# MOTHER TERESA WOMEN'S UNIVERSITY, KODAIKANAL - 624101

# DEPARTMENT OF COMPUTER SCIENCE

# Master of Computer Applications
# (MCA)

Curriculum Framework, Syllabus and Regulations
(Based on TANSCHE syllabus under Choice Based Credit System - CBCS)



(For the candidates to be admitted from the Academic Year 2023-24)

# Mother Teresa Women's University, Kodaikanal.

| TANSCHE REGULATIONS ON LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK FOR POSTGRADUATE EDUCATION | |
|---|---|
| **Programme** | **M.C.A.,** |
| **Programme Code** | |
| **Duration** | **PG - Two Years** |
| **Programme Outcomes (Pos)** | **PO1: Problem Solving Skill:** Apply knowledge of Management theories and Human Resource practices to solve business problems through research in Global context.<br>**PO2: Decision Making Skill:** Foster analytical and critical thinking abilities for data-based decision-making.<br>**PO3: Ethical Value:** Ability to incorporate quality, ethical and legal value-based perspectivesto all organizational activities.<br>**PO4: Communication Skill:** Ability to develop communication, managerial and interpersonal skills.<br>**PO5: Individual and Team Leadership Skill:** Capability to lead themselves and the team to achieve organizationalgoals.<br>**PO6: Employability Skill:** Inculcate contemporary business practices to enhance employabilityskills in the competitive environment.<br>**PO7: Entrepreneurial Skill:** Equip with skills and competencies to become an entrepreneur.<br>**PO8: Contribution to Society:** Succeed in career endeavors and contribute significantly to society.<br>**PO 9 Multicultural competence:** Possess knowledge of the values and beliefs of multiple cultures anda global perspective.<br>**PO 10: Moral and ethical awareness/reasoning:** Ability to embrace moral/ethical values in conducting one's life. |
| **Programme Specific Outcomes (PSOs)** | **PSO1 – Placement:** To prepare the students who will demonstrate respectful engagementwith others' ideas, behaviours, beliefs and apply diverse frames of reference to decisions and actions.<br>**PSO 2 – Entrepreneur:** To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitatestartups and high potential organizations.<br>**PSO3 – Research and Development:** Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development.<br>**PSO4 – Contribution to Business World:** To produce employable, ethical and innovative professionals to sustain in the dynamic business world. |

| | **PSO 5 – Contribution to the Society:** To contribute to the development of the society by collaborating withstakeholders for mutual benefit. |
|---|---|

## WRITTEN EXAMINATION QUESTION PAPER PATTERN

### Theory Paper (Bloom's Taxonomy based)

| **Intended Learning Skills** | **Maximum 75 Marks**<br>**Passing Minimum: 50%**<br>**Duration: Three Hours** |
|---|---|
| Memory Recall/Example/<br>Counter Example / Knowledge about the Concepts/Understanding | **Part–A** (10x2=20Marks)<br>Answer ALL questions<br>**Each Question carries 2 marks** |
| | Two questions from each Unit |
| | **Question 1 toQuestion10** |
| Descriptions/Application<br>(problems) | **Part–B (5x5=25Marks) Answer**<br>**ALL questions**<br>**Each question carries 5 Marks** |
| | **Either - or Type**<br>Both parts of each question from the same Unit |
| | **Question 11 (a) or 11(b)**<br>to<br>**Question 15(a) or 15(b)** |
| Analysis/Synthesis / Evaluation | **Part-C (3x 10 = 30 Marks)**<br>**Answer any THREE questions**<br>**Each question carries 10 Marks** |
| | There shall be FIVE questions covering all the five units |
| | **Question 16 to Question 20** |

**\*Minimum credits required to pass: 91**

| **METHODS OF EVALUATION** | | |
|---|---|---|
| **Internal Evaluation** | Continuous Internal Assessment Test | **25 Marks** |
| | Assignments / Snap Test / Quiz | |
| | Seminars | |
| | Attendance and Class Participation | |
| **External Evaluation** | End Semester Examination | **75 Marks** |
| **Total** | | **100 Marks** |
| | | |

| METHODS OF ASSESSMENT | |
|---|---|
| **Remembering (K1)** | • The lowest level of questions require student store call information from the course content<br>• Knowledge questions usually require students to identify information in the text book. |
| **Understanding (K2)** | • Understanding off acts and ideas by comprehending organizing, comparing, translating, interpolating and interpreting in their own words.<br>• The questions go beyond simple recall and require students to combine data together |
| **Application (K3)** | • Students have to solve problems by using/ applying a concept learned in the classroom.<br>• Students must use their knowledge to determine a exact response. |
| **Analyze (K4)** | • Analyzing the question is one that asks the students to breakdown something into its component parts.<br>• Analyzing requires students to identify reasons causes or motives and reach conclusions or generalizations. |
| **Evaluate (K5)** | • Evaluation requires an individual to make judgment on something.<br>• Questions to be asked to judge the value of an idea, a character, a work of art, or a solution to a problem.<br>• Students are engaged in decision-making and problem–solving.<br>• Evaluation questions do not have single right answers. |
| **Create (K6)** | • The questions of this category challenge students to get engaged in creative and original thinking.<br>• Developing original ideas and problem solving skills |

# Syllabus and Framework for PG Programme in Computer Applications
## MCA

### SEMESTER - I

| Part | Course Code | Course Title | No. of Credits | Hours per week | Marks | | |
|------|-------------|--------------|----------------|----------------|-------|-----|-----|
| | | | | | IA | ESE | Tot |
| PART A | P23CAT11 | Core – I Theory Discrete Mathematics | 5 | 7 | 25 | 75 | 100 |
| | P23CAT12 | Core – II Theory Data Structures and Algorithms | 5 | 7 | 25 | 75 | 100 |
| | P23CAP13 | Core – III Lab Data Structures and Algorithms Lab | 4 | 6 | 25 | 75 | 100 |
| | P23CAE1A / P23CAE1B / P23CAE1C / P23CAE1D | Elective – I (Discipline Specific) Data Engineering and Management / Data Engineering and Management Lab/ Architecture and Frameworks / Architecture and Frameworks Lab | 3 | 5 | 40 | 60 | 100 |
| | P23CAG11 | Elective – II (Generic Course) Women Empowerment | 3 | 5 | 40 | 60 | 100 |
| | | | 20 | 30 | | | |
| | | **SEMESTER II** | | | | | |
| PART A | P23CAT24 | Core - IV Theory Linux and Shell Programming | 5 | 6 | 25 | 75 | 100 |
| | P23CAT25 | Core – V Theory Big Data Analytics | 5 | 6 | 25 | 75 | 100 |
| | P23CAP26 | Core – VI Lab Bigdata Analytics Lab | 4 | 6 | 25 | 75 | 100 |
| | P23CAE2A / P23CAE2B / P23CAE2C / P23CAE2D | Elective - III Internet of Things / Internet of Things Lab/ Computer Vision / Computer Vision Lab | 3 | 4 | 40 | 60 | 100 |
| | P23CSG22 | Elective – IV – Generic Course - Cyber Security | 3 | 4 | 40 | 60 | 100 |
| | P23CAS21 | Data Analysis Using Microsoft Excel | 2 | 4 | 25 | 75 | 100 |
| | | | 22 | 30 | | | |

## P23CAT11 - DISCRETE MATHEMATICS

**Course Objective**
- To know the concepts of relations and functions
- To distinguish among different normal forms and quantifiers
- To solve recurrence relations and permutations & combinations
- To know and solve matrices , rank of matrix & characteristic equations
- To study the graphs and its types

**Unit-I**

**Relations**- Binary relations-Operations on relations- properties of binary relations in a set – Equivalence relations— Representation of a relation by a matrix -Representation of a relation by a digraph – **Functions**-Definition and examples-Classification of functions-Composition of functions-Inverse function

**Unit-II**

**Mathematical Logic**-Logical connectives-**Well formed formulas** – Truth table of well formed formula –Algebra of proposition –Quine's method- **Normal forms of well formed formulas**- Disjunctive normal form-Principal Disjunctive normal form-Conjunctive normal form-Principal conjunctive normal form-**Rules of Inference for propositional calculus** – **Quantifiers**- Universal Quantifiers- Existential Quantifiers

**Unit-III**

**Recurrence Relations**- Formulation -solving recurrence Relation by Iteration- solving Recurrence Relations- Solving Linear Homogeneous Recurrence Relations of Order Two-Solving Linear Non homogeneous Recurrence Relations. **Permutations**-Cyclic permutation-Permutations with repetitions- permutations of sets with indistinguishable objects-**Combinations**- Combinations with repetition

**Unit-IV**

**Matrices-** special types of matrices-Determinants-Inverse of a square matrix-Cramer's rule for solving linear equations-Elementary operations-Rank of a matrix-solving a system of linear equations-characteristic roots and characteristic vectors-Cayley-Hamilton Theorem-problems

**Unit-V**

**Graphs** -Connected Graphs -Euler Graphs- Euler line-Hamiltonian circuits and paths –planar graphs – Complete graph-Bipartite graph-Hyper cube graph-Matrix representation of graphs

**Text book**
1. N.Chandrasekaran and M.Umaparvathi, Discrete mathematics, PHI Learning Private Limited, New Delhi, 2010.

**Reference Book**
1. Kimmo Eriksson &Hillevi Gavel, Discrete Mathematics & Discrete Models, Studentlitteratur AB, 2015.
2. Kenneth H. Rosen Discrete Mathematics and applications, Mc Graw Hill, 2012

**Course Outcomes**

On the successful completion of the course, students will be able

| CO1: | To understand the concepts of relations and functions distinguish among normal forms | K2 | IO |
|------|------|------|------|
| CO2: | To analyze and evaluate the recurrence relations | K4,K5 | HO |
| CO3: | To distinguish among various normal forms and predicate calculus | K5 | HO |
| CO4: | To solve and know various types of matrices | K1 | LO |
| CO5: | To evaluate and solve various types of graphs | K5 | HO |

**K1- Remember, K2- Understand, K3- Apply, K4- Analyze, K5- Evaluate, K6- Create**

## P23CAT12 - DATA STRUCTURES AND ALGORITHMS

**Course Objectives:**
- To get a clear understanding of various ADT structures.
- To understand how to implement different ADT structures with real-time scenarios.
- To analyze the various data structures with their different implementations.
- To get an idea of applying right models based on the problem domain.
- To realize, and understand how and where to implement modern data structures with Python language.

**Unit-I**

**Abstract Data Types:** Introduction-Date Abstract Data Type-Bags-Iterators. **Arrays**: Array Structure-Python List-Two Dimensional Arrays-Matrix Abstract Data Type. **Sets, Maps:** Sets-Maps- Multi-Dimensional Arrays.

**Unit-II**

**Algorithm Analysis:** Experimental Studies-Seven Functions-Asymptotic Analysis. **Recursion:** Illustrative Examples-Analyzing Recursive Algorithms-Linear Recursion- Binary Recursion-Multiple Recursion.

**Unit-III**

**Stacks, Queues, and Deques:** Stacks- Queues- Double-Ended Queues Linked. **Lists:** Singly Linked Lists-Circularly Linked Lists-Doubly Linked Lists. **Trees:** General Trees-BinaryTrees-Implementing Trees-Tree Traversal Algorithms.

**Unit-IV**

**Priority Queues:** Priority Queue Abstract Data Type- Implementing a Priority Queue- Heaps-Sorting with a Priority Queue. **Maps, Hash Tables, and Skip Lists:** Maps and Dictionaries-Hash Tables- Sorted Maps-Skip Lists-Sets, Multisets, and Multimaps.

**Unit-V**

**Search Trees:** Binary Search Trees-Balanced Search Trees-AVL Trees-Splay Trees. **Sorting and Selection:** Merge sort-Quick sort-Sorting through an Algorithmic Lens- Comparing Sorting Algorithms-Selection. **Graph Algorithms:** Graphs-Data Structures for Graphs-Graph Traversals-Shortest Paths-Minimum Spanning Trees.

**Text book:**
1. Rance D. Necaise, "Data Structures and Algorithms Using Python", John Wiley & Sons, 2011. (Unit – 1)**Chapters:** 1, 2, 3.
2. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, "Data Structures and Algorithms in Python", John Wiley & Sons, 2013. (Unit – 2, 3, 4, and 5)**Chapters:** 3 to 12, and 14.

**Reference books:**
1. Dr. Basant Agarwal; Benjamin Baka, "Hands-On Data Structures and Algorithms with Python: Write complex and powerful code using the latest features of Python 3.7", Packt Publishing, 2018.
2. Magnus Lie Hetland, "Python Algorithms: Mastering Basic Algorithms in the Python Language", Apress, 2014.

**Course Outcome:**

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

| CO1 | Understand various ADT concepts | |
|------|------|------|
| CO2 | Familiar with implementation of ADT models with Python language and understand how to develop ADT for the various real-time problems | |
| CO3 | Apply with proper ADT models with problem understanding | K1-K6 |
| CO4 | Apply and Analyze right models based on the problem domain | |
| CO5 | Evaluate modern data structures with Python language | |

K1- Remember, K2 - Understand, K3 - Apply , K4 - Analyze, K5 - Evaluate, K6 -Create

**Mapping with Programme Outcomes:**

|      | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| CO1 | S | M | L | L | L | L | S | S | S | L | M | M |
| CO2 | S | M | S | M | M | L | L | L | L | L | M | M |
| CO3 | S | S | S | L | L | L | M | M | M | M | M | L |
| CO4 | S | S | S | L | L | L | M | M | M | L | L | L |
| CO5 | S | S | S | L | M | M | S | S | S | S | M | L |

**L - Low, M- Medium, S - Strong**

### P23CAP13 - DATA STRUCTURES AND ALGORITHMS LAB

**Course Objectives:**
- To understand Stack , Queue and Doubly Linked ADT structures.
- To implement different ADT structures with real-time scenarios.
- To analyze the recursion concepts.
- To apply different sorting and tree techniques.
- To implement modern data structures with Python language.

**Implement the following problems using Python 3.4 and above**

1. Recursion concepts.
    i) Linear recursion
    ii) Binary recursion.

2. Stack ADT.
3. Queue ADT.
4. Doubly Linked List ADT.
5. Heaps using Priority Queues.
6. Merge sort.
7. Quick sort.
8. Binary Search Tree.
9. Minimum Spanning Tree.
10. Depth First Search Tree traversal.

**Course Outcome:**

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

| CO1 | Strong understanding in various ADT concepts | |
|------|--------------------------------------------------|--------|
| CO2 | To become a familiar with implementation of ADT models | |
| CO3 | Apply  sort and tree search algorithms | K1-K6 |
| CO4 | Evaluate the different data structure models | |
| CO5 | Learn how to develop ADT for the various real-time problems | |

K1- Remember, K2 -  Understand,  K3 - Apply ,  K4 - Analyze,  K5 - Evaluate,  K6 -Create

**Mapping with Programme Outcomes:**

|      | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| CO1  | S   | M   | L   | L   | L   | L   | S   | S   | M   | M    | S    | S    |
| CO2  | S   | M   | S   | M   | M   | L   | S   | M   | S   | L    | M    | M    |
| CO3  | S   | S   | S   | L   | L   | L   | M   | M   | M   | M    | S    | L    |
| CO4  | S   | S   | S   | M   | M   | S   | M   | M   | S   | S    | S    | L    |
| CO5  | S   | S   | S   | S   | L   | M   | S   | M   | M   | M    | M    | L    |

**L - Low,  M- Medium, S – Strong**

**P23CAE1A - Data Engineering and ManagementCourse Objectives:**
- To understand Data Management concepts
- To get brief knowledge on Data Modeling
- To analyse the techniques used in Distributed Databases
- To assess Distributed database and Business Modelling
- To get familiar with CRM tools

**Unit-I**

DATABASE DEVELOPMENT: Database architecture of an information system-Overview of the database development process-Conceptual data modeling-Relational data analysis-Roles of a data model-Physical database design. DATA MANAGEMENT: Problems encountered without data management-Data management responsibilities-Data management activities-Roles within data management-Benefits of data management-Relationship between data management and enterprise

**Unit-II**

CORPORATE DATA MODELLING: Need for a corporate data model-Nature of a corporate data model- Develop a corporate data model - Corporate data model principles. DATA DEFINITION AND NAMING: Elements of a data definition-Data naming conventions.DATA QUALITY: Issues associated with poor data quality-Causes of poor data quality- Dimensions of data quality-Data model quality-Improving data quality. DATAACCESSIBILITY: Data security-Data integrity-Data recovery

**Unit-III:**

USE OF PACKAGED APPLICATION SOFTWARE: Application software packages-Impact on data management. DISTRIBUTED DATA AND DATABASES: Rationale for distributing data-Perfect distributed database system-Top down fragmentation and partitioning. Bottom up integration-The management of replication. BUSINESS INTELLIGENCE: Data warehousing-Multidimensional model of data-Standard reporting tools-Online analytical processing OLAP-Relational schema for a data warehouse.

**Unit-IV:**

CRM: Three main pillars of CRM. GETTING TO KNOW YOUR CUSTOMER: 360-degree client view. UTILIZING ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING IN YOUR CRM STRATEGY: Evolution of AI-Current state of AI-Teaming up AI with people-Applying AI to your CRM solution-ethical aspects of AI-An example of AI in CRM processes.

**Unit-V:**

CLOUD VERSUS ON PREMISE VERSUS HYBRID: Factors influencing vendor selection-Hybrid deployment-what are your options. CRM DIFFERENTIATORS: It's not about the feature list; it's about the ecosystem-Fourth industrial revolution and CRM-AI and smart cloud-To cloud or not to cloud-Leveraging smart cloud into CRM-Big data-Social selling and advertising-Implementation tools-Sustainable CRM platform.

**Text Books:**
1. Keith Gordon, "Principles of Data Management Facilitating Information Sharing", BCS Learning, 2013. (Chapters:1-5, 7,8,12,13,14)
2. Max Fatouretchi, "The Art of CRM", Packt Publishing, 2019.(Chapters: 1,2,5,8,9)

**Reference Books:**
1. Peter Ghavami, "Big Data Management_ Data Governance Principles for Big Data Analytics", De Gruyter, 2020.
2. Francis Buttle, Stan Maklan, Customer Relationship Management Concepts and Technologies, Routledge, 2019.

**Course Outcome:**

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

| Course Outcome | Description | Knowledge Level |
|---|---|---|
| CO1 | Comprehend the Data Management concepts and analyse the relationship with the enterprise | K1- K6 |
| CO2 | Analyze Data Modelling concepts and assess its quality | |
| CO3 | Understand and implement business modelling techniques | |
| CO4 | Evaluate the use of Artificial Intelligence and Machine Learning in CRM | |
| CO5 | Develop CRM applications in cloud | |

K1- Remember, K2 - Understand, K3 - Apply, K4 - Analyze, K5 - Evaluate, K6 -Create

**Mapping with Programme Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | S | S | M | S | M | S | S | S | S | M | S | S |
| CO2 | S | S | S | M | S | S | S | S | S | S | M | S |
| CO3 | S | M | S | S | M | S | M | S | S | M | S | S |
| CO4 | S | S | S | S | S | S | S | M | S | S | M | S |
| CO5 | S | S | S | S | S | S | S | S | S | M | M | S |

L - Low,  M- Medium, S – Strong

## P23CAE1B - Data Engineering and Management Lab

**Course Objectives:**
- To acquire basic scripting knowledge in MongoDB
- To learn CRUD Operation on MongoDB database
- To comprehend MongoDB using DbVisualizer
- To be familiar with Zoho CRM features
- To customize your application using Zoho CRM

1. Write a script to create a MongoDB database and perform insert operation
2. Write a MongoDB script to perform query operations
3. Write a MongoDB Script to perform update operations
4. Write a MongoDB Script to update documents with aggregation pipeline
5. Write a MongoDB script to delete single and multiple documents
6. Write a MongoDB script to perform string aggregation operations
7. Design a Data Model for MongoDB using DbVisualizer
8. Perform CRUD operations using DbVisualizer
9. Create a Zoho CRM account and organize your Tasks, Meetings and Deals
10. Create and maintain a project using Zoho CRM features

**Course Outcomes**

**On the successful completion of the course, students will be able to**

| Course Outcome | Description | Knowledge Level |
|---|---|---|
| **CO1** | Comprehend the scripting knowledge in MongoDB and perform basic operations in shell prompt | **K1- K6** |
| **CO2** | Implement, Create, Read, Update and Delete Operations on MongoDB database | |
| **CO3** | Analyze MongoDB using DbVisualizer | |
| **CO4** | Assess Zoho CRM features for managing the customer relationships | |
| **CO5** | Create a customized application in Zoho CRM | |

**K1- Remember, K2- Understand, K3- Apply, K4- Analyze, K5- Evaluate, K6-Create**

**Mapping with Programme Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | S | S | S | S | S | M | S | S | S | M | S | S |
| CO2 | S | S | S | S | S | S | S | S | S | S | L | S |
| CO3 | S | M | S | S | M | S | M | S | S | S | S | S |
| CO4 | S | S | S | M | S | S | S | L | S | S | M | S |
| CO5 | S | S | S | S | M | S | S | S | S | S | S | S |

**S- Strong; M-Medium; L-Low**

## P23CAE1C - ARCHITECTURE AND FRAMEWORKS

**Course Objectives**

- To understand the basics, benefits and purpose of software architecture
- Understand the quality attributes to fulfil the software requirements and relates the software with an organization
- Explore the design patterns, best practice and paradigms of efficient software development
- Understand the performance and security measures of software architecture
- Enable the developers to advance their carrier in software domain

**Unit – I**

Software architecture introduction – Importance of Software architecture –Software architecture consumers – Architect role - software architecture in an organization – Types of software architects – Software development methodologies – Project management – Office politics – Software risk management – Configuration management – Software product lines

**Unit – II**

Domain Knowledge – Developing business acumen – Domain-driven design – requirement engineering – requirement elicitation –Software Quality attributes: Maintainability – Usability –Availability – Portability – Interoperability - Testability

**Unit – III**

Software Architectures design – Importance - Top-down Versus bottom-up design approaches – Architectural drivers – Documenting the Software architecture design – Systematic approach - Attribute-driven design – Microsoft's technique for architecture and design –Architecture-centric design method – Architecture development method – Tracking the progress of the software architecture's design.

**Unit – IV**

Designing orthogonal software systems – Minimizing complexity – SOLID design principles – Software architecture patterns – layered – Event-driven architecture – Model-View patterns – Service-oriented architecture

**Unit – V**

Architecting Modern Applications.- Importance of Performance – Performance improvement - Server side caching – Web application performance – Database performance -Securing software systems – Threat modelling – Secure by design

**Text Book**

1.    Joseph Ingeno, "Software Architect's Handbook" Packt Publishing 2018.

**Reference books**

1.    Oliver Vogel, Indo Arnold, ArifChughtaiandTImoKehrer, "Software Architecture" Springer-Verlag, 2011.
2.    Ian Gorton, "Essential Software architecture", Second Edition, Springer, 2011
3.    Len Bass, Paul Clements and Rick Kazman, "Software architecture in practice", Third edition, Addison-Wesley, 2013

**Course Outcomes**

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

| | | |
|---|---|---|
| CO1 | Understand, analyze and evaluate the purpose of Software architecture and development methodologies with consideration of risk management | K1-K6 |
| CO2 | Comprehend, apply and evaluate the domain knowledge for software development process and determine the impact of quality attributes. | K1-K6 |
| CO3 | Understand, track and examine the systematic approach for various software design models with effective document process | K1-K6 |
| CO4 | Illustrate and summarize the functions of orthogonal systems with complexity, design principles and design pattern for software architecture | K1-K6 |
| CO5 | Comprehend, analyze and evaluate the performance and security measures for Server, Web and Database applications in order to create the secure software systems for various domain applications | K1-K6 |

**K1- Remember, K2- Understand, K3- Apply , K4- Analyze, K5- evaluate and K6-Create**

**Mapping with Programme Outcome**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | S | - | L | M | S | M | M | L | S | - | - |
| CO2 | M | S | - | M | M | L | S | S | M | M | S | - |
| CO3 | S | M | - | S | S | M | S | M | M | S | M | - |
| CO4 | S | M | L | S | M | L | S | L | S | M | S | M |
| CO5 | M | S | M | L | S | L | M | S | L | S | - | M |

**S- Strong; M-Medium; L-Low**

### P23CAE1D - ARCHITECTURE AND FRAMEWORKS – LAB

**Course Objectives**
- To understand and implement the basic concepts of Software architecture and its functions.
- To acquire programming skills to develop Implement various technologies and services associated with network protocols along with the challenges of data transfer.
- Implement the importance and functioning of Routing Protocols over communication service.
- To acquire skills to connect two routers and any two switches.
- To comprehend related to SSH protocols and accessing the remote device.

Note: Use the solid servers and client specification for implementation

https://github.com/solid/specification/.
Implement the following using Linux / Windows environments

1. Find the WebID profile document and display the necessary attributes
2. Set and access the primary authentications with account recovery mechanisms
3. Set and access the secondary authentications with account recovery mechanisms
4. Design authorization and web access control
5. Find the content representation
6. Reading resources from HTTP REST API and WebSockets API
7. Writing resources from HTTP REST API and WebSockets API
8. Data notification using Social Web App protocol
9. Managing subscriptions and friends list using Social Web App protocol
10. Managing list of followers and following list using Social Web App protocol

**Course Outcomes**

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

| | | |
|---|---|---|
| CO1 | Comprehend the programming skills of Software architecture tools and packages | K1-K6 |
| CO2 | Understand and implement the user profiles and authentication with recovery mechanism. | K1-K6 |
| CO3 | Comprehend and evaluate the access control and content representation use of FTP server | K1-K6 |
| CO4 | Understand and implement reading and writing resources for various applications | K1-K6 |
| CO5 | Identify and examine the notifications, friends, and follower list of social application protocols. | K1-K6 |

**K1- Remember, K2- Understand, K3- Apply, K4- Analyze, K5-Evaluate, K6- Create**

**Mapping Course outcomes with Programme outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | S | S | M | L | M | S | - | - | - | - | - | - |
| CO2 | S | M | S | S | S | M | - | - | - | - | - | - |
| CO3 | S | M | S | M | S | M | - | - | - | - | - | - |
| CO4 | S | M | L | S | M | L | - | - | - | - | - | - |
| CO5 | M | S | M | L | S | L | - | - | - | - | - | - |

**S- Strong; M-Medium; L-Low**

<div align="center">

**SEMESTER – II**

**P23CAT24 - LINUX AND SHELL PROGRAMMING**

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**Course Objective**
- To teach principles of operating system including File handling utilities, Basic Linux commands, Scripts and filters.
- To familiarize fundamentals of shell (bash), shell programming, pipes, Control structures, arithmetic in shell interrupt processing, functions, debugging shell scripts.
- To impart fundamentals of file concepts kernel support for file, File structure related system calls (file API's).
- To facilitate students in understanding Inter process communication, semaphore and shared memory.
- To explore real-time problem solution skills in Shell programming.

**Unit-I**
**Basic bash Shell Commands:** Interacting with the shell-Traversing the file system-Listing files and directories-Managing files and directories-Viewing file contents. **Basic Script Building:** Using multiple commands-Creating a script file-Displaying messages-Using variables-Redirecting input and output-Pipes-Performing math-Exiting the script. **Using Structured Commands:** Working with the if-then statement-Nesting ifs-Understanding the test command-Testing compound conditions-Using double brackets and parentheses-Looking at case.
(Book-1, Chapters: 3, 11, and 12)
**Unit-II**
**More Structured Commands:** Looping with for statement-Iterating with the until statement-Using the while statement-Combining loops - Redirecting loop output. **Handling User Input:** Passing parameters - Tracking parameters - Being shifty - Working with options-Standardizing options-Getting user input. **Script Control:** Handling signals - Running scripts in the background-Forbidding hang-ups -Controlling a Job-Modifying script priority-Automating script execution.
(Book-1, Chapters: 13, 14, and 16)

**Unit-III**
**Creating Functions:** Basic script functions-Returning a value-Using variables in functions-Array and variable functions-Function recursion - Creating a library-Using functions on the command line. **Writing Scripts for Graphical Desktops:** Creating text menus-Building text window widgets-Adding X Window graphics. **Introducing sed and gawk:** Learning about the sed Editor-Getting introduced to the gawk Editor-Exploring sed Editor basics.
(Book-1, Chapters: 17, 18, and 19)
**Unit-IV**
**Regular Expressions:** Defining regular expressions-Looking at the basics-Extending our patterns-Creating expressions. **Advanced sed:** Using multiline commands-Understanding the hold space-Negating a command-Changing the flow-Replacing via a pattern-Using sed in scripts-Creating sed utilities. **Advanced gawk:** Reexamining gawk - Using variables in gawk-Using structured commands-Formatting the printing-Working with functions.
(Book-1, Chapters: 20, 21, and 22)
**Unit-V**

**Working with Alternative Shells:** Understanding the dash shell-Programming in the dash shell-Introducing the zsh shell-Writing scripts for zsh. **Writing Simple Script Utilities:** Automating backups-Managing user accounts-Watching disk space. **Producing Scripts for Database, Web, and E-Mail:** Writing database shell scripts-Using the Internet from your scripts-Emailing reports from scripts. **Using Python as a Bash Scripting Alternative:** Technical requirements - Python Language-Hello World the Python way-Pythonic arguments-Supplying arguments - Counting arguments - Significant whitespace - Reading user input-Using Python to write to files-String manipulation.

 (Book-1, Chapters: 23, 24, 25, and Book-2, Chapter: 14)

**Text book:**

1. Richard Blum, Christine Bresnahan, "Linux Command Line and Shell Scripting BIBLE", Wiley Publishing, 3rd Edition, 2015.**Chapters:** 3, 11 to 14, 16 to 25.
2. Mokhtar Ebrahim, Andrew Mallett, "Mastering Linux Shell Scripting", Packt Publishing, 2nd Edition, 2018. **Chapter:** 14.

**Reference Books:**

1. ClifFlynt,SarathLakshman,ShantanuTushar, "Linux Shell Scripting Cookbook ", Packt Publishing, 3rd Edition, 2017.
2. Stephen G.Kochan, Patrick Wood, "Shell Programming in Unix, Linux, and OS X", Addison Wesley Professional, 4th Edition, 2016.
3. Robert Love, "Linux System Programming", O'Reilly Media, Inc, 2013
4. W.R. Stevens, "Advanced Programming in the UNIX environment", 2nd Edition, Pearson Education, 2013
5. Graham Glass, King Ables, " UNIX for Programmers and Users", 3rd Edition, Pearson Education, 2003

**Course Outcomes**

On the successful completion of the course, students will be able

| CO1: | To understand, apply and analyze the concepts and methodology of Linux shell programming | K1-K6 |
|---|---|---|
| CO2: | To comprehend, impart and apply fundamentals of control structure and script controls | K1-K6 |
| CO3: | To understand, analyses and evaluate the functions, graphical desktop interface and editors | K1-K6 |
| CO4: | To collaborate, apply and review the concepts and methodology of regular expression and advanced gawk | K1-K6 |
| CO5: | To comprehend, use and illustrate the advance concepts such as alternate shell script, data connectivity and  bash scripting using python | K1-K6 |

**K1- Remember, K2- Understand, K3- Apply, K4- Analyze, K5- Evaluate, K6-Create**

**Mapping with Programme Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | S | S | S | - | S | L | - | M | M | M | M | S |
| CO2 | S | S | M | - | S | L | - | M | M | M | M | S |
| CO3 | S | S | M | - | S | L | - | M | M | S | S | S |
| CO4 | S | S | M | - | S | L | - | M | M | M | M | S |
| CO5 | S | S | M | - | S | L | - | M | M | M | M | S |

**S- Strong; M-Medium; L-Low**

## P23CAT25 - BIG DATA ANALYTICS

**Course Objectives**
- To introduce big data tools & Information Standard formats.
- To understand the basic concepts of big data.
- To learn Hadoop, HDFS and MapReduceconcepts.
- To teach the importance of NoSQL.
- To explore the big data tools such as  Hive, HBase and Pig.

**UNIT I**
**Big Data and Analytics:** Classification of Digital Data: Structured Data- Semi Structured Data and Unstructured Data.
Introduction to Big Data: Characteristics – Evolution – Definition - Challenges with Big Data - Other Characteristics of Data - Big Data - Traditional Business Intelligence versus Big Data - Data Warehouse and Hadoop.
Environment Big Data Analytics: Classification of Analytics – Challenges - Big Data Analytics important - Data Science - Data Scientist - Terminologies used in Big Data Environments – Basically Available Soft State Eventual Consistency - Top Analytics Tools

**UNIT II**
**Technology Landscape:** NoSQL, Comparison of SQL and NoSQL, Hadoop -RDBMS Versus Hadoop - Distributed Computing Challenges – Hadoop Overview - Hadoop Distributed File System - Processing Data with Hadoop - Managing Resources and Applications with Hadoop YARN - Interacting with Hadoop Ecosystem

**UNIT III**
**Mongodb and Mapreduce Programming:** MongoDB: Mongo DB - Terms used in RDBMS and Mongo DB - Data Types - MongoDB Query Language.
MapReduce: Mapper – Reducer – Combiner – Partitioner – Searching – Sorting – Compression

**UNIT IV**
**Hive:** Introduction – Architecture - Data Types - File Formats - Hive Query Language Statements – Partitions – Bucketing – Views - Sub- Query – Joins – Aggregations - Group by and Having – RCFile - Implementation - Hive User Defined Function - Serialization and Deserialization.

**UNIT V**
**Pig:** Introduction - Anatomy – Features – Philosophy - Use Case for Pig - Pig Latin Overview - Pig Primitive Data Types - Running Pig - Execution Modes of Pig - HDFS Commands - Relational Operators - Eval Function - Complex Data Types - Piggy Bank - User-Defined Functions - Parameter Substitution – Diagnostic Operator - Word Count Example using Pig - Pig at Yahoo! - Pig Versus Hive

**Text Book:**
1. Seema Acharya, Subhashini Chellappan, "Big Data and Analytics",  Wiley Publications, First Edition,2015

**Reference Book:**
1. Judith Huruwitz, Alan Nugent, Fern Halper, Marcia Kaufman, "Big data for dummies", John Wiley & Sons, Inc. (2013)
2. Tom White, "Hadoop The Definitive Guide", O'Reilly Publications, Fourth Edition, 2015

3. Dirk Deroos, Paul C.Zikopoulos, Roman B.Melnky, Bruce Brown, Rafael Coss, "Hadoop For Dummies", Wiley Publications, 2014
4. Robert D.Schneider, "Hadoop For Dummies", John Wiley & Sons, Inc. (2012)
5. Paul Zikopoulos, "Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data, McGraw Hill, 2012 Chuck Lam, "Hadoop In Action", Dreamtech Publications, 2010

**Course Outcomes**

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

| | | |
|---|---|---|
| CO1: | To understand, illustrate and evaluate the concepts and techniques of Data Science, Big Data Analytics and its tools | K1-K6 |
| CO2: | To collaborate, apply and review the computing for big data in Hadoop, andNoSQL environment. | K1-K6 |
| CO3: | To comprehend, implement and review the concepts of data science and big data analytics projects using MapReduce, and MongoDB | K1-K6 |
| CO4: | To understand, use and analyze the concepts of big data analytics projects using HIVE database. | K1-K6 |
| CO5: | To illustrate, develop and review the concepts of PIG database in Hadoop environment. | K1-K6 |

**K1- Remember, K2- Understand, K3- Apply, K4- Analyze, K5 Evaluate, K6- Create**

**Mapping with Programme Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | S | - | - | - | - | L | - | - | - | - | - | - |
| CO2 | S | - | M | - | M | L | - | - | - | - | - | - |
| CO3 | S | - | S | - | S | L | - | - | - | S | S | S |
| CO4 | S | - | S | - | S | L | - | - | - | S | S | S |
| CO5 | S | - | S | - | S | L | - | - | - | S | S | S |

**S- Strong; M-Medium; L-Low**

## P23CAP26 - BIG DATA ANALYTICS LAB

**Course Objectives**
- To teach the fundamental techniques for handling the big data tools.
- To familiarize the tools required to manage big data.
- To analyse big data using Hadoop, MapReduce, Hive, and Pig
- To teach the fundamental principles in achieving big data analytics with scalability and streaming capability
- To enable students to have skills that will help them to solve complex.

**List of Programs**
1. Implement File System Shell Commands for HDFS in Hadoop Environment
2. Write a Mapreduce program using single reduce function for finding Maximum and Minimum Number
3. Write a Mapreduce program using multiple reduce function for Word Count in an given Text document
4. Implement the following using Pig Latin Input and Output Operations Relational Operations
5. Implement the following using Pig Latin User Defined Functions Advanced Relational Operations
6. Write a Word Count program using Pig Latin Script
7. Write a program to find a maximum temperature using Pig Latin Script
8. Implement the following using Hive commands Handling the Database Creating and Manipulating table
9. Implement Simple Queries for database using Mongo
10. Implement Simple Queries for collections using Mongo

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

| | | |
|---|---|---|
| CO1: | Understand and develop conceptually how Big Data is stored and implement it using different tools | K1-K6 |
| CO2: | Comprehend and implement programs for data storage in HDFS and table manipulation using Big Data tools in Hadoop environment | K1-K6 |
| CO3: | Understand and Critically analyse existing     Big     Datadatasets     and implementations the solutions for it using MongoDB | K1- K6 |
| CO4: | Understand and examine existing Big                Datadatasets               and implementations the solutions using HIVE database | K1- K6 |
| CO5: | Comprehend   and review existing datasets and implementations the solutions to handle it using PIG | K1- K6 |

**K1- Remember, K2- Understand, K3- Apply , K4- Analyze, K5- Evaluate, K6- Create**

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| CO1 | S | S | M | | M | S | - | - | - | - | - | - |
| CO2 | S | M | S | S | S | M | - | - | - | - | - | - |
| CO3 | S | S | S | S | S | S | - | - | - | - | - | - |
| CO4 | S | M | S | S | S | M | - | - | - | - | - | - |
| CO5 | S | S | S | S | S | S | - | - | - | - | - | - |

**S- Strong; M-Medium; L-Low**

## P23CAE2A - INTERNET OF THINGS

**Course Objectives:**
- To get familiar with the evolution of IOT with its design principles
- To outline the functionalities and protocols of internet communication
- To analyze the hardware and software components needed to construct IOT applications
- To identify the appropriate protocol for API construction and writing embedded code
- To realize various business models and ethics in Internet of Things

**UNIT I FUNDAMENTALS OF IOT**

Evolution of Internet of Things – Enabling Technologies – IOT Architectures: oneM2M, IOT World Forum (IOTWF) and Alternative IOT models – Simplified IOT Architecture and Core IOT Functional Stack -– Fog, Edge and Cloud in IOT – Functional blocks of an IOT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects.

**UNIT II IOT PROTOCOLS**

IOT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IOT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks – Application Transport Methods: Supervisory Control and Data Acquisition – Application Layer Protocols: CoAP and MQTT.

**UNIT – III DESIGN AND DEVELOPMENT**

Prototyping Embedded Devices: Electronics - Embedded Computing Basics – Arduino - Raspberry Pi - Beagle Bone Black - Electric Imp. Prototyping the Physical Design: Non digital Methods - Laser Cutting - 3D printing - CNC Milling - Repurposing/Recycling.


**UNIT – IV**

Prototyping Online Components: Getting started with an API - Writing a New API - Real-Time Reactions - Other Protocols. Techniques for Writing Embedded Code: Memory Management - Performance and Battery Life – Libraries - Debugging.

**UNIT – V**

Business Models: History of Business Models – Model – Internet of Starting up – Lean Startups. Moving to Manufacture: Designing Kits - Designing Printed circuit boards – Certification – Costs - Scaling Up Software. Ethics: Privacy – Control – Environment – Solutions.

**Text Books:**
1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, ―IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017 (UNIT I and II)
2. Adrian McEwen and Hakim Cassimally, "Designing the Internet of Things", Wiley, 2014. (UNIT III, IV and V)

**Reference Books:**
1. Ovidiu Vermesan and Peter Friess, "Internet of Things – From Research and Innovation to Market Deployement" , River Publishers, 2014.
2. Peter Waher, "Learning Internet of Things" ,Packt Publishing, 2015.
3. Donald Norris, "The Internet of Things: Do-It-Yourself at Home Projects for Arduino, Raspberry Pi and BeagleBoneBlack",McGraw Hill, 2015.


**Course Outcomes**

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

| CO1: | Comprehend the IoT evolution with its architecture and sensors | |
|------|-----------------------------------------------------------------|---------|
| CO2: | Understand the networking concepts for communication and underlying IoT protocols | |
| CO3: | Assess the embedded technologies and develop prototypes for the IoT products | K1- K6 |
| CO4: | Evaluate the use of Application Programming Interface and design an API for IoT in realitime | |
| CO5: | Recognize the ethics of business models and perform security analysis | |

**K1- Remember, K2- Understand, K3- Apply, K4- Analyze, K5- Evaluate, K6- Create**
**Mapping with Programme Outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| CO1 | S | S | M | S | S | S | S | S | S | S | S | S |
| CO2 | S | S | S | S | S | S | S | M | S | S | M | S |
| CO3 | S | M | S | S | S | S | M | S | S | M | S | S |
| CO4 | S | S | S | S | S | S | S | S | S | S | M | S |
| CO5 | S | S | S | S | M | S | S | S | S | M | M | S |

**S- Strong; M-Medium; L-Low**

## P23CAE2B - INTERNET OF THINGS – LAB

**Course Objectives:**
- To create IoT program to turn ON/OFF LED
- To implement IoT program for object detection
- To develop IoT programs for agricultural purpose
- To create web server program for local hosting
- To design IoT application for health monitoring

1. To develop an IoT program to turn ON/OFF LED light (3.3V)
2. To develop an IoT program using IR sensor (Smart Garbage Monitoring, Detecting Parking Availability, etc.)
3. To develop an IoT program using Humidity and Temperature Monitoring (Forest fire Detection, Weather Monitoring)
4. To develop an IoT web server program for local hosting
5. To develop an IoT program using Soil Moisture Sensor
6. To develop an IoT program using Ultrasonic Sensor (Distance Measurement, etc.)
7. To develop an real-time IoT program using Relay Module (Smart Home Automation with 230V)
8. To develop an IoT program for Fire Detection (Home, Industry,etc.)
9. To develop an IoT program for Gas Leakage detection (Home, Industry, etc.)
10. To develop an IoMT program using Heartbeat Sensor

**Course Outcomes**

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

| CO1 | Implement IoT programs to turn ON/OFF LED | |
|-----|-------------------------------------------|--------|
| CO2 | Develop IoT programs for object detection | |
| CO3 | Create IoT programs for agricultural purpose | K1 - K6 |
| CO4 | Implement web server program for local hosting | |
| CO5 | Design IoT application for health monitoring | |

**K1- Remember, K2- Understand, K3- Apply, K4- Analyze, K5- Evaluate, K6- Create**
**Mapping with Programme Outcomes**

|     | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| CO1 | S | S | M | S | S | S | M | S | S | S | S | S |
| CO2 | S | S | S | S | S | S | S | M | S | S | M | S |
| CO3 | S | M | S | S | S | S | M | S | S | M | S | S |
| CO4 | S | S | S | S | S | S | S | S | S | L | M | S |
| CO5 | S | S | S | S | M | S | L | S | S | M | M | S |

S- Strong; M-Medium; L-Low

## P23CAE2C – COMPUTER VISION

**Course Objectives:**
- To get understanding about Computer vision techniques behind a wide variety of real-world applications.
- To get familiar with various Computer Vision fundamental algorithms and how to implement and apply.
- To get an idea of how to build a computer vision application with Python language.
- To understand various machine learning techniques that are used in computer vision tasks.
- To incorporate machine learning techniques with computer vision systems.

**Unit-I**
**Basic Image Handling and Processing:** PIL – the Python Imaging Library-Matplotlib-NumPy-SciPy-Advanced example: Image de-noising. **Local Image Descriptors:** Harris corner detector-SIFT - Scale-Invariant Feature Transform-Matching Geotagged Images.

**Unit-II**
**Image to Image Mappings:** Homographies -Warping images - Creating Panoramas. **Camera Models and Augmented Reality:** The Pin-hole Camera Model-Camera Calibration-Pose Estimation from Planes and Markers-Augmented Reality.

**Unit-III**
**Multiple View Geometry:** Epipolar Geometry-Computing with Cameras and 3D Structure-Multiple View Reconstruction-Stereo Images. **Clustering Images:** K-means Clustering-Hierarchical Clustering-Spectral Clustering.

**Unit-IV**
**Searching Images:** Content based Image Retrieval-Visual Words-Indexing Images- Searching the Database for Images-Ranking Results using Geometry-Building Demos and Web Applications. **Classifying Image Content:** K-Nearest Neighbors-Bayes Classifier-Support Vector Machines-Optical Character Recognition.

**Unit-V**
**Image Segmentation:** Graph Cuts-Segmentation using Clustering-Variational Methods. **OpenCV:** Python Interface-OpenCV Basics-Processing Video-Tracking.

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

| CO1 | To understand and recall computer vision and its application areas | |
|------|-------------------------------------------------------------------|-------|
| CO2 | To develop build a computer vision system | |
| CO3 | To apply and analyze a design range of algorithms for image processing and computer vision | K1-K6 |
| CO4 | To develop incorporate machine learning techniques with computer vision system | |

| | | |
|---|---|---|
| CO5 | To apply and analyze image segmentation and image registration | |

**K1- Remember, K2 - Understand, K3 - Apply, K4 - Analyze, K5 - Evaluate, K6 -Create**

**Mapping with Programme Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | S | L | M | L | L | L | M | M | M | S | S | L |
| CO2 | S | M | L | M | M | L | S | L | S | L | S | L |
| CO3 | S | S | S | M | M | L | M | L | M | L | M | L |
| CO4 | S | S | S | M | M | L | M | L | M | L | S | L |
| CO5 | S | S | S | M | M | L | S | L | S | L | S | L |

**L - Low,  M- Medium, S - Strong**

## P23CAE2D - COMPUTER VISION LAB

**Course Objectives:**
- To get an idea of how to build a computer vision application with Python language.
- To learn the basic image handling and processing
- To get familiar with various Computer Vision fundamental algorithms and how to implement and apply.
- To get an idea of how to implement the image transforms.
- To understand various image segmentation algorithms.

Implement the following problems using Python with OpenCV

1. Image Loading, Exploring, and displaying an Image.
2. Access and Manipulate of Image Pixels.
3. Image Transformations.
   i) Resizing
   ii) Rotation
4. Addition operation of Two Images.

5. Image filtering operations
   i) Mean Filtering
   ii) Gaussian Filtering

6. Image Binarization Using Simple Thresholding method.

7. Edge Detection operation using Sobel and Scharr Gradients.

8. Find Grayscale and RGB Histograms of an Image.

9. Segment an Image using K-means Clustering algorithm.

10. Write a program to classify an Image using KNN Classification algorithm.

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

| CO1 | To develop and implement the image loading and exploring | |
|-----|----------------------------------------------------------|-------|
| CO2 | To Evaluate the image transforms | |
| CO3 | To apply and analyze for image processing denoising algorithms | K1-K6 |
| CO4 | To design and develop the Image Segmentation using Edge detection and Histograms | |
| CO5 | To apply and analyze image clustering and classification algorithms | |

**K1- Remember, K2 - Understand, K3 - Apply , K4 - Analyze, K5 - Evaluate, K6 -Create**

**Mapping with Programme Outcomes:**

|      | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| CO1  | S   | L   | M   | L   | L   | L   | M   | M   | M   | S    | S    | L    |
| CO2  | S   | M   | L   | M   | M   | L   | S   | L   | S   | L    | S    | L    |
| CO3  | S   | S   | S   | M   | M   | L   | M   | L   | M   | L    | M    | L    |
| CO4  | S   | S   | S   | M   | M   | L   | M   | L   | M   | L    | S    | L    |
| CO5  | S   | S   | S   | M   | M   | L   | S   | L   | S   | L    | S    | L    |

L - Low,  M- Medium, S - Strong

**P23CAG22 – CYBER SECURITY**
**(Generic Elective)**

# P23CAS21-Data Analysis Using Microsoft EXCEL

**(Non-Major Elective)**

## Introduction

The use of computer technology in the experimental sciences has facilitated the way physicists, engineers, chemists, mathematicians, and many others are able to acquire and analyze large amounts of experimental data. There are several hardware and software programs available for this purpose. Examples of software include Microsoft EXCEL, Mathematica, Math Cad, Data Studio, and Cricket Graph. One of the objectives of the science laboratory course is that the student becomes proficient in using computer technology for analyzing data. In industry most data is acquired and analyzed using some type of hardware and software and seldom is it touched by human hands. Therefore, providing the science student with a proficiency in using computer technology to analyze data in the laboratory will be a very valuable skill that will certainly benefit them in their future careers.

### Equipment

1. Windows/Macintoch computer.
2. Microsoft EXCEL (already installed on computers).

### Objective

**To use Microsoft EXCEL to:**
   a) Enter a given set of data into an EXCEL spreadsheet.
   b) Graph the data
   c) Label the title of the graph
   d) Label the axis with appropriate units

    e) Make minor and major gridlines on graph
    f) Scale axis
    g) Obtain the best-curve fit along with the equation
    h) Manipulate data using the mathematical functions of EXCEL without the use of a calculator.

## Exercise 1: Graphical Analysis with EXCEL

*In this exercise you will learn how to enter a given set of data into an EXCEL spreadsheet and use the graphical analysis features.*

1. Open the program EXCEL.
2. Enter the following set of data in column format.

| time | position |
|------|----------|
| 0    | 2        |
| 3    | 5.67     |
| 5    | 14.25    |
| 7    | 22.6     |
| 10   | 39       |
| 13   | 60       |
| 16   | 85       |

3. Select the entire set of data including the headings 'time' and 'position'. Noticed that I have entered the data for 'time' **first and then** 'position'. The reason for doing this is because EXCEL automatically plots the first column of data on the horizontal X-axis and the second column of data on the vertical Y-axis. EXCEL is able to plot the data in any order regardless of how you enter the data, but for now we will use the simplest method.
4. While having the data selected click on the 'Chart Wizard' icon on the Tool Bar. This will bring up a screen menu that will take you through 4 steps on graphing the data you have entered.
5. Select 'XY(Scatter)' from the options available and click 'Next'.
6. A graph will appear with the appropriate data range. Click 'Next'.
7. The 'Titles' screen will appear. In this screen you will be able to enter the title of the graph and label the axis with their appropriate units. Enter the following information:

> Chart Title: Position vs. Time
> Value (X) Axis: time (s)
> Value (Y) Axis: position (m)

8. Next click on the 'Gridlines' tab. Here you enter minor and major gridlines for the X-axis and Y-axis for easier reading of graphical data. Click on 'Next' when finished.
9. The screen that now appears gives you the option of saving the data as a new sheet or as an object in a sheet. Select whichever one is appropriate and then click on 'Finish'.
10. As with any graphical representation of data you must scale your graph appropriately to help interpret the data entered. To scale the horizontal axis double-click on the horizontal axis. The 'Format Axis' screen will appear. Click on the tab that reads 'Scale' and enter the numbers for an appropriate scale.
11. Repeat step 10 to scale the Y-axis.
12. Next, you will obtain the equation of the best curve-fit for the data you have entered. Click anywhere inside the graph to select the graph. Go to the 'Chart' menu and select 'Add Trendline…' Click on the 'Type' tab and select the type of curve that best fits the data. Now click on the 'Options' tab and select 'Display Equation on Chart'. The bestcurve-fit along with the equation should be displayed on the graph.
13. Print graph and data and hand in.

### Exercise 2: Using EXCEL functions for data analysis

EXCEL has the capability of using various mathematical functions to perform data analysis for a given set of data. Large sets of data can be manipulated with ease and efficiency quite rapidly. Consider the following set of data for the variable X:

| X |
|---|
| 2 |
| 4.5 |
| 7 |
| 9 |
| 12.5 |
| 16 |
| 20 |

Suppose an experiment requires that you perform the calculation Ln(X) + 5. Let's go over thesteps on how you would do this on EXCEL.

1. Enter the above set of data into EXCEL in column format. Label the next columnLn(X) + 5.
2. Click on the cell to the right of the first data number and enter the equal sign =. Whenyou enter the equal sign you are telling EXCEL that you will be entering an equation.
3. Now go to the 'Insert' menu and select 'Function'.  Here you have a list of functionsavailable which are sorted out by category.
4. Select 'Math & Trig' and choose the natural log function LN on the right of the screen.Click 'OK'.
5. The screen that now appears wants you to enter the **cell number** that belongs to the datanumber that you want to calculate the natural log. **Click** on the first data number, whichis 2. DO NOT ENTER THE NUMBER 2!
6. Click 'OK'. The numerical number to the right of the number should be 0.693 which isLn(2).
7. Click on the cell with the number 0.693. Add 5 to the equation in the 'Equation Bar' so that it reads = LN(X) + 5 . The value X in LN(X) will be refer to the cell number and *notthe data number.*  Push 'ENTER' and see that the value now reads 5.639.
8. Click on the cell with the number 5.693. Notice that there is a small square at the bottomright-hand corner of the cell. Move the pointer to this corner.  The pointer will change toa small, black cross. Click and drag this corner down until you reach the last cell corresponding to the last data number.  Release the mouse button and notice that you have calculated Ln(X) + 5 for all the data values.
9. Print data and hand-in.

## Summary

After completing these 2 exercises you should be able to analyze and manipulate data acquired inthe physics laboratory using Microsoft EXCEL. These skills will be valuable to you, not only in your physics course, but in other engineering and science courses that you may take. Although you may work with different data analysis software, the process and approach will be similar. If time permits, feel free to 'play around' with the other data analysis features of the program.

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