

M.Sc. INFORMATION TECHNOLOGY

Course Structure and Syllabus

(For the candidates admitted from the academic year 2023-2024 onwards)

CHOICE BASED CREDIT SYSTEM- LEARNING OUTCOMES BASED CURRICULUM FRAME WORK (CBCS-LOCF)



THANTHAI HANS ROEVER COLLEGE (AUTONOMOUS)

(Nationally Re-Accredited by NAAC with B⁺⁺)

(Affiliated to Bharathidasan University, Tiruchirappalli)

ELAMBALUR, PERAMBALUR – 621 220



VISION:

- To be a Centre of excellence in education and research in the frontier areas of Computer Science

MISSION:

- To facilitate quality transformative education in Computer Science
- To promote quality research and innovation in technology for meeting global challenges
- To transform students to competent professionals to cater to the needs of the society.

Programme Outcomes:

- **Disciplinary Knowledge:** Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of a Post graduate programme of study.
- **Critical Thinking:** Capability to apply analytic thought to a body of knowledge; analyse and evaluate evidence, arguments, claims, beliefs based on empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies, and theories by following scientific approach to knowledge development.
- **Problem Solving:** Capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's learning to real life situations.
- **Research related skills:** Ability to analyse, interpret and draw conclusions from quantitative / qualitative data; and critically evaluate ideas, evidence, and experiences from an open minded and reasoned research perspective; Sense of inquiry and capability for asking relevant questions / problem arising / synthesizing / articulating / ability to recognize cause and effect relationships / define problems. Formulate hypothesis, Test / analyse / Interpret the results and derive conclusion, formulation and designing mathematical models
- **Self-directed & Lifelong Learning:** Ability to work independently, identify and manage a project. Ability to acquire knowledge and skills, including "learning how to learn", through self-placed and self-directed learning aimed at personal development, meeting economic, social and cultural objectives.

Programme Specific Outcomes:

- **Disciplinary Knowledge :** Understand and analyze the fundamental knowledge in the Information Technology domain.
- **Critical Thinking :** Enhance the logical, analytical and critical thinking to understand and evaluate the various System Architecture, Networks, Security, Data science, Programming Techniques to solve complex computing problems.
- **Problem Solving :** Ability to develop software applications to provide real world solutions to solve computer technology related problems.
- **Research related skills :** Equipped to be competent in providing optimal and ethical solutions to the technological challenges laid by professional societies.
- **Self-directed & Lifelong Learning :** Adapt to employ the life-long learning skills as the technology evolves over the generations in the field of Information Technology.

Thanthai Hans Roever College (Autonomous), Elambalur, Perambalur - 621 220

M.Sc. INFORMATION TECHNOLOGY - Course Structure Under CBCS

(For the candidates admitted from the academic year 2023-2024 onwards)

Semester	Course Code	Title of the Course	Ins. Hours/ Weeks	Credit	Exam Hours	CIA (Max)	ESE (Max)	Total (Max)
I	23PIT1CC1	Python Programming	6	5	3	25	75	100
	23PIT1CC2	Web Development using Word Press	6	5	3	25	75	100
	23PIT1CC3	Enterprise Resource Planning	6	5	3	25	75	100
	23PIT1CC4P	Python Programming Lab	4	4	3	40	60	100
	23PIT1EC11 23PIT1EC12	Data Structure (Or) Operating Systems	4	3	3	25	75	100
	23PIT1EC21 23PIT1EC22	Data Structure Lab (Or) Operating Systems Lab	4	3	3	40	60	100
	23PITVA21 23PITVA22	R Programming Fundamentals (Or) Network Programming	-	2*	2	50	50	100*
	Total			30	25	-	-	-
II	23PIT2CC5	Database Systems	6	5	3	25	75	100
	23PIT2CC6	Software Engineering	6	5	3	25	75	100
	23PIT2CC7P	RDBMS Lab	5	5	3	40	60	100
	23PIT2EC31 23PIT2EC32	Open Source Technologies (Or) Digital Image Processing	6	3	3	25	75	100
	23PIT2EC41 23PIT2EC42	Open Source Technologies Lab (Or) Digital Image Processing Lab	5	3	3	40	60	100
	23PIT2NME11 23PIT2NME12	Image Editing and Animation (Or) Computer Fundamentals	2	2	3	25	75	100
	23PIT2OC	SWAYAM/NPTEL Online Course	-	2**	-	-	-	100
	Total			30	23	-	-	-

III	23PIT3CC8	Advanced Java	6	5	3	25	75	100
	23PIT3CC9	Mobile Application Development	6	5	3	25	75	100
	23PIT3CC10	Software Project Management	6	5	3	25	75	100
	23PIT3CC11P	Advanced Java Lab	5	3	3	40	60	100
	23PIT3EC51	Internet of Things (Or)	5	3	3	25	75	100
	23PIT3EC52	Trends in Computing						
	23PIT2NME21	Introduction to Data Analytics (or)	2	2	3	25	75	100
	23PIT2NME22	Block chain Technologies						
		Internship/Industrial Activity ***	-	2	3	25	75	100
	23PITVA21	E-Commerce Fundamentals (Or)	-	2*	2	50	50	100
23PITVA22	Data Visualization							
Total			30	25	-	-	-	700
IV	23PCS4CC12	Data Science	6	5	3	25	75	100
	23PIT4PW	Major Project and Viva Voce	6	5	3	40	60	100
	23PIT4EC61	Introduction Robotics (Or)	6	3	3	25	75	100
	23PIT4EC62	Intelligent System						
	23PIT4SE1	Data Science using R Lab	6	2	3	25	75	100
	23PIT4SE2	Soft Skill	6	2	3	25	75	100
		Extension Activity		1				
Total			30	18	-	-	-	500
Grand Total			120	91	-	-	-	2400

*** Internship/Industrial Activity-Internship after 2nd semester during summer vacation -30 Hours and 2 credits will be included in the 3rd semester.

* The value added course credit will not be included in the total CGPA. These courses are extra- credit courses. Instruction hours for these courses is 30 hours

** SWAYAM/NPTEL Online Course -Extra Credit Course. Not considered for grand total &CGPA

Credit Distribution for PG Course

S.No	Course Details	Credit
1	Core Course	62
2	Elective Course	18
3	Skill Enhancement Course	4
4	NME	4
5	Internship	2
6	Extension Activity	1
		91

List of Core Courses:

1. Python Programming
2. Web Development using Word Press
3. Python Programming Lab
4. Web Development using Word Press Lab
5. Database Systems
6. Open Source Technologies
7. RDBMS Lab
8. Open Source Technologies Lab
9. Advanced Java
10. Mobile Application Development
11. Advanced Java Lab
12. Major Project and Viva Voce

List of Elective Courses:

1. Data Structure (or) Object Oriented Analysis and Design
2. Biometric Techniques (or) Digital Image Processing
3. Internet of Things (or) Intelligent systems
4. Introduction to Robotics (or) Trends in computing

List of NME Courses:

1. Image editing and Animation (or) Computer fundamentals
2. Introduction to Data Analytics (or) Introduction to Internet

List of Value Added Courses:

1. R Programming Fundamentals (or) Network Programming
2. Web design (or) Data Visualization

SEMESTER – I

Course Code: 23PIT1CC1
Instruction Hours: 6
Credits: 5

Exam Hours: 3
Internal Marks: 25
External Marks:75

PYTHON PROGRAMMING

Course Objectives :

To acquire programming skills in core Python and to develop database applications in Python

Course Outcomes :

- CO1:** Explain the basic concepts in python language.
- CO2:** Apply the various data types and identify the usage of control statements, loops, functions and modules in python for processing the data
- CO3:** Analyze and solve problems using basic constructs and techniques of python.
- CO4:** Assess the approaches used in the development of interactive application.
- CO5:** To build real time programs using python

UNIT-I:

Core Python: Introduction - Python Basics: Comments - Statements and syntax - variable Assignment - Identifiers - Python objects : Built-in-types - Internal types - Standard Type operators - Standard type Built-in-functions. Numbers : Introduction to Numbers - Integers - Floating point numbers - Complex numbers - Operators - Built-in and factory functions – Conditionals and Loops -Sequences : Strings, Lists and Tuples

UNIT-II:

Mapping and set types.- Functions and functional programming: Introduction - Calling functions - Creating functions - passing functions - Formal arguments - Variable - Length Arguments - Functional Programming - Variable Scope – Recursion

UNIT-III:

Modules: Modules and Files – namespaces - Importing Modules - Features - Built-in functions. Object Oriented Programming: Introduction - Object Oriented Programming – Encapsulation Inheritance – Polymorphism - Errors and Exceptions: Introduction – Exceptions in Python.

UNIT-IV:

GUI Programming: Introduction – Using Widgets: Core widgets- Generic widget properties – Labels – Buttons – Radio Buttons – Check Buttons – Text – Entry – List Boxes – Menus – Frame – Scroll Bars – Scale

UNIT-V:

Database Programming: Connecting to a database using MongoDB - Creating Tables - INSERT-UPDATE - DELETE - READ operations.

Text Book:

1. Wesley J. Chun, (2007), “Core Python Programming”, Pearson Education, Second Edition – (Unit I, II,III).
2. Charles Dierbach, (2015), “Introduction to Computer Science Using Python A Computational Problem-Solving Focus”, Wiley India Edition- (Unit III- Object Oriented Programming)
3. Martin C Brown, (2018), “The Complete Reference Python”, McGraw Hill Education (India) Private Limited – (Unit IV)

Reference Books:

1. Mark Lutz, (2013), “Learning Python Powerful Object Oriented Programming”, O’reilly Media, 5 th Edition.
2. Timothy A. Budd, (2011), “Exploring Python”, Tata MCGraw Hill Education Private Limited, First Edition.
3. Allen Downey, Jeffrey Elkner, Chris Meyers, (2012), “How to think like a computer scientist: learning with Python”

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Course					Hours	Credits			
I	23PIT1CC1	PYTHON PROGRAMMING					6	5			
Course Outcomes (Cos)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓		✓		✓			
CO2	✓	✓				✓	✓	✓	✓		
CO3	✓	✓	✓	✓		✓	✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓	✓		✓	
CO5	✓	✓	✓	✓		✓	✓		✓	✓	
Number of matches (✓) = 37, Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER – I

Course Code: 23PIT1CC2
Instruction Hours: 6
Credits: 5

Exam Hours: 3
Internal Marks: 25
External Marks: 75

WEB DEVELOPMENT USING WORD PRESS

Course Objectives:

The primary course objective of this paper is to learn the fundamentals of basic web concepts, HTML, DHTML, JavaScript and Word Press

Course Outcomes:

CO1: Identify the tools which will be suitable for the requirement of the webpage.

CO2: Implement Java script and Style Sheets effectively in the Web Pages

CO3: Analyze the different tools and built-in functions available to be applied in the webpage

CO4: Rate the design and effectiveness of the Web Pages created.

CO5: Design and publish a website using Word press

UNIT-I:

Introduction to HTML - Lists - Adding Graphics to HTML Documents - Tables - Linking Documents - Frames- Developing HTML Forms

UNIT-II:

Dynamic HTML - Cascading Style Sheets - Use of SPAN Tag - External Style Sheets - Use of DIV Tag - Developing Websites

UNIT-III :

Introduction to JavaScript - JavaScript in Web Pages - Advantages - Writing JavaScript into HTML - Basic Programming Techniques - Operators and Expressions- JavaScript Programming Construct: Conditional Checking, Controlled Loops, Functions: Built-in Functions, User-Defined Functions - Placing Text in a Browser - Dialog Boxes.

UNIT-IV:

JavaScript Document Object Model: Introduction - Understanding Objects in HTML - Handling Events using JavaScript. Forms used by a Website: Form Object - Built-in Objects.

UNIT-V:

Word Press: Installation - Setting and administration- Word press: Theming basics - Our First Word Press Website - Theme Foundation - Menu and navigation - Home page - Dynamic Sidebars and Widgets - Page - archive Page results - Testing and Launching

Text Book:

1. Ivan N. Bayross, (2005), Web Enabled Commercial Applications Development Using HTML, DHTML, JavaScript, perlCGI, 3rd Edition, BPB Publications. (Unit I, II, III and IV)
2. Jesse Friedman, (2012), Web Designer's Guide to WordPress: Plan, Theme, Build, Launch (Voices That Matter), 1st Edition, New Riders. (Unit V)

Reference Books:

1. N.P. Gopalan, J. Akilandeswari, (2009), Web Technology: A Developer's Perspective, Eastern Economy Edition, PHI Learning Private Limited.
2. Deitel&Deitel, (2000), Internet and World Wide Web How to program, Prentice Hall.
3. Jon Duckett, (2004), Beginning Web Programming with HTML, XHTML, and CSS, Wiley Publishing, Inc.

Website and e-Learning Source:

1. http://www.sergey.com/web_course/content.html
2. <http://www.pageresource.com/jscript/index.html>
3. <http://www.peachpit.com/guides/content.aspx>
4. <https://www.tutorialspoint.com/wordpress/index.htm>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Course					Hours	Credits			
I	23PIT1CC2	WEB DEVELOPMENT USING WORD PRESS					6	5			
Course Outcomes (Cos)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓		✓		✓			
CO2	✓	✓				✓	✓	✓	✓		
CO3	✓	✓	✓	✓		✓	✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓	✓		✓	
CO5	✓	✓	✓	✓		✓	✓		✓	✓	
Number of matches (□) = 37, Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER – I

Course Code: 23PIT1CC3
Instruction Hours: 6
Credits: 5

Exam Hours: 3
Internal Marks: 25
External Marks: 75

ENTERPRISE RESOURCE PLANNING

Course Objective:

This course covers concepts in enterprise resource planning (ERP). The main focus of this course is to show how ERP systems integrate business processes across functional areas and support business management and performance analysis.

Course Outcome:

- CO1: Business processes common to most businesses--order processing, Inventory management procurement, etc.
- CO2: Master data common to most businesses--customer, vendor, inventory, etc.
- CO3: Process modeling--creating diagrams to depict the sequence of tasks completed in A business process.
- CO4: How a business process often spans different functional areas of the Business accounting, marketing, material management, etc.
- CO5: How enterprise systems, such as SAP, integrate business functional areas into one enterprise-wide information system.

UNIT-I : Introduction:

Basic ERP Concepts, Enterprise-An overview, Benefits & Risk, Evolution and Structure: Conceptual Model of ERP, The Evolution of ERP, The Structure of ERP.

UNIT-II: ERP & Related Technologies:

Business Process Reengineering (BPR), Data Warehousing and Data Mining, OLAP, Product Life Cycle Management, Supply Chain management, CRM.

UNIT-III: ERP Functional Module: Introduction,

Finance, Manufacturing, Human Resource, Plant maintenance, Material Management, Integration of ERP, Supply Chain and Customer Relationship Application.

UNIT-IV: ERP Implementation:

Implementation Challenges, ERP Implementation Strategies, ERP Implementation Life Cycle, Implementation Methodologies, ERP Projects Teams, Vendors and Consultants, Dealing with employee resistance, Training and Education, data migration, Project Management and monitoring, Post Implementation Activities.

UNIT-V: The ERP Market :

ERP Market Place and Market Place Dynamics, Market Overview, The Changing ERP Market, SAP AG, Oracle, People soft, JD Edwards. Future Directives in ERP.

Text Book:

1. Enterprise Resource Planning – Alexis Leon – Second Edition – TMH

Reference Books:

1.S Sadagopan, “ERP A Managerial Prospective” TMH

2.Alexis Leon, “ERP Demystified”, TMH.c.Rahul V. Altekar “ Enterprisewide Resource Planning” , TMHd.Vinod Kumar Garg and Venkitakrishnan N K, “ Enterprise Resource Planning Concepts and Practice”. PHIe.Joseph A Brady, Ellen F Monk, Bret Wagner, “ Concepts in Enterprise Resource Planning”, Thompson Course Technology

3. ERP in practice – Vaman - TMH

4. Daniel E.O’Leary, Enterprise Resource Planning Systems, Cambridge University Press, 2002.

5. Ellen Monk, Bret Wagner, Concepts in Enterprise resource planning, Cengage learning, Third edition, 2009.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Course					Hours	Credits				
I	23PIT1CC3	ENTERPRISE RESOURCE PLANNING					6	5				
Course Outcomes (Cos)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓	✓	✓	✓		✓		✓				
CO2	✓	✓					✓	✓	✓			
CO3		✓	✓	✓		✓	✓	✓	✓			
CO4	✓	✓	✓	✓	✓	✓		✓	✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Number of matches (✓) = 37, Relationship: High												

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER – I

Course Code: 23PIT1CC4P
Instruction Hours: 5
Credits: 3

Exam Hours: 3
Internal Marks: 40
External Marks: 60

PYTHON PROGRAMMING - PRACTICAL

Course Objectives:

This course gives practical experience in Python basics, Object Oriented programming like Classes, Inheritance, and Polymorphism, GUI Applications and Database connection.

Course Outcomes:

- CO1: Understand the significance of control statements, loops and functions in creating simple programs.
- CO2: Apply the core data structures available in python to store, process and sort the data
- CO3: Analyze the real time problem using suitable python concepts
- CO4: Assess the complex problems using appropriate concepts in python
- CO5: Develop the real time applications using python programming language.

Exercise :

1. Python Basic programs
2. Control Structures
3. Lists
4. Functions and Recursions
5. Modules
6. String Processing
7. Dictionaries and Sets
8. Classes and Objects
9. Polymorphism
10. Inheritance
11. GUI Application
12. Working with Database

Text Book:

1. Wesley J. Chun, (2007), “Core Python Programming”, Pearson Education, Second Edition

Reference Books:

1. Mark Lutz, (2013), “Learning Python Powerful Object Oriented Programming”, O’reillyMedia, 5 th Edition.
2. Timothy A. Budd, (2011), “Exploring Python”, Tata MCGraw Hill Education PrivateLimited, First Edition.
3. Allen Downey, Jeffrey Elkner, Chris Meyers, (2012), “How to think like a

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Course					Hours	Credits			
I	23PIT1CC4P	PYTHON PROGRAMMING - PRACTICAL					5	4			
Course Outcomes (Cos)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓		✓		✓			
CO2	✓	✓				✓	✓	✓	✓		
CO3	✓		✓	✓		✓	✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓		✓	
Number of matches (✓) = 38, Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER – I

Course Code: 23PIT2CC5
Instruction Hours: 6
Credits: 5

Exam Hours: 3
Internal Marks: 25
External Marks: 75

DATA STRUCTURE

Course Objectives:

To become familiar with the various data structures and their applications and to increase the understanding of basic concepts of the design and use of algorithms

Course Outcomes:

CO1: Outline the basic data structures

CO2: Identify the different operations and memory representations

CO3: Interpret different techniques with their complexities

CO4: Interpret different techniques with their complexities

CO5: Choose an algorithm to solve simple problems suited for appropriate situations

UNIT-I:

Introduction and Overview: Definitions – Concept of Data Structures – Overview of Data Structures – Implementation of Data Structures – Arrays: Definition – One Dimensional Array – Multidimensional Arrays: Two Dimensional Array – Sparse Matrices – Three dimensional and n-dimensional Arrays – Stacks : Introduction – Definition – Representation of Stack – Operations on Stack – Applications of Stacks: Evaluation of Arithmetic Expressions – Implementation of Recursion - Tower of Hanoi Problem.

UNIT-II:

Queues: Introduction – Definition – Representation of Queues – **Various Queue Structures :** Circular Queue – Deque – Priority Queue – **Applications of Queues :** Simulation – CPU Scheduling in a Multiprogramming Environment – Round Robin Algorithm – **Linked Lists:** Single Linked List – Circular Linked List – Double Linked List – Circular Double Linked List – **Applications of Linked List:** Polynomial Representation

UNIT-III:

Trees: Basic Terminologies – Representation of Binary Tree: Linear Representation – Linked Representation – **Operations:** Traversals – **Types of Binary Trees:** Expression Tree – Binary Search Tree – Splay tree.

UNIT-IV:

Sorting: Bubble Sort, Insertion Sort, Selection Sort, Shell Sort – Quick Sort - Merge - Sort - Radix Sort - Heap Sort – **Searching:** Linear Search - Binary Search.

UNIT-V:

Graphs: Introduction – Graph representation and its operations – Path Matrix – Graph Traversal - Application of DFS – Shortest Path Algorithm - **Minimum Spanning Tree** : Prim's Algorithm – Kruskal's Algorithm - Greedy – Knapsack – Back Tracking – 8 Queens

Text Book :

1. Debasis Samantha (2013), Classic Data Structures, Second Edition, PHI Learning Private Limited.
2. P. Sudharsan, J. John Manoj Kumar, C & Data Structures, Third Edition, RBA Publications. Unit 4: Chapter 14, Unit 5: Chapter 13
3. Ellis Horowitz, SartajSahni, Sanguthevar Rajeshakaran, (2007), Fundamentals of Computer Algorithms, Second Edition, Universities Press (P) Limited

Reference Books:

1. Sara Baase, (1991), Computer Algorithms – Introduction to Design and Analysis, Addison- Wesley Publishing Company
2. Robert Kruse, C.L.Tondo, Bruce Leung, Data Structures and Program Design in C ,2nd Edition, PHI Publications.

Website and e-Learning Source :

1. <http://www.cs.sunysb.edu/~skiena/214/lectures/>
2. <http://datastructures.itgo.com/graphs/dfsdfs.htm>
3. <http://oopweb.com/Algorithms/Documents/PLDS210/VolumeFrames.html>
4. <http://discuss.codechef.com/questions/48877/data-structures-and-algorithms>
5. <http://code.tutsplus.com/tutorials/algorithms-and-data-structures--cms-20437>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Course					Hours	Credits			
I	23PIT2CC5	DATA STRUCTURE					5	3			
Course Outcomes (Cos)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓		✓		✓			
CO2	✓	✓					✓	✓	✓		
CO3		✓	✓	✓		✓	✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓		✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of matches (✓) = 37, Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER – I

Course Code: 23PIT1EC12
Instruction Hours: 5
Credits: 3

Exam Hours: 3
Internal Marks: 25
External Marks: 75

OPERATING SYSTEMS

Course Objective:

To develop fundamental knowledge of Operating systems, to become familiar with CPU Scheduling, memory and file management concepts, to learn concepts and programming techniques of Linux.

Course Outcome:

CO1: Outline the fundamental concepts of an OS and their respective functionality
CO2: Demonstrate the importance of open-source operating system commands
CO3: Identify and stimulate management activities of operating system
CO4: Analyze the various services provided by the operating system
CO5: Interpret different problems related to process, scheduling, deadlock, memory and files

UNIT-I:

Introduction : Evolution of Operating System - Structure - Processes - The Process Concepts - Inter Process Communication - IPC Problems - Scheduling Levels - Preemptive Vs Non- Preemptive Scheduling - Scheduling Algorithms: First Come First Served - Shortest Job First - Shortest Remaining Time Next - Three Level Scheduling - Round Robin Scheduling - Priority Scheduling -Multiple Queues - Shortest Process Next - Guaranteed Scheduling - Lottery Scheduling - Fair-Share Scheduling - Thread Scheduling

UNIT-II:

Swapping - Virtual Memory - Page Replacement Algorithm – Segmentation

UNIT-III:

Deadlock - Examples of Deadlock - Detection - Recovery - Avoidance - Prevention – Semaphore -Shared Memory

UNIT-IV:

File System - Files - Directories - I/O Management - Disks - Disk Arm Scheduling Algorithm

UNIT-V:

Introduction to Linux: Introducing Shell Programming - Linux File Systems - Linux File system calls - Implementation of Linux File systems - Linux Commands - Directory Oriented Commands - File Oriented Commands - Communication Oriented Commands- General Purpose Commands

Text Book:

1. Andrew S. Tanenbaum, (2001), Modern Operating Systems, 2nd Edition, Prentice Hall of India.
2. B.Mohamed Ibrahim, (2005) Linux Practical Approach, Firewall Media.

Reference Books

1. Silberchatz, Galvin, Gagne, (2003), Operating Systems Concepts, 6th Edition Wiley India Edition.
2. JhonGoerzen, (2002), Linux Programming Bible, 4th Edition, Wiley- dreamtech India (P) Ltd.

Website and e-Learning Source

1. https://www.webopedia.com/TERM/O/operating_system.html
2. https://www.tutorialspoint.com/operating_system/operating_system_tutorial.pdf
3. <http://iips.icci.edu.iq/images/exam/Abraham-Silberschatz-Operating-System-Concepts---9th2012.12.pdf>
4. https://www.informatics.indiana.edu/rocha/academics/i101/pdfs/os_intro.pdf
5. <https://www.youtube.com/watch?v=Ojmyymigvmu>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Course					Hours	Credits				
I	23PIT1EC12	OPERATING SYSTEMS					5	3				
Course Outcomes (Cos)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓	✓	✓	✓		✓		✓				
CO2	✓	✓					✓	✓	✓			
CO3		✓	✓	✓		✓	✓	✓	✓			
CO4	✓	✓	✓	✓	✓	✓		✓	✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Number of matches (✓) = 37, Relationship: High												

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER – I

Course Code: 23PIT1EC21
Instruction Hours: 2
Credits: 2

Exam Hours: 3
Internal Marks: 40
External Marks: 60

DATA STRUCTURE LAB

Course Objective:

Understand various data representation techniques in the real world and Implement linear and non-linear data structures. The students can Analyze various algorithms based on their time and space complexity and Develop real-time applications using suitable data structure. and Identify suitable data structure to solve various computing problems

Course Outcome:

- CO 1: Understand the concept of data structures, python and apply algorithm for solving problems like Sorting, searching, insertion and deletion of data.
- CO 2: Understand linear data structures for processing of ordered or unordered data.
- CO 3: Explore various operations on dynamic data structures like single linked list, circular linked list and doubly linked list.
- CO 4: Explore the concept of non linear data structures such as trees and graphs.
- CO 5: Understand the binary search trees, hash function, and concepts of collision and its resolution methods.

EXERISES:

1. Write Python programs for implementing the following searching techniques to arrange a list of integers in ascending order. a). Linear search & b). Binary search.
2. Write Python programs for implementing the following sorting techniques to arrange a list of integers in ascending order. a. Bubble sort b. Insertion sort c. Selection sort
3. Write Python programs to for the following:
 - a. Design and implement Stack and its operations using List.
 - b. Design and implement Queue and its operations using List
4. Write Python programs for the following:
 - a. Uses Stack operations to convert infix expression into postfix expression.
 - b. Uses Stack operations for evaluating the postfix expression.
5. Write Python programs for the following operations on Single Linked List.
 - (i) Creation (ii) insertion (iii) deletion (iv) traversal
6. Write Python programs for the following operations on Circular Linked List.
 - (i) Creation (ii) insertion (iii) deletion (iv) traversal
7. Write Python programs for the following operations on Double Linked List.
 - (i) Creation (ii) insertion (iii) deletion (iv) traversal in both ways.
8. Write a Python program to implement Stack using linked list

9. Write a Python program to implement Linear Queue using linked list.
10. Write Python programs to implement the following graph traversal algorithms:
 - a. Depth first search.
 - b. Breadth first search.
11. Write a Python program to perform the following:
 - a. Create a binary search tree.
 - b. Traverse the above binary search tree recursively in pre-order, post-order and in-order.
 - c. Count the number of nodes in the binary search tree.

Text Books:

1. Rance D. Necaie, “Data Structures and Algorithms using Python”, Wiley, John Wiley & Sons, INC., 2011.
2. Benjamin Baka, David Julian, “Python Data Structures and Algorithms”, Packt Publishing Ltd., 2017

Web Reference:

1. <https://docs.python.org/3/tutorial/datastructures.html>
2. <http://interactivepython.org/runestone/static/pythonds/index.html>
3. http://www.tutorialspoint.com/data_structures_algorithms
4. <http://www.geeksforgeeks.org/data-structures/>
5. <http://www.studytonight.com/data-structures/>
6. <http://www.coursera.org/specializations/data-structures-algorithms>
7. <http://cse01-iiith.vlabs.ac.in>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Course					Hours	Credits			
I	23PIT1EC21	DATA STRUCTURE LAB					2	2			
Course Outcomes (Cos)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓		✓		✓			
CO2	✓	✓				✓	✓	✓	✓		
CO3	✓		✓	✓		✓	✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓		✓	
Number of matches (✓) = 38, Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER – I

Course Code: 23PIT1EC22
Instruction Hours: 2
Credits: 2

Exam Hours: 3
Internal Marks: 40
External Marks: 60

OPERATING SYSTEMS LAB

Course Objectives:

To provide an understanding of the design aspects of operating system concepts through simulation and Introduce basic Unix commands, system call interface for process management, interprocess communication and I/O in Unix.

Course Outcomes:

- CO1: Simulate and implement operating system concepts
- CO2: Able to know the scheduling techniques
- CO3: Able to know the deadlock management,
- CO4: Able to file management and memory management.
- CO5: Able to implement C programs using Unix system calls.

Exercise:

1. Write C programs to simulate the following CPU Scheduling algorithms
a) FCFS b) SJF c) Round Robin d) priority
2. Write programs using the I/O system calls of UNIX/LINUX operating system (open, read, write, close, fcntl, seek, stat, opendir, readdir)
3. Write a C program to simulate Bankers Algorithm for Deadlock Avoidance and Prevention.
4. Write a C program to implement the Producer – Consumer problem using semaphores using UNIX/LINUX system calls.
5. Write C programs to illustrate the following IPC mechanisms
a) Pipes b) FIFOs c) Message Queues d) Shared Memory
6. Write C programs to simulate the following memory management techniques
a) Paging b) Segmentation

Text Book:

1. Operating System Principles- Abraham Silberchatz, Peter B. Galvin, Greg Gagne 7th Edition, John Wiley
2. Advanced programming in the Unix environment, W.R.Stevens, Pearson education.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Course					Hours	Credits			
I	23PIT1EC22	OPERATING SYSTEMS LAB					2	2			
Course Outcomes (Cos)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓		✓		✓			
CO2	✓	✓				✓	✓	✓	✓		
CO3	✓		✓	✓		✓	✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓		✓	
Number of matches (✓) = 38, Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER – I

Course Code: 23PITVA21
Instruction Hours: -
Credits: 2*

Exam Hours: 2
Internal Marks: 50
External Marks: 50

R PROGRAMMING FUNDAMENTALS

Course Objectives:

To understand the basics in R programming in terms of constructs, control statements, string functions To learn to apply R programming for Text processing To understand the use of R Big Data analytics To able to appreciate and apply the R programming from a statistical perspective.

Course Outcome:

- CO1: Create artful graphs to visualize complex data sets and functions
- CO2: Able to Write more efficient code using parallel R
- CO3: Able to vectorization Interface R with C/C++ and Python
- CO4: Able to increased speed or functionality
- CO5: To be found new packages for text analysis, image manipulation, and perform statistical analysis of the same Develop interfacing R to other Languages

UNIT-I:

Introducing to R – R Data Structures – Help functions in R – Vectors – Scalars – Declarations – recycling – Common Vector operations – Using all and any – Vectorized operations – NA and NULL values – Filtering – Vectorised if-then else – Vector Equality – Vector Element names.

UNIT-II:

Matrix operations – Applying Functions to Matrix Rows and Columns – Adding and deleting rows and columns – Vector/Matrix Distinction – Avoiding Dimension Reduction – Higher Dimensional arrays – lists – Creating lists – General list operations – Accessing list components and values – applying functions to lists – recursive lists.

UNIT-III:

Creating Data Frames – Matrix-like operations in frames – Merging Data Frames – Applying functions to Data frames – Factors and Tables – factors and levels – Common functions used with factors – Working with tables - Other factors and table related functions.

UNIT-IV:

Control statements – Arithmetic and Boolean operators and values – Default values for arguments -Returning Boolean values – functions are objects – Environment and Scope issues – Writing Upstairs -Recursion – Replacement functions – Tools for composing function code – Math and Simulations in R Creating Graphs – Customizing Graphs – Saving graphs to files – Creating three-dimensional plots.

UNIT-V:

Interfacing Periods 9 Interfacing R to other languages – Parallel R – Basic statistics – Linear Model – Generalized Linear models – Non-linear models – Time series and Auto-correlation – Clustering

Text Book:

1. Norman Matloff, “The Art of R Programming: A Tour of Statistical Software Design”, NoStarch Press, 2011.

Reference Book:

1. Jared P. Lander, “R for Everyone: Advanced Analytics and Graphics”, Addison-Wesley Data & Analytics Series, 2013.
2. Mark Gardener, “Beginning R – The Statistical Programming Language”, Wiley, 2013
3. Robert Knell, “Introductory R: A Beginner's Guide to Data Visualisation, Statistical Analysis and Programming in R”, Amazon Digital South Asia Services Inc, 2013.’

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Course					Hours	Credits			
I	23PITVA21	R PROGRAMMING					-	2*			
Course Outcomes (Cos)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓		✓		✓			
CO2	✓	✓				✓	✓	✓	✓		
CO3	✓		✓	✓		✓	✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓		✓	
Number of matches (✓) = 38, Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER – I

Course Code: 23PITVA22
Instruction Hours: -
Credits: 2*

Exam Hours: 2
Internal Marks: 50
External Marks: 50

NETWORK PROGRAMMING

Course Objectives:

As a student in Computer Networking (BSCN) to gain valuable skills in computer networks (switching, routing), system and network administration, computer and network security, operating systems, web programming, databases, and project management.

Course Outcome:

- CO1: Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.
- CO2: Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.
- CO3: Communicate effectively in a variety of professional contexts.
- CO4: Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.
- CO5: Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline.

UNIT-I:

Networking & TCP/IP: Communication protocols, Network architecture, UUCP, XNS, IPX/SPX for LANs, TCP & IP headers, IPv4 & v6 address structures, Programming Applications: Time & date routines, Internet protocols: Application layer, Transport layer, Network layer, Datalink layer protocols, Chat, Email, Web server working method & programming.

UNIT-II:

Socket Programming: Creating sockets, Posix data type, Socket addresses, Assigning address to a socket, Java socket programming, Thread programming, Berkeley Sockets: Overview, socket address structures, byte manipulation & address conversion functions, elementary socket system calls – socket, connect, bind, listen, accept, fork, exec, close, TCP ports (ephemeral, reserved), Berkeley Sockets: I/O asynchronous & multiplexing models, select & poll functions, signal & fcntl functions, socket implementation (client & server programs), UNIX domain protocols.

UNIT-III:

APIs & Winsock Programming: Windows socket API, window socket & blocking I/O model, blocking sockets, blocking functions, timeouts for blocking I/O, API overview, Different APIs & their programming technique, DLL & new API's, DLL issues, Java Beans.

UNIT-IV:

Web Programming & Security: Java network programming, packages, RMI, Overview of Javascript, WAP architecture & WAP services, Web databases, Component technology, CORBA concept, CORBA architecture, CGI programming, Firewall & security technique, Cryptography, Digital Signature.

UNIT-V:

Client Server Programming: Client side programming: Creating sockets, implementing generic network client, Parsing data using string Tokenizer, Retrieving file from an HTTP server, Retrieving web documents by using the URL class. Server side programming: Steps for creating server, Accepting connection from browsers, creating an HTTP server, Adding multithreading to an HTTP server.

Text Book:

1. W. Richard Stevens, —Unix Network Programming Vol – II, 2nd Edition, Prentice Hall of India / Pearson Education, 1998.
2. William Stallings, —SNMP, SNMPV2, SNMPV3 and RMON 1 and 2, 3rd Edition, Addison Wesley, 1999.
3. D. E. Comer, —Internetworking with TCP/IP Vol – III, (BSD Sockets Version), 2nd Edition, Prentice Hall of India, 2003.

Reference Book:

1. W. Richard Stevens, Bill Fenner, Andrew M. Rudoff, "Unix Network Programming, Volume 1: The Sockets Networking API", Third Edition, ISBN:0-13-141155-1, Addison Wesley Pearson Education, 2004
2. Behrouz A Forouzan, Debdeep Mukhopadhyay "Cryptography and Network Security", Second Edition, ISBN -13:978-0-07—070208-0 Tata McGraw Hill Education Private Limited 2010
3. William Stallings, "Cryptographic and network security Principles and Practices", Four Edition, Publisher Prentice Hall, November 2005
4. Andre Perez, "Network Security", First Edition, Publisher John Wiley & Sons, 2014
5. Gary R. Wright, W. Richard Stevens, "TCP/IP Illustrated: The Implementation", ISBN 0- 201-63354-X, Vol. 2, 1st Edition, Addison Wesley Professional, January 2008

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Course					Hours	Credits			
I	23PITVA22	NETWORK PROGRAMMING					-	2*			
Course Outcomes (Cos)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓		✓		✓			
CO2	✓	✓				✓	✓	✓	✓		
CO3	✓		✓	✓		✓	✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓		✓	
Number of matches (✓) = 38, Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER – II

Course Code: 23PIT2CC5
Instruction Hours: 6
Credits: 5

Exam Hours: 3
Internal Marks: 25
External Marks: 75

DATABASE SYSTEMS

Objectives of the Course:

To understand the basic DBMS models, architecture, query and to normalize the database. To Learn Transaction Processing, Recovery and Distributed Database.

Course Outcomes:

- CO1: Explain the relational databases and uses of PL/SQL
- CO2: Apply Schema, ER- Model, normalization, transaction, concurrency, and recovery on tables using SQL and PL/SQL.
- CO3: Assess databases based on models and Normal Forms.
- CO4: Analyze and manage relational & distributed, database, transaction, concurrency control and query languages
- CO5: Design and construct tables and manipulate it effectively using PL/SQL database objects

UNIT-I:

Introduction: Database System Applications-Purpose of Database Systems-View of Data- Database Users and Administrators. **Relational Database:** Structure of Relational Databases- Databases Schema- Keys-Schema Diagrams-**Formal Relational Query Languages:** Relational Algebra-Tuple Relational Calculus

UNIT-II:

Database Design: Overview of Design Process-The Entity Relationship Model-Constraints- Removing Redundant Attributes in Entity Sets-Entity-Relationship Diagrams-Reduction to Relational Schemas-Extended E-R features -Alternative Notations for Modeling Data. **Relational Database Design:** Features of Good Relational Design-Functional Dependency- **Normalization:** 1NF, 2NF, 3NF, BCNF, 4NF, 5NF- Functional Dependency Theory

UNIT-III:

Transaction Management: Transaction Concept-Simple Transaction Model-Storage Structure- Transaction Atomicity and Durability-Transaction Isolation-Serializability. **Concurrency Control:** Lock Based Protocols-Locks-Granting of Locks-Two Phase Locking Protocol-Time Stamp Based Protocol - **Recovery System:** Failure Classification-**Recovery and Atomicity:** Log Records-Database Modification-Concurrency Control and Recovery-Recovery Algorithm

UNIT-IV:

Distributed Database: Homogeneous and Heterogeneous Databases-Distributed Data storage- Distributed Transactions-Commit Protocols-Concurrency Control in Distributed Databases- Distributed Query Processing. Case study: MongoDB

UNIT-V: SQL - Table Fundamentals - Viewing Data - Inserting - Deleting - Updating - Modifying - Constraints - Functions - Grouping - Subqueries - Joins - Views.**PL/SQL:** Introduction - PL/SQL Block - Data Types And Variables - Control Structure - Cursors - PL/SQL Security - Locks. PL/SQL Database Objects: Exception Handling- Packages - Procedures and Functions - Database Triggers

Text Book:

1. Abraham Silberchatz, Henry F.Korth, S.Sudarshan, Database Systems Concepts, SixthEdition, Tata Mcgraw Hill.
2. Ivan Bayross, SQL, PL/SQL The Programming Language of ORACLE, Fourth edition, BPBPublications. Unit IV & V

Reference Books:

1. AtulKahate, Introduction to Database Management systems, Pearson education.
2. Carlo Zaniolo, Stefano Ceri, Christos Faloutsos, R.T.Snodgrass, V.S.Subrahmanian, (1997),Advanced Database Systems, Morgan Kaufman.
3. George Koch, Kelvin Loney, (2002), Oracle 9i : The Complete Reference, Oracle Press, TataMcGrawHill Publication.
4. RamezElmasri, Shamkant B. Navathe (2014), “Database Systems”, Sixth edition, PearsonEducation, New Delhi

Website and e-Learning Source :

1. <http://awtrey.com/tutorials/dbeweb/database.php>
2. <http://www.slideshare.net/SalamaAlbusaidi/emerging-database-technology-multimedia-database>.
3. <http://www.tutorialspoint.com/dbms/index.htm>
4. <http://www.tutorialspoint.com/plsql/index.htm>
5. [https://opentextbc.ca/dbdesign/chapter/chapter-11-functional-dependencies/\(FunctionalDependencies\)](https://opentextbc.ca/dbdesign/chapter/chapter-11-functional-dependencies/(FunctionalDependencies))

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Course					Hours	Credits			
II	23PIT2CC5	DATABASE SYSTEMS					6	5			
Course Outcomes (Cos)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓		✓	✓	✓	
CO2	✓	✓	✓	✓	✓	✓	✓		✓	✓	
CO3	✓	✓		✓			✓	✓			
CO4	✓		✓		✓	✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Number of matches (✓) = 40, Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER – II

Course Code: 23PIT2CC6
Instruction Hours: 6
Credits: 5

Exam Hours: 3
Internal Marks: 25
External Marks: 75

SOFTWARE ENGINEERING

Course Objectives

The aim of the course is to provide an understanding of the working knowledge of the techniques for estimation, design, testing and quality management of large software development projects.

Course Outcomes:

- CO1: How to apply the software engineering lifecycle by demonstrating competence in communication, planning, analysis, design, construction, and deployment
- CO2: An ability to work in one or more significant application domains
- CO3: Work as an individual and as part of a multidisciplinary team to develop and deliver quality software
- CO4: Demonstrate an understanding of and apply current theories, models, and techniques that provide a basis for the software lifecycle
- CO5: Demonstrate an ability to use the techniques and tools necessary for engineering Practice

UNIT – I:

Introduction to Software Engineering: The evolving role of software, changing nature of software, software myths. A Generic view of process: Software engineering- a layered technology, a process framework, the capability maturity model integration (CMMI), process patterns, process assessment, personal and team process models. Process models: The waterfall model, incremental process models, evolutionary process models, the unified process.

UNIT – II:

Software Requirements: Functional and non-functional requirements, user requirements, system requirements, interface specification, the software requirements document. Requirements engineering process: Feasibility studies, requirements elicitation and analysis, requirements validation, requirements management. System models: Context models, behavioral models, data models, object models, structured methods.

UNIT – III:

Design Engineering: Design process and design quality, design concepts, the design model. Creating an architectural design: software architecture, data design, architectural styles and patterns, architectural design, conceptual model of UML, basic structural modeling, class diagrams, sequence diagrams, collaboration diagrams, use case diagrams, component diagrams.

UNIT – IV:

Testing Strategies: A strategic approach to software testing, test strategies for conventional software, black-box and white-box testing, validation testing, system testing, the art of debugging. Product metrics: Software quality, metrics for analysis model, metrics for design model, metrics for source code, metrics for testing, metrics for maintenance.

UNIT – V:

Metrics for Process and Products: Software measurement, metrics for software quality.

Risk management: Reactive Vs proactive risk strategies, software risks, risk identification, risk projection, risk refinement, RMMM, RMMM plan. Quality Management: Quality concepts, software quality assurance, software reviews, formal technical reviews, statistical software quality assurance, software reliability, the ISO 9000 quality standards.

Text Books:

1. Software Engineering, A practitioner's Approach- Roger S. Pressman, 6th edition, Mc Graw Hill International Edition.
2. Software Engineering- Sommerville, 7th edition, Pearson Education.
3. The unified modeling language user guide Grady Booch, James Rumbaugh, Ivar Jacobson, Pearson Education.

Reference Books:

1. Software Engineering, an Engineering approach- James F. Peters, Witold Pedrycz, John Wiley.
2. Software Engineering principles and practice- Waman S Jawadekar, The Mc Graw-Hill Companies.
3. Fundamentals of object-oriented design using UML Meiler page-Jones: Pearson Education.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Course					Hours	Credits			
II	23PIT2CC6	SOFTWARE ENGINEERING					6	5			
Course Outcomes (Cos)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓		✓	✓	✓	
CO2	✓	✓	✓	✓	✓	✓	✓		✓	✓	
CO3	✓	✓		✓			✓	✓			
CO4	✓		✓		✓	✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Number of matches (✓) = 40, Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER – II

Course Code: 23PIT2CC7P
Instruction Hours: 5
Credits: 5

Exam Hours: 3
Internal Marks: 40
External Marks: 60

RDBMS LAB

Course Objectives:

The primary Course Objective of this paper is to learn and implement SQL & PL/SQL.

Course Outcomes:

- CO1: Understand the basic principles of database management systems.
- CO2: Draw Entity-Relationship diagrams to represent simple database application Scenarios
- CO3: Write SQL queries for a given context in relational database.
- CO4: Discuss normalization techniques with simple examples.
- CO5: Describe transaction processing and concurrency control concepts.

Exercise:

1. DDL Commands
2. DML Commands
3. DCL Commands
4. Usage of Sub Queries in DML and Create-SQL
5. Solving queries using built-in functions
6. Simple programs in PL/SQL block
7. Exception Handling in PL/SQL
8. Programs using Implicit Cursors
9. Programs using Explicit Cursors
10. Procedures & User-defined functions
11. Creation of Triggers

Text Book:

1. Ivan Bayross, SQL, PL/SQL The Programming Language of ORACLE, Fourth edition, BPB Publications

Reference Books:

2. RamezElmasri, Shamkant B. Navathe (2014), "Database Systems", Sixth edition, Pearson Education, New Delhi

Website and e-Learning Source :

1. <http://awtrey.com/tutorials/dbeweb/database.php>
2. <http://www.slideshare.net/SalamaAlbusaidi/emerging-database-technology-multimedia-database>.
3. <http://www.tutorialspoint.com/dbms/index.htm>
4. <http://www.tutorialspoint.com/plsql/index.htm>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Course					Hours	Credits			
II	23PIT2CC7P	RDBMS LAB					5	5			
Course Outcomes (Cos)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓		✓	✓	✓	
CO2		✓	✓	✓	✓	✓	✓		✓	✓	
CO3	✓	✓	✓	✓		✓	✓	✓			
CO4	✓		✓		✓	✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓		✓	✓	✓		
Number of matches (✓) = 40, Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER – II

Course Code: 23PIT2EC31
Instruction Hours: 6
Credits: 3

Exam Hours: 3
Internal Marks: 25
External Marks: 75

OPEN SOURCE TECHNOLOGIES

Course Objectives:

To learn the efficiency of Open Source Technology and to train to have a good practical knowledge of how to write successful PHP and Ruby code and utilizing a database using PHP.

Course Outcomes:

- CO1: Demonstrate the setup and configuration of development environment to write PHP and Ruby Scripts
- CO2: Select the appropriate language fundamentals and techniques to write and compile PHP and Ruby programs
- CO3: Examine the bugs and analyze how to prevent and remove the bugs
- CO4: Test and debug the application with sample inputs to check the correctness and consistency of the scripts
- CO5: Create simple programs that make use of various PHP and Ruby features and functions and solve web application and database tasks using PHP

UNIT-I :

PHP: Introduction – Creating a PHP page – Running PHP page –HTML and PHP – Printing Text – Comment Statements – Working with variables – Storing data in variables - Interpolating strings – Constants - Understanding Internal Datatypes – Operators – Flow Control – Strings: String Functions - Converting to and from strings - Formatting text strings - Working with numbers.

UNIT-II :

Date and Time - Create an Array - Use an Associative Array - Functions to Work with Arrays - Work with Arrays of Arrays - Create and Use Functions

UNIT-III:

Reading Data in web pages: Handling various controls - PHP Browser-Handling power: Data Validation - File Handling: Opening a file – Reading Text from a file – Closing a file- Working with Databases: Creating, Inserting, Accessing, Updating, Deleting and Sorting Database - Work with Cookies and Sessions

UNIT-IV:

Ruby: Getting Started with Ruby – Working with Numbers and Strings – Variables – Constants – Operators – Conditionals and Loops

UNIT-V:

Arrays - Hashes - Methods - Blocks: Classes and Objects : Creating a Class and an Object-Exception Handling – File Handling

Text Book:

1. Steven Holzner, (2016), “PHP: The Complete Reference”, McGraw Hill Education Private Limited, Indian Edition. (Unit I, II)
2. RachnaKapur, Mario Briggs, Tapas Saha, Ulisses Costa, Pedro Carvalho, Raul F. Chong, Peter Kohlmann (2010), “Getting Started with Open Source Development”, DB2 on Campus Book Series. (Unit III)
3. <http://indexof.es/Ruby/Beginning%20Ruby%20On%20Rails.pdf> (Unit IV)
4. <http://www.cs.uni.edu/~wallingf/teaching/agile-may2010/ruby/programming-ruby.pdf>(Unit V)

Reference Books:

1. W. Jason Gilmore (2010), “Beginning PHP &MySQL”, Apress.
2. Joel Murach, Ray Harris (2010), “PHP and MySQL”, Shroff Publishers & Distributors
3. Larry Ullman (2008), “PHP 6 and MySQL 5”, Pearson Education.
4. John Coggeshall (2006), “PHP 5”, Pearson Education.
5. Michale C. Glass (2004), “Beginning PHP, Apache, MySQL Web Development”, WileyDreamTech Press.

Website and e-Learning Source:

1. <http://www.w3schools.com/php/>
2. <http://howtostartprogramming.com/PHP/>
3. <http://www.massey.ac.nz/~nhreyes/MASSEY/159339/Lectures/Lecture%2011%20-%20PHP%20-%20Part%205%20-%20CookiesSessions.pdf>
4. <http://www.tutorialspoint.com/mysql/>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Course					Hours	Credits			
II	23PIT2EC31	OPEN SOURCE TECHNOLOGIES					6	3			
Course Outcomes (Cos)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓		✓	✓	✓	
CO2	✓	✓	✓	✓	✓	✓	✓		✓	✓	
CO3	✓	✓		✓			✓	✓			
CO4	✓		✓		✓	✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Number of matches (✓) = 40, Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER – II

Course Code: 23PIT2C32
Instruction Hours: 6
Credits: 3

Exam Hours: 3
Internal Marks: 25
External Marks: 75

DIGITAL IMAGE PROCESSING

Course Objectives:

To become familiar with digital image fundamentals. To get exposed to simple image enhancement techniques in Spatial and Frequency domain. To learn concepts of degradation function and restoration techniques.

Course Outcome:

CO1: Know and understand the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms.

CO2: Operate on images using the techniques of smoothing, sharpening and enhancement.

CO3: Understand the restoration concepts and filtering techniques.

CO4: Learn the basics of segmentation, features extraction.

CO5: Compression and recognition methods for color models.

UNIT-I: DIGITAL IMAGE FUNDAMENTALS

Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels - Color image fundamentals - RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms - DFT, DCT.

UNIT-II: IMAGE ENHANCEMENT

Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement.

UNIT-III: IMAGE RESTORATION

Image Restoration - degradation model, Properties, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering

UNIT-IV: IMAGE SEGMENTATION

Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation – Region growing – Region splitting and merging – Morphological processing- erosion and dilation, Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm.

UNIT-V: IMAGE COMPRESSION AND RECOGNITION

Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching.

Text Books:

1. Rafael C. Gonzalez, Richard E. Woods, 'Digital Image Processing', Pearson, Third Edition, 2010.
2. Anil K. Jain, 'Fundamentals of Digital Image Processing', Pearson, 2002.

Reference Books:

1. Kenneth R. Castleman, 'Digital Image Processing', Pearson, 2006.
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, 'Digital Image Processing using MATLAB', Pearson Education, Inc., 2011.
3. D.E. Dudgeon and R.M. Mersereau, 'Multidimensional Digital Signal Processing', Prentice Hall Professional Technical Reference, 1990.
4. William K. Pratt, 'Digital Image Processing', John Wiley, New York, 2002
5. Milan Sonka et al 'Image processing, analysis and machine vision', Brookes/Cole, Vikas Publishing House, 2nd edition, 1999.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Course					Hours	Credits			
II	23PIT2C32	DIGITAL IMAGE PROCESSING					6	3			
Course Outcomes (Cos)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓		✓	✓	✓	
CO2	✓	✓	✓	✓	✓	✓	✓		✓	✓	
CO3	✓	✓		✓			✓	✓			
CO4	✓		✓		✓	✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Number of matches (✓) = 40, Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER III

Course Code: 23PIT3CC8

Instruction Hours: 6

Credits: 5

Exam Hours: 3

Internal Marks: 25

External Marks: 75

ADVANCED JAVA

Course Objectives:

To understand the basic concepts of core principles of the Java language and gain knowledge to develop dynamic Web applications using applet, servlet, jsp and JavaBean.

Course Outcomes:

- CO1: Understand and explain programming language constructs, Java mechanisms, OOP and Internet programming concepts
- CO2: Apply logical constructs as well as include Object oriented features, Packages, Interfaces, Exceptions and Threads, JDBC, Internet programming technologies when appropriate
- CO3: Compare and contrast classical and advanced Java in terms of features, architecture, platform and technologies
- CO4: Choose an approach to solve real world problem from the acquired knowledge of Java
- CO5: Create programs that make strong use of classes and objects and develop JDBC, GUI, Web and Enterprise based applications

UNIT-I:

The Genesis of Java: Java's Magic, The Java Buzzwords-An Overview of Java - Data types, Variables, Arrays-Operators-Control Statements- Introducing Classes – A Close Look at Methods and Classes-Inheritance.

UNIT-II:

String Handling Functions – Collections Framework: Collection Classes, StringTokenizer, Date, Calendar - Abstract Classes - Packages and Interfaces: Packages – Access Protection Importing Packages – Interfaces

UNIT-III:

Exception Handling: Exception types – Creating your own exceptions - Multithreaded Programming: Creating a Thread, Creating Multiple Threads, Using isAlive() and join(), Thread Priorities, Synchronization, Inter-thread Communication, Suspending, Resuming and Stopping Threads - JDBC.

UNIT-IV:

The Applet Class-Event Handling – Introducing the AWT: Working with windows, graphics and Text, Using AWT Controls, Layout Managers and Controls - Developing JavaServer Pages

UNIT-V:

Developing Servlets -Structuring Web application with the MVC pattern – Sessions and Cookies - Using JSP tags with JavaBeans

Text Books:

1. Herbert Schildt, (2004), “Java 2: The Complete Reference”, Fifth Edition, Tata McGraw Hill, New Delhi.
2. Joel Murach, (2008), “Andrea Steelman,,Murach”s Java Servlets and JSP”, Second Edition, Shroff Publishers

Reference Books:

1. Matthew Mac Donald, (2002), “ASP.NET : The Complete Reference”, MC Graw Hill.
2. VladaMatena, (2003), “Applying Enterprise JavaBeans”, Second Edition, Addison Wesley.
3. Cay S Horstmann& Gary Cornell, Core Java Vol II Advanced Features, Eighth Edition, Addison Wesley.
4. Bruce W Perry (2004), Java Servlets & JSP Cook Book, Second edition, O’reilly Media.

Web References:

1. <http://netbeans.org/kb/docs/javaee/javaee-intro.html>
2. <http://www.jsptube.com/>
3. <http://articles.sitepoint.com/article/java-servlets-1>
4. <http://www.java-tips.org/java-tutorials/tutorials/introduction-to-java-servlets-with-netbeans.html>
5. <http://download.oracle.com/javase/tutorial/javabeans/index.html>
6. <http://www.javapoint.com/steps-to-connect-to-the-datadase-in-java/> (Unit III: JDBC)

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Course					Hours	Credits			
III	23PIT3CC8	ADVANCED JAVA					6	5			
Course Outcomes (Cos)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓		✓		✓			
CO2		✓				✓	✓	✓	✓		
CO3	✓	✓	✓	✓			✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓		✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of matches (✓) = 37, Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER III

Course Code: 23PIT3CC9
Instruction Hours: 6
Credits: 5

Exam Hours: 3
Internal Marks: 25
External Marks: 75

MOBILE APPLICATION DEVELOPMENT

Course Objectives:

To provide the students with the basics of Android Software Development tools, development of software on mobile platforms and deploying software to mobile devices.

Course Outcomes:

- CO1: Demonstrate the setup and configuration of Android Development Environment
- CO2: Apply the necessary UI components with different styles, themes, views, and layouts.
- CO3: Examine and implement the required services such as messaging, mailing, Multimedia concepts for the given problem.
- CO4: Test and debug the Android applications with different inputs.
- CO5: Create mobile applications that make use of various android features, functions and database tasks.

UNIT-I:

Getting Started with Android Programming – Using Eclipse for Android Development – Using Android Emulator - Getting to know the Android User Interface: Understanding the Components of a Screen

UNIT-II:

Designing your User Interface with views: Basic Views – Picker Views – List Views - Displaying Pictures.

UNIT-III:

Activities, Fragments and Intents : Understanding Activities – Applying Styles and Themes to an Activity – Displaying a Dialog Window – Displaying a Progress Dialog – Linking Activities Using Intents – Fragments.

UNIT-IV:

Menus with Views: Option Menu – Context Menu. Utilizing the Action Bar: Adding Action Items to the Action Bar – Customizing the Action Items and Application Icon -Working with Audio and Video.

UNIT-V :

Messaging: SMS Messaging – Sending E- Mail- Data Persistence: Creating and Using Databases – Developing Android Services – Publishing Android Applications.

Case Study: Create an Android Application and prepare it for publishing.

Text Book:

1. Wei – Meng Lee, (2012), Beginning Android 4 Application Development, Wiley India Edition.

Reference Books:

1. OnurCinar, (2012), Android Apps with Eclipse, Apress, Springer (India) Private Limited.
2. RetoMeier, (2010), Professional Android 2 Application Development, Wiley India Edition.

Web References:

1. <http://developer.android.com/training/basics/firstapp/index.html>
3. www.vogella.com/articles/Android/article.html
4. www.coreservlets.com/android-tutorial/
5. www.edumobile.org/android/category/android-beginner-tutorial
6. <http://www.androidhive.info/2011/11/android-sqlite-database-tutorial/> (Unit V: Ex. No.3 (SQLite Database))

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Course					Hours	Credits				
III	23PIT3CC9	MOBILE APPLICATION DEVELOPMENT					6	5				
Course Outcomes (Cos)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓	✓	✓	✓		✓		✓				
CO2		✓				✓	✓	✓	✓			
CO3	✓	✓	✓	✓			✓	✓	✓			
CO4	✓	✓	✓	✓	✓	✓	✓		✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Number of matches (✓) = 37, Relationship: High												

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER III

Course Code: 23PIT3CC10
Instruction Hours: 6
Credits: 5

Exam Hours: 3
Internal Marks: 25
External Marks: 75

SOFTWARE PROJECT MANAGEMENT

Course Objectives:

To acquire knowledge in various software development models, Extract and analyze software requirements specifications for different projects; Develop skills in basic architecture/design and apply standard coding practices;

Course Outcomes:

CO1: Students would have acquired knowledge in various software development models, Capable of extracting and analyzing software requirements specifications for different projects;

CO2: Develop skills in basic architecture/design and apply standard coding practices;

CO3: Identify and implement of the software metrics;

CO4: recommendations to improve the operations of the development of the project;

CO5: Demonstrate the need for appropriate decision making, control and performance evaluation of a project.

UNIT-I:

Basics of Software Project Management:

Introduction to Software - Introduction to Software Project Management.

UNIT-II:

Software Project Initiation: Software Project Evaluation - Contract Management - Requirements Management.

UNIT-III:

Software Project Planning: Software Estimation Tools - Techniques and Models - Software Project Management Plan - Schedule Management - Cost Management.

UNIT-IV:

Software Project Execution, Monitoring and Control:

Risk Management - Quality Management - Software Project Reviews.

UNIT-V:

Project Closure and Maintenance:

Software Project Closure - Software Maintenance, Support and Implementation.

Text Books:

1. "Software Project Management" - Subramanian Chandramouli, SaikatDutt - Pearson India Education Services Pvt. Ltd, 2015.
2. "Software Project Management" - Bob Hughes & Mike Cotterell – Fourth Edition - 2008 - ISBN: 978-0-07-061985-2.

Reference Book:

1. Jibithesh Mishra, Ashok Mohanty, "Software Engineering", Pearson Education, 2011.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Course					Hours	Credits			
III	23PIT3CC11	SOFTWARE PROJECT MANAGEMENT					6	5			
Course Outcomes (Cos)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓		✓		✓			
CO2		✓				✓	✓	✓	✓		
CO3	✓	✓	✓	✓			✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓		✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of matches (✓) = 37, Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER III

Course Code: 23PIT3CC11P
Instruction Hours: 5
Credits: 3

Exam Hours: 3
Internal Marks: 40
External Marks: 60

ADVANCED JAVA - PRACTICAL

Course Objectives:

This course gives practical training in basics and advanced Java programming like applet, Servlets, JSP and Java Beans.

Course Outcomes:

- CO1 : Demonstrate understanding and use of different Java mechanisms for efficient application development
- CO2 : Use an appropriate development environment to write, compile and run Java Programs
- CO3 : Analyze the problem and apply the appropriate problem solving method with the required building blocks and mechanisms of Core and Advanced Java
- CO4 : Test the correctness and consistency of the Java program with different inputs
- CO5 : Create simple applications that make use of core java concepts and develop JDBC, GUI, Web and Enterprise based applications

Exercises:

1. Classes and objects
2. Implementing classes
3. Strings
4. Collection
5. Date and Calendar
6. Packages
7. Exception handling
8. Threads
9. JDBC
10. Applets
11. Event handling
12. Servlet
13. Simple Web Applications
14. Using Sessions and Cookies
15. Forwarding requests and Redirecting responses
16. Web Applications using Database
17. Bean
18. Developing Simple Beans
19. Use Beans with JSP tags

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Course					Hours	Credits			
III	23PIT3CC11P	ADVANCED JAVA - PRACTICAL					5	3			
Course Outcomes (Cos)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓		✓	✓		
CO2	✓	✓	✓		✓	✓	✓		✓	✓	
CO3	✓	✓	✓	✓		✓	✓	✓			
CO4	✓		✓		✓	✓		✓	✓	✓	
CO5		✓	✓	✓	✓		✓	✓	✓		
Number of matches (✓) = 39, Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER III

Course Code: 23PIT3EC51
Instruction Hours: 5
Credits: 3

Exam Hours: 3
Internal Marks: 25
External Marks: 75

INTERNET OF THINGS

Course Objectives:

To understand the underlying concepts in Internet of Things (IoT) and to provide indepth knowledge on state of the art in the IoT, challenges and future directions.

Course Outcomes:

CO1: Students will be explored to the interconnection and integration of the physical world and the cyber space.

CO2: They are also able to design & develop IOT Devices.

CO3: Able to understand the application areas of IOT ·

CO4: Able to realize the revolution of Internet in Mobile Devices,

CO5: Cloud & Sensor Networks · Able to understand building blocks of Internet of Things and characteristics.

UNIT-I: INTRODUCTION TO IoT

Requirements of IoT: The definition of the Internet of Things, main assumptions and perspectives- Platform for IoT devices. Economics and Technology of the IoT –Issues in IoT and solutions-Architecture of IoT. Anatomy of IoT: Traditional Internet Protocol Vs Chirps –Applying network intelligence at propagator nodes-Transport and functional architectures.

UNIT-II: IoT DEVICES

IoT Devices-Temporary and Ad-hoc devices-Addressing issues-End devices in dedicated networks- Converting states to chirps-RFID integration in the IoT-End devices with higher demands- Small data-Building a web of things-Autonomy and coordination-Structuring a tree-Housekeeping message-Role of integrator function Degrees of functionality-Aggregating end points-Packaging options.

UNIT-III: DATA AND HUMAN INTERACTION

Data and Human Interaction: Functions of IoT-Analysis and control-Neighborhood and affinities- Public private and other kinds of data- Publishing agent- Searching for and managing agents- High and low level loops- Human interface and control points Collaborative scheduling tools-Packaging and provisioning- Distributed integrator functions- Filtering the streams-IP Alternative-Protocol based on category classification-Skeletal architecture of chirp packets- Pattern driven-Propagator node networks and operation-Power of local agents and integrator functions-High level interchange.

UNIT-IV: IoT APPLICATIONS

Moore's Law –Intelligence near the edge- Incorporating legacy devices- Staying in the loop -Social machines-Applications of IoT–Agriculture- Home healthcare-Efficient process control-Factory application- Home automation- Natural sciences- Living applications-Origin of IoT- Open source networking solutions- Shared software and business process vocabularies.

UNIT-V: CREATING IoT PROJECTS

Creating the IoT projects: Sensor project-Actuator project – Controller-Camera. Using an IoT service platform- Selecting an IoT. Platform- The claysterplatformInterfacing our devices using XMPP- Creating control application.

Text Books:

1. “Rethinking the Internet of Things-A scalable approach to connecting everything”, by Francis DaCosta, Apress open publication, 2013.
2. “Learning Internet of Things” by Peter Waher, PACKT Publishing-Birmingham-mumbai 2015.

Reference Books:

1. “Internet of Things: A Hands on Approach”, by Arhdeep Bahga and Vijay Madiseti (<http://www.internet-of-things-book.com/>).
2. “Getting started with the internet of things”, by Cuno Pfister, O’Rielly Publication.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Course					Hours	Credits			
III	23PIT3EC51	INTERNET OF THINGS					5	3			
Course Outcomes (Cos)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓		✓		✓			
CO2		✓				✓	✓	✓	✓		
CO3	✓	✓	✓	✓			✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓		✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of matches (✓) = 37, Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER III

Course Code: 23PIT3EC52
Instruction Hours: 5
Credits:3

Exam Hours: 3
Internal Marks: 25
External Marks: 75

TRENDS IN COMPUTING

Course Objectives:

To understand the concepts and infrastructure of cloud computing and its business applications. To understand the scope, design and model of grid

Course Outcomes:

- CO1: Outline the history, applications, benefits and limitations of Cloud, Grid and Green Computing
- CO2: Describe the cloud infrastructure services, virtualization and determine how applications can be developed using cloud services:
- CO3: Identify cloud storage providers, software components of grid, technologies applied in building a green system and various key sustainability in Green IT Trends
- CO4: Analyse the migrations and security concerns of cloud, different grid models, resources and also identify how the distributed computing environments can be built from lower level services
- CO5: Assess the business cases of cloud, and also various laws, approaches and protocols for regulating green IT

UNIT-I:

Cloud Computing: Basics: Overview – Applications – Intranets and the Cloud – First Movers in the Cloud – Organization and Cloud Computing: Benefits – Limitations – Security Concerns- The Business Case for Going to the Cloud: Cloud Computing Services - Deleting Datacenter.

UNIT-II:

Hardware and Infrastructure: Clients – Security – Network – Services- Accessing the Cloud: Platforms - Cloud Storage: Overview – Cloud Storage Providers.

UNIT-III:

Developing Applications: Google – Microsoft - Local Cloud and Thin Clients: Virtualization – Server Solutions – Thin Clients – Migrating to the Cloud.

UNIT-IV:

Grid Computing: Introduction - Benefits – Grid Terms and Concepts: Types of Resources – Jobs and Applications –Scheduling, Reservation and Scavenging – Grid Software Components – Grid user role: User Perspective – Administrator Perspective - Design: Building grid architecture - Models – Topologies – Phases and Activities.

UNIT-V:

Green Computing: Introduction - History of Green Computing - Regulations and Industry Initiative - The Demons behind Green Computing - Approaches to Green Computing - Role of IT vendors - Green Computing Tips - Future is Green.

Text Books:

1. Anthony T. Velte, Toby J. Velte, Robert Elsenpeter, "Cloud Computing - A practical Approach", McGraw Hill, 2010.
2. Bart Jacob, Michael Brown, Kentaro Fukui, and Nihar Trivedi, "Introduction to Grid Computing", IBM Redbook, 2005.

Reference Books:

1. George Reese, "Cloud Application Architectures: Building Applications and Infrastructures in the cloud", O'Reilly Media Inc., 2009.
2. Halper Fern, Kaufman Marcia, Bloor Robin, Hurwit Judith, "Cloud Computing for Dummies ", Wiley India Pvt Ltd, 2009.
3. J. Velete, Anthony T. Velete, Robert Elsenpeter, "Green IT – Reduce Your Information System's Environmental Impact While Adding to the Bottom Line", McGraw-Hill, 2008.
4. Bud E. Smith," Green Computing: Tools and Techniques for Saving Energy, Money, and Resources", Auerbach Publications, 2013.

Website and e-Learning Source:

- 1.http://www.siteground.com/tutorials/cloud/cloud_computing_infrastructure.htm
- 2.<http://thecloudtutorial.com/>
- 3.<http://studymafia.org/wp-content/uploads/2015/11/CSE-Green-Computing-Report.pdf>
- 4.http://www.znu.ac.ir/data/members/dastjerdi_mohammad/Book11.pdf (Unit IV)
- 5.<http://www.cs.kent.edu/~farrell/grid06/lectures/grid01.pdf> (Unit V)

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Course					Hours	Credits				
III	23PIT3EC52	TRENDS IN COMPUTING					5	3				
Course Outcomes (Cos)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓	✓	✓	✓		✓		✓				
CO2		✓				✓	✓	✓	✓			
CO3	✓	✓	✓	✓			✓	✓	✓			
CO4	✓	✓	✓	✓	✓	✓	✓		✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Number of matches (✓) = 37, Relationship: High												

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER III

Course Code: 23PIT2NME21
Instruction Hours: 2
Credits: 2

Exam Hours: 3
Internal Marks: 25
External Marks: 75

INTRODUCTION TO DATA ANALYSTICS

Course Objectives:

To be exposed to big data. Learn the different ways of Data Analysis. Be familiar with data streams. Learn the mining and clustering. Be familiar with the visualization.

Course Outcome:

CO1: Apply the statistical analysis methods.
CO2: Compare and contrast various soft computing frameworks.
CO3: Design distributed file systems.
CO4: Apply Stream data model.
CO5: Use Visualisation techniques

UNIT- I: INTRODUCTION TO BIG DATA

Introduction to Big Data Platform – Challenges of conventional systems - Web data – Evolution of Analytic scalability, analytic processes and tools, Analysis vs reporting - Modern data analytic tools, Stastical concepts: Sampling distributions, resampling, statistical inference, prediction error.

UNIT- II: DATA ANALYSIS

Regression modelling, Multivariate analysis, Bayesian modeling, inference and Bayesian networks, Support vector and kernel methods, Analysis of time series: linear systems analysis, nonlinear dynamics - Rule induction - Neural networks: learning and generalization, competitive learning, principal component analysis and neural networks; Fuzzy logic: extracting fuzzy models from data, fuzzy decision trees, Stochastic search methods.

UNIT-III: MINING DATA STREAMS

Introduction to Streams Concepts – Stream data model and architecture - Stream Computing, Sampling data in a stream – Filtering streams – Counting distinct elements in a stream – Estimating moments – Counting oneness in a window – Decaying window - Realtime Analytics Platform(RTAP) applications - case studies - real time sentiment analysis, stock market predictions.

UNIT-IV: FREQUENT ITEMSETS AND CLUSTERING

Mining Frequent itemsets - Market based model – Apriori Algorithm – Handling large data sets in Main memory – Limited Pass algorithm – Counting frequent itemsets in a stream – Clustering Techniques – Hierarchical – K- Means – Clustering high dimensional data – CLIQUE and PROCLUS – Frequent pattern based clustering methods – Clustering in non-euclidean space – Clustering for streams and Parallelism.

UNIT-V: FRAMEWORKS AND VISUALIZATION

MapReduce – Hadoop, Hive, MapR – Sharding – NoSQL Databases - S3 - Hadoop Distributed file systems – Visualizations - Visual data analysis techniques, interaction techniques; Systems and applications:

Text Books:

1. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, 2007.
2. Anand Rajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press, 2012.

Reference Books:

1. Bill Franks, Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with advanced analytics, John Wiley & sons, 2012.
2. Glenn J. Myatt, Making Sense of Data, John Wiley & Sons, 2007 Pete Warden, Big Data Glossary, O'Reilly, 2011.
3. Jiawei Han, Micheline Kamber "Data Mining Concepts and Techniques", Second Edition, Elsevier, Reprinted 2008.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Course					Hours	Credits			
III	23PIT2NME21	INTRODUCTION TO DATA ANALYTICS					2	2			
Course Outcomes (Cos)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓		✓		✓			
CO2		✓				✓	✓	✓	✓		
CO3	✓	✓	✓	✓			✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓		✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of matches (✓) = 37, Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER – III

Course Code: 23PIT2NME22
Instruction Hours: 2
Credits: 2

Exam Hours: 3
Internal Marks: 25
External Marks: 75

BLOCKCHAIN TECHNOLOGY

Course Objectives:

To study the basics of Block chain technology, private and public Block chain, and smart contract. This paper familiarizes the students to explore various aspects of Block chain technology like application in various domains

Course Outcome:

CO1: Understand and explore the working of Block chain technology
CO2: Identify the security and privacy implications of block chain technology
CO3: Apply the learning of solidity to build de-centralized apps on Ethereum
CO4: Analyze the working of Smart Contracts and the working of Hyper ledger
CO5: Assess the methods relevant for design, development and operation of block chain based applications

UNIT-I:

Introduction of Cryptography and Block chain : Definition of Block chain - Block chain Technology Mechanisms & Networks - Block chain Origins - Objective of Block chain - Block chain Challenges - Transactions and Blocks - P2P Systems - Keys as Identity - Digital Signatures, Hashing, and public key cryptosystems - private vs. public Block chain.

UNIT-II:

Bit coin and Cryptocurrency : Bit coin Terminology- The Bit coin Network - The Bit coin Mining Process - Mining Developments - Bit coin Wallets - Decentralization and Hard Forks - Ethereum Virtual Machine (EVM) - Merkle Tree- Double- Spend Problem - Block chain and Digital Currency- Transactional Blocks - Impact of Block chain Technology on Cryptocurrency

UNIT-III:

Introduction to Ethereum : Introduction to Ethereum - Consensus Mechanisms- Metamask Setup - Ethereum Accounts -Transactions -Receiving Ethers- Smart Contracts

UNIT-IV:

Introduction to Hyper ledger and Solidity Programming : Definition of Hyper ledger - Distributed Ledger Technology & its Challenges - Hyper ledger & Distributed Ledger Technology -Hyper ledger Fabric -Hyper ledger Composer - Solidity - Language of Smart Contracts - Installing Solidity & Ethereum Wallet - Basics of Solidity - Layout of a Solidity Source File & Structure of Smart Contracts - General Value Types

UNIT-V:

Block chain Applications: Internet of Things -Medical Record Management System - Domain Name Service and Future of Block chain -Alt Coins

Text Books:

1. Imran Bashir, “Mastering Block chain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained”, Second Edition, Packt Publishing, 2018
2. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, “Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction” Princeton University Press, 2016
3. Antonopoulos and G. Wood, “Mastering Ethereum: Building Smart Contracts and Dapps”, O’Reilly Publishing, 2018

Reference Books:

1. Antonopoulos, Mastering Bitcoin, O’Reilly Publishing, 2014
2. D. Drescher, Block chain Basics. Apress, 2017

Website and e-Learning Source:

1. <https://nptel.ac.in/courses/106/104/106104220/#>
2. <https://www.udemy.com/course/build-your-blockchain-az/>
3. <https://eduxlabs.com/courses/blockchain-technology- training/?tab=tab-curriculum>
4. <https://www.geeksforgeeks.org/consensus-algorithms-in-blockchain/>
5. [https://ec.europa.eu/programmes/erasmus-plus/project-result-content/eb79d492-327b-](https://ec.europa.eu/programmes/erasmus-plus/project-result-content/eb79d492-327b-43d8-b479-dd0fd9fd4490/BLISS%2003)

[43d8-b479-dd0fd9fd4490/BLISS%2003](https://ec.europa.eu/programmes/erasmus-plus/project-result-content/eb79d492-327b-43d8-b479-dd0fd9fd4490/BLISS%2003)
T3%20Unit%201%20slides%20v3.0%20final%20controled.pptx

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Course					Hours	Credits			
II	23PIT2NME22	BLOCKCHAIN TECHNOLOGY					2	2			
Course Outcomes (Cos)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓		✓		✓			
CO2		✓				✓	✓	✓	✓		
CO3	✓	✓	✓	✓		✓	✓		✓		
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓		✓	✓	✓	✓	
Number of matches (✓) = 37, Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER III

Course Code: 23PITVA21
Instruction Hours: -
Credits: 2*

Exam Hours: 2
Internal Marks: 50
External Marks: 50

E-COMMERCE FUNDAMENTALS

Course Objective:

This course provides an introduction to information systems for business and management.

Course Outcomes:

CO1: Analyze the impact of E-commerce on business models and strategy.

CO2: Describe the major types of E-commerce.

CO3: Explain the process that should be followed in building an E-commerce presence.

CO4: Identify the key security threats in the E-commerce environment.

CO5: Describe how procurement and supply chains relate to B2B E-commerce.

UNIT-I:

Electronic Commerce Framework – Electronic Commerce and Media Convergence – The Anatomy of E-Commerce Applications – Electronic Commerce Consumer Applications – Electronic Commerce Organization Applications. The Network Infrastructure for Electronic Commerce: Components of the High way – Network Access Equipment – Global information Distribution Networks.

UNIT-II:

The Internet as a Network Infrastructure: The Internet Terminology – NSFNET Architecture and components – National Research and Education Network – Internet Governance – An overview of Internet Applications- The Business of Internet Commercialization: Telco/Cable/On-Line Companies - National Independent ISPs – Regional Level ISPs – Local –level ISPs – Internet Connectivity options.

UNIT-III:

Electronic Commerce and the World Wide Web: Architectural Framework for Electronic Commerce – World Wide Web as the Architecture – Technology behind the Web – Security and the Web, Consumer-Oriented Electronic Commerce: Consumer- Oriented Applications – mercantile process model – mercantile models from the consumer’s perspective.

UNIT-IV:

Electronic Payment Systems: Types of Electronic Payment Systems – Digital Token based Electronic Payment Systems – Credit Card – Based Electronic Payment Systems-Risk and Electronic Payment Systems – Designing Electronic Payment Systems. Inter Organizational Commerce and EDI: Electronic Data Interchange – EDI Applications in Business – EDI: Legal, Security and Privacy issues.

UNIT-V:

Advertising and the Marketing on the Internet: The New Age of Information Search and Retrieval – Electronic Commerce Catalogs – Information filtering – Consumer – Data Interface – Emerging Tools. On Demand Education and Digital Copyrights: Computer-based Education and Training – Technological Components of Education on demand. Software Agents: Characteristics and Properties of Agents – The Technology behind Software Agents – Applets, Browsers and Software Agents.

Text Books:

1. "Frontiers of Electronic Commerce", Ravikalakota & Andrew Whinston, Adison Wesley, 2000.

Reference Books:

1. "Electronic Commerce", Pete Loshin & Paul A.Murphy, Second edition, Jaico Publishing House, 2000.
2. David Whiteley, "E-Commerce Strategy, Technologies and Applications", 1st Edition, Tata Mc-Graw-Hill, 2001.

Web Reference:

1. <https://forms.iimk.ac.in/libportal/ebook/EB8.pdf>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme SpecificOutcomes:

Semester	Code	Title of the Course					Hours	Credits			
III	23PITVA21	E-COMMERCE Fundamentals					-	2*			
Course Outcomes (Cos)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓		✓		✓			
CO2		✓				✓	✓	✓	✓		
CO3	✓	✓	✓	✓			✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓		✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of matches (✓) = 37, Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER III

Course Code: 23PITVA22
Instruction Hours: -
Credits: 2*

Exam Hours: 2
Internal Marks: 50
External Marks: 50

DATA VISUALIZATION

Course Objectives:

To learn different statistical methods for Data visualization.

Course Outcome:

CO1: Able to learn basics of R and Python.

CO2: To learn usage of Watson studio.

CO3: To learn about packages Numpy, pandas and matplotlib.

CO4: To learn functionalities and usages of Seaborn.

CO5: To learn functionalities and usages of Seaborn.

UNIT- I: Introduction to Statistics:

Introduction to Statistics, Difference between inferential statistics and descriptive statistics, Inferential Statistics- Drawing Inferences from Data, Random Variables, Normal Probability Distribution, Sampling, Sample Statistics and Sampling Distributions. R overview and Installation- Overview and About R, R and R studio Installation, Descriptive Data analysis using R, Description of basic functions used to describe data in R.

UNIT-II: Data manipulation with R:

Data manipulation packages, Data visualization with R . Data visualization in Watson Studio: Adding data to data refinery, Visualization of Data on Watson Studio.

UNIT-III: Python:

Introduction to Python, How to Install, Introduction to Jupyter Notebook, Python scripting basics, Numpy and Pandas.

UNIT-IV: Data Visualization Tools in Python:

Introduction to Matplotlib, Basic plots using matplotlib, Specialized Visualization Tools using Matplotlib, Advanced Visualization Tools using Matplotlib Waffle Charts, Word Clouds.

UNIT-V:

Introduction to Seaborn: Seaborn functionalities and usage, Spatial Visualizations and Analysis in Python with Folium, Case Study.

Text Books:

1. Core Python Programming - Second Edition, R. Nageswara Rao, Dreamtech Press.
2. R Graphics Essentials for Great Data Visualization by Alboukadel Kassambara

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Course					Hours	Credits			
III	23PITVA22	DATA VISUALIZATION					-	2*			
Course Outcomes (Cos)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓		✓		✓			
CO2		✓				✓	✓	✓	✓		
CO3	✓	✓	✓	✓			✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓		✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of matches (✓) = 37, Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER IV

Course Code: 23PIT4CC12
Instruction Hours: 6
Credits: 5

Exam Hours: 3
Internal Marks: 25
External Marks: 75

DATA SCIENCE

Course Objectives:

To Understand the basics of data science and perform data analysis, Data mining tasks & techniques

Course Outcome:

CO1: Outline the basics in data science

CO2: Identify suitable technique for the given problem

CO3: Analyse and formulating data for the problem under consideration

CO4: Interpret and demonstrate the knowledge of data analysis techniques in decision making

CO5: Develop the model using data mining and computing techniques

UNIT-I:

Introduction: Data Mining – Kinds of Data and Patterns to be Mined – Technologies used – Kinds of Applications are Targeted - Major Issues –Data objects and Attribute types – Basic statistical Descriptions of Data – Data Visualization - **Data Preprocessing:** Data Cleaning – Data Integration - Data Reduction - Data Transformation

UNIT-II:

Classification: Basic concepts - Decision Tree Induction: Working of Decision Tree - Building Decision Tree - Methods for Expressing Attribute Test Conditions - Measures for Selecting the Best Split - Algorithm for Decision Tree Induction – Classification: Alternative Techniques: Rule - Based Classifier– Nearest Neighbour Classifier - Bayesian Classifiers.

UNIT-III:

Association Analysis: Basic Concepts - Frequent Itemset Generation - Rule Generation - Compact Representation of Frequent Item sets –FP Growth Algorithm

UNIT-IV:

Cluster Analysis: Introduction-Desired Features of Cluster Analysis -Types of Data-Computing Distance - Types of Cluster Analysis Methods - Partitioning Methods - Hierarchical Methods – Density - Based Methods - Cluster Analysis Software

UNIT-V:

Web Data Mining: Introduction - Web terminology and characteristics - Locality and Hierarchy in the web- Web Content Mining - Web Usage Mining - Web Structure Mining – Web Mining- software

Text Books:

1. Vipin Kumar - Michael Steinbach - Pang - Ning Tan - (2006) - Introduction to Data Mining - Pearson Education. (Unit II: Chapters 4 & 5; Unit III: Chapter 6)
2. Jiawei Han and Micheline Kamber - (2012) - Data Mining Concepts and Techniques - Third Edition - Morgan Kaufmann. (Unit I : Chapters 1, 2 &3;)
3. G.K. Gupta, "Introduction to Data mining with case studies", 2nd Edition, PHI Private limited, New Delhi, 2011. (Unit IV: Chapter 4, Unit V: Chapters 5)

Reference Books:

1. Bhavani M. Thuraisingham - Data Mining: Technologies - techniques - tools and trends - CRC Press
 2. Yanchang Zhao (2012 - 2013) - R and Data Mining: Examples and Case Studies - Elsevier.
 3. Robert I. Kabacoff (2011) - R in Action Data analysis and graphics with R - Manning Publications.
- Samir Madhavan, "Mastering Python for Data Science", Packet Publishing, 2015

Website and e-Learning Source:

1. <http://www.thearling.com/text/dmwhite/dmwhite.htm>
2. <http://oai.dtic.mil/oai/oai?verb=getRecord&metadataPrefix=html&identifier=AD0770256>
3. <https://www.datamentor.io/r-programming#tutorial>
4. <http://www.csis.pace.edu/~ctappert/cs816-15fall/books/2015DataScience&BigDataAnalytics.pdf>
5. <http://www.rdatamining.com/>
6. <https://www.analyticsvidhya.com/blog/2016/02/complete-tutorial-learn-data-science-scratch/>
7. https://www.tutorialspoint.com/data-mining/dm_classification_prediction.htm
(Classification)

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Course					Hours	Credits			
IV	23PIT4CC12	DATA SCIENCE					6	5			
Course Outcomes (Cos)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓		✓		✓			
CO2	✓	✓				✓	✓	✓	✓		
CO3	✓	✓	✓	✓		✓	✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of matches (✓) = 40, Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER –IV
DISSERTATION (INDUSTRY/RESEARCH)

Course Code: 23PIT4PW
Instruction Hours: 6
Credits: 5

Exam Hour: 3
Internal Marks: 40
External Marks: 60

MAJOR PROJECT AND VIVA VOCE

Course Outcomes:

- CO1: Demonstrate a sound technical knowledge of their selected project topic.
CO2: Undertake problem identification: formulation and solution.
CO3: Design solutions to complex problems utilizing systems approach and enable to:
Conduct the science projects.
CO4: Communicate large in written an oral forms.
CO5: Demonstrate the knowledge: skills and attitudes of a student

S.No	Work Description	Maximum Marks
1	Dissertation	80
2	Viva voce	20
Total		100

Colour Code : Blue –Addition / Replacement; Red - Deletion

Note: PASSING MINIMUM: 50 MARKS

I Review: December last week

- Confirmation letter from the company
- Project type & title
- Company profile
- Synopsis
- Contact number & mail_id of the external guide
- S/w selection

II Review: January 3rd week

- Data or System flow diagram
- Documentation of first three chapters
- Database design
- Input design : Forms
- Output design : Reports

III Review : February 3rd week

- Complete coding
- Test plan with demo
- Rough documentation of the entire project

IV Review : March 1st week

- Corrected rough draft
- Explanation of the entire project
- Execution of Implementation Work

Note:

- Attending all the review is compulsory
- PPT and necessary Documentation should be brought for each Review
- Font size in documentation has to be 12 : Times New Roman : Space 1.5
- Document should be neatly aligned and justified
- No change can be made in the review marks later
- Internal mark will be submitted at the same day of review to controller section.

Relationship Matrix for Course Outcomes - Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Course					Hours	Credits			
IV	23PIT4PW	Project with Viva-Voce					6	5			
Course Outcomes (Cos)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓		✓	✓	✓	
CO2	✓	✓		✓	✓	✓	✓		✓	✓	
CO3	✓	✓	✓	✓		✓	✓	✓			
CO4	✓		✓	✓	✓	✓		✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓		✓		
Number of matches (☐) = 40, Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER - IV

Course Code: 23PIT4EC61
Instruction Hours: 6
Credits: 3

Exam Hours: 3
Internal Marks: 25
External Marks: 75

Introduction Robotics

Course Objectives:

To provide an introduction to Robotics and Automation including robot classification, design and selection, analysis and applications in industry. To provide information on various types of end effectors, their design, interfacing and selection.

Course Outcomes:

CO1: List and explain the basic elements of industrial robots

CO2: Analyse robot kinematics and its control methods.

CO3: Classify the various sensors used in robots for better performance

CO4: Summarize various industrial and non-industrial applications of robots

CO5: Mathematically describe a kinematic robot system

UNIT-1: ROBOT BASICS

Robot- Basic concepts, Need, Law, History, Anatomy, specifications.

Robot configurations-Cartesian, cylinder, polar and articulate.

Robot wrist mechanism, Precision and accuracy of robot.

UNI- 2: ROBOT ELEMENTS

End effectors-Classification, Types of Mechanical actuation, Gripper design, and Robot drive system Types, Position and velocity feedback devices-Robot joints and links-Types, Motion interpolation.

UNIT-3: ROBOT SENSORS

Sensors in robot – Touch sensors-Tactile sensor – Proximity and range sensors. Force sensor- Light sensors, Pressure sensors, Introduction to Machine Vision and Artificial Intelligence.

UNIT-4: ROBOT APPLICATIONS

Industrial applications of robots, Medical, Household, Entertainment, Space, Underwater, Defence, Disaster management. Applications, Micro and Nan robots, Future Applications.

UNIT-5: Introduction to Robot Mechanics

Introduction to Robot Mechanics- Power and torque- Acceleration and velocity- Design models for ground mobile robots- Design models for mechanic arms and lifting systems

Text Books:

Learning Resources:

1. Mikell P. Groover, Mitchell Weiss, Roger N Nagel, Nicholas G Odrey, “Industrial Robotics Technology, Programming and Applications”, Tata –McGraw Hill Pub. Co., 2008.
2. Deb.S.R and Sankha Deb, "Robotics Technology and Flexible Automation", Tata McGraw Hill Publishing Company Limited, 2010.

Reference books:

1. Klafter.R.D, Chmielewski.T.A, and Noggin's., “Robot Engineering: An Integrated Approach”, Prentice Hall of India Pvt. Ltd., 1994.
2. Fu.K.S, Gonzalez.R.C&Lee.C.S.G, “Robotics control, sensing, vision and intelligence”, Tata- McGraw Hill Pub. Co., 2008
3. Yu. “Industrial Robotics”, MIR Publishers Moscow, 1985.

Web Reference:

1. <https://ocw.mit.edu/courses/2-12-introduction-to-robotics-fall-2005/pages/lecture-notes/>
2. <https://www.doc.ic.ac.uk/~ajd/Robotics/RoboticsResources/lecture1.pdf>

Relationship Matrix for Course Outcomes - Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Course					Hours	Credits			
IV	23PIT4EC61	Introduction Robotics					6	3			
Course Outcomes (Cos)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓		✓	✓	✓	
CO2	✓	✓		✓	✓	✓	✓		✓	✓	
CO3	✓	✓	✓	✓		✓	✓	✓			
CO4	✓		✓	✓	✓	✓		✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓		✓		
Number of matches () = 40, Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER IV

Course Code: 23PIT4EC62
Instruction Hours: 6
Credits:3

Exam Hours: 3
Internal Marks: 25
External Marks: 75

INTELLIGENT SYSTEM

Course Objective:

To acquire knowledge on various intelligent system techniques and methodologies and to have enriched knowledge on Knowledge representation, problem solving, and learning methods in solving particular engineering problems.

Course Outcomes:

- CO1: Outline the applicability, strength and weakness of artificial intelligence in solving computational problems
- CO2: Demonstrate the role of knowledge representation, problem solving and learning in Intelligent-system engineering
- CO3: Identify the characteristics of AI, Knowledge representation, Experts systems and its variants with ANN and robotics.
- CO4: Analyze a comprehensive background in both software and hardware to work with the future of robotics and adaptive systems
- CO5: Assess the scientific background through various real time examples

UNIT-I :

Artificial Intelligence: AI problems-AI technique-**Problem Search:**-Production Systems – Problem Characteristics – Production system characteristics- **Heuristic Search techniques:** Generate and Test – Hill Climbing – Constraint Satisfaction, Means-end analysis

UNIT-II :

Knowledge representation issues: Representations and mappings – Approaches to Knowledge representations –Frame problem –. **Using Predicate Logic:** Representing simple facts in logic - Representing Instance and ISA relationships – Computable functions and predicates – Resolution

UNIT-III :

Representing knowledge using rules: Procedural Vs Declarative knowledge – Logic programming – Forward Vs Backward reasoning – Matching – Control knowledge.
Knowledge representation summary: Syntactic and Semantic spectrum of representation- Logic and slot – and-filler structures-Other representational techniques

UNIT-IV :

Rule-based expert systems: Introduction- Rules as a knowledge representation technique-players- Structure- Forward chaining and backward chaining inference techniques- **Fuzzy expert systems:** Introduction- Fuzzy sets- Linguistic variables and hedges- Operations - Fuzzy rules- - Building a fuzzy expert system

UNIT-V:

Artificial neural networks: Neuron- perceptron- Multilayer neural networks- - The Hopfield network- **Robotics:** Introduction-Robot hardware-Perception-Moving-Robotic software architecture

Text Book:

1. Elaine rich and Kelvin Knight, “Artificial Intelligence “, Tata McGraw hill Publication, 3rdEdition, 2009. [Unit - I,II,III]
Unit I : Chapters 1, 2, 3
Unit II : Chapters 4, 5
Unit III : Chapters 6, 11
2. Artificial Intelligence: A Guide to Intelligent Systems, 3rd edition, Michael Negnevitsky, Addison Wesley, 2011.[Unit IV-Chapter 1,2,4,V-Chapter 6]
3. Artificial Intelligence a modern Approach “– Stuart Russell & Peter Norvig, 3rd Edition Pearson Education[Unit V-Chapter 25-Robotics]

Reference Books:

1. “Artificial Intelligence a modern Approach “– Stuart Russell & Peter Norvig, 3rd Edition, Pearson Education.
2. “Artificial Intelligence “, George F Luger , 4thEdition , Pearsons Education Publ, 2002.
3. “Foundations of Artificial Intelligent And Expert Systems”, V S Janaki Raman, K Sarukesi, P Gopalakrishnan, Macmillan India Limited

Website and e-Learning Source:

1. <https://www.techopedia.com/definition/190/artificial-intelligence-ai>
2. https://www.tutorialspoint.com/artificial_intelligence/artificial_intelligent_systems.htm
3. <https://data-flair.training/blogs/heuristic-search-ai/>
4. <http://teaching.csse.uwa.edu.au/units/CITS7212/Lectures/Students/Fuzzy.pdf>
<http://engineering.nyu.edu/mechatronics/smart/pdf/Intro2Robotics.pdf>

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Course					Hours	Credits			
IV	23PIT4EC62	INTELLIGENT SYSTEM					6	3			
Course Outcomes (Cos)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓		✓		✓			
CO2	✓	✓				✓	✓	✓	✓		
CO3	✓	✓	✓	✓		✓	✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of matches (✓) = 40, Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER IV

Course Code: 23PIT4SE1
Instruction Hours: 6
Credits: 2

Exam Hours: 3
Internal Marks: 25
External Marks: 75

DATA SCIENCE USING R LAB

Course Objectives:

To understand the python libraries for data science and to learn descriptive analytics on the benchmark data sets and present and interpret data using visualization packages in Python.

Course Outcome:

CO1: Make use of the python libraries for data science

CO2: Make use of the basic Statistical and Probability measures for data science. Lab Manual

CO3: Perform descriptive analytics on the benchmark data sets.

CO4: Perform correlation and regression analytics on standard data sets CS3361 Data Science Laboratory.

CO5: Present and interpret data using visualization packages in Python.

Exercise:

1. Download, install and explore the features of NumPy, SciPy, Jupyter, Statsmodels and Pandas packages.
2. Working with Numpy arrays
3. Working with Pandas data frames
4. Reading data from text files, Excel and the web and exploring various commands for doing descriptive analytics on the Iris data set. CS3361 Data Science Laboratory
5. Use the diabetes data set from UCI and Pima Indians Diabetes data set for performing the following:
 - a. Univariate analysis: Frequency, Mean, Median, Mode, Variance, Standard Deviation, Skewness and Kurtosis.
 - b. Bivariate analysis: Linear and logistic regression modeling
 - c. Multiple Regression analysis
 - d. Also compare the results of the above analysis for the two data sets.
6. Apply and explore various plotting functions on UCI data sets.
 - a. Normal curves
 - b. Density and contour plots
 - c. Correlation and scatter plots
 - d. Histograms CS3361 Data Science Laboratory Lab Manual
 - e. Three dimensional plotting
7. Visualizing Geographic Data with Basemap

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Course					Hours	Credits			
IV	23PIT4SE1	DATA SCIENCE USING R LAB					6	2			
Course Outcomes (Cos)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓		✓		✓			
CO2	✓	✓				✓	✓	✓	✓		
CO3	✓	✓	✓	✓		✓	✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of matches (✓) = 40, Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER IV

Course Code: 23PIT4SE2
Instruction Hours: 6
Credits : 2

Exam Hours: 3
Internal Marks: 25
External Marks: 75

RESEARCH METHODOLOGY

Course Objectives:

To impart knowledge and skills required for research problem formulation, analysis, solutions, technical paper writing and drafting and filing patents.

Course Outcome:

- CO1: Understanding of research, IPR and patent fundamentals
- CO2: Identify the issues involved in research, IPR and patent filing
- CO3: Apply suitable instrumentation and sampling techniques for the research studies and recognize the framework for protecting IPR and process for obtaining patents
- CO4: Analyze data, and interpret research findings using appropriate methods and importance of IPR and patent protection in promoting research and development
- CO5: Design and develop research reports, research proposals, academic papers and patents

UNIT-I:

Research Methodology: Objectives and Motivation of research - Types of research - Research approaches - Significance of research - Research methods verses methodology - research and scientific method - importance of research methodology - research process - approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations- criteria of good research. defining the research problem: definition of research problem - problem formulation - necessity of defining the problem - technique involved in defining a problem.

UNIT-II:

Literature Survey and Data Collection: Importance of literature survey - Sources of information - Assessment of quality of journals and articles - Information through internet. Effective literature studies approaches, analysis, plagiarism, and research ethics. Data - Preparing, Exploring, examining and displaying

UNIT-III:

Research Analysis and Design: Meaning of research design - Need of research design - Different research designs - Basic principles of experimental design - Developing a research plan - Design of experimental set-up - Use of standards and codes. Overview of Multivariate analysis, Hypotheses testing and Measures of Association. Presenting Insights and findings using written reports and oral presentation.

UNIT-IV:

Intellectual Property Rights: Nature of Intellectual Property: Patents, Designs, Trade and Copyright- Process of Patenting and Development: technological research, innovation, patenting, development- Role of WIPO and WTO in IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance

UNIT-V:

Patent Rights: Scope of Patent Rights- Licensing and transfer of technology- Patent information and databases- Geographical Indications -New Developments in IPR: Administration of Patent System, IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs -Licenses, Licensing of related patents, patent agents, Registration of patent agents.

Text Books:

1. R. Ganesan, "Research Methodology for Engineers", MIP Publishers, Chennai, 2011.
2. Catherine J. Holland, "Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets", Entrepreneur Press, 2007.

Reference Books:

1. Peter S. Menell, Mark A. Lemley, Robert P. Merges, "Intellectual Property in the New Technological "Vol. I Perspectives, 2021.
2. Laura R. Ford,"The Intellectual Property of Nations: Sociological and Historical Perspectives on a
3. RatanKhananabis and SuvasisSaha, "Research Methodology", Universities Press, Hyderabad, 2015.
4. David Hunt, Long Nguyen, Matthew Rodgers, "Patent searching: tools & techniques", Wiley, 2007.
5. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners" 2010

Website and e-Learning Source:

1. <https://www.coursera.org/courses?query=research%20methodology>
2. <https://www.researchgate.net/topic/Research-Methodology>
3. https://www.wto.org/english/tratop_e/trips_e/intell_e.htm
4. <https://www.isical.ac.in/~palash/research-methodology/RM-lec9.pdf>
5. https://mrcet.com/downloads/digital_notes/CSE/Mtech/I%20Year/RESEARCH%20METHODLOGY.pdf

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Course					Hours	Credits			
IV	23PIT4SE2	RESEARCH METHODOLOGY					6	2			
Course Outcomes (Cos)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓		✓		✓			
CO2	✓	✓				✓	✓	✓	✓		
CO3	✓	✓	✓	✓		✓	✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of matches (✓) = 40, Relationship: High											

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