IPS Academy, Institute of Engineering & Science

(A UGC Autonomous Institute, Affiliated to RGPV, Bhopal)

Scheme Based on AICTE Flexible Curriculum

Department of Computer Science & Engineering

Bachelor of Technology (B.Tech.) [Computer Science & Engineering (IoT)]

V Semester

S.No.	Subject Code	Category	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours per week			Total Credits
				Theory			Practical						
				End Sem	Mid Sem. Exam.	Quiz/ Assignment	End Sem	Term work / Lab Work & Sessional		L	T	P	
1.	**PCC-CIOT501**	PCC	**Microprocessor & Microcontroller**	70	20	10	60	40	**200**	2	1	2	**4**
2.	**PCC-CIOT502**	PCC	**Operating Systems**	70	20	10	60	40	**200**	3	–	2	**4**
3.	**PCC-CIOT503**	PCC	**Theory of Computation**	70	20	10	60	40	**200**	2	1	2	**4**
4.	**PCC-CIOT504**	PCC	**Programming in PYTHON**	–	–	–	60	40	**100**	–	–	4	**2**
5.	**PEC-CIOT501**	PEC	**Elective-I**	70	20	10	–	–	**100**	4	–	–	**4**
6.	**OEC-CIOT501**	OEC	**Open Elective-I**	70	20	10	–	–	**100**	3	–	–	**3**
7.	**PROJ-CIOT501**	PROJ	**Seminar-I**	–	–	–	–	50	**50**	–	–	2	**1**
8.	**–**	PROJ	**Internship-I**	To be completed during semester break. Its Evaluation / Credit to be added in Sixth Semester.									
			Total	**350**	**100**	**50**	**240**	**210**	**950**	**14**	**2**	**12**	**22**

Electives-I	**Open Electives-I**
PEC-CIOT501(A) Software Engineering & Project Management	OEC-CIOT501(A) Entrepreneurship
PEC-CIOT501(B) Advanced Computer Architecture	OEC-CIOT501(B) IPR
PEC-CIOT501(C) Agile Software Development	OEC-CIOT501(C) Operation Research
PEC-CIOT501(D) Multimedia Design for IoT	OEC-CIOT501(D) Probability Theory & Statistics

1 Hr Lecture	1 Hr Tutorial	2 Hr Practical
1 Credit	1 Credit	1 Credit

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V-Semester

PCC-CIOT501	**Microprocessor and Microcontroller**	**2L: 1T: 2P (4hrs.)**	**4 credits**

Prerequisite: None

Course Objective: To develop an in-depth understanding of the operation of microcontrollers and an exposure to basic peripherals, its programming and interfacing techniques

Course Contents :(40 hrs.)

Module 1: (10hrs.)

The architecture of 8086 microprocessor, BIU and EU, register organization, pin diagram, memory organization, buffers and latches, 8288 bus controller, maximum and minimum modes, addressing modes.

Module 2: (10 hrs.)

Input-Output interfacing: Memory Mapped I/O and Peripherals I/O. PPI 8255 Architecture and modes of operation, Programmable Interrupt Controller (PIC 8259) DMA controller (8257) Architecture, Programmable interval timer 8254, USART 8251.

Module 3: (08 hrs.)

Introduction to microcontrollers, 8051 architecture, pin description, I/O configuration, interrupts, addressing modes

Module 4: (06hrs.)

Introduction to PIC microcontroller: Architecture, memory organization, addressing modes and instruction set, ARM Architecture, ARM programmer's model, addressing modes.

Module 5: (06hrs.)

Introduction to AVR microcontroller Overview of AVR family, AVR Microcontroller architecture, status register, Special function registers, RAM, ROM & EEPROM space, On-Chip peripherals, ATmega32 pin configuration & function of each pin, Fuse bits of AVR.

Course Outcome:

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

1. Understand 16 bit Microprocessor's (8086) internal logic design.
2. Apply the architectural knowledge for the real time problem solving using interfacing concepts
3. Understand the basic concepts of 8051 Microcontroller, Interfacing of 8051 to external memory and Instruction set of 8051.
4. Understand the architecture of PIC and ARM controllers.
5. Develop real time software and hardware for embedded systems using AVR ATMega 32 Microcontroller.

Reference Books:

1. Advance microprocessor and peripheral –A.K. Ray and K. M. Bhurchandi, Tata Mcgraw Hill.
2. The 8051 microcontroller and embedded systems-M.A. Mazidi, Janice GillispieMazidi, Pearson Prentice Hall
3. Embedded Systems: Introduction to ARM Cortex-M Microcontrollers- Dr. Jonathan W. Valvano
4. Programming and Customizing the AVR Microcontroller- Dhananjay Gadre, Mc Graw Hill Education.
5. PIC Microcontroller and Embedded systems using Assembly and C for PIC18- Muhammad Ali Mazidi, Rolin D. Mckinlay,Danny Causey , Pearson Education.

List of Experiments:

1. Assembly Language Programs of Microprocessor 8086.
2. Assembly Language Programs of Microcontroller 8051.
3. Assembly Language Programs for Interfacing Chips.
4. Programs of PIC Microcontroller.
5. Programs of ARM Microcontroller.
6. Programs of AVR Microcontroller.

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V-Semester

PCC-CIOT502	Operating Systems	3L: 0T: 2P (4hrs.)	4 credits

Prerequisite: Computer Organization & Architecture

Course Objective:

This Course provides a comprehensive introduction of Operating System, Process Management, Memory Management, File Management and I/O management.

Course Contents: (40 hrs.)

Module 1: (06 hrs.)

Introduction to Operating Systems: Function, Evolution, Different Types, Desirable Characteristics and features of an O/S, Operating Systems Services: Types of Services, Different ways of providing these Services – Utility Programs, System Calls, Operating System Structure, and Spooling & Buffering.

Module 2: (11 hrs.)

CPU Scheduling : Process Concept, Scheduling Concepts, Types of Schedulers, Scheduling Criteria, Process State Diagram, Scheduling Algorithms, Operation on Process, Algorithms Evaluation, System calls for Process Management; Multiple Processor Scheduling; Concept of Threads. Concurrent Processes : Real and Virtual Concurrency, Mutual Exclusion, Synchronization, Inter- Process Communication, Critical Section Problem, Solution to Critical Section Problem : Semaphores – Binary and Counting Semaphores, WAIT & SIGNAL Operations and their implementation. Deadlocks: Deadlock Problems, Characterization, Prevention, Avoidance, Recovery.

Module 3: (11 hrs.)

Memory Management: Different Memory Management Techniques – Partitioning, Swapping, Segmentation, Paging, Paged Segmentation, Comparison of these techniques, Techniques for supporting the execution of large programs: Overlay, Dynamic Linking and Loading, Virtual Memory – Concept, Implementation by Demand Paging etc., Page replacement algorithms.

Module 4: (06 hrs.)

File Systems: File Concept, User's and System Programmer's view of File System, Disk Organization, Tape Organization, Different Modules of a File System, Disk Space Allocation Methods – Contiguous, Linked and Indexed. Directory Structures, File Protection, System Calls for File Management, Disk Scheduling Algorithms.

Module 5: **(06 hrs.)**

Introduction to Network, Distributed and Multiprocessor Operating Systems. Case Studies: Unix/Linux, WINDOWS and other Contemporary Operating Systems.

Course Outcomes:

1. State the core concepts of operating system, evolution and types of operatingsystem.
2. Illustrate various input output concepts, interprocess communication and deadlock
3. Illustrate process scheduling and memory management techniques.
4. Describe the concept of file and disk management.
5. State the core concepts of network, distributed and multiprocessor operating system.

List of Text / Reference Books:

1. Avi Silberschatz, Peter Galvin, Greg Gagne, "Operating System Concepts Essentials", Wiley Asia Student Edition, 10th Edition, 2018.
2. William Stallings, "Operating Systems: Internals and Design Principles", Prentice Hallof India, 5th Edition, 2005.
3. Charles Crowley, "Operating System: A Design-oriented Approach", Irwin Publishing, 1st Edition.
4. Gary J. Nutt, "Operating Systems: A Modern Perspective", Addison-Wesley, 2nd Edition.
5. Maurice Bach, "Design of the Unix Operating Systems", Prentice-Hall of India, 8th Edition.
6. Daniel P. Bovet, Marco Cesati, "Understanding the Linux Kernel", O'Reillyand Associates, 3rd Edition.
7. Andrew S. Tanenbaum, "Modern Operating Systems", Prentice Hall, 3rd Edition,2007.
8. Bovet & Cesati, "Understanding the Linux Kernel", O'Reily, 3rd Edition.

List of Experiment:

Write a program:

1. To implement FCFS CPU scheduling algorithm.
2. To implement SJF CPU scheduling algorithm.
3. To implement Priority CPU Scheduling algorithm.
4. To implement Round Robin CPU scheduling algorithm.
5. To compare various CPU Scheduling Algorithms over different Scheduling Criteria.
6. To implement classical inter process communication problem (producer consumer).
7. To implement classical inter process communication problem (Reader Writers).
8. To implement classical inter process communication problem (Dining Philosophers).
9. To implement & Compare various page replacement algorithms.
10. To implement & Compare various Disk & Drum scheduling Algorithms
11. To implement Banker's algorithms.
12. To implement Remote Procedure Call (RPC).
13. Write a Devices Drivers for any Device or peripheral.

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V-Semester

PCC-CIOT503	**Theory of Computation**	**2L: 1T: 2P (5 hrs.)**	**4 credits**

Prerequisite: Discrete structure

Course Objective:

The main objective of this course is to understand fundamental of Theory of Computation.

Course Contents: (40 hrs.)

Module 1: (08 hrs.)

Introduction of Automata Theory: Examples of automata machines, Finite Automata as a language acceptor and translator, Moore machines and mealy machines, composite machine, Conversion from Mealy to Moore and vice versa.

Module 2: (08 hrs.)

Types of Finite Automata: Non-Deterministic Finite Automata (NDFA), Deterministic finite automata machines, conversion of NDFA to DFA, minimization of automata machines, regular expression, Arden's theorem. Meaning of union, intersection, concatenation and closure, 2- way DFA.

Module 3: (08 hrs.)

Grammars: Types of grammar, context sensitive grammar, and context free grammar, regular grammar. Derivation trees, ambiguity in grammar, simplification of context free grammar, conversion of grammar to automata machine and vice versa, Chomsky hierarchy of grammar, killing null and unit productions. Chomsky normal form and Greibach normal form.

Module 4: (08 hrs.)

Push down Automata: example of PDA, deterministic and non-deterministic PDA, conversion of PDA into context free grammar and vice versa, CFG equivalent to PDA, Petrinet model.

Module 5: (08 hrs.)

Turing Machine: Techniques for construction. Universal Turing machine Multitap, multihead

and multidimensional Turing machine, N-P complete problems. Decidability and Recursively Enumerable Languages, decidability, decidable languages, undecidable languages, Halting problem of Turing machine & the post correspondence problem.

Course Outcomes

1. Explain the basic concepts of switching and finite automata theory & languages.
2. Relate practical problems to languages, automata, computability and complexity.
3. Construct abstract models of computing, check their power to recognize the languages and analyze the grammar, its types, simplification and normal form.
4. Interpret rigorously formal mathematical methods to prove properties of languages, grammars and automata.
5. Develop an overview of how automata theory, languages and computation are applicable in engineering application.

List of Text / Reference Books:

1. Daniel I.A. Cohen,"Introduction to Computer Theory",Wiley India, 2nd Edition,2003.
2. John E Hopcroft, Jeffrey D. Ullman and Rajeev Motwani, "Introduction to Automata Theory, Languages and Computation", Pearson Education, 2nd Edition,2001.
3. K.L.P Mishra & N.Chandrasekaran,"Theory of Computer Science", PHI Learning, 3rdEdition,2006.
4. Peter Linz, "Introduction to Automata Theory and Formal Languages", Narosa Publishing. 3rdEdition,2007.
5. John C Martin, "Introduction to languages and the theory of computation", TATA McGraw Hill, 3rd Edition 2013.
6. Harry R. Lewis and Christos H. Papadimitriou, "Elements of the Theory ofComputation", Pearson Education Asia,2nd edition, 1998.
7. Dexter C. Kozen, "Automata and Computability", Undergraduate Texts in ComputerScience, Springer,1st edition,2012.
8. Michael Sipser, "Introduction to the Theory of Computation", PWS Publishing., 3rd edition,2012.

List of Experiments:

Design a Program for:

1. Creating machine that accepts three consecutive one.
2. Creating machine that accepts the string always ending with 101.
3. Mode 3 Machine
4. Accepting decimal number divisible by 2.
5. Creating a machine which accepts string having equal no. of 1's and 0's.
6. Creating a machine which count number of 1's and 0's in a given string.
7. Find 2's complement of a given binary number.
8. Increment the given binary number by 1.
9. Convert NDFA to DFA.
10. PDA machine that accept the well-formed parenthesis.
11. PDA to accept WCWR where w is any string and WR is reverse of that string and

C is a Special symbol.

12. Turing machine that's accepts the following language an b n c n where n>0.

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V-Semester **Elective-I**

PCC-CIOT504	**Programming in PYTHON**	**0L: 0T: 4P (4hrs.)**	**2 credits**

Course Objective:

The course is designed to provide Basic knowledge of Python. Python programming is intended for software engineers, system analysts, program managers and user support personnel who wish to learn the Python programming language. Learning Outcomes: Problem solving and programming capability

Module 1: (07 hrs.)

Introduction, History, Features, Python –Environment Setup Local Environment Setup, Getting Python, Installation of Python, Use of IDE

Module 2: (10 hrs.)

Python –Basic Syntax Python Identifiers, Reserved Words, Lines & Indentation, Multiline Statements, Quotation in Python, Comments & other useful constructs, Python –Variables Assigning Values to Variables, Multiple Assignment, Standard Data Types

Module 3: (08 hrs.)

Python –Variables, Assigning Values to Variables, Multiple Assignment, Standard Data Types; Python Numbers, Python Strings, Python Lists, Python Tuples, Dictionary, Data Type Conversion

Module 4: (08 hrs.)

Python –Basic Operators, Types of Operators, Arithmetic Operators, Comparison Operators, Assignment Operators, Bitwise Operators, Logical Operators, Operator Precedence, Python – Decision Making & Loops, Flowchart, If statement Syntax

Module 5: (08 hrs.)

Python-Functions, Syntax for defining a function, Calling a Function, Function Arguments, Anonymous Functions Python-Applications & Further Extensions, Data analysis packages.

Course Outcome:

1. Install Python and have knowledge of syntax of Python.
2. Describe the Numbers, Math functions, Strings, List, Tuples and Dictionaries in Python.
3. Express different Decision Making statements and Functions.
4. Develop code in Python using functions, loops etc.
5. Design GUI Applications in Python and evaluate different database operations.

List of Text Books / Reference Books:

1. Eric Matthes, “Python Crash Course: A Hands-On, Project-Based Introduction to Programming”, No Starch Press.
2. ZedA. Shaw, “Learn Python the Hard Way” (3rdEdition), Addison Wesley.
3. Paul Barry, “Head-First Python”, O‟Reilly.
4. John Zelle, Franklin,”Python Programming”, Beedle & Associates Inc.

List of Experiments:

Write a Python program:

1. To find GCD of two numbers.
2. To find the square root of a number by Newton‟s Method.
3. To find the exponentiation of a number.
4. To find the maximum from a list of numbers.
5. To perform Linear Search
6. To perform binary search.
7. To perform selection sort.
8. To perform insertion sort.
9. To perform Merge sort.
10. To find first n prime numbers.
11. To multiply matrices.
12. For command line arguments.
13. To find the most frequent words in a text read from a file.
14. To simulate elliptical orbits in Pygame.
15. To bouncing ball in Pygame.
16. To demonstrate data analysis packages using python like Pandas, Filtering, etc.

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V-Semester E**ective-I**

PEC-CIOT501(A)	**Software Engineering & Project Management**	**4L: 0T: 0P (4hrs.)**	**4 credits**

Course Objective:

The purpose of this subject is to cover the underlying concepts and techniques used in Software Engineering & Project Management.

Course Contents: (40 hrs.)

Module 1: (08 hrs.)

The Software Product and Software Process

Software Product and Process Characteristics, Software Process Models: Linear Sequential Model, Prototyping Model, RAD Model, Evolutionary Process Models like Incremental Model, Spiral Model, Component Assembly Model, RUP and Agile processes. Software Process customization and improvement, CMM, Product and Process Metrics, Feasibility Analysis, Cost Estimation Model.

Module 2: (08 hrs.)

Requirement Elicitation, Analysis, and Specification

Functional and Non-functional requirements, Requirement Sources and Elicitation Techniques, Use case Modeling, System and Software Requirement Specifications, Requirement Validation, Traceability.

Module 3: (08 hrs.)

Software Design

The Software Design Process, Design Concepts and Principles, Software Modeling and UML, Architectural Design, Architectural Views and Styles, User Interface Design, Function- oriented Design, SA/SD Component Based Design and Design Metrics.

Module 4: (08 hrs.)

Software Analysis and Testing

Software Static and Dynamic analysis, Code inspections, Software Testing, Fundamentals, Software Test Process, Testing Levels, Test Criteria, Test Case Design, Test Oracles, Test Techniques, Black-Box Testing, White-Box Unit Testing and Unit, Testing Frameworks, Integration Testing, System Testing and other Specialized, Testing, Test Plan, Test Metrics, Testing Tools.

Module 5: (08 hrs.)

Software Maintenance & Software Project Measurement

Need and Types of Maintenance, Software Configuration Management (SCM), Software Change Management, Version Control, Change control and Reporting, Program Comprehension Techniques, Re-engineering, Reverse Engineering, Tool Support. Project Management Concepts, Project and Process Planning, Resources Allocations, Project Scheduling and Tracking, Risk Assessment and Mitigation, Software Quality Assurance (SQA). Project Plan, Project Metrics.

Course Outcomes:

1. Decompose the given project in various phases of a lifecycle.
2. Choose appropriate process model depending on the user requirements.
3. Perform various life cycle activities like Analysis, Design, Implementation, Testing & Maintenance.
4. Know various processes used in all the phases of the product.
5. Apply the knowledge, techniques, and skills in the development of a software product

List of Text / Reference Books:

1. Pankaj Jalote ,"An Integrated Approach to Software Engineering", Narosa Pub, 2005
2. Rajib Mall, "Fundamentals of Software Engineering" Second Edition, PHILearning,Fouth Edition, 2014.
3. P, S. Pressman "Software Engineering. A Practitioner's Approach" New edition, McGraw Hills,7th edition,2010.
4. Sommerville,"Software Enginerring",Pearson Education, 9th Edition,2011.
5. Richard H.Thayer,"Software Enginerring & Project Managements", WileyIndia
6. Waman S.Jawadekar,"Software Enginerring", TMH,2004.
7. Bob Hughes, M.Cotterell, Rajib Mall "Software Project Management", McGrawHill,Sixth Edition,2017
8. Schwalbe, Kathy "Information Technology Project Management" 8th Edition, 2016.
9. Kieron Conway "Software project Management from concept to development Black Book" Dreamtech Press.
10. Deepak Jain, "Software Engineering principle and practices" Oxford UniversityPress,2008.
11. Bell Douglas "Software Engineering for students" ,Pearson Education.,4th Edition,2005.
12. Kelkar "Software Project Management," PHI Learning,3rd edition 2012.

Perspectives:

1. Software Engineering is the process of creating software systems.
2. Software Engineering reduces high software cost and complexity while increasingreliability.
3. Software Engineering is a part of project management in which software projects are planned, implemented, monitored and controlled.

Recommendations:

Students pursuing a concentration in **Software Engineering & Project Management** must alsotake the following concentration requirements and electives:

1. Project-I
2. Project-II
3. Project-III
4. Mobile Application Development

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V-Semester **Elective-I**

PEC-CIOT501(B)	**Advanced Computer Architecture**	**4L: 0T: 0P (4hrs.)**	**4 credits**

Prerequisite: Computer Organization & Architecture

Course Objective:
This subject aims to provide students with a fundamental knowledge of computer hardware and computer systems, with an emphasis on system design and performance

Course Contents: (42 hrs.)
Module 1: (08 hrs.)
Flynn's Classification, System Attributes to Performance, Parallel computer models - Multiprocessors and multicomputers, Multivector and SIMD Computers. Data and resource dependences, Hardware and software parallelism, Program partitioning and scheduling, Grain size and latency, Control flow, data flow and Demand driven mechanisms.
Static interconnection networks, Dynamic interconnection Networks: Bus Systems, Crossbar Switch, Multiport Memory, Multistage and Combining Networks

Module 2: (08 hrs.)
Instruction set architecture, CISC Scalar Processors , RISC Scalar Processors, VLIW architecture, Memory Hierarchy, Inclusion, Coherence and Locality, Memory capacity planning. Interleaved memory organization-memory interleaving, pipelined memory access, Bandwidth and Fault Tolerance. Backplane Bus System: Backplane bus specification, Addressing and timing protocols, Arbitration transaction and interrupt.

Module 3: (08 hrs.)
Linear pipeline processor, Nonlinear pipeline processor, Instruction pipeline design, Mechanisms for instruction pipelining, pipeline hazards, Dynamic instruction scheduling - score boarding and Tomosulo's algorithm, Branch handling techniques, Arithmetic Pipeline Design, Static arithmetic pipeline, Multifunctional arithmetic pipelines. Superscalar pipeline design, Super pipeline processor design.

Module 4: (10 hrs.)
Cache coherence, Snoopy protocols, Directory based protocols. Message routing schemes in multicomputer network, deadlock and virtual channel. Vector Processing Principles, Vector

instruction types, Vector-access memory schemes. Vector supercomputer architecture, SIMD organization: distributed memory model and shared memory model. Principles of Multithreading: Multithreading Issues and Solutions, Multiple-Context Processors.

Module 5: (08 hrs.)

Parallel Programming Models, Shared-Variable Model, Message-Passing Model, Data-Parallel Model, Object-Oriented Model, Functional and Logic Models, Parallel Languages and Compilers, Language Features for Parallelism, Parallel Programming Environment, Software Tools and Environments.

Course Outcomes:

1. Discuss the classes of computers, and new trends and developments in computer architecture.
2. Study advanced performance enhancement techniques such as pipelines, dynamic scheduling branch predictions, caches.
3. Compare and contrast the modern computer architectures such as RISC, Scalar, and multi CPU systems.
4. Criticallyevaluate the performance of different CPU architecture.
5. Improve the performance of applications running on different CPU architectures.
6. Develop applications for high performance computingsystems.

List of Text / Reference Books:

1. Kai Hwang, "Advanced computer architecture", TMH,2001.
2. J.P.Hayes, "computer Architecture and organization"; MGH,3rd edition.
3. V.Rajaranam & C.S.R.Murthy, "Parallel computer"; PHI Learning,7th edition,2006.
4. Kain,"Advance Computer Architecture: -A System Design Approach", PHI Learning,1st edition 2010.
5. M.J Flynn, "Computer Architecture, Pipelined and Parallel Processor Design"; Narosa Publishing,2011.
6. Hwang and Briggs, "Computer Architecture and Parallel Processing"; MGH,2017.
7. David E. Callav & Jaswinder Pal Singh Marge Kaufmann",Advance Computer Architecture", EIS India.
8. Sajjan G. Shiva, Taylar & Francis, "Advance Computer Architecture,2018.

Perspectives:

1. Knowing what's inside the Computer systems and how it works will help you design, develop and implement applications better, faster, cheaper, more efficient, and easier to use.
2. Computer Architecture is essential to writing efficient, scalable code.
3. Computer Architecture is used to describe the attributes of a system as seen by the programmer, i.e., the conceptual structure and functional behavior as distinct from the organization of the dataflow and controls, the logic design, and the physicalimplementation.

Recommendations:

Students pursuing a concentration in **Advanced Computer Architecture** must also take the following concentration requirements and electives:

1. Project-I
2. Project-II
3. Project-III
4. Mobile Application Development
5. Embedded System

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V-Semester **Elective-I**

PEC-CIOT501(C)	**Agile Software Development**	**4L: 0T: 0P (4hrs.)**	**4 credits**

Course Objective:

To learn best practices and methods of software development

Course Contents: (40 hrs.)

Module 1: (08 hrs.)

Fundamentals of Agile Process: Introduction and background, Agile Manifesto and Principles, Stakeholders and Challenges, Overview of Agile Development Models: Scrum, Extreme Programming, Feature Driven Development, Crystal, Kanban, and Lean Software Development.

Module 2: (08 hrs.)

Agile Projects: Planning for Agile Teams: Scrum Teams, XP Teams, General Agile Teams, Team Distribution; Agile Project Lifecycles: Typical Agile Project Lifecycles, Phase Activities, Product Vision, Release Planning: Creating the Product Backlog, User Stories, Prioritizing and Estimating, Creating the Release Plan; Monitoring and Adapting: Managing Risks and Issues, Retrospectives.

Module 3: (08 hrs.)

Introduction to Scrum: Agile Scrum Framework, Scrum Artifacts, Meetings, Activities and Roles, Scrum Team Simulation, Scrum Planning Principles, Product and Release Planning, Sprinting: Planning, Execution, Review and Retrospective; User story definition and Characteristics, Acceptance tests and Verifying stories, Burn down chart, Daily scrum, Scrum Case Study.

Module 4: (08 hrs.)

Introduction to Extreme Programming (XP): XP Lifecycle, The XP Team, XP Concepts: Refactoring, Technical Debt, Timeboxing, Stories, Velocity; Adopting XP: Pre-requisites, Challenges; Applying XP: Thinking- Pair Programming, Collaborating, Release, Planning, Development; XP Case Study.

Module 5: **(08 hrs.)**

Agile Software Design and Development: Agile design practices, Role of design Principles, Need and significance of Refactoring, Refactoring Techniques, Continuous Integration, Automated build tools, Version control; Agility and Quality Assurance: Agile Interaction Design, Agile approach to Quality Assurance, Test Driven Development, Pair programming: Issues and Challenges.

Course Outcome:

1. Describe the fundamental principles and practices associated with each of the agile development methods.
2. Explain the Agile project lifecycle.
3. Describe the Agile Scrum framework.
4. Apply core values and principles of Agile Methods in software development.
5. Apply core values and principles of Agile Methods in software development.

List of Text / Reference Books:

1. Robert C. Martin, "Agile Software Development- Principles, Patterns and Practices, Prentice Hall,2013.
2. Kenneth S. Rubin, "Essential Scrum: A Practical Guide to the Most Popular Agile Process", AddisonWesley, 2012.
3. James Shore and Shane Warden, "The Art of Agile Development", O'Reilly Media, 2007.
4. Craig Larman, "Agile and Iterative Development: Amanager's Guide", Addison-Wesley,2004.
5. Ken Schawber, Mike Beedle, "Agile Software Development with Scrum", Pearson, 2001.
6. Cohn, Mike, "Agile Estimating and Planning", Pearson Education, 2006.
7. Cohn, Mike, "User Stories Applied: For Agile Software Development "Addison Wisley,2004.

Online Resources:

1. IEEE Transactions on Software Engineering
2. IEEE Transactions on Dependable and Secure Computing
3. IET Software
4. ACM Transactions on Software Engineering and Methodology (TOSEM)
5. ACM SIGSOFT Software Engineering Note

Perspectives:

1. Agile Software Development is to focus more on producing working software and less on documentation.
2. Agile Software Development emphasizes on continuous development and delivery,which makes businesses review their software quality metrics on a repeated basis.
3. Agile Software Development are encourages transparency that enables businesses toalign further with IT departments.

Recommendations:

Students pursuing a concentration in **Agile Software Development** must also take the following concentration requirements and electives:

1. Project-I
2. Project-II
3. Project-III
4. Mobile Application Development

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V-Semester **Electives -1**

PEC-CIOT501(D)	**Multimedia Design for IoT**	**4L: 0T: 0P (4hrs.)**	**4 credits**

Prerequisite: None

Course Objective:

This course aims to introduce the fundamental elements of multimedia. It will provide an understanding of the fundamental elements in multimedia. The emphasis will be on learning the representations, perceptions and applications of multimedia. Software skills and hands on work on digital media will also be emphasized.

Course Contents :(40 hrs.)

Module 1: (08hrs.)

Light sources: Basic illumination models, halftone patterns and dithering techniques, Properties of light, Standard primaries and chromaticity diagram, Intuitive colour concepts, RGB, YIQ, CMY, HSV, HLS color models, Colour selection. Output primitives: points and lines, line drawing algorithms, loading the frame buffer, line function; circle and ellipse generating algorithms; Pixel addressing and object geometry, filled area primitives.

Module 2: (08 hrs.)

Two & Three dimensional geometric transformations: Translation, Rotation, Scaling, Composite, Windowing & Clipping: World Coordinate System, Screen Coordinate System, Viewing Transformation, Parallel & Perspective Projection, Types of Parallel & Perspective Projection, Clipping operations — point, line, and polygon clipping algorithms.

Module 3: (08 hrs.)

What is Multimedia, Components of Multimedia, Multimedia System Architecture, Multimedia I/O technologies, Data & File Format standards: RTF, TIFF, MIDI, JPEG, DIB. Audio: Digital Audio, MIDI, Processing Sound, Sampling, Compression, Video: Avi, 3GP, MOV, MPEG, MP4, Compression Standards, Compression through Spatial and Temporal Redundancy, Multimedia Authoring

Module 4: (07hrs.)

Definition of Animation, History of Animation, Application of Animation in Graphics, Benefits of Animation, Application of Animation in Multimedia, Basic principle, Animation Techniques: Cell Animation, Computerized Animation, Basic Types of Animation: Real time and non-real time animation, 2D Graphics, 3D Graphics, Concept of 2D computer animation – Sprite Animation: Process, Advantages & Disadvantages of Sprite animation – Rendered animation: Rendering-Process and examples of rendered animation

Module 5: (09hrs.)

Introduction of JavaScript in Graphics, use of different graphic libraries: Plotly.js, Chart.js, Google Chart, JavaScript HTML Animation, use of different elements: Fireworks, fade effects, roll-in and roll-out, page-in and page-out, object movements

Course Outcome:

1. Understand the basic concepts of Multimedia.
2. Demonstrate various algorithms for two and three dimensional transformation
3. Explore various file formats of multimedia.
4. Apply different animations on 2D and 3D.
5. Understand various javascript libraries for chart and HTML Animation

List of Text / Reference Books:

1. Donald Hearn and M.Pauline Baker, "Computer Graphics C Version", Pearson Education,2003.
2. Foley, V a n D a m, F e i n e r , H u g h e s , " Computer G r a p h i c s : Principles a nd P r a c t i c e " Pearson Education India, Third Edition,2013
3. Rogers, "Procedural Elements of Computer Graphics", Tata McGraw Hill
4. Ranjan Parekh "Principles of Multimedia", Tata McGraw-Hill Education, 2006
5. Rajesh K Maurya, "Computer Graphics with Virtual Reality System ", Wiley India, 2009
6. Pakhira,"Computer Graphics, Multimedia & Animation", PHI learning
7. Khalid Sayood , "Introduction to Data Compression", Morgan Kaufmann, Fourth Edition,2012
8. Prabat K Andleigh and Kiran Thakrar, "Multimedia Systems and Design", PHI Learning, 1996.
9. Tay Vaughan, "Multimedia making it work", Tata McGraw Hill edition,8th edition 2010.
10. Amarendra N Sinha & Arun D Udai, "Computer Graphics", McGraw Hill publication,1st edition,2008.
11. Mukherjee, "Fundamental of Computer Graphics and Multimedia", PHI Learning.

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V-Semester **Open Eective-I**

OEC-CIOT501(A)	Entrepreneurship	3L: 3T: 0P (4hrs.)	3 credits

Prerequisite(s): NA

Course outcomes:

1. To inculcate entrepreneurship skills to students.
2. To aware about industry structure and how to start up a company.
3. To aware about types of Enterprises.
4. To understand E-commerce practices.
5. To understand and practice Digital Marketing.

Course Objectives:

- To develop conceptual understanding of the concept of Entrepreneurship
- To learn the government's policy.
- To Learn about **t**ypes of Enterprises
- To Learn about E-commerce and its Technological Aspects
- To Learn about Digital Marketing

Course Content:

Module 1 (08Hrs)

Entrepreneurship: Definition, requirements to be an entrepreneur, entrepreneur and entrepreneur, entrepreneur and manager, growth of entrepreneurship in India, women entrepreneurship, rural and urban entrepreneurship

Module 2 (10Hrs)

Entrepreneurial Motivation

Motivating factors, motivation theories-Maslow's Need Hierarchy Theory, McClelland's Acquired Need Theory, government's policy actions towards entrepreneurial motivation, entrepreneurship development programme.

Module 3 (10Hrs)

Types of Enterprises and Ownership Structure: Small scale, medium scale and large scale enterprises, role of small enterprises in economic development; proprietorship, partnership, Ltd. companies and co-operatives: their formation, capital structure and source of finance

Module 4 (12Hrs)

E-commerce and its Technological Aspects: Overview of developments in Information Technology and Defining E-Commerce: The scope of E commerce, Electronic Market, Electronic Data Interchange, Internet Commerce, Benefits and limitations of E-Commerce, Produce a generic framework for E-Commerce, Architectural framework of Electronic Commerce, Web based E Commerce Architecture.

Module5 (10Hrs)

Introduction to Digital Marketing:. Evolution of Digital Marketing from traditional to modern era, Role of Internet, Search Engine Advertising, Display marketing, Social Media Marketing

Text Books:

1. Koontz &O' Donnel¸ Essentials of Management, Tata McGraw Hill,NewDelhi,2009
2. Peter F Drucker, The Practice of Management, McGraw Hill, NewYork,1960
3. Peter F.Drucker, Innovation and Development, McGraw Hill, NewYork,2000.

Reference Books:

1. Mohanty SK; Fundamental of Entrepreneurship; PHI, 2005.
2. Davis & Olson; Management Information System; TMH,1985.

Perspective:

Entrepreneurship education cultivates innovative talents, which are an important driving force for future development. At present, innovation-driven development strategies place new demands on entrepreneurship education

Recommendation:

Entrepreneurship is not just about start-ups. It is a problem-solving frame of mind that requires technical expertise, a business sense, an ability to anticipate the future, and an appreciation of social context

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V-Semester Open E**ective-I**

OEC-CIOT501(B)	**Intellectual Property Rights**	**3L: 0T: 0P (4hrs.)**	**3 credits**

Prerequisite(s): NA

Course Objective:

- To be familiar with the concept of intellectual property.
- To be familiar with Purpose and function of trademarks
- To be familiar with Fundamental of copy right law
- To clear idea of the trade Secrete
- To be familiar with latest development in the field of intellectual property.

Module 1 **(08 Hrs)**

Introduction to Intellectual Property: Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights.

Module 2 **(08 Hrs)**

Trade Marks: Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting, and evaluating trade mark, trade mark registration processes.

Module 3 **(10 Hrs)**

Law Of Copyrights: Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law. Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer

Module 4 **(08 Hrs)**

Trade-Secrets: Trade secrete law, determination of trade secrete status, liability for misappropriations of trade secrets, protection for submission, trade secrete litigation. Unfair competition: Misappropriation right of publicity, false advertising.

Module 5 **(08 Hrs)**

New Development In Intellectual Property: new developments in trade mark law; copy right law, patent law, intellectual property audits. International overview on intellectual property, international – trade mark law, copy right law, international patent law, and international development in trade secrets law.

Course Outcome:

After completion of the course student will be able to:

1. Understand the concept of intellectual property.
2. Understand what is trademark and its importance.
3. Understand the law of copyright.
4. Understand how trade secrete help in competitive market
5. Understand the latest trends in intellectual property.

Text Books & References:

1.Intellectual property right, Deborah.E.Bouchoux, Cengagelearning.
2.Intellectual property right –Unleashing the knowledge economy, Prabuddha Ganguli, Tata McGraw Hill Publishing company ltd.

Perspective:

The subject of IPR includes patents (granted to inventions that are new, no obvious, and useful, for a period of 20 years) designs, trademarks, Copyright etc. Students possess an understanding on IPR so that they can add more value when they join industries because they can apply these concepts in day to day scenarios protecting the assets of both the organization and as well as their customers.

Recommendation:

Each industry should evolve its own IPR policies, management style, strategies, and so on depending on its area of specialty. Pharmaceutical industry currently has an evolving IPR strategy requiring a better focus and approach in the coming era.

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V-Semester Open E**ective-I**

OEC-CIOT501(C)	**Operation Research**	**3L: 0T: 0P (4hrs.)**	**3 credits**

Pre requisite(s): M-II, M-III

Course Objective:

1. To be familiar with all the OR Techniques and optimization methods.
2. To be familiar with various inventory control techniques.
3. To be familiar with waiting line models and Competitive strategy.
4. To clear idea of the decision making and meta-heuristic algorithm.
5. To understand project network analysis.

Course Content:

Module 1 (12 Hrs)

Linear system and distribution models: Mathematical formulation of linear systems by LP, solution of LP for two variables, Simplex method, special cases of LP- transportation and assignment model and their graphical solution, Vogels Approximation Method (VAM) or penalty method, cell evaluation degeneracy.

Module 2 (10 Hrs)

Inventory Models: Necessity of inventory in process and safety stock, problem of excess inventory and cycle time, JIT/ Lean Mfg; basics of inventory models with deterministic demand, Classical EOQ Model, ABC, VED and other analysis based on shelf life, movement, size, MRP technique and calculations, lot sizing in MRP, linking MRP with JIT; evolution of MRP to ERP to SCM and e-business.

Module 3 (10 Hrs)

Waiting Line Models: Introduction, Input process, service mechanism, Queue discipline, single server (M/M/1), average length and average time calculations, optimum service rate; basic multiple server models (M/M/s)

Competitive strategy: concept and terminology, assumptions, pure and mixed strategies, two person zero sum games, saddle point, dominance, graphical, algebraic and LP methods for solving game theory problems.

Module 4 (10 Hrs)

Decision Analysis: Decision under certainty, risk Probability and uncertainty, Hurwitz criterion AHP assigning weight and consistency test of AHP. **Metaheuristics:** definition of heuristic and metaheuristic algorithms.

Module 5 (10 Hrs)

Network Analysis: Project Planning, Scheduling and Controlling; Project management; Network Techniques and its role in project management, Network logics, Fulkerson's Law, Merits and Demerits of AON Diagrams; Progr amme Evaluation and Review Technique (PERT), Critical Path Method (CPM), Determination of critical path, Float/Slack.

Course Outcome:

After completion of the course student will be able to:

1. Understand the concept of optimization and its application.
2. Understand the concept of various inventory control techniques used in industries.
3. Understand the concept of Queuing and Game Theory.
4. Understand the idea of the decision making and application of meta-heuristic algorithm
5. Implement project management concepts, tools and techniques in order to achieve project success

Text Books :

1. Hillier FS and Liberman GJ; Introduction to Operations Research concept and cases; TMH , 8th Ed. 2008.
2. Heera and Gupta,Operation Research, S Chand Pub.reprint with corrections ,2017
3. Sharma JK; Operations Research; Macmillan 3rd Ed. 2006.
4. Heera and Gupta ,Problems in Operations Research Principles and Solutions, S Chand Pub, 4th Ed. 2015.

Reference Books:

1. Taha H; Operations research; PHI, 10th Ed.2019.
2. Jain, pandey & shrivastava; Quantitative techniques for management, New Age publishers.2019
3. Srinivasan G; Quantitative Models In Operations and SCM; PHI Learning, 2017
4. Sen RP; Operations Research-Algorithms and Applications; PHI Learning, 2009
5. Bronson R ;Theory and problems of OR; Schaum Series; TMH, 2016.

Perspective:

Operations Research is interdisciplinary field, intermixing theories and methodologies from mathematics, management science, computer science, operations management, economics, engineering, decision support, soft computing and many more.

Recommendation:

Operations research and computers interact in many scientific fields of vital importance to our society. These include, among others, transportation, economics, investment strategy, inventory control, logistics. Computers & Operations Research (COR) provides an forum for the application of computers and operations research techniques to problems in these and related fields.

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V-Semester **Open Eective-I**

OEC-CIOT501(D)	**Probability Theory & Statistics**	**3L: 0T: 0P (4hrs.)**	**3 credits**

Course Objective: To understand the basic concept of probability, LPP, Index number and perform the data analysis with suitable forecasting in research and project phases.

Module-1: Probability (9 Hours)
Probability, Types of probability, Random variable, Probability function, Sampling: purpose and principle of sampling, Methods of sampling, Size of sample, Merits and limitations of sampling, Sampling distribution, Conditional probability, Baye's theorem.

Module-2: Correlation and Regression Analysis (9 Hours)
Correlation analysis: Significance, Correlation & Causation, Types of correlation, Methods of studying correlation, Multiple correlation, Regression analysis: Difference between correlation and regression, Bivariate linear regression model, Regression lines, Equations, Coefficients.

Module-3: Hypothesis Testing (8 Hours)
Concept of hypothesis, Types of error in testing, Level of significance, Null and alternative hypothesis, Special tests of significance: The Chi ($\chi 2$) test, The Z-Score test, The T-test, Test for proportion.

Module-4: Linear Programming (9 Hours)
Linear programming: General linear programming problem (LPP), Standard and canonical form of LPP, Formulation of LPP, Graphical solution, Simplex method, Artificial variable techniques: Two phase method, Big-M method, Duality: definition of the dual problem, Dual simplex method.

Module-5: Index Numbers, Forecasting and Time Series Analysis (10 Hours)
Index numbers: Use of index numbers, Unweighted index numbers, Weighted index numbers, Quantity index numbers, Volume index numbers, Time reversal test, Factor reversal test, Forecasting: Introduction, Steps in forecasting, Methods of forecasting, Time series analysis: Components of time series, Straight line trends, Non-linear trend.

Course Outcomes:
1: Apply fundamental concepts of probability to Computer Science & Engineering problem.
2: Apply and explain the Correlation & Regression to Computer Science & Engineering project.
3: Apply the various test of significance to structure engineering decision-making problems.
4: Apply various linear programming methods to Computer Science & Engineering.
5: Apply and analyze the index numbers, forecasting analysis and time series analysis on suitable classified data.

Textbooks/References:

1. Connor, L R and Morreu, A J H, Statistics in Theory and Practice, Pitman, London, 1964.
2. Wannacott and Wannacott, Introductory Statistics, John Wiley & Sons, New York,5th Edition, 1990.
3. Willams, Ken (ed), Statistics and Urban Planning, Charles Knight & Co. Ltd, London, 1975.
4. Yamane, Taro, Statistics – An Introductory Analysis, Harper, New York, 1973.
5. D. C. Montgomery and G. C. Runjer, Applied Statistics & Probability for Engineers, Wiley Publication, 6thEdition, 2014.
5. A. Ravindran, D. T. Phillips and James J. Solberg, Operations Research- Principles and Practice, John Wiley & Sons, 2nd Edition 2007.
6. Hamdy A. Taha: Operations Research-An Introduction, Prentice Hall, 10th Edition, 2019.
7. F.S. Hillier, G.J. Lieberman, Introduction to Operations Research- Concepts and Cases, Tata McGraw Hill, 10th Edition, 2017.
8. C. Chatfield, The Analysis of Time Series - An Introduction, Chapman and Hall, 7th edition 2019.
9. Peter J. Brockwell and Richard A. Davis, Introduction to Time Series and Forecasting, Springer, 3rd Edition 2016.
10. S. Ross, A first course in probability, Pearson education India, 6th edit