Fifth Semester

Theory

Sl. No.	Category	Subject Code	Subject Name	L-T-P	Credit
1	ESC	19IT5ES01T	Python Programming	3-0-0	3
2	PCC	19IT5PC01T	**PCC-7:** Formal Language & Automata Theory	3-0-0	3
3	PCC	19IT5PC02T	**PCC-8:** Machine Learning	3-0-0	3
4	PEC	19IT5PE01T/ 19IT5PE02T/ 19IT5PE03T/ 19IT5PE04T	**Prof Elective-2 :** Knowledge Discovery & Data Mining/ High Performance Computing/ Mobile App Development/ Artificial Intelligence	3-0-0	3
5	OEC	19IT5OE01T	**Open Elective-1 (For other branch students)** JAVA Programming	3-0-0	3
6	OEC	19IT5OE02T	**Open Elective-2 (For other branch students)** Computer Networks	3-0-0	3
7	OEC	19EC5OE01T/ 19EC5OE02T/ 19EE5OE01T	**Open Elective-1 (For IT students)** VLSI Design Microprocessor and Interfacing Renewable Energy Systems	3-0-0	3
8	OEC	19CE5OE03T/ 19EC5OE03T	**Open Elective-2 (For IT 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	19IT5ES01L	Python Programming Lab	0-0-2	1
2	PCC	19IT5PC02L	**PCC Lab-7:** Formal Language & Automata Theory Lab	0-0-2	1
3	PCC	19IT5PC03L	**PCC Lab-8:** Machine Learning Lab using Python.	0-0-2	1
4	PSI	19CM5PS01L	Summer Internship / Training	0-0-2	1
Total Credit (Practical)					**4**
Total Semester Credit					**22**

19IT5ES01T	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, builtin 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 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.
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

19IT5PC01T	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:

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.

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

19IT5PC02T	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, Modeling 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, Decision trees random forest, SVM, example of regression, common regression algorithms.

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

Unsupervised Learning –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, back propagation, Overview of Deep Learning.

Course Outcome:

1. Equip students with knowledge of fundamentals concepts in machine learning.
2. Ability to analyze 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 Education.
2. 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

19IT5PE01T	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: **[10 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

19IT5PE02T	High Performance 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: Review of Basic Organization and Architectural Techniques [10Hrs]

RISC processors, Characteristics of RISC processors, RISC vs. CISC, Classification of instruction set architectures, Review of performance measurements, Basic parallel processing techniques: instruction level, thread level and process level.

Module-2: Instruction Level Parallelism [10Hrs]

Basic concepts of pipelining, Arithmetic pipelines, Instruction pipelines, Hazards in a pipeline: structural, data and control hazards, Overview of hazard resolution techniques, Dynamic instruction scheduling, Brach prediction techniques, Instruction-level parallelism using software approaches, Superscalar techniques, Speculative execution, Case study: Intel family of processors.

Module-3: Multi-Processors [10 Hrs]

Centralized vs. distributed shared memory, Interconnection topologies, Multiprocessor architecture, Symmetric multiprocessors, Cache coherence problem, memory consistency, Multicore architecture, Case study: multiprocessors, co-processors like GPU.

Module-4: Process Level Parallelism [10Hrs]

Distributed Computers, Clusters, Grid

Text Books:

1. Hennessey and Patterson, “Computer Architecture: A Quantitative Approach”, Morgan Kaufman.

References Books:

1. K. Hwang, F. A. Briggs, “Computer architecture and parallel processing”, McGraw-Hill.
2. “Intel® 64 and IA-32 Architectures Optimization Reference Manual”, http://www.intel.com/content/www/us/en/architecture-and-technology/64-ia-32-architectures-optimizationmanual.html
3. “Intel® 64 and IA-32 Architectures Software Developer Manuals”, http://www.intel.com/content/www/us/en/processors/architectures-software-developer-manuals.html
4. “Nvidia Kepler Compute Architecture White Paper”, http://www.nvidia.com/object/nvidia-kepler.html.

Digital Learning Resources

Course Name	Foundation Engineering
Course Link	https://nptel.ac.in/courses/105/105/105105176/
Course Instructor	Prof. Koushik Deb, Department of Civil Engineering, IIT Kharagpur

19IT4PE03T	Mobile App Development (3-0-0)	3 Credit

Course Objective:

1. To facilitate students to understand android SDK2.
2. To help students to gain a basic understanding of Android application development3.
3. To inculcate working knowledge of Android Studio development tool

Module-1: Introduction to Android:
The Android Platform, Android SDK, Eclipse Installation, Android Installation, Building you First Android application, Understanding Anatomy of Android Application, Android Manifest file.

Module-2: Android Application Design Essentials:
Anatomy of an Android applications, Android terminologies, Application Context, Activities, Services, Intents, Receiving and Broadcasting Intents, Android Manifest File and its common settings, Using Intent Filter, Permissions.

Module-3: Android User Interface Design Essentials:
User Interface Screen elements, Designing User Interfaces with Layouts, Drawing and Working with Animation.

Module-4: Testing
Testing Android applications, Publishing Android application, Using Android preferences, Managing Application resources in a hierarchy, working with different types of resources.

Module-5:
Using Common Android APIs:
Using Android Data and Storage APIs, Managing data using Sqlite, Sharing Data between Applications with Content Providers, Using Android Networking APIs, Using Android Web APIs, Using Android Telephony APIs, and Deploying Android Applicationto the World.

COURSE OUTCOMES: At the end of this course, students will be able to:

1. Identify various concepts of mobile programming that make it unique from programming for other platforms,
2. Critique mobile applications on their design pros and cons,
3. Utilize rapid prototyping techniques to design and develop sophisticated mobile interfaces,
4. Program mobile applications for the Android operating system that use basic and advanced phone features, and
5. Deploy applications to the Android marketplace for distribution

TEXT BOOKS:

1. Lauren Darcey and Shane Conder, "Android Wireless Application Development", Pearson Education, 2nd ed. (2011)
2. Reto Meier, "Professional Android 2 Application Development", Wiley India Pvt Ltd2.
3. Mark L Murphy, "Beginning Android", Wiley India Pvt Ltd3.
4. Android Application Development All in one for Dummies by Barry Burd, Edition-1

19IT5PE04T	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

19IT5OE01T	Java Programming (3-0-0)	3 Credits

Course Objective:

1. Learn the syntax, semantics and idioms of the Java programming language.
2. Gain confidence in object oriented programming principles through lots of practical exercises that provide useful exposure to the core Java class libraries.

Module- 1 **[8 Hrs]**

Introduction to Java and Java programming Environment. Object Oriented Programming Concepts: Encapsulation, Abstraction, Inheritance ,Polymorphism.

Fundamental Programming Structure: Data Types, variable, keywords, typecasting, Arrays, Operators and their precedence.

Control Flow: Java's Control Statements (if, switch, iteration, statement, while, do-while, for, Nested loop). Concept of Objects and Classes, Using Existing Classes building your own classes, constructor overloading, static , final, this keyword.

Module - 2 **[8 Hrs]**

Inheritance: Introduction, types of inheritance. Use of super keyword. Method overriding, Dynamic method Dispatch, Using Abstract Classes, Using final with inheritance. The Object Class.

Packages & Interfaces: Packages, Access Protection, Importing package, Interface, Implementing Interfaces, variables in Interfaces, Interfaces can be extended.

Module -3 **[8 Hrs]**

Exception Handling: Fundamentals, Types Checked , Unchecked exceptions, Using try & catch, Multiple catch, throw , throws, finally, Java's Built in exceptions, user defined exception.

String Handling: String constructors, String length, Character Extraction, String Comparison, Modifying a string.

Module 4 **[6 Hrs]**

Java I/O: Classes & Interfaces, Stream classes, Byte streams, Character streams, Serialization.

Multi Threading: Java Thread Life Cycle, Thread Priorities, Synchronization, Creating a thread, Runnable interface, Creating Multiple threads, Using isAlive () and join (), wait () & notiCS().

Module-5 **[10 Hrs]**

Wrapper Classes : Wrapper classes and its methods.

Collection Framework: Introduction, interfaces, List, Set, Map etc, List interfaces and its classes.

Event Handing: Event Delegation Model, Event Classes, Event Listener Interfaces, Adapter classes.

AWT: AWT Classes window fundamentals, component, container, panel, Window, Frame, working with Graphics , Control Fundamentals , Layout managers, Handling Events by Extending AWT components.

Course Outcome:

1. Implement and apply various Object Oriented programming concepts.
2. Applying Collection Classes and Files, Multiple Threads, & handle Exceptions in developing a java applications.
3. Developing a Java standalone application having front end design and back end.

Text Books:

1. Java: One Step Ahead by Anita Seth (Author), B.L. Juneja (Author) Oxford University Press.
2. Head First Java 2nd edition Kathy Sierra & Bert Bates
3. JAVA Complete Reference (9th Edition) Herbert Schildt.

Reference Books:

1. https://www.udemy.com/java-the-complete-java-developer-course/
2. Java Programming Masterclass for Software Developers Created by Tim Buchalka, Tim Buchalka's Learn Programming Academy, Goran Lochert

Digital Learning Resources

Course Name	Foundation Engineering
Course Link	https://nptel.ac.in/courses/105/105/105105176/
Course Instructor	Prof. Koushik Deb, Department of Civil Engineering, IIT Kharagpur

19IT5OE02T	Computer Networks (3-0-0)	3 Credits

Course Objective:

1. Understand the concepts of data communication, layered model, wireless devices in computer networks.
2. Explain the various techniques used to access a shared channel in the network and IEEE specifications for LANs.
3. List types of networking devices, backbone networks and Internet Protocol (IP)addressing.
4. Explain the responsibilities of network, transport and application layers.

Module - 1 **[12 Hrs]**

Overview of Data Communication Networks, Protocols and standards, OSI Reference model, TCP/IP Protocol.

Physical Layer: Analog Signals, Digital Signals, Data Rate Limits, Transmission Impairment, Data rate limit, Digital Transmission: Digital-to-Digital conversion, Analog-to-Digital conversion, Transmission modes, Analog Transmission: Digital-to-Analog conversion, Analog-to-Analog conversion, Multiplexing: Frequency Division Multiplexing (FDM), Wave Division Multiplexing (WDM), Time Division Multiplexing (TDM), Transmission Media: Guided Media (Twisted-Pair Cable, Coaxial Cable and Fiber-Optic Cable) and unguided media (wireless), Switching: Circuit Switched Network, Datagram Network, Virtual-Circuit Network.

Module - 2 **[12 Hrs]**

Error Detection and correction: Types of Errors, Error Detection mechanism (Linear codes, CRC, Checksum), Error Correction mechanism: Hamming Encoding. Data Link Control and Protocols: Flow and Error Control, Stop-and-Wait ARQ. Go-Back-N ARQ, Selective Repeat ARQ, HDLC and Point-to-Point Protocol Multiple Access: Random Access (ALOHA, CSMA, CSMA/CD, CSMA/CA), Controlled Access (Polling, Reservation, Token Passing).

Module - 3 **[6 Hrs]**

Wireless LANs: IEEE 802.11 and Bluetooth.

Connecting Devices: Passive Hub, Repeater, Active Hub, Bridge, Two layers Switch, Router, Three layers Switch, Gateway.

Virtual Circuit Networks: Frame Relay, Architecture & layers, ATM: Design goals, Architecture & layers.

Module - 4 **[6 Hrs]**

Network Layer: IPV4 addresses, IPV6 addresses, Internet Protocol: Internetworking, IPV4 datagram, IPV6 packet format and advantages. Network Layer Protocols: ARP, RARP, IGMP and ICMP. Routing: Unicast Routing Protocols and Multicast Routing Protocols.

Transport Layer: Process to Process Delivery, User Datagram Protocol (UDP) and Transmission Control Protocol (TCP).

Module - 5 **[6 Hrs]**

Domain Name System (DNS): Name Space, Domain Name Space, DNS in Internet, Resolution and Dynamic Domain Name System (DDNS), Remote logging, Electronic Mail (SMTP) and file transfer (FTP), WWW: Architecture & Web document.

Course Outcome:

1. Explain computer network reference models, networking devices and different transmission techniques.
2. Reason the need for flow and error control at the data link layer and explain the associated protocols; enumerate the shared channel access methods, associated protocols and Wired LAN standards and implementations.
3. Explain how network layer, transport layer and application layer facilitates the transfer of message from one node to another in a global network.

Text Books:

1. Data Communications and Networking, Behrouz A. Forouzan, Tata McGraw-Hill, 5th Edition(2013).
2. Computer Networks, A. S. Tannenbum, D. Wetherall, Pearson Education, 5th Edition(2014).
3. Data and Computer Communications, William Stallings, Pearson Education, 10th Edition(2018).

Reference Books:

1. Computer Networking, A Top-Down Approach, James F. Kurose, Keith W. Ross, Pearson publication, 6th Edition(2017).
2. http://www.nptelvideos.in/2012/11/computer-networks.html, Prof. Sujoy Ghosh, IIT, Kharagpur.
3. https://nptel.ac.in/courses/106105183/, Prof. SoumyaKantiGhosh, IIT, Kharagpur.
4. https://www.classcentral.com/course/stanford-openedx-introduction-to-computer-networking-1578, Prof. Philip Levis and Professor Nick McKeown, Stanford University.

Digital Learning Resources

Course Name	Foundation Engineering
Course Link	https://nptel.ac.in/courses/105/105/105105176/
Course Instructor	Prof. Koushik Deb, Department of Civil Engineering, IIT Kharagpur

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 and RCX

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**. (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 Renewable Energy.
2. Keeps abreast with the latest technology and toolset.
3. Communicate effectively to propagate ideas and promote teamwork
4. Attain intellectual leadership skills to cater to the changing needs of power industry, academia, society and environment

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 Speed ratio.

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 energy systems.

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 the society.
2. Understanding the architecture and programming of embedded processor (ARM or FPGA) or microcontroller
3. Familiarization with the embedded computing platform design and analysis.
4. To acquire the knowledge in interfacing protocols and related Hardwires.

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 System Design, 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:

5) An Introduction to the Constitution of India, D.D. Basu, Prentice Hall, New Delhi. (Latest Edition)
6) An Introduction to the Constitution of India, M. V. Pylee, Vikas, New Delhi, 1998.
7) Constitutional Questions in India: The President, Parliament and the States, A. G. Noorani, Oxford University Press, Delhi, 2000.
8) Indian Political System, J.C. Johari, Anmol Publishers, New Delh,1996.
9) 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 makethem understand the Importance of roots of knowledge system.
2. To make the students understand the traditional knowledge and analyse it and apply it totheir 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.

19IT5ES01L	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.

19IT5PC02L	Formal Language & Automata Theory Lab (0-0-2)	1 Credits

Course 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

19IT5PC03L	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

Experiment 1: Implement least square algorithm to find the decision surface for a given data with two features. Also plot the decision surface along with the points.

Experiment 2: Implement the Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs. Modify the regression algorithm adding lasso and ridge regularization.

Experiment 3: Implement the Bayes classifier to classify the given set of data which has convex shape and is linearly separable. Evaluate the performance of the classifier using precision and recall and prove that Bayes classifier is optimal in such case.

Experiment 4: Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets

Experiment 5: Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.

Experiment 6: Build a Linear SVM model and test the same using appropriate data sets. Modify the SVM model by considering kernels like RBF evaluate the performance of the system on chosen data set. Also compare the performance of the two models.

Experiment 7. Implement the perceptron algorithm on dataset and show with an animation how the decision boundary changes with each epoch.

Experiment 8. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering.

Experiment 9: Implement the RNN algorithm for training a time series data and by increasing the layer in RNN show that it suffers from exploding and vanishing gradients.

Experiment 10: Implement convolutional neural network for image classification. Vary the number of kernels, convolutional layer, stride, and pooling parameters and report the result for image classification. Use fashion MNIST classification dataset for the experiment.

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
4. Identify and apply Machine Learning algorithms to solve real world problems.

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.