester	02 credits
	II Semester	02 credits
Industrial Training	III Semester	06 credits
Pedagogy Training	III Semester	02 credits
Self Study Course	III Semester	04 credits
Project work	III Semester	08 credits
Project work	IV Semester	26 credits
A total of 100 credits for 2 years		

Scheme of Teaching and Examination for M.Tech. Computer Engineering – 2017-18

I Semester M.Tech. Computer Engineering

Sl.no	Course code	Course	Teaching Dept.	Credit Pattern	Total Credits	Marks Allotted		Total Marks
				L :T: P/S*:H		CIE	SEE	
1	P17MCEN11	Multicore Architecture & Parallel Programming	CSE	3:1:0:5	04	50	50	100
2	P17MCEN12	Advanced Data Structures &Algorithms	CSE	3:0:1:4	04	50	50	100
3	P17MCEN13	Embedded Computing Systems	CSE	3:1:0:5	04	50	50	100
4	P17MCEN14	Real Time Systems	CSE	3:1:0:5	04	50	50	100
5	P17MCEN15x	Elective – I	CSE	3:1:0:5	04	50	50	100
6	P17MCEN16x	Elective – II	CSE	3:1:0:5	04	50	50	100
7	P17MCENL17	Parallel Programming Lab	CSE	0:0:4:4	02	50	50	100
Total					26	400	300	700

Electives

Sl.no	Course code	Elective - I	Credit Pattern L:T:P:H
1	P17MCEN151	Cyber Crime and Digital Forensic	3:1:0:5
2	P17MCEN152	Computer System Performance & Analysis	3:1:0:5
Elective – II			
1	P17MCEN161	Cloud Computing	3:1:0:5
2	P17MCEN162	Network Routing Algorithms	3:1:0:5

II Semester M.Tech. Computer Engineering

Sl.no	Course code	Course	Teaching Dept.	Credit Pattern	Total Credits	Marks Allotted		Total Marks
				L :T: P/S*:H		CIE	SEE	
1	P17MCEN21	Arm Based Processor	CSE	3:1:0:5	04	50	50	100
2	P17MCEN22	Wireless sensor Networks	CSE	3:0:1:4	04	50	50	100
3	P17MCEN23	Foundation for Internet of Things	CSE	3:1:0:5	04	50	50	100
4	P17MCEN24x	Elective – III	CSE	3:1:0:5	04	50	50	100
5	P17MCEN25x	Elective – IV	CSE	3:1:0:5	04	50	50	100
6	P17MCEN26x	Elective – V	CSE	3:1:0:5	04	50	50	100
7	P17MCENL27	Internet of Things Lab	CSE	0:0:4:4	02	50	50	100
Total					26	400	300	700

Electives

Sl. No	Course code	Elective - III	Credit Pattern L:T:P:H
1	P17MCEN241	Managing Big Data	3:1:0:5
2	P17MCEN242	Multimedia communication	3:1:0:5
Elective – IV			
1	P17MCEN251	Storage Area Network	3:1:0:5
2	P17MCEN252	Machine Learning Techniques	3:1:0:5
Elective – V			
1	P17MCEN261	Soft Computing	3:1:0:5
2	P17MCEN262	Digital Image Processing	3:1:0:5

*** L - Lecture T -Tutorial P – Practical S – Seminar H-Hours**

III Semester M.Tech. Computer Engineering

Sl.No	Course code	Course	Teaching Dept.	Credit Pattern	Total Credits	Marks Allotted		Total Marks
				L :T: P/S*:H		CIE	SEE	
1	P17MCEN31	Self Study course	CSE	0:2:2:4	04	50	50	100
2	P17MHSM32	Pedagogy/Research Methodology	HS&M	0:2:2:4	02	100	---	100
3	P17MCEN33	Seminar	CSE	---	02	100	---	100
4	P17MCEN34	Project Phase – I	CSE	---	04	100	---	100
5	P17MCEN35	Project Phase - II	CSE	---	04	100	---	100
6	P17MCEN36	Industrial Training	CSE	---	06	100	---	100
				Total	22	550	50	600

IV Semester M.Tech. Computer Engineering

Sl. No.	Course code	Course	Teaching dept.	Credit Pattern	Total Credits	Marks Allotted		Total Marks
				L :T: P /S* :H		CIE	SEE	
1	P17MCEN41	Project Phase - III	CSE	---	04	100	---	100
2	P17MCEN42	Project Phase - IV Thesis Evaluation	CSE	---	10	100	---	100
3	P17MCEN43	Project Phase - V Project Work Viva Voce	CSE	---	08	---	100	100
4	P17MCEN44	Term Paper	CSE	---	04	---	100	100
			Total		26	200	200	400
* L - Lecture T -Tutorial P – Practical S - Seminar								

1 Eight weeks of compulsory Industrial Training to be undergone by the students during their third semester. A report on Industrial Training is to be submitted by the student. The report has to be evaluated by Industrial guide and Institute guide for CIE of 50 marks (industry and supervisor evaluation average marks for 50 each). The student must give seminar based on Industrial Training before a committee constituted by the department for remaining CIE of 50 marks.

2 The Laboratories are CIE with report submission and seminar presentation /Viva Voce of 50 marks each.

3 Pedagogy/Research methodology is CIE with objective type of question for evaluation

4 The seminar (III Semester) shall be of 100 marks CIE. It is based on the current topics presentation along with a report submission for evaluation each of 50 marks.

5 Project work Phase-1, 2 & 3 to be awarded by the Department committee constituted for the purpose

a) The Project Phase-I evaluation shall be of 100 marks CIE. It is based on Report Submission consisting of Title, Introduction, Literature Survey, Summary of Literature Survey, Objectives and Methodology (50 Marks) and Presentation (50 marks) each.

b) The Project Phase-II evaluation shall be of 100 marks CIE. It is based on Report Submission consisting of Experimentation, Theoretical analysis approach and results (if completed as a stage work) and Presentation for 50 marks each.

c) The Project Phase-III evaluation shall be of 100 marks CIE. It is based on Thesis manuscript and presentation for 50 marks each (work completion report).

6 The Project Phase-IV evaluation shall be of 100 marks CIE. It is based on the evaluation done separately by internal and external examiners and average marks of the two examiner shall be consider as final marks

7 The Project Phase-V evaluation shall be of 100 marks SEE. It is based on Thesis presentation and project viva voce has to be conducted jointly by internal and external examiner for a total of 100 marks SEE.

8 The term paper is purely based on the project work he/she chooses.

9 The Term paper shall be for 100 marks SEE. It has to be evaluated by the committee formed by HOD consisting of PG coordinator, guide and subject expert internal/ external for each candidate.

10 The term paper evaluation is based on the publication of an article in peer reviewed conference/ journal (national/ international) and quality of the journal. If the term paper is not published by the candidate or the same is communicated for publication at the end of his/ her tenure, then the committee formed by HOD consisting of PG coordinator, guide and subject expert internal/ external for each candidate will asses.

11 The self study course shall consist of five units with lab component and he/ she must be able to demonstrate the knowledge gained by the candidates. The course content must be tailer made by the department to suit their requirements.

12 The self study course shall be of 100 marks. The course evaluation is based on the lab report submission/ assignment/ viva -voce as CIE 50 marks and SEE for 50 marks.

Course Title: Multicore Architecture & Parallel Programming			
Course Code: P17MCEN11	**Sem: I**	**L-T-P-H: 3:1:0:5**	**Credits - 4**
Contact Period: Lecture: 52 Hrs., Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course Learning Objectives (CLO's)

The course P17MCEN11 aims to:

1. Define technologies of multicore architecture and performance measures
2. Demonstrate problems related to multiprocessing
3. Illustrate windows threading, posix threads, openmp programming
4. Analyze the common problems in parallel programming

Course Content

Unit-1

Introduction to Multi-core Architecture Motivation for Concurrency in software, Parallel Computing Platforms, Parallel Computing in Microprocessors, Differentiating Multi-core Architectures from Hyper- Threading Technology, Multi-threading on Single-Core versus Multi-Core Platforms Understanding Performance, Amdahl's Law, Growing Returns: Gustafson's Law. **System Overview of Threading :** Defining Threads, System View of Threads, Threading above the Operating System, Threads inside the OS, Threads inside the Hardware, What Happens When a Thread Is Created, Application Programming Models and Threading, Virtual Environment: VMs and Platforms, Runtime Virtualization, System Virtualization.

10 Hours

Unit-2

Fundamental Concepts of Parallel Programming :Designing for Threads, Task Decomposition, Data Decomposition, Data Flow Decomposition, Implications of Different Decompositions, Challenges You'll Face, Parallel Programming Patterns, A Motivating Problem: Error Diffusion, Analysis of the Error Diffusion Algorithm, An Alternate Approach: Parallel Error Diffusion, Other Alternatives. Threading and Parallel Programming Constructs: Synchronization, Critical Sections, Deadlock, Synchronization Primitives, Semaphores, Locks, Condition Variables, Messages, Flow Control- based Concepts, Fence, Barrier, Implementation-dependent Threading Features

10 Hours

Unit-3

Threading APIs :Threading APls for Microsoft Windows, Win32/MFC Thread APls, Threading APls for Microsoft. NET Framework, Creating Threads, Managing Threads, Thread Pools, Thread Synchronization, POSIX Threads, Creating Threads, Managing Threads, Thread Synchronization, Signaling, Compilation and Linking.

10 Hours

Unit-4

OpenMP: A Portable Solution for Threading : Challenges in Threading a Loop, Loopcarried Dependence, Data-race Conditions, Managing Shared and Private Data, Loop Scheduling and Portioning, Effective Use of Reductions, Minimizing Threading Overhead, Work-sharing Sections, Performance-oriented Programming, Using Barrier and No wait, Interleaving Single-thread and Multi-thread Execution, Data Copy-in and Copy-out, Protecting Updates of Shared Variables, Intel Task queuing Extension to OpenMP, OpenMP Library Functions, OpenMP Environment Variables, Compilation, Debugging, performance

10 Hours

Unit-5

Solutions to Common Parallel Programming Problems : Too Many Threads, Data Races, Deadlocks, and Live Locks, Deadlock, Heavily Contended Locks, Priority Inversion, Solutions for Heavily Contended Locks, Non-blocking Algorithms, ABA Problem, Cache Line Ping-ponging, Memory Reclamation Problem, Recommendations, Thread-safe Functions and Libraries, Memory Issues, Bandwidth, Working in the Cache, Memory Contention, Cache-related Issues, False Sharing, Memory Consistency, Current IA-32 Architecture, Itanium Architecture, High-level Languages, Avoiding Pipeline Stalls on IA-32,Data Organization for High Performance.

10 Hours

Text Books:

1. Multicore Programming , Increased Performance through Software Multi-threading by Shameem Akhter and Jason Roberts , Intel Press , 2006

Course outcomes:

The students shall able to:

1. **Point out** the salient features of different multicore architectures and how they exploit parallelism.
2. **Define** fundamental concepts of parallel programming and its design issues
3. **Compare** the different threading API‟S.
4. **Demonstrate** the role of OpenMP and programming concept
5. **Explain** the concepts of deadlocks, data races & Design a Nonblocking Algorithms.

Course Title: Advanced Data Structures & Algorithms			
Course Code: P17MCEN12	**Sem: I**	**L-T-P-H: 3:0:1:4**	**Credits - 4**
Contact Period: Lecture: 52 Hrs., Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course Learning Objectives (CLO's)

The course P17MCEN12 aims to:

1. Understand the different asymptotic notations.
2. Design dynamic-programming and graph algorithms.
3. Understand multithreaded and number theoretic algorithms, understand the operations of heap.
4. Understand string matching algorithms and operations on tries.
5. Explain NP-complete problem and approximation algorithm.

Course Content

Unit -1

Review of Analysis Techniques: Growth of Functions: Asymptotic notations; Standard notations and common functions;

Recurrences -The substitution method, recursion-tree method, the master method.

10 Hours

Unit -2

Dynamic Programming - Matrix-Chain multiplication**,** Elements of dynamic programming**,** longest common subsequences.

Graph algorithms: Bellman - Ford Algorithm; Single source shortest paths in a DAG; Johnson's Algorithm for sparse graphs; Flow networks and Ford-Fulkerson method.

10 Hours

Unit -3

Mutithreaded algorithms-Basics of dynamic multithreaded algorithm; Multithreaded merge sort.

Number -Theoretic Algorithms: Elementary notions; GCD; Modular Arithmetic; Solving modular linear equations; The Chinese remainder theorem

Heaps: Binary, Binomial, Fibonacci**, leftist, Skew.**

11 Hours

Unit -4

Advanced data structures: Tries (prefix trees) – insert ,delete ,search operations, K-d trees.

String-Matching Algorithms:

Naïve string Matching; Rabin - Karp algorithm; String matching with finite automata; Knuth-Morris-Pratt algorithm.

10 Hours

Unit -5

NP-Completeness: Polynomial time, Polynomial time verification, NP-Completeness and reducibility, NP-Complete problems.

Approximation Algorithms: vertex cover problem, the set – covering problem, randomization and linear programming, the subset – sum problem**.**

11 Hours

Text Books:

1. T. H Cormen, C E Leiserson, R L Rivest and C Stein: Introduction to Algorithms, 3rd Edition, PrenticeHall of India, 2012.
2. Mark Allan Weiss, Data Structures and Algorithms Analysis in C++, 4th Edition, Pearson, 2014, ISBN-13: 9780132847377 (Java, 3rd Edition, 2012, ISBN:0-132-57627-9 / 9780132576277)
3. Aho, Hopcroft and Ullman, Data structures and algorithms, 1st edition, Pearson Education.

Reference Books:

1. Ellis Horowitz, Sartaj Sahni, S.Rajasekharan: Fundamentals of Computer Algorithms, 2nd Edition, Universities press, 2007.

Course outcomes:

1. Analyze worst case, best case and average case running time of algorithms using asymptotic notation.
2. Design and analyze algorithms to optimization problems and apply graphs to model engineering problems when appropriate.
3. Implement multithread algorithm and use theory of congruence in application.
4. Apply appropriate string matching algorithm according to the application.
5. Choose appropriate approximation algorithms for NP complete problems.

Course Title: Embedded Computing Systems			
Course Code: P17MCEN13	**Sem: I**	**L-T-P-H: 3:1:0:5**	**Credits - 4**
Contact Period: Lecture: 52 Hrs., Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course Learning Objectives (CLO's)

The course P17MCEN13 aims to:

The course aims to:

1. To allow students to undertake the design and development process for embedded (dedicated) computer systems and familiarize with instruction sets and CPU performance.
2. To provide knowledge about bus based computer systems, program design and analysis.
3. To understand unique design problems and challenges of real-time systems
4. To provide knowledge about the environment in which they operate and to know how to integrate embedded hardware, software, and operating systems to meet the functional requirements of embedded applications.
5. To familiarize with the recognition for and the motivation to further development of their knowledge and skills as embedded engineering advances occur in industry.

Course Content

Unit - 1

Embedded Computing: Introduction, Complex Systems and Microprocessors, Embedded Systems Design Process, Formalism for System design. Design Example: Model Train Controller; Instruction Sets, CPUs: Preliminaries, ARM Processor, Programming Input and Output, CPU Performance, CPU Power Consumption.

11 Hours

Unit - 2

Bus-Based Computer Systems: CPU Bus, Memory Devices; Component Interfacing, Designing with Microprocessor; Development and Debugging; System-Level Performance Analysis Design Example: Alarm Clock. Program Design and Analysis: Components for embedded programs; Models of programs, Basic Compilation Techniques; Program optimization; Program-Level performance analysis; Program-Level energy and power analysis; Analysis and optimization of program size; Program validation and testing; Design Example: Software modem.

11 Hours

Unit - 3

Real Time Operating System (RTOS) Based Design: Basics of OS; Kernel, types of OSs, tasks, processes; Threads; Multitasking and Multiprocessing; Context switching; Scheduling Policies; Task Communication; Task Synchronization; Device drivers; How to Choose an RTOS; Power management and Optimization for processes.

10 Hours

Unit - 4

Distributed Embedded Systems: Distributed Embedded Architectures; Networks for Embedded Systems: I2C Bus, CAN Bus, Ethernet, Myrinet, Internet, Network Based Design. Embedded Systems Development Environment: The Integrated Development Environment; Types of File generated on Cross Compilation; Dis-assembler/Decompiler, Simulators; Emulators and Debugging; Target Hardware Debugging.

10 Hours

Unit - 5

Trends in the embedded Industry: Processor trends in embedded system; Embedded OS Trends; Development Language Trends; Open standards; frameworks and Alliances; Bottlenecks

10 Hours

Text Books:

1. Wayne Wolf: Computers as Components, Principles of Embedded Computing Systems Design, 4th Edition, Elsevier, 2016.
2. Shibu K V: Introduction to Embedded Systems, Tata McGraw Hill, 2009.

Reference Books:

1. James K. Peckol: Embedded Systems, A contemporary Design Tool, Wiley India, 2008.
2. Tammy Neorgaard: Embedded Systems Architecture, Elsevier, 2005.

Course Outcomes:

1. Explain design methodologies for embedded systems.
2. Describe bus based systems and explain program design and analysis.
3. Define the unique design problems and challenges of real-time systems
4. Explain network protocols for embedded systems and describe environment in which embedded system can be developed.
5. Explain the trends in embedded industry.

Course Title: Real time Systems			
Course Code: P17MCEN14	**Sem: I**	**L-T-P-H: 3:1:0:5**	**Credits - 4**
Contact Period: Lecture: 52 Hrs., Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course Learning Objectives (CLO's)

The course P17MCEN14 aims to:

The student should be able to understand

1. Real-Time systems, modeling and Design of Real-Time Systems.
2. Task scheduling,
3. Resource management and Resource access control.
4. Hardware Issues
5. Real-time operating systems and Memory Management.

Course Content

Unit -1

Typical Real-time Applications: Digital Control; High –level Controls; Signal Processing; Other Real-Time Applications.

Hard Versus Soft Real-time Systems: Jobs and Processor; Release Times, Deadlines, and Timing Constraints; Hard and Soft Timing Constraints; Hard Real – Time Systems; Soft Real – Time Systems.

A Reference Model of Real-time Systems: Processor and Resources; Temporal Parameters of Real-Time Workload; Periodic Task Model; Precedence Constraints and Data Dependency; Other Types of Dependencies; Functional Parameters; Resource Parameters of Jobs and Parameters of Resources; Scheduling Hierarchy.

Commonly used Approaches to Real-time Scheduling: Clock – Driven Approach; Weighted Round-Robin Approach; Priority-Driven Approach; Dynamic versus Static Systems; Effective Release Times and Deadlines; Optimality of the EDF and the LST Algorithms; Challenges in Validating Timing Constraint in Priority – Driven Systems; Off-Line versus On-Line Scheduling. 11 Hours

Unit -2

Clock-Driven Scheduling: Notations and Assumptions; Static, Timer-Driven Scheduler; General Structure of Cyclic Schedules; Cyclic Executives; Improving the Average Response Time of Aperiodic Jobs; Scheduling Sporadic Jobs; Practical Considerations and Generalizations; Algorithm for Constructing Static Schedules; Pros and Cons of Clock – Driven Scheduling.

Priority-Driven Scheduling of Periodic Tasks: Static Assumption; Fixed – Priority versus Dynamic-Priority Algorithms; Maximum Schedulable Utilization; Optimality of the RM and DM Algorithms; A Schedulability Test for Fixed-Priority Tasks with Short Response Times; Sufficient Schedulability Conditions for the RM and DM Algorithms.

11 Hours

Unit -3

Scheduling Aperiodic and Sporadic Jobs in Priority-Driven Systems: Assumptions and approaches; Deferrable Servers; Sporadic Servers; Scheduling of Sporadic Jobs.

Resources and Resource Access Control: Assumptions on Resources and their Usage; Effects of Resource Contention and Resource Access Control; Non Preemptive Critical Sections; Basic Priority-Inheritance Protocol; Basic Priority-Ceiling Protocol.

10 Hours

Unit -4

Hardware Consideration: Basic Architecture; Hardware Interfacing; Central Processing Unit; Memory; Input/Output; Enhancing Performance; Other special devices; Non-Von-Neumann Architectures.

10 Hours

Unit -5

Real Time Operating system

Real Time Kernel; Theoretical Foundations of RTOS; Intertask Communication and Synchronization; Memory Management.

10 Hours

Text Books:

1. Liu, Jane W.S., Real Time Systems, Pearson Education, 2002.
2. Laplante, Phillip A., Real-Time Systems Design and Analysis, Wiley, 3rd Ed., 2004.

Course Outcome

1. **Understand** the Real-Time Systems, **importance** of real-time constraints, be **able** to model real-time system according to reference model and **Study** various methods of task scheduling.
2. **Explain** Clock-driven scheduling approach and Priority-driven scheduling approach.
3. **Analyze** how to schedule Aperiodic and sporadic jobs and Manage Resources.
4. **Explain** Hardware issues in real-time system.
5. **Understand** Real-time operating systems and **Explains** achieving multitasking and concurrency.

Course Title: Cyber Crime and Digital Forensic			
Course Code: P17MCEN151	**Sem: I**	**L-T-P-H: 3:1:0:5**	**Credits - 4**
Contact Period: Lecture: 52 Hrs., Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course Learning Objectives (CLO's)

The course P17MCEN151 aims to:

1. Discuss computer forensics fundamentals, provides an overview of computer forensics, types of computer forensics technology, services.
2. To provide knowledge about vendor and computer forensics services, data recovery relates to computer forensics.
3. Discuss about Evidence collection and data seizure, duplication and preservation of digital Evidence.
4. To discuss about computer image verification and authentication, discovery of electronic evidence, identification of data.
5. To provide knowledge about Reconstructing Past events, solution to the dilemma network forensics.

Course Content

Unit – 1

Computer forensics fundamentals Introduction: what is computer forensics?, Use of computer forensics in law enforcement, Computer forensics assistance to human resources /employment proceedings, Computer forensics services, Benefits of professional forensics methodology SLC: Steps taken by computer forensics specialists, who can use computer forensic evidence? Types of computer forensics technology, Types of military computer forensic technology, Types of law enforcement, Computer forensic technology, Types of business computer forensic technology.

10 Hours

Unit –2

Occurrence of cybercrime, Cyber detectives, fighting cyber crime with risk –management techniques, Computer forensics investigative services SLC: Forensic process improvement. Introduction of Data recovery, Data back-up and recovery, the role of back-up in data recovery, The data-recovery solution.

10 Hours

Unit –3

Evidence collection and data seizure Why collect evidence?, Collection options, Obstacles, Types of evidence, The rules of evidence, Volatile evidence, General procedure, Collection and archiving, Methods of collection, Artifacts, Collection steps, Preserving the digital crime scene,

Computer evidence processing scene, Legal aspects of collecting SLC: preserving computer forensic evidence.

11 Hours

Unit –4

Computer image verification and authentication Special needs of evidential authentication, Practical consideration, Practical implementation, Electronic document discovery: a powerful new litigation tool, Time travel, SLC: Forensics identification and analysis of technical surveillance devices.

10 Hours

Unit – 5

Reconstruction past events How to become a digital detective, Useable file formats, Unusable file formats, Converting files, Network forensics scenario, A technical approach,

Destruction of e-mail, Damaging computer evidence, Documenting the intrusion on destruction of data SLC: System testing.

11 Hours

Text Books:

1. Computer Forensics computer crime scene investigation by **John R VACCA** , Firewall Media ,2009 edition Reprint 2012.
   =

Reference Books:

1. Guide to computer forensics and investigations by Bill Nelson,Amelia Phillips,Christopher Stuart, Cengage Learning publications, 4th edition 2013.
2. Computer Forensics by David Cowen -CISSP , Mc GrawHill education , Indian edition 2013.

Course Outcomes:

On Successful completion of the course, the students will be able to

1. Identify and need for computer forensics
2. Analyze the computer forensic technology
3. Describe the process of data recovery
4. Explain legal aspects of collecting and preserving computer evidence
5. How to recover electronic documents
6. Distinguish between usable and unusable file formats

Course Title: Computer System Performance & Analysis			
Course Code: P17MCEN152	**Sem: I**	**L-T-P-H: 3:1:0:5**	**Credits - 4**
Contact Period: Lecture: 52 Hrs., Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course Learning Objectives (CLO's)

The course aims to:

1. To understand the mathematical foundations needed for performance evaluation of computer systems
2. To understand the metrics used for performance evaluation
3. To understand the analytical modeling of computer systems
4. To enable the students to develop new queuing analysis for both simple and complex systems
5. To introduce the students to analytical techniques for evaluating scheduling policies

Course Content

Unit -1

Introduction: The art of Performance Evaluation; Common Mistakes in Performance Evaluation, A Systematic Approach to Performance Evaluation, Selecting an Evaluation Technique, Selecting Performance Metrics, Commonly used Performance Metrics, Utility Classification of Performance Metrics, Setting Performance Requirements.

12 Hours

Unit -2

Workloads, Workload Selection and Characterization: Types of Workloads, addition instructions, Instruction mixes, Kernels; Synthetic programs, Application benchmarks, popular benchmarks. Work load Selection: Services exercised, level of detail; Representativeness; Timeliness, Other considerations in workload selection. Work load characterization Techniques: Terminology; Averaging, Specifying dispersion, Single

Parameter Histograms, Multi Parameter Histograms, Principle Component Analysis, Markov Models, Clustering.

10 Hours

Unit - 3

Monitors, Program Execution Monitors and Accounting Logs: Monitors: Terminology and classification, Software and hardware monitors, Software versus hardware monitors, Firmware and hybrid monitors, Distributed System Monitors, Program Execution Monitors and Accounting Logs, Program Execution Monitors, Techniques for Improving Program Performance, Accounting Logs, Analysis and Interpretation of Accounting log data, Using accounting logs to answer commonly asked questions.

10 Hours

Unit - 4

Capacity Planning and Benchmarking: Steps in capacity planning and management; Problems in Capacity Planning; Common Mistakes in Benchmarking; Benchmarking Games; Load Drivers; Remote- Terminal Emulation; Components of an RTE; Limitations of RTEs.

Experimental Design and Analysis: Introduction:

Terminology, Common mistakes in experiments, Types of experimental designs, 2k Factorial Designs, Concepts, Computation of effects, Sign table method for computing effects; Allocation of variance; General 2k Factorial.

Designs, General full factorial designs with k factors: Model, Analysis of a General Design, Informal Methods. 10 Hours

Unit - 5

Queuing Models: Introduction: Queuing Notation; Rules for all Queues; Little's Law, Types of Stochastic Process. Analysis of Single Queue: Birth-Death Processes; M/M/1 Queue; M/M/m Queue; M/M/m/B Queue with finite buffers; Results for other M/M/1 Queuing Systems. Queuing Networks: Open and Closed Queuing Networks; Product form networks, queuing Network models of Computer Systems. Operational Laws: Utilization Law; Forced Flow Law; Little's Law; General Response Time Law; Interactive Response Time Law; Bottleneck Analysis; Mean Value Analysis and Related Techniques; Analysis of Open Queuing Networks; Mean Value Analysis; Approximate MVA; Balanced Job Bounds; Convolution Algorithm, Distribution of Jobs in a System, Convolution Algorithm for Computing G(N), Computing Performance using G(N), Timesharing Systems,

Hierarchical Decomposition of Large Queuing Networks: Load Dependent Service Centers, Hierarchical Decomposition, Limitations of Queuing Theory. 10 Hours

Text Book:

1. Raj Jain: The Art of Computer Systems Performance Analysis, John Wiley and Sons, 2013.

Reference Books:

1. Paul J Fortier, Howard E Michel: computer Systems Performance Evaluation and prediction, Elsevier, 2003.
2. Trivedi K S: Probability and Statistics with Reliability, Queuing and Computer Science Applications, 2nd Edition, Wiley India, 2001.

Course Outcomes:

The students shall be able to:

1. Explain the need for performance evaluation and the metrics used for it
2. Apply Little's law and other operational laws.
3. Apply the operational laws to open and closed systems.
4. Apply discrete-time and continuous-time Markov chains to model real world systems.
5. Apply analytical techniques for evaluating scheduling policies

Course Title: Cloud Computing			
Course Code: P17MCEN161	**Sem: I**	**L-T-P-H: 3:1:0:5**	**Credits - 4**
Contact Period: Lecture: 52 Hrs., Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course Learning Objectives (CLO's)

The course P17MCEN161 aims to:

1. To describe how to use Cloud Services.
2. To implement Virtualization
3. To implement Task Scheduling algorithms.
4. Apply Map-Reduce concept to applications.
5. To build Private Cloud.

Course Content

Unit-1

Introduction, Cloud Infrastructure

Cloud computing, Cloud computing delivery models and services, Ethical issues, Cloud vulnerabilities, Cloud computing at Amazon, Cloud computing the Google perspective, Microsoft Windows Azure and online services, Open-source software platforms for private clouds, Cloud storage diversity and vendor lock-in, Energy use and ecological impact, Service level agreements, User experience and software licensing.

10 Hours

Unit-2

Cloud Computing: Application Paradigms.

Challenges of cloud computing, Architectural styles of cloud computing, Workflows: Coordination of multiple activities, Coordination based on a state machine model: The Zookeeper, The Map Reduce programming model, A case study: The Grep The Web application , Cloud for science and engineering, High-performance computing on a cloud, Cloud computing for Biology research, Social computing, digital content and cloud computing.

10 Hours

Unit-3

Cloud Resource Virtualization.

Virtualization, Layering and virtualization, Virtual machine monitors, Virtual Machines, Performance and Security Isolation, Full virtualization and paravirtualization, Hardware support for virtualization, Case Study: Xen a VMM based paravirtualization, Optimization of network virtualization, vBlades, Performance comparison of virtualmachines, The dark side of virtualization.

10 Hours

Unit-4

Cloud Resource Management and Scheduling.

Policies and mechanisms for resource management, Application of control theory to task scheduling on a cloud, Stability of a two-level resource allocation architecture, Feedback control based on dynamic thresholds, Coordination of specialized autonomic performance managers, A utility-based model for cloud-based Web services, Resourcing bundling: Combinatorial auctions for cloud resources, Scheduling algorithms for computing clouds, Fair queuing, Start-time fair queuing, Borrowed virtual time, Cloud scheduling subject to deadlines, Scheduling Map Reduce applications subject to deadlines, Resource management and dynamic scaling,

10 Hours

Unit-5

Cloud Security, Cloud Application Development.

Cloud security risks, Security: The top concern for cloud users, Privacy and privacy impact assessment, Trust, Operating system security, Virtual machine Security, Security of virtualization, Security risks posed by shared images, Security risks posed by a management OS, A trusted virtual machine monitor, Amazon web services: EC2 instances, Connecting clients to cloud instances through firewalls, Security rules for application and transport layer protocols in EC2, How to launch an EC2 Linux instance and connect to it, How to use S3in java, Cloud-based simulation of a distributed trust algorithm, A trust management service, A cloud service for adaptive data streaming, Cloud based optimal FPGA synthesis.

12 Hours

Exercises Text Book:

1.Dan C Marinescu: Cloud Computing Theory and Practice. Elsevier(MK) 2013.

References:

1.Rajkumar Buyya , James Broberg, Andrzej Goscinski: Cloud Computing Principles and Paradigms, Willey 2014.
2.John W Rittinghouse, James F Ransome:Cloud Computing Implementation, Management and Security, CRC Press 2013.

Course Outcomes

The students shall able to:

1. To describe how to use Cloud Services.
2. To implement Virtualization
3. To implement Task Scheduling algorithms.
4. Apply Map-Reduce concept to applications.
5. To build Private Cloud.

Course Title: Network Routing Algorithms			
Course Code: P17MCEN162	**Sem: I**	**L-T-P-H: 3:1:0:5**	**Credits - 4**
Contact Period: Lecture: 52 Hrs., Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course Learning Objectives (CLO's)

The course P17MCEN162 aims to:

1. Discuss layered architecture for communication networks and the specific functionality of the network layer.
2. Explain the basic principles of routing and the manner, this is implemented in conventional networks.
3. Explain the evolving routing algorithms based on Internetworking requirements, optical backbone and the wireless access part of the network.
4. Compare and contrast different routing algorithms existing and their performance characteristics.

Course Content

Unit - 1

NETWORK ROUTING: BASICS AND FOUNDATIONS: Networking and Network Routing: An Introduction: Addressing and Internet Service: An Overview, Network Routing: An Overview, IP Addressing, On Architectures, Service Architecture, Protocol Stack Architecture, Router Architecture, Network Topology Architecture, Network Management Architecture, Public Switched Telephone Network, Communication Technologies, Standards Committees, Last Two Bits. Routing Algorithms: Shortest Path and Widest Path: Bellman–Ford Algorithm and the Distance Vector Approach, Dijkstra's Algorithm, Comparison of the

Bellman–Ford Algorithm and Dijkstra's Algorithm, Shortest Path Computation with Candidate Path Caching, Widest Path Computation with Candidate Path Caching, Widest Path Algorithm, k-Shortest Paths Algorithm Routing Protocols: Framework and Principles: Routing Protocol, Routing Algorithm, and Routing Table, Routing Information Representation and Protocol Messages, Distance Vector Routing Protocol, Link State Routing Protocol, Path Vector Routing Protocol, Link Cost

12 Hours

Unit - 2

ROUTING IN IP NETWORKS: IP Routing and Distance Vector Protocol Family : Routers, Networks, and Routing Information: Some Basics, Static Routes, Routing Information Protocol, Version 1 (RIPv1), Routing Information Protocol, Version 2 (RIPv2), Interior Gateway Routing Protocol (IGRP), Enhanced Interior Gateway Routing Protocol (EIGRP), Route Redistribution OSPF and Integrated IS-IS :From a Protocol Family to anInstanceof a Protocol, OSPF: Protocol Features, OSPF Packet Format, Examples of Router LSAs and Network LSAs, Integrated IS-IS, Similarities and Differences Between IS-IS and OSPF Internet Routing Architectures: Internet Routing Evolution, Addressing and Routing: Illustrations, Current Architectural View of the Internet, Allocation of IP Prefixes and AS Number, Policy-Based Routing, Point of Presence, Traffic Engineering Implications, Internet Routing Instability.

11 Hours

Unit - 3

Router Architectures: Functions of a Router, Types of Routers, Elements of a Router, Packet Flow, Packet Processing: Fast Path versus Slow Path, Router Architectures. IP Address Lookup Algorithms: Impact of Addressing on Lookup, Longest Prefix Matching, Naïve Algorithms, Binary Tries, Multibit Tries, Compressing Multibit Tries, Search by Length Algorithms, Search by Value Approaches, Hardware Algorithms, Comparing Different Approaches. IP Packet Filtering and Classification: Importance of Packet Classification, Packet Classification Problem, Packet Classification Algorithms, Naïve Solutions, Two-Dimensional Solutions, Approaches ford Dimensions, Extending Two-Dimensional Solutions, Divide and Conquer Approaches, Tuple Space Approaches, Decision Tree Approaches, Hardware-Based Solutions.

10 Hours

Unit - 4

ADVANCED ROUTING PROTOCOLS FOR WIRELESS NETWORKS: Wireless networking basic aspects, Basic routing concepts, AD hoc routing, Mesh routing, Vehicular routing, Sensor routing.

9 Hours

Unit - 5

TOWARD NEXT GENERATION ROUTING: Quality of Service Routing: QoS Attributes, Adapting Shortest Path and Widest Path Routing: A Basic Framework, Update Frequency, Information Inaccuracy, and Impact on Routing, Lessons from Dynamic Call Routing in the Telephone Network, Heterogeneous Service, Single-Link Case, A General Framework for Source-Based QoS Routing with Path Caching, Routing Protocols for QoS Routing MPLS and GMPLS: Traffic Engineering Extension to Routing Protocols, Multiprotocol Label Switching, Generalized MPLS, MPLS Virtual Private Networks. Routing and Traffic Engineering with MPLS: Traffic Engineering of IP/MPLS Networks, VPN Traffic Engineering, Routing/Traffic Engineering for Voice Over MPLS. VoIP Routing: Interoperability through IP and PSTN : PSTN Call Routing Using the Internet, PSTN Call Routing: Managed IP Approach, IP-PSTN Interworking for VoIP, IP Multimedia Subsystem, Multiple Heterogeneous Providers Environment and All-IP Environment of VoIP Services.

10 Hours

Text Books:

1. Deepankar Medhiand Karthikeyan Ramasamy, "Network Routing: Algorithms, Protocols, and Architectures", (The Morgan Kaufmann Series in Networking), Elsevier Inc 2007
2. Miguel Elias M. Campista and Marcelo G. Rubinstein, "Advanced Routing Protocols for Wireless Networks", John Wiley & Sons, Inc, © ISTE Ltd 2014

Reference Books:

1. William Stallings, "High speed networks and Internets Performance and Quality of Service", 2nd Edition, Pearson Education Asia. Reprint India 2002.
2. M. Steen Strub, "Routing in Communication network," Prentice –Hall International, Newyork, 1995.
3. James D. McCabe, "Network Analysis, Architecture, and Design", 3rd Edition, 2007 Elsevier Inc.

Course Outcomes:

The students should be able to:

1. Apply his knowledge for identifying a suitable routing algorithm.
2. Analyze Router Architectures and its functionalities.
3. Implementing routing algorithm and analyzing its performance.
4. Understand routing protocols for wireless networks.
5. Design a new algorithm or modify an existing algorithm to satisfy the evolving demands in the network and by the user applications.

Course Title: Parallel Programming Lab			
Course Code: P17MCENL17	**Sem: I**	**L-T-P-H: 0:0:4:4**	**Credits - 2**
Contact Period: Lecture: 52 Hrs., Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course Learning Objectives (CLO's)

The course P17MCENL17 aims to:

PART-A OPENMP PROGRAMS

1. Write an OpenMP program which performs C=A+B & D=A-B in separate blocks/sections where A,B,C & D are arrays.
2. Write an OpenMP program to add all the elements of two arrays A & B each of size 1000 and store their sum in a variable using reduction clause.
3. Write an OpenMP program to multiply two matrices A & B and find the resultant matrix C
4. Write an OpenMP program to find the number of processes, number of threads, etc (the environment information).
5. Write an OpenMP program to find the largest element in an array using critical section.
6. Write an OpenMP program to find the largest element in an array using locks.
7. Write an OpenMP program to find the sum of an array A and store the result in a variable.
8. Write an OpenMP program to print all the letters of the alphabet A- Z using threads.
9. Write an OpenMP program to show how thread private clause works.
10. Write an OpenMP program to show how first private clause works. (Factorial program)

PART-B MPI PROGRAMS

1. Write a MPI program to calculate and print the value of PI.
2. Write a MPI program to send the message from a process whose rank=3 to all other remaining processes.
3. Write a MPI program where each processor sends an integer number and its rank to the master processor, where the master gathers all the information and prints the data accordingly.
4. Write a MPI program to find sum of 'n' integers on 'p' processors using point-to-point communication libraries call
5. Write a MPI program to Broadcast a message.

Course Title: Arm Based Processor			
Course Code: P17MCEN21	**Sem: II**	**L-T-P-H: 3:1:0:5**	**Credits - 4**
Contact Period: Lecture: 52 Hrs., Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course Learning Objectives (CLO's)

The course P17MCEN21 aims to:

1. Describe the programmer's model of ARM processor and create and test assembly level programming.
2. Analyze various types of coprocessors and design suitable co-processor interface to ARM processor.
3. Analyze floating point processor architecture and its architectural support for higher level language.
4. Become aware of the Thumb mode of operation of ARM
5. Identify the architectural support of ARM for operating system and analyze the function of memory Management unit of ARM

Course Content

Unit-1

An Introduction to Processor Design: Processor architecture and organization. Abstraction in hardware design. A simple processor. Instruction set design. Processor design trade-offs. The Reduced Instruction Set Computer. Design for low power consumption. The ARM Architecture: The Acorn RISC Machine. Architectural inheritance. The ARM programmer's model. ARM development tools.

10 Hours

Unit-2

ARM Assembly Language Programming: Data processing instructions. Data transfer instructions. Control flow instructions. Writing simple assembly language programs. ARM Organization and Implementation: 3-stage pipeline ARM organization. 5-stage pipeline ARM organization. ARM instruction execution. ARM implementation. The ARM coprocessor interface

10 Hours

Unit-3

The ARM Instruction Set: Introduction. Exceptions. Conditional execution. Branch and Branch with Link (B, BL) Branch, Branch with Link and exchange instructions (BX, BLX). Software Interrupt (SWI). Data processing instructions. Multiply instructions. Count leading zeros (CLZ - architecture v5T only). Single word and unsigned byte data transfer instructions. Half-word and signed byte data transfer instructions. Multiple register transfer instructions. Swap memory and register instructions (SWP). Status register to general register

transfer instructions . General register to status register transfer instructions. Coprocessor instructions. Coprocessor data operations . Coprocessor data transfers. Coprocessor register transfers. Breakpoint instruction (BRK - architecture v5T only). Unused instruction space. Memory faults. ARM architecture variants. Architectural Support for High-Level Languages: Abstraction in software design. Data types. Floating point data types. The ARM floating-point architecture. Expressions . Conditiona al statements. Loops. Functions and procedures. Use of memory. Run-time environment.

12 Hours

Unit-4

The Thumb Instruction Set: The Thumb bit in the CPSR .The Thumb programmer's model. Thumb branch instructions. Thumb software interrupts instruction. Thumb data processing instructions. Thumb single register data transfer instructions. Thumb multiple register data transfer instructions. Thumb breakpoint instruction. Thumb implementation. Thumb applications. Architectural Support for System Development: The ARM memory 10 Hours interface. The Advanced Microcontroller Bus Architecture (AMBA). The ARM reference peripheral specification. Hardware system prototyping tools. The JTAG boundary scan test architecture. The ARM debug architecture. Embedded Trace. Signal processing support.

10 Hours

Unit-5

ARM Processor Cores: ARM7TDMI. ARM8. ARM9TDMI.ARM10TDMI Memory Hierarchy: Memory size and speed. On-chip memory. Memory management. Architectural Support for Operating Systems. An introduction to operating systems. The ARM system control coprocessor. CP15 protection unit registers. ARM protection unit. CP15 MMU registers. ARM MMU architecture. Synchronization. Context switching. Input / Output.

10 Hours

Text Books:

1. Steve Furber:ARM System on Chip Architecture by S.B Fuber 2nd Edition, Pearson 2013.

Reference Books:

1. Joseph Yiu: The definitive guide to ARM Cortex M3 M4 processors, Elsevier Newnes 3rd edition 2014

Course outcomes: The students shall able to:

1. **Categorize** the hardware and software issues related to the design of a Microcontroller based system catering to the needs of medium and higher end applications.
2. **Explain** the architecture and programming of the 32-bit ARM Processors
3. **Demonstrat**e different ARM instruction set
4. **Demonstrate** thumb instruction sets
5. **Design and develop** ARM specific applications

Course Title: Wireless Sensor Networks			
Course Code: P17MCEN22	**Sem: II**	**L-T-P-H: 3:0:1:4**	**Credits - 4**
Contact Period: Lecture: 52 Hrs., Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course Learning Objectives (CLO's)

The course P17MCEN22 aims to:

1. Architect sensor networks for various application setups.
2. Develop an understanding of architecture of WSN and routing protocols
3. Determine suitable medium access protocols and radio hardware.
4. Prototype sensor networks using commercial components.
5. Provision quality of service, fault-tolerance, security and other dependability requirements while coping with resource constraints

Course Content

Unit-1

Overview Of Wireless Sensor Networks: Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks. Applications of Wireless Sensor Networks: Introduction, Background, Range of Applications, Examples of Category 2 WSN Applications, Examples of Category 1 WSN Applications.

Architectures: Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes , Operating Systems and Execution Environments, Network Architecture - Sensor Network Scenarios, Optimization Goals and Figures of Merit, Design principles for WSNs, Gateway Concepts.

12 Hours

Unit-2

Wireless Transmission Technology and Systems: Introduction, Radio Technology Primer, Available Wireless Technologies.

MAC and Routing Protocols for Wireless Sensor Networks: Introduction, Background, Fundamentals of MAC Protocols, MAC Protocols for WSNs, Sensor-MAC case Study, IEEE802.15.4 LR-WPANs Standard Case Study.

Routing Protocols for Wireless Sensor Networks: Introduction, Background, Data Dissemination and Gathering, Routing Challenges and Design. Issues in WSNs, Routing Strategies in WSNs.

12 Hours

Unit-3

Transport Control and Middleware for Wireless Sensor Networks: Traditional Transport Control Protocols, Transport Protocol Design Issues, Examples of Existing, Transport Control Protocols, Performance of Transport Control Protocols. Middleware for Wireless Sensor Networks: Introduction, WSN Middleware Principles, Middleware Architecture, Existing Middleware.

11 Hours

Unit-4

Localization and positioning: Properties of localization procedures, possible approaches, Mathematical basics for lateration problem, Single hop localization, Positioning in multihop environments.

9 Hours

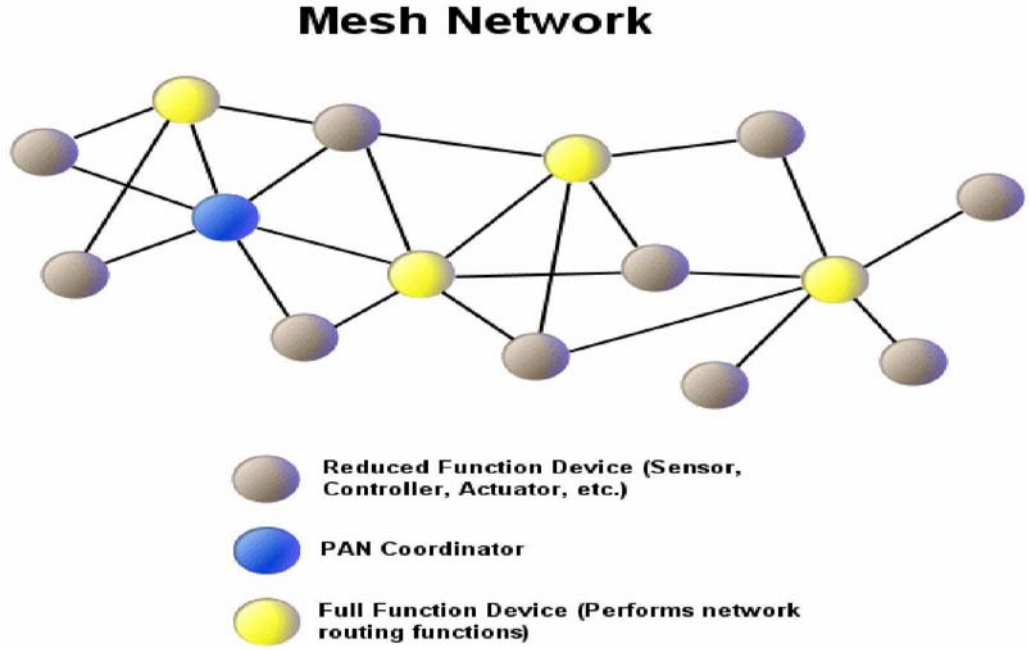
Unit-5

Topology control: Motivation and basic ideas, controlling topology in flat networks, Hierarchical networks by dominating sets and by clustering, combining hierarchical topologies and power control, adaptive node activity. 8 Hours

Lab Component
Using QualNet simulator

1. Analyze the network performance with respect to packet delivery in a WSN network with **star topology** With 5 reduced function devices randomly deployed with IEEE 8011.15.4 using.
    a. AODV(Reactive)
    b. BELLMAN FORD ALGORITHM(DSDV)(Proactive)

   Repeat the experiment with more than 10 nodes randomly deployed and compare the performance.
2. Repeat the experiment 1 with various settings for Transmission power (range) Analyze the difference in performance with various simulation time
3. Analyze the network performance with respect to packet delivery in a WSN network as given in scenario with **MESH topology** using IEEE 8011.15.4 with
    a. AODV
    b. DSR



Repeat the experiment with **more** RFD nodes randomly deployed and compares the performance.

4. Repeat the experiment 2 with various settings for
    a. Transmission power (range)
    b. Mobility models (PAN)
    c. Energy models
    d. Battery model

   Analyze the difference in performance with various simulation times.
5. Analyze the network performance with respect to packet delivery in a WSN network with CLUSTER **topology** using IEEE 8011.15.4 with
    a. AODV
    b. BELLMAN FORD ALGORITHM

Text book :

1. Willig Holger Karl & Andreas Willig, " Protocols And Architectures for Wireless Sensor Networks" , John Wiley, 2005.
2. KAZEM SOHRABY, DANIEL MINOLI, TAIEB ZNATI, “Wireless Sensor Networks: Technology, Protocols and Applications:, WILEY , Second Edition (Indian) , 2014

Reference book:

1. Feng Zhao, Leonidas Guibas, " Wireless Sensor Network",Elsevier, 1st Ed. 2004 (ISBN: 13- 978-1-55860-914-3)
2. **Waltenegus Dargie, Christian Poellabauer** Fundamentals of Wireless Sensor Networks: Theory and Practice,John Wiley (**ISBN: 978-0-470-99765-9)**
3. Anna Hac, Wireless Sensor Network Designs,John Wiley

Course outcomes

The student will be able to: -

1. Develop applications of wireless sensor networks.
2. Explain architecture of WSN and apply routing protocol
3. Propose various transport control and middleware protocols that exist for sensor networks.
4. Analyze different positioning and localization algorithms.
5. Explain topology control.

Course Title: Foundation for Internet of Things			
Course Code: P17MCEN23	**Sem: II**	**L-T-P-H: 3:1:0:5**	**Credits - 4**
Contact Period: Lecture: 52 Hrs., Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course Learning Objectives (CLO's)

The course P17MCEN23 aims to:

Course Content

Unit -1

Introduction to Internet of Things, Definition and Characteristics of IoT, Physical Design of IoT, IoT Protocols, IoT communication models, IoT Communication APIs, IoT enabled Technologies, Wireless Sensor Networks, Cloud Computing, Big data analytics, Communication protocols, Embedded Systems, IoT Levels and Templates, Domain Specific IoTs: Home, City, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health and Lifestyle, **IoT and M2M: Introduction, M2M , Difference between IoT and M2M**

11 Hours

Unit-2

Key IoT Technologies: Device Intelligence, Communication Capabilities, Mobility Support, Device power, Sensor technology, RFID technology, IoT Physical Devices and Endpoints, Introduction to Raspberry PI, Interfaces (serial, SPI, I2C), Programming: Python program with Raspberry PI with focus of interfacing external gadgets, controlling output, reading input from pins

10 Hours

Unit -3

IoT communication reference architecture: Wireless Communication Technology for IoT, Wi-Fi (IEEE 802.11), Bluetooth, ZigBee, UWB (IEEE 802.15.4), NFC, 6LoWPAN. IoT Application Protocol: Constrained Application Protocol, MQ Telemetry Transport (MQTT).

10 Hours

Unit-4

IoT Physical Servers and Cloud Offerings: Introduction to Cloud Storage models and communication APIs Web server, Web server for IoT, Cloud fo IoT, Python web application framework designing a RESTful web API, Amazon Web services for IoT

10 Hours

Unit-5

Introduction to Arduino:

Arduino board – Architecture, setting up the board, Introduction to sensors and actuators, implementing simple program by interfacing with sensors and actuators

Case Studies Illustrating IoT Design

Introduction , Home Automation : Smart Lighting , Home Intrusion Detection **,** Cities : Smart Parking , Environment :, Weather Monitoring System , Air Pollution Monitoring **,** Forest Fire Detection , Agriculture **:** Smart Irrigation

11 Hours

Text book:

1. A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Internet of Things, Universities Press, 2015.
2. Matt Richardson & Shawn Wallace, Getting Started with Raspberry Pi, O'Reilly (SPD), 2014.
3. Daniel Minoli, Building the Internet of Things with IPv6 and MIPv6:The Evolving World of M2M Communications, Wiley, 2013
4. Michael McRoberts "Beginning Arduino" , Technology in action 2nd edition.

Reference

1. Michael Miller, The Internet of Things, First Edition, Pearson, 2015.
2. Claire Rowland, Elizabeth Goodman et.al., Designing Connected Products, First Edition, O'Reilly, 2015

Course Outcomes :

On Completion of the course, the students will be able to

1. Analyze the characteristics of IoT Enabling Technologies and applications
2. Apply design issues of key IOT technologies and prototype with Raspberry Pi
3. Analyze reference architecture of IOT communication protocols.
4. Develop IoT applications using Arduino ,sensors and Raspberry Pi.
5. Apply cloud services for IOT objects and implement cloud service integrated with IOT applications.

Course Title: Managing Big Data			
Course Code: P17MCEN241	**Sem: II**	**L-T-P-H: 3:1:0:5**	**Credits - 4**
Contact Period: Lecture: 52 Hrs., Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course Learning Objectives (CLO's)

The course P17MCEN141 aims to:

1. Define big data and related technologies.
2. Analyze Technologies for Handling Big Data and Hadoop Ecosystem
3. Acquire clear understanding of NoSQL Data Management
4. Acquire a clear understanding of Analytics and Big Data
5. Analyze the various data visualization techniques and relevant case studies related to various industries.

Course Content

Unit-1

Getting an Overview of Big Data and Hadoop Ecosystem

Big Data, History of Data Management – Evolution of Big Data, Structuring Big Data, Types of Data, Elements of Big Data, Volume, Velocity, Variety ,Veracity ,Big Data Analytics

,Advantages of Big Data Analytics ,Careers in Big Data ,Skills Required, Future of Big Data. Business Intelligence, Preventing Fraud Using Big Data Analytics.
Hadoop Ecosystem, Hadoop Distributed File System, HDFS Architecture, Features of HDFS, MapReduce, Features of MapReduce, Hadoop YARN. SLE: HBase, Hive, Pig, Sqoop, Flume.

11 Hours

Unit-2

Understanding MapReduce Fundamentals and HBase

The MapReduce Framework, Exploring the Features of MapReduce, Working of MapReduce, Exploring Map and Reduce Functions, Techniques to Optimize MapReduce Jobs, Hardware/Network Topology, Synchronization, File System, Uses of MapReduce, Role of HBase in Big Data Processing, Characteristics of HBase, Installation of HBase.

9 Hours

Unit -3

NoSQL Data Management

Introduction to NoSQL, Characteristics of NoSQL, Evolution of Databases, Aggregate Data Models, Key Value Data Model, Document Databases, Relationships, Graph Databases, SchemaLess Databases, Materialized Views, Distribution Models, Sharding, MapReduce Partitioning and Combining, Composing MapReduce Calculations,CAP Theorem

10 Hours

Unit-4

Understanding Analytics and Big Data

Comparing Reporting and Analysis, Reporting, Analysis, The Analytic Process, Types of Analytics, Basic Analytics, Advanced Analytics, Operationalized Analytics, Monetized Analytics, Characteristics of Big Data Analysis, Points to Consider during Analysis, Frame the Problem Correctly, Statistical Significance or Business Importance? , Making Inferences versus Computing Statistics, Developing an Analytic Team, Convergence of IT and Analytics, Understanding Text Analytics, Skills required for an Analyst

10 Hours.

Unit -5

Data Visualization

Introducing Data Visualization, Techniques Used for Visual Data Representation, Types of Data Visualization, Applications of Data Visualization, Visualizing Big Data, Deriving Business Solutions, Turning Data into Information, Tools Used in Data Visualization, Proprietary Data Visualization Tools, Open-Source Data Visualization Tools, Analytical Techniques Used in Big Data Visualization, Tableau Products. Relevant Case Studies related to Automation and other Industries : Product Design and Development, Use of Big Data in Preventing Fraudulent Activities, Preventing Fraud Using Big Data Analytics, Use of Big Data in Detecting Fraudulent Activities in Insurance Sector, Fraud Detection Methods, Use of Big Data in Retail Industry, Use of RFID Data in Retail. SLE: Installation of Tableau Public

10 Hours

Textbook:

1. Big Data: Black Book, DT Editorial Services, Wiley India Pvt Ltd, 2015 Edition.

Reference Books:

1. Arvind Sathi, “Big Data Analytics: Disruptive Technologies for Changing the Game”, 1st Edition, IBM Corporation, 2012
2. Big Data Analytics with R and Hadoop, VigneshPrajapati, -Packt Publishing 2013

3. Michael Minelli, Michehe Chambers, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Business", 1st Edition, AmbigaDhiraj, Wiely CIO Series, 2013.

Course Outcome: On successful completion of the course the students will be able to

1 Analyze Technologies for Handling Big Data and Hadoop Ecosystem
2. Acquire clear understanding of MapReduce Fundamentals and HBase
3. Explain managing of Big data Without SQL
4. Acquire a clear understanding of Analytics and Big Data
5. Analyze the various data visualization techniques and relevant case studies related to various industries.

Course Title: Multimedia Communication			
Course Code: P17MCEN242	**Sem: II**	**L-T-P-H: 3:1:0:5**	**Credits - 4**
Contact Period: Lecture: 52 Hrs., Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course Learning Objectives (CLO's)

The course P17MCEN242 aims to:

1. Define the Multimedia Communication Models
2. Explain Multimedia Transport in Wireless Networks
3. Solve the Security issues in multimedia networks
4. Illustrate real-time multimedia network applications.
5. Explain different network layer based application.

Course Content

Unit - 1

Introduction, multimedia information representation, multimedia networks, multimedia applications, Application and networking terminology, network QoS and application QoS, Digitization principles,. Text, images, audio and video.

11 Hours

Unit - 2

Text and image compression,, compression principles, text compression- Runlength, Huffman, LZW, Document Image compression using T2 and T3 coding, image compression- GIF, TIFF and JPEG. **- 11 Hrs**

Unit - 3

Audio and video compression, audio compression – principles, DPCM, ADPCM, Adaptive and Linear predictive coding, Code-Excited LPC, Perceptual coding, MPEG and Dolby coders video compression, video compression principles.

10 Hours

Unit - 4

Video compression standards: H.261, H.263, MPEG, MPEG 1, MPEG 2, MPEG-4 and Reversible VLCs, MPEG 7 standardization process of multimedia content description, MPEG 21 multimedia framework.

10 Hours

Unit - 5

Notion of synchronization, presentation requirements, reference model for synchronization, Introduction to SMIL, Multimedia operating systems, Resource management, process management techniques. 10 Hours

Text Books:

1. Fred Halsall, "Multimedia Communications", Pearson education, 2001.
2. Raif Steinmetz, Klara Nahrstedt, "Multimedia: Computing, Communications and Applications", Pearson education, 2002.

Reference Books:

1. K. R. Rao, Zoran S. Bojkovic, Dragorad A. Milovanovic, "Multimedia Communication Systems", Pearson education, 2004.
2. John Billamil, Louis Molina, "Multimedia : An Introduction", PHI, 2002.

Course Outcomes:

The students should be able to:

- Deploy the right multimedia communication models.
- Apply QoS to multimedia network applications with efficient routing techniques.
- Solve the security threats in the multimedia networks.
- Develop the real-time multimedia network applications
- Explain the notion of synchronization.

Course Title: Storage Area Network			
Course Code: P17MCEN251	**Sem: II**	**L-T-P-H: 3:1:0:5**	**Credits - 4**
Contact Period: Lecture: 52 Hrs., Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course Learning Objectives (CLO's)

The course P17MCEN251 aims to:

1. Discuss the fundamentals of storage centric and server centric systems
2. Analyze the metrics used for Designing storage area networks
3 Explain the RAID concepts
4 Explain strong virtualization concepts.
5 Apply the techniques used for data maintenance.

Course Content

Unit -1

Introduction: Server Centric IT Architecture and its Limitations; Storage – Centric IT Architecture and its advantages. Case study: Replacing a server with Storage Networks The Data Storage and Data Intelligent Disk Subsystems: Architecture of Intelligent Disk Subsystems; Hard disks and Internal I/O Channels; JBOD, Storage virtualization using RAID and different RAID levels; Caching: Acceleration of Hard Disk Access; Intelligent disk subsystems, Availability of disk subsystems.

10 Hours

Unit -2

I/O Techniques: The Physical I/O path from the CPU to the Storage System; SCSI; Fibre Channel Protocol Stack; Fibre Channel SAN; IP Storage. Network Attached Storage: The NAS Architecture, The NAS hardware Architecture, The NAS Software Architecture, Network connectivity, NAS as a storage system. File System and NAS: Local File Systems; Network file Systems and file servers; Shared Disk file systems; Comparison of fibre Channel and NAS.

10 Hours

Unit -3

Storage Virtualization: Definition of Storage virtualization; Implementation Considerations; Storage virtualization on Block or file level; Storage virtualization on various levels of the storage Network Symmetric and Asymmetric storage virtualization in the Network.

10 Hours

Unit -4

SAN Architecture and Hardware devices: Overview, Creating a Network for storage; SAN Hardware devices The fibre channel switch; Host Bus Adaptors; Putting the storage in SAN; Fabric operation from a Hardware perspective. Software Components of SAN: The switch's Operating system; Device Drivers; Supporting the switch's components; Configuration options for SANs.

10 Hours

Unit -5

Management of Storage Network: System Management, Requirement of management System, Support by Management System, Management Interface, Standardized Mechanisms, Property Mechanisms, In-band Management, Use of SNMP, CIM and WBEM, Storage Management Initiative Specification (SMI-S), CMIP and DMI, Optional Aspects of the Management of Storage Networks, Summary.

10 Hours

Text Book:

1. Ulf Troppens, Rainer Erkens and Wolfgang Muller: Storage Networks Explained, Wiley India,2015.
2. 1. Robert Spalding: "Storage Networks The Complete Reference", Tata McGraw-Hill, 2011.

Reference Books:

1. Marc Farley: Storage Networking Fundamentals – An Introduction to Storage Devices, Subsystems, Applications, Management, and File Systems, Cisco Press, 2005.
2. Richard Barker and Paul Massiglia: "Storage Area Network Essentials A Complete Guide to understanding and Implementing SANs", Wiley India, 2006.

Course outcomes:

The students shall able to:

1. Discuss the fundamentals of storage centric and server centric systems(L1)
2. Analyze the metrics used for Designing storage area networks(L2)
3 Explain the RAID concepts(L3)
4 Explain strong virtualization concepts.(L3)
5 Apply the techniques used for data maintenance (.L4)

Course Title: Machine Learning Techniques			
Course Code: P17MCEN252	**Sem: II**	**L-T-P-H: 3:1:0:5**	**Credits - 4**
Contact Period: Lecture: 52 Hrs., Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course Learning Objectives (CLO's)

The course P17MCEN252 aims to:

1. Explain basic concepts of learning and decision trees.
2. Compare and contrast neural networks and genetic algorithms
3. Apply the Bayesian techniques and instant based learning
4. Examine analytical learning and reinforced learning

Course Content

Unit-1

INTRODUCTION, CONCEPT LEARNING AND DECISION TREES

Learning Problems – Designing Learning systems, Perspectives and Issues – Concept Learning – Version Spaces and Candidate Elimination Algorithm – Inductive bias – Decision Tree learning – Representation – Algorithm – Heuristic Space Search

10 Hours

Unit-2

NEURAL NETWORKS AND GENETIC ALGORITHMS

Neural Network Representation – Problems – Perceptrons – Multilayer Networks and Back Propagation Algorithms – Advanced Topics – Genetic Algorithms – Hypothesis Space Search – Genetic Programming – Models of Evolution and Learning.

10 Hours.

Unit-3

BAYESIAN AND COMPUTATIONAL LEARNING

Bayes Theorem – Concept Learning – Maximum Likelihood – Minimum Description Length Principle – Bayes. Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier– Bayesian Belief Network – EM Algorithm – Probably Learning – Sample Complexity for Finite and Infinite Hypothesis Spaces – Mistake Bound Model.

10 Hours.

Unit-4

INSTANT BASED LEARNING AND LEARNING SET OF RULES

K- Nearest Neighbor Learning – Locally Weighted Regression – Radial Basis Functions – CaseBased Reasoning – Sequential Covering Algorithms – Learning Rule Sets – Learning First Order Rules – Learning Sets of First Order Rules – Induction as Inverted Deduction – Inverting Resolution

10 Hours.

Unit-5

ANALYTICAL LEARNING AND REINFORCED LEARNING

Perfect Domain Theories – Explanation Based Learning – Inductive-Analytical Approaches - FOCL Algorithm – Reinforcement Learning – Task – Q-Learning – Temporal Difference Learning

10 Hours.

Textbook:

1. Tom M. Mitchell, “Machine Learning”, McGraw-Hill Education (INDIAN EDITION), 2013.

Reference Books:

1. Ethem Alpaydin, “Introduction to Machine Learning”, 2nd Ed., PHI Learning Pvt. Ltd., 2013.
2. T. Hastie, R. Tibshirani, J. H. Friedman, “The Elements of Statistical Learning”, Springer; 1st edition, 2001.

Course outcomes

On Completion of the course, the students will be able to

1. Choose the learning techniques with this basic knowledge.
2. Apply effectively neural networks and genetic algorithms for appropriate applications.
3. Apply Bayesian techniques and derive effectively learning rules.
4. Explain the different machine learning techniques.
5. Choose and differentiate reinforcement and analytical learning techniques

Course Title: Soft Computing			
Course Code: P17MCEN261	**Sem: II**	**L-T-P-H: 3:1:0:5**	**Credits - 4**
Contact Period: Lecture: 52 Hrs., Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course Learning Objectives (CLO's)

The course P17MCEN261 aims to:

1. To learn the key aspects of Soft computing
2. To know about the components and building block hypothesis of Genetic algorithm.
3. To gain insight onto Neuro Fuzzy modeling and control.
4. To understand the Fuzzy decision making, and its applications.
5. To gain knowledge in machine learning through Support vector machines.

Course Content

Unit - 1

Introduction to soft computing: Neural networks, Fuzzy logic, Genetic algorithms, Hybrid systems and its applications. Fundamental concept of ANN, Evolution, basic Model of ANN, Terminologies used in ANN, MP model, Hebb model.

11 Hours

Unit - 2

Perceptron Network: Adaptive linear neuron, Multiple adaptive linear neurons, Back propagation Network (Theory, Architecture, Algorithm for training, learning factors, testing and applications of all the above NN models).

11 Hours

Unit - 3

Introduction to classical sets and fuzzy sets: Classical relations and fuzzy relations, Membership functions.

10 Hours

Unit - 4

Defuzzification: Fuzzy decision making, and applications.

10 Hours

Unit - 5

Genetic algorithms: Introduction, Basic operations, Traditional algorithms, Simple GA General genetic algorithms, the schema theorem, Genetic programming, applications.

10 Hours

Text book

1. Principles of Soft computing, Shivanandam, Deepa S. N Wiley India,) ISBN 13: 9788126527410, 2011 (Chapters 1, 2, 3(Upto 3.5), 7, 8, 9, 10, 13, 15 (upto 15.6 & 15.9,15,10)

References

1. Neuro-fuzzy and soft computing, J.S.R. JANG, C.T. SUN, E. MIZUTANI, Phi (EEE edition), 2012.

Course outcomes:

The student shall be able to

1 Implement machine learning through neural networks.
2. Design Genetic Algorithm to solve the optimization problem
3. Develop a Fuzzy expert system.
4. Model Neuro Fuzzy system for clustering and classification.

Course Title: Digital Image Processing			
Course Code: P17MCEN262	**Sem: II**	**L-T-P-H: 3:1:0:5**	**Credits - 4**
Contact Period: Lecture: 52 Hrs., Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course Learning Objectives (CLO's)

The course P17MCEN262 aims to:

1. To understand the image fundamentals.
2. To understand the mathematical transforms necessary for image processing and to study the image enhancement techniques.
3. To understand the image degradation/restoration model and different noise models.
4. To understand the uses of pseudo colors and to study the image compression models.
5. To understand Morphological Image Processing and the image segmentation.

Course Content

Unit – 1

Digital Image Fundamentals: What is Digital Image Processing, fundamental Steps in Digital Image Processing, Components of an Image processing system, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships between Pixels, Linear and Nonlinear Operations.

10 Hours

Unit – 2

Image Enhancement in Spatial domain: Some Basic Gray Level Trans– formations, Histogram Processing, Enhancement Using Arithmetic/Logic Operations.

Image Enhancement In Frequency Domain: Introduction to the Fourier transform, smoothing frequency domain filters, sharpening frequency domain filters.

11 Hours

Unit – 3

Image Restoration: Model of image degradation/restoration process, noise models, Restoration in the Presence of Noise, Only– Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Linear Position– Invariant Degradations, inverse filtering, minimum mean square error (Weiner) Filtering

11 Hours

Unit – 4

Color Image Processing: Color fundamentals, color models, pseudo color Image processing, basics of full color image processing, color transformations.

Image Compression: Fundamentals, Image Compression Models, Elements of Information Theory

10 Hours

Unit – 5

Morphological Image Processing: Dilation and Erosion, opening and closing, Some Morphological algorithms.

Image Segmentation

Detection of discontinuities, Edge Linking and Boundary Detection, Thresholding, Region–Based Segmentation.

10 Hours

Text book:

1. "Digital Image Processing", Rafael C. Gonzalez and Richard E. Woods Pearson Education, 2009, 3rd edition.

Reference books:

1. "Fundamentals of Digital Image Processing", Anil K. Jain, Pearson Edition, 2001.
2. "Digital Image Processing", S. Jayaraman and others.

Course Outcomes

After learning all the units of the course, the student is able to

1 Describe the various steps in image processing.
2 Develop the suitable filters for image enhancement.
3 Analyze the image degradation restoration model and noise models.
4 Apply the color image processing techniques.
5 Develop the algorithms for image segmentation and Morphological image processing.

Course Title: Internet of Things Lab			
Course Code: P17MCENL27	**Sem: II**	**L-T-P-H: 0:0:4:4**	**Credits - 2**
Contact Period: Lecture: 52 Hrs., Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course Learning Objectives (CLO's)

The course P17MCENL27 aims to:

Using Arduino Board

1. Demonstrate using arduino board to blink the LED continously.
2. Demonstrate to show that how to fade an LED on pin 9 using the analogWrite() function.
3. Demonstrate the use of switch and to control the ON and OFF of LED.
4. Demonstrate using arduino board to read the status of switch.

Using Raspberry Pi

5. Program to blink LED continuously.
6. Program to control output using an input.
7. Interfacing the PIR Motion Sensor to the Raspberry Pi's Input GPIO to detect motion.