Fifth Semester

Theory

Sl. No.	Category	Subject Code	Subject Name	L-T-P	Credit
1	ESC	19CS5ES01T	Python Programming	3-0-0	3
2	PCC	19CS5PC01T	**PCC-7:**Formal Language & Automata Theory	3-0-0	3
3	PCC	19CS5PC02T	**PCC-8:** Machine Learning	3-0-0	3
4	PEC	19CS5PE01T/ 19CS5PE02T/ 19CS5PE03T/ 19CS5PE04T	**Prof Elective-2 :** Knowledge Discovery & Data Mining/ Cloud Computing/ Mobile computing/ Artificial Intelligence	3-0-0	3
5	OEC	19CS5OE01T	**Open Elective-1(Other Branch)** Introduction Python Programming	3-0-0	3
6	OEC	19CS5OE02T	**Open Elective-2 (Other Branch)** Database Management System	3-0-0	3
7	OEC	19EC5OE01T/ 19EC5OE02T/ 19EE5OE01T	**Open Elective-1 (For CSE students)** VLSI Design Microprocessor and Interfacing Renewable Energy Systems	3-0-0	3
8	OEC	19CE5OE03T/ 19EC5OE03T	**Open Elective-2 (For CSE students)** Geo-Environmental Engineering Embedded System Design	3-0-0	3
9	MC	19CM5MC01T/ 19CM5MC02T	**Mandatory:** Constitution of India/ Essence of Indian Tradition Knowledge	3-0-0	0
Total Credit (Theory)					**18**

Practical

1	ESC	19CS5ES01L	Python Programming Lab	0-0-2	1
2	PCC	19CS5PC01L	**PCC Lab-7:** Formal Language & Automata Theory Lab	0-0-2	1
3	PCC	19CS5PC02L	**PCC Lab-8:** Machine Learning Lab	0-0-2	1
4	PSI	19CM5PS01L	Summer Internship / Training	0-0-2	1
Total Credit (Practical)					**4**
Total Semester Credit					**22**

19CS5ES01T	Python Programming (3-0-0)	3 Credits

Course Objective:

1. Identify/characterize/define a problem.
2. Design a program to solve the problem.
3. Create executable code.
4. Read most Python code and write basic unit tests.

Module-1: **[10 Hrs]**

Features and History of python, Literal constants, variables and identifiers, data types, Input operations, comments, reserve words, indentation, operators and expressions, operations on strings, other data types, conditional branching statements, loop structures, break, continue, pass, else.

Functions definition, function call, variable scope and lifetime, return statement, more on defining functions, lambda functions, recursive functions, modules, packages in python, globals(), locals() and reload().

Module-2: **[10 Hrs]**

Concatenating, appending and multiplying strings, string formatting operator, built in string methods and functions, slice operation, ord() and chr(), in and not in operations, comparing strings, iterating strings, string module, match(), search() and sub(), findall() and finditer().

File handling: filepath, types of files, opening and closing files, reading and writing files, file position, renaming and deleting files, directory methods.

Data structures: sequence, lists, functional programming, tuple, sets, dictionaries,

Module-3: **[10 Hrs]**

Classes and objects: class methods and self arguments, the _init_(), class variable and object variable, _del_(),public and private data members, calling a class method from another class method, built-in functions to set, get and delete class attributes

Inheritance, types, composition or containership, abstract classes or interfaces

Operator overloading: implementing Operator overloading, reverse adding, overriding _getitem_() and _setitem_() methods, overriding the in operator, overloading the misc functions

Module-4: **[10 Hrs]**

Error and exception handling: handling exceptions, multiple exception blocks, multiple exception s in a single block, except block without exception, else clause, raising exception, instantiating exceptions, handling exceptions in invoked functions, builtin and user defined exceptions, the finally block, predefined cleanup action

Demonstration of Numpy, Tensorflow, jax. Demonstration to ML librares like pytorch, keras, trax, and Demonstration of graph plotting using Matplotlib,

Course Outcome:

1. To understand why Python is a useful scripting language for developers.
2. To learn how to design and program Python applications.
3. To learn how to use lists, tuples, and dictionaries in Python programs.
4. To learn how to identify Python object types.

Text Books

1: Python programming, Reema Thareja, Oxford publications
2: learning python , Mark lutz, oreilly

Reference Books:

3: Statistics and Machine Learning in Python Release 0.1, Edouard Duchesnay, Tommy Löfstedt
4: Python data Analytics , Fabio Nelli, Apress

Digital Learning Resources

Course Name	Programming Data Structures and Algorithm in Python
Course Link	https://nptel.ac.in/courses/106/106/106106145/
Course Instructor	Prof. Madhavan Mukund, Chennai Mathematical Institute

19CS5PC01T	Formal Language & Automata Theory (3-0-0)	3 Credits

Course Objective:

1. Identify different formal language classes and their relationships.
2. Design grammars and recognizers for different formal languages.
3. Prove or disprove theorems in automata theory using its properties.
4. Determine the decidability and intractability of computational problems.

Module-1: **[8 Hrs]**

Alphabet, string, Language, Finite representation of Language. Finite Automata: Deterministic & Non Deterministic Finite Automate. Language accepted by DFA & NFA, Ɛ NFA. Equivalence of NFA and DFA, constructing NFA to equivalent DFA. Myhill Neroda Theorem, Equivalent states & Minimized DFA, Examples.

Module-2: **[10 Hrs]**

Grammar: Representation. Language generated by a grammar. Chomsky Hierarchy. Context Free Grammar. Normal Forms – CNF/GNF. Regular Language & Closure Properties of RL. Identifying Non-regular language: Using Pigeonhole principle and using A pumping Lemma. Regular Expression. Language associated with Regular Expression & associated operators, Closure Properties. Regular Grammar. Equivalence of Regular Language, Arden's theorem, Regular expression and Regular Grammar.

Module-3: **[7 Hrs]**

Pushdown Automata. Language accepted by PDA (by going to final state &emptying stack). Context free grammar to PDA. Pumping Lemma for CFL. Closure properties and decision algorithm for CLF.

Module-4: **[7 Hrs]**

Turing machine. Turing machine as language acceptors. Single tape and multitape turing machines. Non deterministic Turing machine, Universal Turing machine and Linear Bounded Automata. Rice's Theorem (No Proof).

Module- 5: **[8 Hrs]**

Computability and decidability. The Turing machine halting problem. Turing machine models and complexity classes. Cook's theorem(No Proof). Some NP problems and their language representation: SAT, 3-SAT, Graph colorability, Hamiltonian Cycle, Vertex Cover Problem.

Course Outcome:

1. Able to understand the concept of abstract machines and their power to recognize the languages.
2. Able to employ finite state machines for modeling and solving computing problems.
3. Able to design context free grammars for formal languages.
4. Able to distinguish between decidability and undecidability.
5. Able to gain proficiency with mathematical tools and formal methods.

TEXT BOOKS:

1. An Introduction to Finite Languages and Automata – Peter Linz, Jones & Berlett, Fifth Edition, 2011
2. Introduction to Automata Theory, Languages, and Computation – Hopcroft, Ullman, Addison Wesley,3rd Edition, Indian Reprint 2011

Reference Books:

1. Introduction to the theory of computation – Michael Sipser, Thompson, 2nd Edition, 2012
2. Introduction to Languages and the Theory of Computation – John Martin, McGrawhill, Second Edition, Indian Reprint 2013.

Digital Learning Resources

Course Name	Theory of Automata, Formal Languages and Computation
Course Link	https://nptel.ac.in/courses/106/106/106106049/
Course Instructor	Prof. Kamala Krithivasan, IIT Madras

19CS5PC02T	Machine Learning (3-0-0)	3 Credits

Course Objective:

1. Develop a concise knowledge on understanding of the fundamental concept of machinelearning.
2. Understand the different learning algorithms and implement them.
3. Gain experience in applying machine learning algorithms to real world problem.

Module-1: **[6 Hrs.]**

Introduction to Machine Learning, Model Preparation, Modelling and Evaluation, Human learning versus machine learning, types of machine learning, applications of machine learning, tools for machine learning, Machine Learning Activities, Data structures for machine learning, Data Pre- processing, selecting a model, training a model, model representation and interpretability, evaluating performance of a model, improving performance of a model, Learning theory, Hypothesis and target class, Hilbert space, Inductive bias and bias-variance tradeoff.

Module-2: **[6 Hrs.]**

Feature Engineering, Bayesian Concept Learning, Introduction to feature engineering, feature transformation, feature subset selection, Importance of Bayesian methods, Bayes' theorem, concept learning through Bayes' theorem, Bayesian Belief Network

Module-3: **[12 Hrs.]**

Supervised Learning –Classification, Regression, Example of supervised learning, classification model, classification learning steps, common classification algorithms – KNN, Decission trees random forest, SVM, example of regression, common regression algorithms,

Module-4: **[12 Hrs.]**

UnsupervisedLearning –Clustering, pattern finding using association rules, Unsupervised learning versus supervised learning, applications of unsupervised learning, clustering and its types, Apriori algorithm for association rule learning

Module-5: **[4 Hrs.]**

Neural Network: Understanding the biological neuron, exploring artificial neuron, types of activation functions, early implementation of artificial neural network, architectures of neural network, learning process in artificial neural network, backpropagation, Overview of Deep Learning

Course Outcome:

1. Equip students with knowledge of fundamentals concepts in machine learning.
2. Ability to analyse and validate different learning algorithms.
3. fine tune machine learning algorithms and evaluate models generated from data.

Textbooks:

1: Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das, "Machine Learning", Pearson Education2: C. M. Bishop, Pattern Recognition and Machine Learning, Springer, 2010.

Reference Books:

1. J. Friedman, T. Hastie, and R. Tibshirani.The elements of statistical learning.Vol. 1, no. 10. New York:Springer series in statistics, 2001.

2. S. Shalev-Shwartz, and S. Ben-David. Understanding machine learning: From theory to algorithms. Cambridge university press, 2014.

Digital Learning Resources

Course Name	Introduction to Machine Learning
Course Link	https://nptel.ac.in/courses/106/106/106106139/
Course Instructor	Dr. Balaraman Ravindran, IIT Madras

19CS5PE01T	Knowledge Discovery & Data Mining (3-0-0)	3 Credits

Course Objectives

1. Identify the scope and necessity of Data Mining and Knowledge Discovery.
2. To understand various tools of Data Mining and their techniques to solve the real time problems.
3. To develop ability to design various algorithms based on data mining tools.
4. To develop further interest in research and design of new Data Mining techniques.

Module-1: **[12 Hrs.]**

Knowledge Discovery in Databases (KDD) process: data integration, mining, and interpretation of patterns in large collections of data. Overall Architecture, Data Warehouse Database Sourcing, Data pre-processing techniques: Acquisition, Clean-up & Transformation Tools, Metadata data mining techniques for classification, regression, clustering, deviation detection, and association analysis; and evaluation of patterns mined from data.

Module-2: **[10 Hrs.]**

Data Warehousing Component, Defining Features, data warehouses and data marts, overview of the components, metadata in the data warehouse. OLAP in the Data Warehouse: Demand for Online analytical processing, need for multidimensional analysis, OLAP definitions and rules, OLAP characteristics, major features, dimensional analysis, hypercube. Drill-down and roll-up, slice-and-dice or rotation, OLAP models, overview of MOLAP model, ROLAP model, ROLAP versus MOLAP.

Module-3: **[12 Hrs.]**

Data Mining Basics: What is Data Mining, Data Mining Defined, The knowledge discovery process, OLAP versus data mining, data mining and the data warehouse, Major Data Mining Techniques, Cluster detection, decision trees, memory-based reasoning, link analysis, neural networks, Data Mining Applications, Benefits of data mining in industry, banking and finance

Module-4: **[6 Hrs.]**

Web mining: classifying web pages, extracting knowledge from the web, mining the World Wide Web, Spatial Data Mining, Multimedia Data Mining, Text Mining.

Course Outcome:

1. Identify and distinguish data mining applications from other IT applications
2. Describe data mining algorithms
3. Describe applicability of data mining
4. Suggest appropriate solutions to data mining problems
5. Analyze data mining algorithms and techniques
6. Work as a team in solving challenging data mining problems

TEXT BOOKS:

1. Jiawei Han, Micheline Kamber, and Jian Pei, "Data Mining Concepts and Techniques", Third Edition, Elsevier.
2. Data Warehousing, Data Mining & OLAP by Alex & Stephen, McGraw Hill.

Reference Books:

1. Vikram Pudi & P. Radha Krishna, Data Mining, Oxford University Press.
2. Reema Thareja, Data Warehousing, Oxford University Press.

Digital Learning Resources

Course Name	Data Mining
Course Link	https://nptel.ac.in/courses/106/105/106105174/
Course Instructor	Prof. Pabitra Mitra, IIT Kharagpur

19CS5PE02T	Cloud Computing (3-0-0)	3 Credits

Course Objectives

1. To provide students with the fundamentals and essentials of Cloud Computing.
2. To provide students a sound foundation of the Cloud computing so that they are able to start using and adopting Cloud Computing services and tools in their real life scenarios.
3. To enable students exploring some important cloud computing driven commercial systems and applications.
4. To expose the students to frontier areas of Cloud Computing and information systems, while providing sufficient foundations to enable further study and research.

Module- 1: **[10 Hrs.]**

Evolution of Computing Paradigms - Overview of Existing Hosting Platforms, Grid Computing, Utility Computing, Autonomic Computing, Dynamic Datacenter Alliance, Hosting / Outsourcing, Introduction to Cloud Computing, Workload Patterns for the Cloud, "Big Data", IT as a Service, Technology Behind Cloud Computing,

Module- 2: **[10 Hrs.]**

A Classification of Cloud Implementations- Amazon Web Services - IaaS, The Elastic Compute Cloud (EC2), The Simple Storage Service (S3), The Simple Queuing Services (SQS), VMware vCloud - IaaS, vCloud Express, Google AppEngine - PaaS, The Java Runtime Environment,

Module- 3: **[10 Hrs.]**

The Python Runtime Environment- The Datastore, Development Workflow, Windows Azure Platform - PaaS, Windows Azure, SQL Azure, Windows Azure AppFabric, Salesforce.com - SaaS / PaaS, Force.com, Force Database - the persistency layer, Data Security, Microsoft Office Live - SaaS, LiveMesh.com, Google Apps - SaaS, A Comparison of Cloud Computing Platforms, Common Building Blocks.

Module- 4: **[10 Hrs.]**

Cloud Security – Infrastructure security – Data security – Identity and access management Privacy- Audit and Compliance.

Course Outcome:

1. Explain the core concepts of the cloud computing paradigm: how and why this paradigm shift came about, the characteristics, advantages and challenges brought about by the various models and services in cloud computing.
2. Apply the fundamental concepts in datacenters to understand the tradeoffs in power, efficiency and cost.
3. Identify resource management fundamentals, i.e. resource abstraction, sharing and sandboxing and outline their role in managing infrastructure in cloud computing.
4. Analyze various cloud programming models and apply them to solve problems on the cloud.

Text Book:

1. Kai Hwang, Geoffrey C. Fox and Jack J. Dongarra, "Distributed and Cloud Computing from Parallel Processing to the Internet of Things", Morgan Kaufmann, Elsevier, 2012
2. Barrie Sosinsky, "Cloud Computing Bible" John Wiley & Sons, 2010

Reference Books:

3. Tim Mather, Subra Kumaraswamy, and Shahed Latif, "Cloud Security and Privacy An
4. Enterprise Perspective on Risks and Compliance", O'Reilly 2009

Digital Learning Resources

Course Name	Cloud computing
Course Link	https://nptel.ac.in/courses/106/105/106105167/
Course Instructor	Prof. Soumya Kanti Ghosh, IIT Kharagpur

Course Name	Cloud Computing and Distributed Systems
Course Link	https://nptel.ac.in/courses/106/104/106104182/
Course Instructor	Dr.Rajiv Misra, IIT Patna

19CS4PE03T	Mobile Computing (3-0-0)	3 Credit

Course Objective:

1. Explain the basics of mobile Computing, their architectures
2. Describe the functionality of Mobile IP and Wireless protocols.
3. Classify different types of mobile telecommunication systems, satellite communication system.
4. Make use of mobile operating systems in developing mobile application

Module – 1: **[6 Hrs]**

Introduction to Personal Communications Services (PCS): PCS Architecture, mobility management, Networks signalling, Global System for Mobile Communication (GSM) System overview: GSM Architecture, Mobility management, Network signaling.

Module – 2: **[12 Hrs]**

General Packet Radio Services (GPRS): GPRS Architecture, GPRS Network Nodes, Mobile Data Communication; WLANs (Wireless LANs) IEEE 802.II standard, Mobile IP. Wireless Application Protocol (WAP): The Mobile Internet standard, WAP Gateway and Protocols, wireless mark-up Languages (WML), Wireless Local Loop (WLL): Introduction to WLL Architecture, wireless Local Loop Technologies.

Module – 3: **[06 Hrs]**

Third Generation (3G) Mobile Services: Introduction to International Mobile Telecommunications 2000 (IMT 2000) Vision, Wideband Code Division Multiple Access (W-CDMA), and CDMA 2000.

Module – 4: **[10 Hrs]**

Global Mobile Satellite Systems; case studies of the IRIDIUM, ICO and GLOBALSTAR systems. Wireless Enterprise Networks: Introduction to Virtual Networks, Blue tooth technology, Blue tooth Protocols. Server-side programming in Java, Pervasive web application architecture, Device independent example application.

Module – 5: **[6 Hrs]**

Mobile Device Operating System, Commercial mobile operating systems, Software development kit, iOS, Android, Windows phones, M-Commerce, Mobile transaction system, related security issues, 4G technology, fundamental concepts of mobile cloud computing and different application instances.

Course Outcome:

1. Understand fundamentals of wireless communications.
2. Analyze security, energy efficiency, mobility, scalability, and their unique characteristics in wireless networks.
3. Demonstrate basic skills for cellular networks design.
4. Apply knowledge of TCP/IP extensions for mobile and wireless networking.

TEXT BOOKS:

1. J. Schiller: Mobile Communication, Pearson Education
2. Rajkamal: Mobile Computing, Oxford University Press.
3. Burkhardt: Pervasive Computing, Pearson Education.

Reference Books:

1. Hansmann, Merk: Principles of Mobile Computing, 2nd Edition, Springer.
2. P. Stavronlakis: Third Generation Mobile Telecommunication Systems, Springer.
3. SandeepSinghal: The Wireless Application Protocol, Pearson Education.

Digital Learning Resources

Course Name	Mobile Computing
Course Link	https://nptel.ac.in/courses/106/106/106106147/
Course Instructor	Prof. Pushpendra Singh, Prof.Sridhar Iyer, IIT Madras

19CS5PE04T	Artificial Intelligence (3-0-0)	3 Credits

Course Objective:

1. To learn the concepts of Artificial Intelligence
2. To learn the methods of solving problems using Artificial Intelligence
3. To introduce the concepts of Expert Systems and it design procedure

Module-1: **[12 Hrs]**

Intelligence and AI, Agents, Model of different types of agent: reactive, deliberative, goal-driven, utility-driven, and learning agents, Environment, Properties of Environment, State Space, Knowledge, Rationality, Turing Test. Search Techniques - definition and importance, uninformed search – DFS, BFS, iterative deepening, iterative broadening, depth limited search, Issues in design of heuristics, Best First search, A* and AO* search, Hill climbing, Simulated Annealing, Constraint Satisfaction Problem, 8-puzzle problem, Crypto arithmetic problem,

Module-2: **[10 Hrs]**

Adversarial Search, Game Playing, minmax search, alpha-beta pruning. Knowledge Representation in AI, Logic - propositional, predicate, First Order Logic. Normal forms. Modus Ponens & Modus Tollens, Theorem Proving, Principle of Resolutions, Non-Monotonic Reasoning. Semantic Net, Frame.

Module-3: **[12 Hrs]**

Planning and its importance. Classical & partial order planning, Conditional Planning. Uncertainty, type of uncertainty, Probabilistic Reasoning- joint distribution reasoning, Bayesian networks, learning, explanation based learning, induction learning-Decision Tree, statistical learning- Bayesian learning, expectation maximization, hidden Markov model, closed world problems.

Module-4: **[6 Hrs]**

Expert Systems – Design Techniques, components, Problem and knowledge domain, Knowledge engineering approach, error in design of expert system, life cycle of expert system, MYCIN and dendral – an expert system.

Course Outcome:

1. Ability to comprehend AI & ES to analyze and map real world activities to digital world
2. Ability to identify problems that are amenably solved by AI methods
3. Ability to design and carry out an empirical evaluation of different AI algorithms

Text Books:

1. Artificial Intelligence – Knight & Rich, McGraw Hill, 3rd Edition.
2. Principles of Artificial Intelligence – N. J. Nilson, 2nd Edition, Narosa Publishing.

Reference Books:

1. Artificial Intelligence A Modern Approach – Russel & Norvig, 2nd Edition, Pearson.

2. Introduction to Artificial Intelligence and Expert Sys – D.W. Patterson, Prentice Hall.
3. Expert System: Principle and programming - Joseph Giarratano, Gary Riley
4. NPTEL course - https://nptel.ac.in/courses/106106126/

Digital Learning Resources

Course Name	Artificial Intelligence
Course Link	https://nptel.ac.in/courses/106/105/106105079/
Course Instructor	Prof. P. Dasgupta, IIT Kharagpur

19CS5OE01T	Introduction Python Programming (3-0-0)	3 Credits

Course Objective:

1. Identify/characterize/define a problem.
2. Design a program to solve the problem.
3. Create executable code.
4. Read most Python code and write basic unit tests.

Module-1: **[10 Hrs]**

Features and History of python, Literal constants, variables and identifiers, data types, Input operations, comments, reserve words, indentation, operators and expressions, operations on strings, other data types, conditional branching statements, loop structures, break, continue, pass, else. Functions in python.

Module-2: **[10 Hrs]**

Concatenating, appending and multyplying strings, string formatting operator, built in string methods and functions, slice operation, ord() and chr(), in and not in operations, comparing strings, iterating strings, string module, match(), search() and sub(), findall() and finditer().
Data structures: sequence, lists, functional programming, tuple, sets, dictionaries,

Module-3: **[10 Hrs]**

Classes and objects: class methods and self arguements, the _init_(), class variable and object variable, _del_(),public and private data members, calling a class method from another class method, builtin funcitons to set,get and delete class attributes
Inheritance, types, composition or containership, abstract classes or interfaces
Operator overloading: implementing Operator overloading, reverse adding, overriding _getitem_() and _setitem_() methods, overriding the in operator, overloading the misc functions

Module-4: **[10 Hrs]**

Error and exception handling: handling exceptions, multiple exception blocks, multiple exceptions in a single block, except block without exception, else clause, raising exception, instantiating exceptions, handling exceptions in invoked functions, builtin and user defined exceptions, the finally block, predefined cleanup action.

Course Outcome:

1. To understand why Python is a useful scripting language for developers.
2. To learn how to design and program Python applications.
3. To learn how to use lists, tuples, and dictionaries in Python programs.
4. To learn how to identify Python object types.

Text Books

1. Python programming, Reema Thareja, Oxford publications.
2.learning python , Mark lutz, oreilly.

Reference Books:

1. Statistics and Machine Learning in Python Release 0.1, Edouard Duchesnay, Tommy Löfstedt
2. Python data Analytics , Fabio Nelli, Apress.

Digital Learning Resources

Course Name	Programming Data Structures and Algorithm in Python
Course Link	https://nptel.ac.in/courses/106/106/106106145/
Course Instructor	Prof. Madhavan Mukund, Chennai Mathematical Institute

19CS5OE02T	Database Management System (3-0-0)	3 Credits

Course Objectives :

1. To learn data models, conceptualize and depict a database system using ER diagram
2. To understand the internal storage structures in a physical DB design
3. To know the fundamental concepts of transaction processing techniques

Module-1: **[5 hours]**

Introduction: Purpose of Database System -- Views of data – data models, database management system, three-schema architecture of DBMS, components of DBMS. E/R Model - Conceptual data modelling - motivation, entities, entity types, attributes relationships, relationship types, E/R diagram notation, examples.

Module-2: **[10hours]**

Relational Model: Relational Data Model - Concept of relations, schema-instance distinction, keys, referential integrity and foreign keys, relational algebra operators, SQL - Introduction, data definition in SQL, table, key and foreign key definitions, update behaviours. Querying in SQL, notion of aggregation, aggregation functions group by and having clauses, embedded SQL

Module-3: **[7 hours]**

Database Design: Dependencies and Normal forms, dependency theory - functional dependencies, Armstrong's axioms for FD's, closure of a set of FD's, minimal covers, definitions of 1NF, 2NF, 3NF and BCNF, decompositions and desirable properties of them, algorithms for 3NF and BCNF normalization, 4NF, and 5NF

Module-4: **[10hours]**

Transactions: Transaction processing and Error recovery - concepts of transaction processing, ACID properties, concurrency control, locking based protocols for CC, error recovery and logging, undo, redo, undo-redo logging and recovery methods.

Module-5: **[8 hours]**

Implementation Techniques: Data Storage and Indexes - file organizations, primary, secondary index structures, various index structures - hash-based, dynamic hashing techniques, multi-level indexes, B+ trees.

Course Outcomes

1. Ability to Install, configure, and interact with a relational database management system
2. Ability to master the basics of SQL and construct queries using SQL
3. Ability to design and develop a large database with optimal query processing

Text Books:

1. A. Silberschatz, Henry F. Korth, and S. Sudharshan, “Database System Concepts”, 7thEd, Tata McGraw Hill, 2019.
2. C. J. Date, A. Kannan and S. Swamynathan, “An Introduction to Database Systems”, 8thed, Pearson Education, 2006

Reference Books:

3. RamezElmasri and Shamkant B. Navathe, "Fundamentals of Database Systems", 7thEdition, Pearson/Addisionwesley, 2016
4. Raghu Ramakrishnan, "Database Management Systems", Third Edition, McGraw Hill, 2003

Digital Learning Resources

Course Name	Database Systems Course
Course Link	https://nptel.ac.in/courses /106/104/106104135/
Course Instructor	Dr. Arnab Bhattacharya, IIT,Kanpur

Course Name	Introduction to Database Systems
Course Link	https://nptel.ac.in/courses/106 /106/106106220/
Course Instructor	Prof. P.Sreenivasa Kumar, IIT,Madras

19EC5OE01T	VLSI DESIGN (3-0-0)	3 Credits

COURSE OBJECTIVE:

1. To understand the concept of VLSI Design Methodology, Design Flow, fabrication steps of NMOS as well as CMOS process and MOSFET the static and switching behavior of MOSInverter.
2. To understand the design and working of combinational and sequential MOScircuits.
3. To understand the concept of semiconductor memories.
4. To understand the concept of Layout of CMOS Digital Circuits, DRC, LVS andRCX

SYLLABUS:

Module-1 **[8Hours]**

Introduction, Historical perspective, VLSI Design methodologies, VLSI Design Flow, Design Hierarchy, Design Styles, CAD Technology .(Text Book 1 ,Chapter 1(1.1,1.4,1.5,1.6,1.8,1.11)) Fabrication of MOSFETS, Fabrication processes, NMOS Fabrication, CMOS n-well process, Layout Design rules, Stick Diagrams, Full Custom Mask Layout Design.

MOS Transistor, Review of structure and operation of MOSFET (n-MOS enhancement type), CMOS, MOSFET V-I characteristics, MOSFET scaling and small geometry effects, MOSFET capacitances.

Module-2 **[10Hours]**

MOS Inverters:

Basic NMOS inverters, characteristics, inverters with resistive load and with n-type MOSFET load, CMOS inverter and characteristics.

MOS inverters: Switching characteristics and interconnect effects: Delay time definitions and calculation, inverter design with delay constraints, estimation of parasitic switching power dissipation of CMOS inverters.

Module-3 **[8Hours]**

Combinational MOS logic circuits:

CMOS logic circuits, state style, complex logic circuits, pass transistor logic. (Text Book 1,Chapter 7 (7.3, 7.47.5))

Sequential logic circuit – introduction, SR latch, clocked latch & flip-flop circuits, CMOS D latch and edge triggered flip-flop**.**

Module-4 **[6Hours]**

Semiconductor Memories:

Introduction, Read Only Memory Circuits, Static Read-Write Memory (SRAM) Circuits, Dynamic Read-Write Memory (DRAM) Circuits.

Module-5 **[8Hours]**

Layout concepts and examples of CMOS Inverter, 2-Input NAND Logic Gate, 2-Input NOR Logic Gate, 2:1 Multiplexer using Transmission Gate, D-Latch using Transmission Gate, Concept of DRC, LVS and RCX.

COURSE OUTCOME:

After completion of the course, the student will be able to

1. Analyze the characteristic of MOSFET, understand the fabrication steps, design CMOS inverters, calculate the dimension of MOSFETs for delay and inverter threshold voltage.

2. Design combinational and sequential circuits using CMOS technology and verify their functionalities.
3. Analyze the memory cells and verify its functionality.
4. Analyze the layout and verification of CMOS integrated circuits.

TEXT BOOKS:

1. Sung-Mo Kang, Yusuf Leblebici and Chul Woo Kim, *CMOS Digital Integrated Circuits: Analysis and Design*, 4th Edition, Tata McGraw-Hill Publishing Company Limited, 2015. **(Some portions of modules 1, 2, 3, 4 and5)**
2. DebaprasadDas, *VLSIDesign, 2ndEdition, OxfordUniversityPress, 2015, NewDelhi*.
   a. **(Some portions of modules 1, 2, 3, 4 and 5)**

REFERENCE BOOKS:

1. Neil h. e. weste, David Harris and Ayan Banerjee, *CMOS VLSI design a circuits and systems perspective,* 4th Edition, Pearson Education,2015.
2. Jan M. Rabaey, Anantha Chandrakasan and Borivoje Nikolic, *Digital Integrated Circuits– A Design Perspective,* 2nd Edition, PHI Learning, 2016, NewDelhi
3. Douglas A. Pucknell and K. Eshraghian, *Basic VLSI Design*, 3rd Edition, PHI Learning, 2009, NewDelhi

DIGITAL LEARNING RESOURCES:

Course Name	CMOS Digital VLSI Design
Course Link	https://nptel.ac.in/courses/108/107/108107129/
Course Instructor	Prof. Sudeb Dasgupta | IIT Roorkee

Course Name	Digital VLSI Design
Course Link	https://nptel.ac.in/courses/108/103/108103108/
Course Instructor	Prof. Chandan Karfa | IIT Guwahati

19EC5OE02T	MICROPROCESSOR AND INTERFACING (3-0-0)	3 Credits

COURSE OBJECTIVE:

1. Understand the main components and working principle of the Intel 8086 microprocessor and its programming.
2. Understand the Memory organization, interfacing and the interrupt concept of 16-bit microprocessor.
3. To make the interfacing of the I/O devices using programmable interfacing devices.
4. To enable the students to understand the basic components and working principle of the Intel 32-bit processor80386.

SYLLABUS:

Module-1 **[10Hours]**

8086 Microprocessor:

Introduction: Overview of Microcomputer organization.

Intel 8086 Microprocessor: Introduction, 8086 Programmer's model: Register organization, **Hardware Architecture**: Bus interface unit (BIU), Execution unit (EU), Pipelined operation, physical address generation and Memory segmentation.

8086 Pin description: Common, Minimum and maximum mode Pin and Signals, Bus cycle and System configuration.

Module-2 **[8Hours]**

8086 Memory Interfacing and Interrupt technique:

8086 Memory Interfacing: External Memory addressing, EPROM and RAM interface with 8086.

8086 Interrupt: Interrupt Processing, sources of interrupt in 8086, Interrupt Instructions, Interrupt types, IVT, Hardware Interrupts and Interrupt priorities.

Module-3 **[8Hours]**

8086 Instruction set and programming:

8086 Addressing modes, Instruction set: data transfer, arithmetic, bit manipulation, branch and processor control, assembler directives and programming

Module-4 **[10Hours]**

Peripheral interfacing and its programming:

Introduction to basic I/O interface, I/O interfacing techniques in 8086.

Interfacing devices: 8255 PPI, 8254 Timer, 8251 USART, ADC-0808/0809, and DAC-0800 interfacing using PPI.

Module-5 **[8Hours]**

32-bit Microprocessor 80386:

Salient features of 80386, Architecture and Signal Description of 80386. Register Organization of 80386, Hardware Memory organization 80386 Memory management: Real mode, Segment translation, protected

mode, Memory paging mechanism and Virtual 8086Mode

COURSE OUTCOME:

After completion of the course, the student will be able to

1. Gain deep knowledge on 8086 microprocessor architecture and pin and signals and demonstrate the memory interfacing and illustrate the use of interrupts.
2. Identify the addressing modes and illustrate the different classification and functions of 8086 microprocessor instructions and apply the knowledge in assembly language programming.
3. Illustrate the design aspect of I/O interface and Design and development of interfacing various I/O devices using programmable peripheral devices with the 8086 microprocessor.
4. Study and understand the architecture and memory management system of 80386 advanced microprocessors.

TEXT BOOKS:

1. A. K. Ray and K. M. Bhurchandi, **"***Advanced Microprocessors andPeripherals***",** 3rd Edition, Tata McGraw Hill Education,2000, New Delhi.
2. Walter A Triebel and Avtar Singh, "*The 8088 and 8086 Microprocessors, Programming, Interfacing, Software, Hardware and Applications*", 4th edition, Pearson Education, 2014, Noida

REFERENCE BOOKS:

1. Barry B. Brey, *The Intel Microprocessors, Architecture, Programming and Interfacing*, 8th Edition, Pearson Education, 2009,Noida
2. Doughlas.V.Hall, *Microprocessor and Interfacing : Programming and Hardware*, 2nd Edition, McGraw Hill, 1992,Noida
3. Yu-chengliu and Glenn a. Gibson, *Microcomputer Systems: The 8086/8088 Family Architecture, Programming & Design***-**, 2ndEdition, Prentice Hall of India, 2007, New Delhi

DIGITAL LEARNING RESOURCES:

Course Name	Microprocessors and interfacing
Course Link	https://nptel.ac.in/courses/108/103/108103157/
Course Instructor	Prof. Shaik Rafi Ahmed, Department of Electronics and Electrical Engineering, IIT Guwahati

19EE5OE01T	RENEWABLE ENERGY SYSTEMS (3-0-0)	3 Credits

COURSE OBJECTIVE:

The program is expected to enable the students to

1. Design and develop innovative products and services in the field of RenewableEnergy.
2. Keeps abreast with the latest technology andtoolset.
3. Communicate effectively to propagate ideas and promoteteamwork
4. Attain intellectual leadership skills to cater to the changing needs of power industry, academia, society andenvironment

SYLLABUS

Module-1 **[4 Hours]**

Introduction: Causes of Energy Scarcity, Solution to Energy Scarcity, Factors Affecting Energy Resource Development, Energy Resources and Classification, Renewable Energy – Worldwide Renewable Energy Availability, Renewable Energy in India.

Quality of Energy: Measure of Quality of energy, Identification of potential energy resources in terms of their quality. Dependency of Efficiency of energy conversion on Quality of energy. Cogeneration, Dispersed or Distributedgeneration.

Module-2 **[8Hours]**

Energy from Sun: Sun- earth Geometric Relationship, Solar radiation geometry, Layer of the Sun, Earth – Sun Angles and their Relationships, Solar Energy Reaching the Earth's Surface, Sunpath diagram and evaluation of insolation quality at a location using Sunpath, Solar Thermal EnergyApplications.
Solar Thermal Energy Collectors: Types of Solar Collectors, Configurations of Certain Practical Solar Thermal Collectors, Material Aspects of Solar Collectors, Concentrating

Collectors, Parabolic Dish – Stirling Engine System, Working of Stirling or Brayton Heat Engine, Solar Collector Systems into Building Services, Solar Water Heating Systems, Passive Solar Water Heating Systems, Applications of Solar Water Heating Systems, Active Solar Space Cooling, Solar Air Heating, Solar Dryers, Crop Drying, Space Cooing, Solar Cookers, Solar pond.

Module-3 **[7Hours]**

Solar Photovoltaic Cells: Components of Solar Cell System, Elements of Silicon Solar Cell, Equivalent Circuit of a PV Cell, Impact of parameters of PV cell performance, Solar Cell materials, Practical Solar Cells, I – V Characteristics of Solar Cells, Maximum Power Point Tracking (MPPT), MPPT algorithms: P&O, Incremental Conductance, Efficiency of Solar Cells, Photovoltaic Panels, Shading & Mitigation techniques, Applications of Solar Cell Systems.

Module-4 **[10Hours]**

Wind Energy Conversion System (WECs): Energy content in wind, extractible content of energy through WECs. Types of wind turbines with respect to axis of rotation (Horizontal & vertical axis wind turbine), working principle (lift and drag type) etc.

Airfoil terminology - Blade element theory - Blade design - Rotor performance and dynamics- Balancing technique (Rotor &Blade), significant parameters determining efficiency of WECs, Pitch angle, No of blades, solidity, Tip Speedratio.

Constant speed Constant frequency - Variable speed variable frequency - Up wind-Down wind - Stall control-Pitch control - Gear coupled generator type - Direct generator drive/PMG/Rotor excited sync generator.

Module-5 **[10Hours]**

Integrated Energy Systems: System Aspects of Integration: voltage effects, thermal effects, fault level. Islanding. Stand Alone Systems: Network voltage and system efficiency, Case studies of standalone system. Hybrid Energy Systems and its economic evaluation. Technological aspects of power electronic systems connection to the grid. Hybrid and integrated energy systems, Total energy concept and waste heat utilization, Energy modeling to optimize different systems.

COURSE OUTCOMES:

1. Appraise the need and possibility of extracting solar energy and converting into electrical energy using PVcell.
2. Design and analyze stand-alone and grid connected PVsystem.
3. Describe the dynamics of wind turbine and electricalgenerator.
4. Select and design suitable configuration of the wind energy conversion system based on application.
5. Suggest, design and analyze hybrid energysystems.

TEXT BOOKS:

1. Non-conventional Energy Sourcesby G.D.Rai(Author), Khanna Publishers.
2. Renewable Energy, by Boyle, Godfrey. Oxford University Press.
3. Renewable Energy Systems – Design and Analysis with Induction Generators, by M.GodoySimoes, Felix A.Farret, CRCpress.
4. Micro-grid:AConceptualSolution,RobertLasseter,PaoloPiagi,PESC2004,June2004.

REFERENCE BOOKS:

1. Renewable Energy Resources by John Twidelland Tony Weir, Taylor Francis Group.
2. Renewable Energy Sources for fuels and Electricity by Laurie Barrtom, Island Press.

DIGITAL LEARNING RESOURCES:

Course Name	Solar, Wind and Biomass Energy Systems
Course Link	https://nptel.ac.in/courses/103/103/103103206/
Course Instructor	Prof. R. Anandalakshmi Prof. Vaibhav Vasant Goud, Department of Chemical Engineering, IIT Guwahati

Course Name	Solar & Wind Energy
Course Link	https://nptel.ac.in/courses/103/107/103107157/
Course Instructor	Prof. P. Mondal, Department of Chemical Engineering, IIT Roorkee

Course Name	Energy Resources
Course Link	https://www.youtube.com/watch?v=cZSYukWvpsE
Course Instructor	Prof. Rangan Benarjee, Department of Energy Science & Technology, IIT Bombay

Course Name	Design of Photovoltaic system
Course Link	https://www.youtube.com/watch?v=hr2sId412zU&list=PLuv3GM6-gsE2KyXoBTQ6lbrwn22Z3SiVm&index=2
Course Instructor	Prof. L. Umanand, Department of Electronic System Engineering, IISC Bangalore

19CE5OE03T	Geo-Environmental Engineering (3-0-0)	3 Credits

Course Objective:

1. To know the sub-surface contamination, geo- synthetics types and its application.
2. To gain comprehensive knowledge solid and hazardous waste management.
3. To provide knowledge on contaminant transport.
4. To understand about the remediation techniques.
5. To know the basic concept of Landfill design.

Module-01 **[8 hrs]**

Introduction: Scope, importance, waste generation, subsurface contamination, Geo-synthetics: Types, manufacturing functions, applications and economics.

Module-02 **[8 hrs]**

Solid and Hazardous Waste Management: Classification of waste, Characterization solid wastes, Environmental Concerns with waste, waste management strategies.

Module-03 **[8 hrs]**

Contaminant Transport: Transport process, Mass-transfer process, Bioremediation, Phytoremediation.

Module-04 **[8 hrs]**

Remediation Techniques: Objectives of site remediation, various active and passive methods, Soil washing, Emerging Remediation Technologies.

Module-05 **[8 hrs]**

Landfills: Types of landfills, Site Selection, Waste Containment Liners, Leachate collection system, Cover system, Gas collection system.

Course Outcome:

After completion of the course the student can

1. Understand surface contamination, geo-synthetic types and its function.
2. Analyze the classification of waste and waste management strategies.
3. Identify contaminant transport mechanisms in soils.
4. Understand the principles of soil treatment techniques
5. Get idea about different landfill concepts.

Text Books:

1. K. R. Reddy and H D Sharma, "*Geoenvironmental Engineering: Site Remediation, waste containment, and emerging waste management technologies*", John Willey , New Jersey, USA
2. R N. Yong, "*Geo Environmental Engineering: Contaminated Ground: Fate of Pollutions and Remediation*"., Thomson Telford , London, UK.

Reference Books:

1. L N Reddy and H.I. Inyang, "*Geoenvironmental Engineering: Principles and Applications*", Marcel Dek , New York, USA
2. R. W. Sarsby, "*Environmental Geotechnics*", Thomson Telford , London, UK

Digital Learning Resources

Course Name	Geo-Environmental Engineering
Course Link	https://nptel.ac.in/courses/105/102/105102160/
Course Instructor	Prof. Manoj Datta, Department of Civil Engineering, IIT Delhi

19EC5OE03T	Embedded System Design (3-0-0)	3 Credits

COURSE OBJECTIVES:

1. To get the knowledge of the Embedded technology and its utility to thesociety.
2. Understanding the architecture and programming of embedded processor (ARM or FPGA) ormicrocontroller
3. Familiarization with the embedded computing platform design andanalysis.
4. To acquire the knowledge in interfacing protocols and relatedHardwires.

SYLLABUS:

Module-1 **[10Hours]**

Introduction to Embedded Systems:

Hardware and Software Concepts: Embedded Systems, Application and characteristics of Embedded System, Overview of Processor and Hardware Units in Embedded System, Embedded Software into a system, Introduction to Embedded SystemDesign, Introduction to Embedded System Architecture.
System-on-Chip, NoC, Embedded Hardware Modeling and Design: System-on-chip (SoC),Network-on-chip (NoC), Levels of Hardware modeling, Embedded Hardware Design and Development.

Module-2 **[8Hours]**

8051, AVR ATmega and ARM Microcontrollers:

Microcontrollers, AVR Microcontrollers, ARM processor –based system Design

Sensors, A/D–D/A Converters, Actuators and Interfacing:

Sensors, A/D–D/A Converters, Actuators, interfacing Techniques, Network Embedded System, Internet-Enable Systems-Network Protocols, Wireless and Mobile System Protocols.

Module-3 **[8Hours]**

Real-Time Operating System (RTOS) and Real-Time task scheduling:

RTOS: concepts, types of Real time Task and their characteristics, task scheduling, Feature of RTOS, device driver, interrupts and Service mechanism

Module– 4 **[8 Hours]**

IoT System- System Architecture and Design:

IoT, Internet connectivity and IoT connectivity, Edge computing Architecture and Application, IoT communication module Protocols, Rapid prototype designing using open source Boards.

Module– 5 **[8 Hours]**

EMBEDDED AI- System Architecture and Design:

Artificial Intelligence Embedded AI hardware and Software Development, Embedded AI Application

COURSE OUTCOME:

After completion of the course, the student will be able to

1. Design an embedded system application
2. Implement the peripheral interfacing.
3. Use system design techniques to develop firmware
4. Develop embedded system solution to automation and IoTs Application.

TEXT BOOKS:

1. K. V. SHIBU, *Introduction to Embedded Systems*, McGraw Hill Publication Company Limited, 2009, New Delhi.

REFERENCE TEXT BOOKS:

1. Raj Kamal, *Title Embedded Systems*, 4th Edition, McGraw Hill Publication Company Limited, 2020, New Delhi
2. David E. Simon, Addition Wesley, *An Embedded Software Primer*, Wiley, 1999, New Delhi.
3. K. Short, *Embedded Microprocessor Systems Design: An Introduction Using the Intel 80C188EB*, Prentice Hall,1998, ISBN-10 : 0132494671,ISBN-13 :978-0132494670

DIGITAL LEARNING RESOURCES:

Course Name	Embedded System Design
Course Link	https://nptel.ac.in/courses/106/105/106105159/
Course Instructor	Prof. Anupam Basu, Department of Computer Science and Engineering, IIT Kharagpur

19CS5MC01T	Constitution of India (1-0-0)	0 Credits

Course Objective:

1. This course acquaints students with the constitutional design of state structures and institutions, and their actual working over time.
2. The course traces the embodiment of some of these conflicts in constitutional provisions, and shows how these have played out in political practice.

Module-1: Introduction to the Indian Constitution **[10 Hrs]**

a) Preamble & its Philosophy
b) Salient Features of Indian Constitution

Module-2: Key Concepts **[10 Hrs]**

a) Citizenship- Methods of acquiring & loosing, Fundamental Rights & Fundamental Duties
b) Directive Principles of State Policy

Module-3: Union Government: Organization, powers & function **[10 Hrs]**

a) Legislature: Union Parliament
b) Executive: President, Vice-President, Prime Minister & Council of Ministers
c) Judiciary: Supreme Court

Module-4: State Government: Organization, powers & functions **[10 Hrs]**

a) State Legislature- Composition & Powers
b) State Executive: Governor, Chief Minister & Council of Ministers - powers & functions
c) State Judiciary: High Court- Composition & Powers

Course Outcome:

1. Able to understand historical background of the constitutional making and its importance for building a democratic India, the structure of Indian government, the structure of state government, the local Administration,
2. Able to apply the knowledge on directive principle of state policy, the knowledge in strengthening of the constitutional institutions like CAG, Election Commission and UPSC for sustaining democracy.
3. Able to analyze the History, features of Indian constitution, the role Governor and Chief Minister, role of state election commission, the decentralization of power between central, state and local self-government. Able to evaluate Preamble, Fundamental Rights and Duties, Zilla Panchayat, block level organization, various commissions of viz SC/ST/OBC and women.

Text Books:

1) An Introduction to the Constitution of India, D.D. Basu, Prentice Hall, New Delhi. (Latest Edition)
2) An Introduction to the Constitution of India, M. V. Pylee, Vikas, New Delhi, 1998.
3) Constitutional Questions in India: The President, Parliament and the States, A. G. Noorani, Oxford University Press, Delhi, 2000.
4) Indian Political System, J.C. Johari, Anmol Publishers, New Delh,1996.
5) Constitutional Development and National Movement in India, V.D. Mahajan, S. Chand and Co, New Delhi, 1986

19CS5MC02T	Essence of Indian Tradition Knowledge (1-0-0)	0 Credits

Course Objectives :

1. To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system.
2. To make the students understand the traditional knowledge and analyse it and apply it to their day to day life

Module 1: **[8 hours]**

Introduction to traditional knowledge: Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, Indigenous Knowledge (IK), characteristics, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge

Module 2: **[6 hours]**

Protection of traditional knowledge: The need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.

Module 3: **[8 hours]**

Legal framework and TK: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act); The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016.

Module 4: **[8hours]**

Traditional knowledge and intellectual property: Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge

Module 5: **[10hours]**

Traditional Knowledge in Different Sectors: Traditional knowledge and engineering, Traditional medicine system, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK

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

1. Identify the concept of Traditional knowledge and its importance.
2. Explain the need and importance of protecting traditional knowledge.
3. IIllustrate the various enactments related to the protection of traditional knowledge.
4. Interpret the concepts of Intellectual property to protect the traditional knowledge.
5. Explain the importance of Traditional knowledge in Agriculture and Medicine.

Text Books:

1. Traditional Knowledge System in India, by Amit Jha, 2009.
2. Traditional Knowledge System in India by Amit Jha Atlantic publishers, 2002.
3. Knowledge Traditions and Practices of India" Kapil Kapoor1, Michel Danino2.

19CS5ES01L	Python Programming Lab (0-0-2)	1 Credits

Lab Objectives:

1. To write, test, and debug simple Python programs.
2. To implement Python programs with conditionals and loops.
3. Use functions for structuring Python programs.
4. Represent compound data using Python lists, tuples, and dictionaries.
5. Read and write data from/to files in Python.

Lab Outcomes:

Upon completion of the course, students will be able to
1. Write, test, and debug simple Python programs.
2. Implement Python programs with conditionals and loops.
3. Develop Python programs step-wise by defining functions and calling them.
4. Use Python lists, tuples, dictionaries for representing compound data.
5. Read and write data from/to files in Python

Week - No	S.No/Program .No	List of Programs
1	1	A) Create a list and perform the following methods 1) insert() 2) remove() 3) append() 4) len() 5) pop() 6) clear()
	2	B) Create a dictionary and apply the following methods 1) Print the dictionary items 2) access items 3) use get() 4)change values 5) use len()
	3	C) Create a tuple and perform the following methods 1) Add items 2) len() 3) check for item in tuple 4)Access iems
2	1	A) Write a python program to add two numbers.
	2	B) Write a python program to print a number is positive/negative using if-else.
	3	C) Write a python program to find largest number among three numbers.
	4	D) Write a python Program to read a number and display corresponding day using if_elif_else?

3	1	A) Write a program to create a menu with the following options 1. TO PERFORM ADDITITON 2. TO PERFORM SUBTRACTION 3. TO PERFORM MULTIPICATION 4. TO PERFORM DIVISION Accepts users input and perform the operation accordingly. Use functions with arguments.
	2	B) Write a python program to check whether the given string is palindrome or not.
	3	C) Write a python program to find factorial of a given number using functions
	4	D) Write a Python function that takes two lists and returns True if they are equal otherwise false
4	1	A) Write a program to double a given number and add two numbers using lambda()?
	2	B) Write a program for filter() to filter only even numbers from a given list.
	3	C) Write a program for map() function to double all the items in the list?
	4	D) Write a program to find sum of the numbers for the elements of the list by using reduce()?
5	1	A) Demonstrate a python code to implement abnormal termination?
	2	B) Demonstrate a python code to print try, except and finally block statements
	3	C) Write a python program to open and write "hello world" into a file?
	4	D) Write a python program to write the content "hi python programming" for the existing file.
6	1	A) Write a python program to get python version.
	2	B) Write a python program to open a file and check what are the access permissions acquired by that file using os module?
	3	C) Write a python program to display a particular month of a year using calendar module.
	4	D) Write a python program to print all the months of given year.

7	1	A) Write a python program to print date, time for today and now.
	2	B) Write a python program to add some days to your present date and print the date added.
	3	C) Write a python program to print date, time using date and time functions
	4	D) Write a python program which accepts the radius of a circle from user and computes the area (use math module).
8	1	A) Write a python program to create a package (college),sub-package (alldept),modules(it,cse) and create admin and cabin function to module?
	2	B) Write a python program to create a package (Engg), sub-package(years),modules (sem) and create staff and student function to module?
9	1	A) Write a python Program to display welcome to MRCET by using classes and objects.
	2	B) Write a python Program to call data member and function using classes and objects
	3	C) Write a program to find sum of two numbers using class and methods
	4	D) Write a program to read 3 subject marks and display pass or failed using class and object.
10	1	A) Using a numpy module create an array and check the following: 1. Type of array 2. Axes of array 3. Shape of array 4. Type of elements in array
	2	B) Using a numpy module create array and check the following: 1. List with type float 2. 3*4 array with all zeros 3. From tuple 4. Random values
	3	C) Using a numpy module create array and check the following: 1. Reshape 3X4 array to 2X2X3 array 2. Sequence of integers from 0 to 30 with steps of 5 3. Flatten array 4. Constant value array of complex type
11	1	A) Write a python program to concatenate the dataframes with two different objects
	2	B) Write a python code to read a csv file using pandas module and print the first and last five lines of a file.
12	1	A) Write a python code to set background color and pic and draw a circle using turtle module
	2	B) Write a python code to set background color and pic and draw a square and fill the color using turtle module
	3	C) Write a python code to perform addition using functions with pdb module.

19CS5PC01L	Formal Language & Automata Theory Lab (0-0-2)	1 Credits

Laboratory Objective:

1 To model, compare and analyze different computational models and define Finite Automaton.
2 To explain relationship between different languages and automata
3 To understand the relation between Context-free Languages and PDA.
4 To learn how to design PDA as acceptor and TM as Calculators.

Laboratory Experiments:

1 Building Finite Automaton from Language (DFA & NFA)

2 Converting from NFA to DFA

3 Minimization of DFA

4 Converting from Regular Expression to NFA

5 DFA to Regular Expression and Regular Grammar

6 Design of Context-Free Grammar & Construction of Parse Tree, Transforming Context-Free Grammar into Chomsky Normal Form

7 Building Push-Down Automaton

8 Building Turing Machine

Course Outcome:

1. Analyze and design finite automata, regular languages and equivalence among them.
2. Create finite automata from regular expression also able to generate Regular Expression from Finite Automata.
3. Differentiate and design different form of Context-Free Grammar.
4. Analyze and design the different types of automata like push down automata, linear bounded automata and Turing machine.

Text Books:

1. An Introduction to Finite Languages and Automata – Peter Linz, Jones & Berlett, Fifth Edition, 2011
2. Introduction to Automata Theory, Languages, and Computation – Hopcroft, Ullman, Addison Wesley,3rd Edition, Indian Reprint 2011
3. Introduction to the theory of computation – Michael Sipser, Thompson, 2nd Edition, 2012
4. Introduction to Languages and the Theory of Computation – John Martin, McGrawhill, Second Edition, Indian Reprint 2013

19CS5PC02L	Machine Learning Lab using Python. (0-0-2)	1 Credits

Course Objective:

1. Make use of Data sets in implementing the machine learning algorithms.
2. Implement the machine learning concepts and algorithms in any suitable language of choice.

Laboratory Experiments

1. Build a multivariate logistic regression model to classify glass type of glass given different glass mixture features using the Glass Identification Dataset from UCI Machine Learning Repository.
2. Implement supervised machine learning algorithm (Classification – K Nearest Neighbourhood) in python to classify breast tumour data into malignant breast tumour or benign breast tumour (use breast tumour dataset) and obtain its accuracy level.
3. Implement supervised machine learning algorithm (Classification – K Nearest Neighbourhood) in python to classify iris data into setosa, virginica, versicolor using iris dataset and obtain its accuracy level.
4. Implement supervised machine learning algorithm (Classification – Support Vector Machine) in python to classify breast tumour data into malignant breast tumour or benign breast tumour (use breast tumour dataset) and obtain its accuracy level.
5. Write a python program to build an email spam classifier using support vector machines for the Spam base dataset from UCI machine learningrepository.
6. Implement unsupervised machine learning algorithm (Clustering – K Means) in python on Titanic dataset to cluster data (use Titanic dataset) by removing the class label.
7. Implement unsupervised machine learning algorithm (Clustering – K Means) in python on Breast Tumour dataset to cluster data (use Breast Tumour dataset) by removing the class label.
8. Implement unsupervised machine learning algorithm (Clustering – Hierarchical) in python on Titanic dataset to cluster data (use Titanic dataset).
9. Implement Apriori algorithm in python to find rules which explain association between different products for given transactions at a retail store. (The data is available at https://drive.google.com/file/d/1NUXoptUlHY8z4KcFKpFA6sQN5KnWzk3 p/view?usp=sharing)
10. Implement text classification using neural network in python/R on Twenty Newsgroupdataset from UCI machine learning repository.
11. Implement supervised machine learning algorithm (Classification - Naïve Bayes algorithm) in python/R on Pima Indians Diabetes dataset and obtainits accuracy level.
12. classification and prediction algorithms on UCI dataset using Python's scikit-learn library

References:

1. Peter Harrington, “Machine Learning in Action”, DreamTech.
2. Michael Bowles, “Machine Learning in Python”, Wiley.
3. Gavin Hackeling, Mastering Machine Learning with scikit-learn, Packt.

4. Giuseppe Bonaccorso, Machine Learning Algorithms - Second Edition, Packt.

Course Outcome:

1. Understand the implementation procedures for the machine learning algorithms
2. Design Java/Python programs for various Learning algorithms.
3. Apply appropriate data sets to the Machine Learning algorithms

Course Code: 19CS5MC02T	**Course Name:** Essence of Indian Tradition Knowledge	**L-T-P** 1- 0- 0	**Credit** 0

Course Objectives:

1. To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system.

2. To make the students understand the traditional knowledge and analyze it and apply it to their day to day life.

Syllabus

Module-I **[8 hours]**

Introduction to traditional knowledge: Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, Indigenous Knowledge (IK), characteristics, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge

Module-II **[6 hours]**

Protection of traditional knowledge:The need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.

Module-III **[8 hours]**

Legal framework and TK: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act); The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016.

Module-IV **[8 hours]**

Traditional knowledge and intellectual property: Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge

Module-V **[10 hours]**

Traditional Knowledge in Different Sectors: Traditional knowledge and engineering, Traditional medicine system, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK.

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

1. Identify the concept of Traditional knowledge and its importance.
2. Explain the need and importance of protecting traditional knowledge.
3. IIllustrate the various enactments related to the protection of traditional knowledge.
4. Interpret the concepts of Intellectual property to protect the traditional knowledge.
5. Explain the importance of Traditional knowledge in Agriculture and Medicine.

Text Books:

1. Traditional Knowledge System in India, by Amit Jha, 2009.
2. Traditional Knowledge System in India by Amit Jha Atlantic publishers, 2002.
3. Knowledge Traditions and Practices of India" Kapil Kapoor1, Michel Danino2.