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BASAVESHWAR ENGINEERING COLLEGE
BAGALKOTE- 587 102
Artificial Intelligence and Machine Learning

22UAI302C	**Data Structures and Applications**	**04-Credits**
Hrs/Week:04	**L:T:P:4:0:0**	CIE Marks:50
Total Hours:52		SEE Marks:50

UNIT - I	**13 Hrs**
The stack: Definition and Examples: Primitive operations, An Example, The stack as an Abstract data type. Representing Stacks in C: Implementing pop operation, Testing for exceptional conditions, Implementing the push operations. , An Example- Infix, Postfix and Prefix: Basic Definitions and Examples, Evaluating a postfix expression, Program to evaluate a postfix expression, Limitations of the program, Converting an expression from Infix to Postfix, Program to convert an expression from Infix to Postfix.	
UNIT – II	**13 Hrs**
Recursion: Recursive definition and processes: The factorial function, Properties of recursive definitions or Algorithms. , Recursion in C: Factorial in C., writing recursive programs: The Towers of Hanoi Problem. **Queues: The queue and its sequential representation**: The queue as an abstract data type, C implementation of queues, The insert operation, The priority queue, Array implementation of a priority queue. **Lists: Linked lists**: Inserting and removing nodes from a list, Linked implementation of stacks, The getnode and freenode operations, Linked implementation of queues, The linked list as a data structure, Examples of list operations, List implementation of priority queues, Header Nodes.	
UNIT - III	**13 Hrs**
Lists in C: Array implementation of lists, Limitations of the array implementation, Allocating and freeing dynamic variables, Linked lists using dynamic variables, Queues as lists in C, Examples of list operations in C, Non integer and non homogeneous lists, Comparing the dynamic and array implementation of lists, Implementing Header Nodes. An example: simulation using linked lists. **Other list structures**: Circular lists, The stack as a circular list, The queue as a circular list, Primitive operations on circular lists, The Josephus problem, Header nodes, Addition of long positive integers using circular lists.	
UNIT - IV	**13 Hrs**
Trees: Binary trees: Basics, Operation on Binary trees, Applications of Binary trees. Binary tree representations: Node representations of Binary trees, Node Representation of binary trees, Internal & external nodes, Implicit array representation of Binary trees, Choosing a Binary tree representation, Binary tree traversal in C, traversal using a father field, heterogeneous binary trees. **Trees and their applications**: C representation of trees, Tree traversals, General expressions as trees, Evaluating an expression tree, Constructing tree.	

Text Books:

1. Data structure using C", Aaron M. Tennenbaum, Yedidyah Langsam and Moshe J. Augenstein, Pearson Education/PHI 2006.

Reference books:

1. Behrouz A. Forouzan and Richard F. Gilberg, Thomson, "Computer Science A structured Programming Approach using C", II edition, 2003.
2. Richard F. Gilberg and Behrouz, "Data structures A pseudo code approach with c ", Thomson, 2005.

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3. Robert Kruse and Breuse Leung, "Data structures and program Design in C", PEARSON Education, 2007.
4. Ellis Horowitz and Sartaj Sahni, Fundamentals of Data Structures in C, 2nd Ed, Universities Press,2014.
5. Seymour Lipschutz, Data Structures Schaum's Outlines, Revised 1st Ed, McGraw Hill, 2014.
6. Reema Thareja, Data Structures using C, 3rd Ed, Oxford press, 2012.

Course Outcomes:

CO 1. Identify different data structures and their applications
CO 2. Apply stack and queues in solving problems.
CO 3. Demonstrate applications of linked list.
CO 4. Explore the applications of trees to model and solve the real-world problem.

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BAGALKOTE- 587 102
Artificial Intelligence and Machine Learning

22UAI403C	**Operating Systems**	**04-Credits**
Hrs/Week: 04	**L:T:P:4:0:0**	CIE Marks:50
Total Hours:40		SEE Marks:50

UNIT - I	**13 Hrs**
Introduction to operating systems, types and services. **Role of Operating systems:** user view, system view; Operating System structure; Operating System operations; Operating System Services; User - Operating System interface; System calls; Types of system calls; System programs; Operating System design and implementation; Operating System structure; Virtual machines. Process management: Process concept; Concepts of process: Process status, Process description, Process model, Operations on processes.	
UNIT – II	**13 Hrs**
Process management, threads and process synchronization. **Process Scheduling:** Basic concepts; scheduling criteria; Scheduling algorithms; Multiple-Processor scheduling, Inter-process communication (Intd.), Threads: concepts, Multi-Threaded Programming: Overview; Multithreading models; **Synchronization:** The Critical section problem; Peterson's solution; Synchronization hardware; Semaphores; Classical problems of synchronization; Monitors.	
UNIT - III	**13 Hrs**
Deadlocks and memory management: Deadlocks: Deadlocks: System model; Deadlock characterization; Methods for handling deadlocks; Deadlock prevention; Deadlock avoidance; Deadlock detection and recovery from deadlock Memory Management Strategies: Background; Swapping; Contiguous memory allocation; Paging; Structure of page table; Segmentation.	
UNIT - IV	**13 Hrs**
Virtual Memory Management: Background; Demand paging; Page replacement; Allocation of frames. **File system: concepts and implementation, secondary storage structures. File System:** File concept; Access methods; Directory structure; File system mounting; File sharing; Implementing File System: File system structure; File system implementation; Directory implementation; Allocation methods; Free space management.	
Text Books: **1.** Abraham Silberschatz, Peter Baer Galvin , Greg Gagne: Operating System 7th edition, Addison Wesley	
Reference books: **1.** D.M Dhamdhere: Operating systems - A concept based Approach, 2nd Edition, Tata McGraw- Hill, 2002.	

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22UAI402C	Analysis & Design of Algorithms (I)	Credits:04
L:T:P:3:0:2		CIE Marks:50
Total Hours/Week: 40/03		SEE Marks:50

UNIT-I	10 + 6 Hrs
Introduction: Notion of Algorithm, Fundamentals of Algorithmic Problem Solving, Important Problem Types, Fundamental Data Structures. **Fundamentals of the Analysis of Algorithm Efficiency:** Analysis Framework, Asymptotic Notations and Basic Efficiency Classes, Mathematical Analysis of Non-recursive and Recursive Algorithms, Example – Fibonacci Numbers. **Brute Force:** Selection Sort and Bubble Sort, Sequential Search and Brute-Force String Matching, Exhaustive Search.	
UNIT–II	**10 + 6 Hrs**
Divide and Conquer: Mergesort, Quicksort, Binary Search, Binary Tree Traversals and Related Properties, Multiplication of Large Integers and Strassen's Matrix Multiplication. **Decrease and Conquer:** Insertion Sort, Depth First Search, Breadth First Search, Topological Sorting, Algorithms for Generating Combinatorial Objects.	
UNIT–III	**10 + 6 Hrs**
Transform and Conquer: Presorting, Balanced Search Trees, Heaps and Heapsort, Problem Reduction. **Space and Time Tradeoffs:** Sorting by Counting, Input Enhancement in String Matching, Hashing, B-Trees. **Dynamic Programming:** Computing a Binomial Coefficient, Warshall's and Floyd's Algorithms, Optimal Binary Search Trees. The Knapsack Problem and Memory Functions.	
UNIT–IV	**10 + 6 Hrs**
Greedy Technique: Prim's Algorithm, Kruskal's Algorithm, Dijkstra's Algorithm, Huffman Trees. **Limitations of Algorithm Power:** Lower-Bound Arguments, Decision Trees, Problems Coping with the Limitations of Algorithm Power: Backtracking, Branch-and-Bound.	
Reference books: 1. "Introduction to Algorithms", Stein, PHI, 2nd Edition, 2. "Computer Algorithms", Horowitz E., Sahni S., Rajasekaran S., Galgotia Publications, 2001	
Text Books: 1. "Introduction to The Design & Analysis of Algorithms", Anany Levitin, Pearson Education, 3rd Edition, 2017	

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Course Outcomes : After completion of the course student will be able to

CO1: Understand the notion of an algorithm, asymptotic notations and different problem types.
CO2: Analyze the recursive and non-recursive algorithms.
CO3: Understand the algorithm design techniques using divide and conquer approach.
CO4: Understand the algorithm design techniques using dynamic programming and greedy approaches.
CO5: Explain the algorithm design techniques using backtracking, branch & bound, NP-complete and NP-hard problems.

Course Outcomes	Programme Outcomes												PSO	PSO	PSO
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2											3	3	2
CO2	3	2		2									3	3	2
CO3	3	3	2	1									3	3	3
CO4	3	3	3	2									2	3	3
CO5	3	2	3	2									2	3	2

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22UAI404C	Data Science for AI L: T: P: 3: 0: 0	Credit: 03
Hrs/Week: 03Hrs		CIE Marks: 50
Total Hours: 40Hrs		SEE Marks: 50

UNIT-I	10 Hrs.

Significance of data in AI , AI Software Development life cycle , Compare traditional software development with AI Software Development, Example – Game rules (Chess).

Machining Learning , Machine learning types , Machine learning workflow , Machine learning applications , Challenges in ML , Building a model-steps involved . Pipelines: Data engineering , Machine learning , Deployment.
Introduction to Data Science, Data Science uses, Data Science tools and technique. Big Data : Vs of Big Data - Sources of data, Role of Big Data in AI&ML.

Data: Introduction, Data types: Structured Data, Unstructured Data, Challenges with Unstructured Data.

Data Collection: Open Data, Social Media Data, Multimodal Data, Data Storage and Presentation.

Data Preprocessing: Importance of data preprocessing, Data cleaning , Assess Data quality , Data anomalies , Detect missing values with pandas data frame functions: info() and .isna() , Diagnose type of missing values with visual and statistical methods (eg. chi-squared test of independence). Approaches to deal with missing values: Keep the missing value as is , Remove data objects with missing values ,,Remove the attributes with missing values , Estimate and impute missing values.

Detecting outliers :univariate outlier detection, bivariate outlier detection, Time series outlier detection. Dealing with outliers : Do nothing, Replace with the upper cap or lower cap, Perform a log transformation, Remove data objects with outliers .

Data Integration :Overview, data integration challenges. Approaches: Adding attributes , Adding data objects.
Data reduction : Distinction between data reduction and data redundancy. Objectives: Methods with numerosity data reduction with dimensionality data reduction.

Data transformation: Need for data transformation, Normalization, Standardization Data transformation with - binary coding, ranking transformation and discretization. Data transformation with ranking transformation and discretization.

UNIT–II	10 Hrs.

Exploratory data analysis : overview , EDA goals and benefits. Univariate data analysis: Characterizing data with descriptive statistics , Univariate distribution, Univariate comparison plots , Univariate composition plots .

Univariate analysis tests : Hypothesis testing Error, Test statistic, type, interpreting test statistics. Understanding p-value.

Multivariate analysis: Finding relationship in data using Covariance and Correlation.

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Multivariate distribution plot ,Multivariate comparison plot, Multivariate relationship plot ,Multivariate composition plot.

Feature Engineering, Data Splitting Importance of data splitting - Training set - Validation set - Testing set, Underfitting and Overfitting

UNIT–III	10 Hrs.

Machine Learning pipeline, Supervised Learning: Regression, Types of regression, Regularization in ML, Real-Life Applications. Linear regression Overview: Types, Simple linear regression, Multiple linear regression, Polynomial linear regression, Applications of Linear Regression .

Understanding Simple linear regression, Regression equation, Assumptions, Gradient descent, Setting up the regression problem. Implementation: Student score based on study hours Problem statement, Create a model to analyses the relation between CIE and SEE result using sklearn. Create a model to analyze the relation between crop yield and rain fall rate, Build linear regression model using Stats model. Model Evaluation & testing: Evaluate regression model, Evaluation Metric, Coefficient of Determination or R-Squared (R2) , Root Mean Squared Error (RSME) . Optimize regression model, Gradient descent.

Cross-validation: Why do we need Cross-Validation? Techniques - Hold out method - Leave One Out Cross-Validation - K-Fold Cross-Validation.

Multiple Linear Regression: Overview, Assumptions , Normal Equation , Applications. Identification and collection of regression dataset, Perform data exploration, preprocessing and splitting on datasets , build regression model , evaluate the model , minimize the cost function using Boston housing price dataset from sci-kit learn datasets . Overfitting vs underfitting in Linear regression.

Supervised learning – classification, Types: Binary classification, Multi-Label Classification, Multi-Class Classification, Imbalanced Classification, Classification models , Applications

KNN Classification: Overview, KNN classification and regression , Choosing best K using validation method, Perform classification on Breast cancer data set using sklearn. Evaluation Metrics for Classification - confusion matrix, Accuracy, Precision and Recall ,Specificity , F1-score , AUC-ROC.

UNIT–IV	10 Hrs.

Decision tree, Understanding Entropy, information gain, Issues in decision tree, Overfitting in decision tree classifier and Pruning, Decision Tree Classifier Applications. Build decision tree-based model in python for like Play Tennis dataset from sci-kit learn Or any classification dataset from UCI , Kaggle. Evaluation of decision tree model with different metrics. Hyper parameter tuning for Decision Tree Classifier.

Logistic regression: Introduction to logistic regression. Difference between linear and logistic regression. Applications of logistic regression. The Logistic Function. The Logistic Regression Model. Gradient Descent and Optimization. Model Evaluation. Model Validation. Implementing Logistic Regression in Python (sklearn) for real world problems.

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Un supervised Learning: Definition and differences from supervised learning, Applications of unsupervised learning. Types of Unsupervised Learning, Overview of Clustering: Definition and types of clustering, Applications of clustering in different fields. Introduction to K-Means Clustering :Concept of K-Means Clustering. History and development of the K-Means algorithm, Real-world applications. Understanding the K-Means Algorithm: The objective function of K-Means, Steps involved in the K-Means algorithm. Distance Metrics: Euclidean distance and its importance in K-Means, Other distance metrics (Manhattan, Cosine), Choosing the right distance metric. Practical Implementation in Python (sklearn). Evaluating and Validating Clusters.
Reference Books/ Journals/ Technical Reports
1. "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" by Aurélien Géron, 2. "Python for Data Analysis" by Wes McKinney. 3. Online Courses: Coursera (Andrew Ng's Machine Learning), edX, Udacity. 4. Tutorials and Blogs: Towards Data Science, Kaggle kernels.

Course Outcome for Unit I:

- **Comprehensive Understanding of Data and AI Development Lifecycle**:
  - Students will understand the significance of data in AI, the AI Software Development Life Cycle, and compare it with traditional software development. They will gain practical skills in machine learning workflows, data science tools, Big Data, and data preprocessing, integration, reduction, and transformation.

Course Outcome for Unit II:

- **Mastering Exploratory Data Analysis and Data Preparation**:
  - Students will gain proficiency in exploratory data analysis (EDA) techniques, including univariate and multivariate data analysis, hypothesis testing, and understanding p-values. They will also learn the importance of feature engineering and data splitting, and understand the concepts of underfitting and overfitting in model training.

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Course Outcome for Unit III:

- **Developing and Evaluating Machine Learning Models**:
  - Students will understand the machine learning pipeline, with a focus on supervised learning techniques including various types of regression and classification models. They will gain hands-on experience in implementing, evaluating, and optimizing regression models using real-world datasets and Python libraries, and comprehend the importance of cross-validation and model evaluation metrics in preventing overfitting and underfitting.

Course Outcome for Unit IV:

- **Implementing and Evaluating Advanced Machine Learning Algorithms**:
  - Students will understand decision trees, including entropy, information gain, and issues such as overfitting and pruning. They will build, evaluate, and tune decision tree models, and gain practical skills in implementing logistic regression and unsupervised learning algorithms, including k-means clustering, with a focus on their applications, optimization, and evaluation using Python.

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22UAI405C	Embedded Systems (Integrated)	Credits: 03
L:T:P:2:0:2		CIE Marks:50
Total Hours/Week: 40 (28 T+12 P)		SEE Marks:50

UNIT-I	08 Hrs
8051 Architecture: Features of 8051 microcontroller, Internal block diagram, Oscillator and clock, Accumulator, Data pointer, Program counter, Program status word, Stack pointer, Special function registers, Timer/ counter, I/O ports, Memory organization.	
UNIT–II	**06 Hrs**
Addressing modes: Immediate, register, direct and indirect addressing modes. **Instruction Set and Programming:** Data transfer, Arithmetic, Logic and compare instructions, and assembly programs	
UNIT- III	**06 Hrs**
Control transfer instructions, Miscellaneous instructions of 8051 microcontroller and assembly programs. **8051 Programming in C:** Data types and time delay in 8051 C, I/O programming in C, Logical operations in C.	
UNIT- IV	**08 Hrs**
Interfacing Peripherals with 8051 Microcontroller: LED interfacing, Seven segment LED interfacing, LCD interfacing, Stepper motor interfacing, DC motor interfacing (programs for interfacing peripherals in assembly)	

Reference books

1. Kenneth J. Ayala, "8051 Microcontroller: Architecture, Programming and Applications", 3rd Edition, Thomson publication , 2005.
2. Muhammad Ali Mazidi, Janice Gillespie Mazidi, Rolin D. McKinlay, "The 8051 Microcontroller and Embedded Systems: using Assembly & C", 2nd Edition, Pearson, 2006.

Course Outcomes: After completion of the course student will be able to

CO1: Describe the internal architecture and instruction set of 8051 microcontroller.
CO2: Develop assembly and C programs using 8051 instructions and embedded C.
CO3: Analyze the given 8051 assembly programs.
CO4: Develop software and hardware for interfacing peripherals with 8051 microcontroller.

Course Outcomes	Programme Outcomes												PSO 1	PSO 2	PSO 3
	1	2	3	4	5	6	7	8	9	10	11	12			
CO1	3	2													
CO2	3	2	1												
CO3	3	3	2												
CO4	3	3	2												

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22UAI407C	Agile Methodologies L:T:P:1:0:0	01-Credits
Hrs/Week: 01		CIE Marks:50
Total Hours:15		SEE Marks:50

Objectives:

1. Understanding Agile Principles: To grasp the foundational principles behind Agile methodologies, such as iterative development, customer collaboration, and responding to change over following a plan.
2. Agile Practices and Techniques: Introducing students to various Agile practices and techniques such as user stories, Project Planning and Design, Estimation planning, daily stand-ups, retrospectives, and continuous integration.
3. Knowledge of Agile Frameworks: To familiarize students with popular Agile frameworks.

UNIT-I	04 Hrs.
Introduction: Software Development Life Cycle (SDLC), Different types of software development models, Need of Agile software development, agile context– Manifesto, Principles, Methods, Values, Roles, Artifacts, Stakeholders, and challenges. Business benefits of software agility.	
UNIT–II	**04 Hrs.**
Project Planning: Recognizing the structure of an agile team– Programmers, Managers, Customers. User stories– Definition, Characteristics and content. Estimation– Planning poker, Prioritizing, and selecting user stories with the customer, projecting team velocity for releases and iterations	
UNIT–III	**03 Hrs.**
Project Design: Fundamentals, Design principles–Single responsibility, Open-closed, Liskov substitution, Dependency-inversion, Interface-segregation	
UNIT–IV	**04 Hrs.**
Design Methodologies: Need of scrum, Scrum practices –Working of scrum, Project velocity, Burn down chart, Sprint backlog, Sprint planning and retrospective, Daily scrum, Scrum roles– Product Owner, Scrum Master, Scrum Team.	

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Reference Books

Text Books

1. Ken Schawber, Mike Beedle, "Agile Software Development with Scrum", International Edition, Pearson.
2. Robert C. Martin, "Agile Software Development, Principles, Patterns and Practices", First International Edition, Prentice Hall.
3. Pedro M. Santos, Marco Consolaro, and Alessandro Di Gioia, "Agile Technical Practices Distilled: A learning journey in technical practices and principles of software design", First edition, Packt Publisher.

Reference Books

1. Lisa Crispin, Janet Gregory, "Agile Testing: A Practical Guide for Testers and Agile Teams", International edition, Addison Wesley.
2. Alistair Cockburn, "Agile Software Development: The Cooperative Game", 2nd Edition, Addison-Wesley

E-Books and Online learning material

1. "The Complete Guide to Agile Software Development" https://clearbridgemobile.com/complete-guideagile-software-development/
2. "Agile Fundamentals Ebook: A Complete Guide for Beginners", https://agileken.com/agilefundamentals-ebook/

Online Courses and Video lectures

1. "Agile Software Development", https://www.edx.org/course/agile-software-development Accessed on August 27, 2021.
2. "Agile Software Development", https://www.coursera.org/learn/agile-software-development Accessed on August 27, 2021.

Course Outcomes

On completion of the course, the student will have the ability to:

CO1: **Interpret** the concept of agile software engineering and its advantages in software development.
CO2: **Determine** the role of design principles in agile Project Planning.
CO3: Students should be able to **apply** key design principles, including Single Responsibility Principle (SRP), Open-closed Principle (OCP), Liskov Substitution Principle (LSP), Dependency Inversion Principle (DIP), and Interface Segregation Principle (ISP), to develop software solutions that are flexible, extensible, and easy to maintain
CO4: **Make use** of various tools available to agile teams to facilitate the project.

Evaluation Scheme

Assessment	Marks	Weightage
CIE-I	20	20
CIE-II	20	20
Assignments/ Case Study	10	10
SEE	50	50
Total	100	100

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CIE: Pattern of Examination: Descriptive pattern
Time: 1 ½ hours (90Minutes)
Maximum Marks: 40
Answer any Two full question

Q.No.	Question	Marks	CO	BLL
	Unit-I	20		
1. a				
b.				
c.				
d.				
	Unit-II			
2.a.		20		
b.				
c.				
d.				
	Unit-I &Unit-II			
3. a.		20		
b.				
c.				
d.				

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SEE: Pattern of Examination: Descriptive pattern
Time: 1 ½ hours (90Minutes)
Maximum Marks: 50
Note: Answer any Five question selecting at least one from each unit.

Q.No.	Question	Marks	CO	BLL
	Unit-I			
1. a		10		
b.				
c.				
d.				
2. a		10		
b.				
c.				
d.				
	Unit-II			
3. a.		10		
b.				
c.				
d.				
4. a.		10		
b.				
c.				
d.				
	Unit-III			
5. a.		10		
b.				
c.				
d.				
6. a		10		
b.				
c.				
d.				
	Unit-IV			
7. a		10		
b.				
c.				
d.				
8. a.		10		
b.				
c.				
d.				

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21UAI503C	Machine Learning Algorithms(I) L:T:P:3:0:0	03-Credits
L:T:P:2:0:2		CIE Marks: 50
Total Hours/Week: 40 (28 T+12 P)		SEE Marks: 50

UNIT - I	10 Hrs
Introduction: Introduction to Machine Learning, Examples of Machine Learning Applications. Well posed learning problems, Designing Learning System, Perspectives and issues in Machine Learning. **Decision Tree Learning**: Introduction, Decision tree representation, Appropriate problems for decision tree learning, the basic decision tree learning algorithm, Hypothesis space search in decision tree learning, Inductive Bias in decision tree learning, Issues in decision tree learning.	
UNIT – II	**10 Hrs**
Artificial Neural Networks (ANN): Introduction, Neural Network Representations, Appropriate Problems For Neural Network Learning, Perceptron, Multilayer Networks And The Back propagation Algorithm, Remarks On The Back propagation Algorithm, An Illustrative Example: Face Recognition. **Hypothesis and Performance Evaluation**: Basic Performance Criterion, Precision and recall, Other ways to measure Performance, Estimating Hypothesis Accuracy, Basics of Sampling Theory, General approach for deriving confidence intervals, difference in error of two hypothesis, comparing learning algorithms.	
UNIT - III	**10 Hrs**
Bayesian learning: Introduction, Bay's theorem, Maximum likelihood and least squared hypothesis, Maximum likelihood hypothesis for predicting probabilities, Minimum Description length principle, Bay's optimal classifier, Gibbs algorithm, Naive Bay's Classifier. An Example: Classify Text. **Instance Based Learning**: Introduction, k-Nearest Neighbor Learning, Locally Weighted Regression, Radial Basis function, and case based reasoning.	
UNIT - IV	**10 Hrs**
Dimensionality Reduction: Introduction, Subset Selection, Principal Components Analysis, Factor Analysis, Multi dimensional scaling, Linear descreminant analysis, isomap, Locally Linear Embedding. **Clustering**: Introduction, Mixture Densities, K-means Clustering, Expectation Maximization Algorithm, Mixture Latent Variable models, Supervised learning after clustering, Hierarchical clustering, Choosing the number of clusters.	
Text Books: 1. Tom Mitchell, Machine Learning, McGraw- Hill Publications, 2nd Edition, 2013. 2. Ethem Alpaydin, Introduction to Machine Learning, MIT press, Cambridge, Massachusetts,	

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London, 2nd Edition, 2010.
Reference Books: 1. Trevor Hastie. Robert Tipeshirani, Jerome Fredman, Elements of Statistical Learning, Springer, 2nd Edition, 2010. 2. Luis Pedro Coelho and Willi Richart, Building Machine Learning Systems with Python, PACKT Publication, 2nd Edition, 2013. .
Course Outcomes: CO1: Define machine learning and types of learning algorithms CO2: Explain various machine learning algorithms. CO3: Apply machine learning algorithm to solve problems of moderate complexity. CO4: Analyze performance of algorithms by varying some parameters. CO5: To formulate machine learning model for the simple problem.

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Artificial Intelligence and Machine Learning

UAI701C	Big Data Analytics L:T:P:4:0:0	04-Credits
Hrs/Week: 04		CIE Marks:50
Total Hours:40		SEE Marks:50

UNIT - I	13 Hrs
Types of Digital Data: Classification of Digital Data – Structured Data, SemiStructured Data, and Unstructured Data. Introduction to Big Data: Characteristics of Data, Evolution of Big Data, Definition of Big Data, Challenges with Big Data,What is Big Data? Other Characteristics of Data Which are not Definitional Traits of Big Data, Why Big Data? Are We Just an Information Consumer or Do we also Produce Information? Traditional Business Intelligence (BI) versus Big Data, A Typical Data Warehouse Environment, A Typical Hadoop Environment, What is New Today? What is changing in the Realms of Big Data? **Big Data Analytics:** Where do we Begin? What is Big Data Analytics? What Big Data Analytics Isn't? Why this Sudden Hype Around Big Data Analytics? Classification of Analytics, Greatest Challenges that Prevent Businesses from Capitalizing on Big Data, Top Challenges Facing Big Data, Why is Big Data Analytics Important? What Kind of Technologies are we looking Toward to Help Meet the Challenges Posed by Big Data? Data Science, Data Scientist. Terminologies Used in Big Data Environments, Basically Available Soft State Eventual Consistency (BASE), Few Top Analytics Tools.	
UNIT – II	**13 Hrs**
Big Data Technology Landscape - NoSQL (Not Only SQL) and Hadoop.**NoSQL (Not Only SQL)** - Where is it used? What is it?, Types of NoSQL databases, Why NoSQL?, Advantages of NoSQL, What we miss with NoSQL?, NoSQL Vendors, SQL Versus NoSQL, NewSQL, Comparison of SQL, NoSQL, and NewSQL. **Hadoop:** Features of Hadoop, Key advantages of Hadoop, Versions of Hadoop - Hadoop 1.0, Hadoop 2.0, Overview of Hadoop Ecosystems, Hadoop Versus, SQL, Integrated Hadoop systems offered by leading market vendors, Cloud based Hadoop solutions. Introducing Hadoop, Why Hadoop? Why not RDBMS?, RDBMS versus Hadoop, Distributed Computing Challenges, History of Hadoop, Hadoop Overview, Use Case of Hadoop, Hadoop Distributors, HDFS (Hadoop Distributed File System), Processing Data with Hadoop, Managing Resources and Applications with Hadoop YARN (Yet another Resource Negotiator), Interacting with Hadoop Ecosystem.	
UNIT - III	**13 Hrs**
Introduction to MongoDB: What is MongoDB? Why MongoDB?, Terms Used in RDBMS and MongoDB, Data Types in MongoDB, MongoDB Query Language.- Insert, Save, Update, Remove, find methods, Dealing with NULL values, Count, Limit, Sort and Skip Methods. **Introduction to Cassandra:** An Introduction, Features of Cassandra, CQL Data types, CQLSH, Keyspaces, CRUD (Create, Read, Update and Delete) Operations, Collections.	
UNIT - IV	**13 Hrs**
Hive: What is Hive?, Hive Architecture, Hive Data Types, Hive File Formats, Hive Query Language (HQL), RCFile Implementation, SerDe, User-defined Function (UDF). Introduction to Pig: What is Pig?, The Anatomy of Pig, Pig on Hadoop, Pig Philosophy, Use Case for Pig: ETL Processing, Pig Latin Overview, Data Types in Pig, Running Pig, Execution Modes of Pig, Relational Operators, Eval Function, Complex Data Types.	

Text Books:

1. Seema. Acharya and Subhashini. C, "Big Data and Analytics", 1st Edition, Wiley India, 2015 (Chapters 1,2,3,4,5,6,7,9,10).

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Reference books:

1. Bart. Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", 1 st Edition, Wiley, 2014.
2. DT Editorial Services, "Big Data: Black Book, Comprehensive Problem Solver", 1 st Edition, Dreamtech Press, 2016.
3. Tom. White, "Hadoop – The Definitive Guide", 3rd Edition, O'Reilly, 2012.
4. Alex Holmes, "Hadoop in Practice", 2nd Edition, Dreamtech Press India Pvt. Ltd, 2014.
5. Dayong. Du, "Apache Hive Essentials", 2 nd Edition, Packt Publishing Limited, 2018.
6. Alan. Gates, "Programming Pig", 2nd Edition, Shroff/O'Reilly, 2016.
7. Alan. Gates, "Programming Pig: Dataflow Scripting with Hadoop", 2 nd Edition, Shroff/O'Reilly, 2016.

Online Resources:

1. https://www.tutorialspoint.com/machine_learning_with_python/index.htm
2. https://www.guru99.com/machine-learning-tutorial.htm
3. https://www.geeksforgeeks.org/machine-learning/
4. http://archive.ics.uci.edu/ml/index.php (Popular dataset resource for ML beginners)

Course Outcomes:

After completing the course, the student will be able to:

CO1: Analyze the characteristics of digital data and its challenges in big data environment.

CO2: Analyze the challenges of big data analytics and its terminologies that prevent businesses from capitalizing.

CO3: Build meaningful conversations on Big Data and analytics using Hadoop.

CO4: Identify suitable types of NoSQL databases to solve complex engineering problems.

CO5: Apply Hive and Pig tools on structured data for processing and analyzing

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BASAVESHWAR ENGINEERING COLLEGE
BAGALKOTE- 587 102
Artificial Intelligence and Machine Learning

UAI702C	**INTERNET OF THINGS**	**03-Credits**
Hrs/Week: 03	L: T:P:S **(3:0:0:0)**	**CIE Marks:**50
Total Hours: 40 Hrs		**SEE Marks:**50

UNIT - I	**10 Hrs**
Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and IoT, IoT Challenges, IoT Network Architecture and Design, Drivers Behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack.	
UNIT – II	**10 Hrs**
Smart Objects: The "Things" in IoT, Sensors, Actuators, and Smart Objects, Sensor Networks, Connecting Smart Objects, Communications Criteria, IoT Access Technologies: Salient features of protocol stacks utilizing IEEE 802.15.4 (Intd.). IP as the IoT Network Layer, The Business Case for IP, the need for Optimization, Optimizing IP for IoT	
UNIT - III	**10 Hrs**
Data and Analytics for IoT, An Introduction to Data Analytics for IoT, Machine Learning, Big Data Analytics Tools and Technology, Edge Streaming Analytics, Network Analytics. Securing IoT, A Brief History of OT Security, Common Challenges in OT Security, How IT and OT Security Practices and Systems Vary, Formal Risk Analysis Structures: OCTAVE and FAIR.	
UNIT - IV	**10 Hrs**
IoT Physical Devices and Endpoints - Arduino UNO: Introduction to Arduino, Arduino UNO, Installing the Software, Fundamentals of Arduino Programming. IoT Physical Devices and Endpoints - RaspberryPi: Introduction to RaspberryPi, About the RaspberryPi Board: Hardware Layout. Operating Systems on RaspberryPi, Configuring RaspberryPi. Smart and Connected Cities, An IoT Strategy for Smarter Cities, Smart City IoT Architecture.	

Textbooks

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", Edition, Pearson Education (Cisco Press Indian Reprint). (ISBN:978 - 9386873743)
2. Srinivasa K G, "Internet of Things", CENGAGE Leaning India, 2017

Reference Books

1. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014. (ISBN:978-8173719547)
2. Raj Kamal, "Internet of Things: Architecture and Design Principles",1st Edition, McGraw Hill Education, 2017. (ISBN: 978-9352605224)

Course Outcomes:

CO1: To recall IT, OT, IoT and Digitization concepts.

CO2: To describe various IoT network architectures and designs.

CO3: To describe IoT network engineering.

CO4: To explain data and analytics for IoT.

CO5: To describe IoT Physical Devices and Endpoints.

CO6: To explain various IoT strategies/applications.

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BVVS

BASAVESHWAR ENGINEERING COLLEGE
BAGALKOTE- 587 102
Artificial Intelligence and Machine Learning

UAI705E	Reinforcement Learning	03-Credits
Hrs/Week: 03	L:T:P:3:0:0	CIE Marks: 50
Total Hours: 40		SEE Marks: 50

UNIT - I	10 Hrs
Introduction to RL, Markov Decision Process (MDP): Markov Process, Markov Reward Process, Markov Decision Process and Bellman Equations, Partially Observable MDPs.**Planning by Dynamic Programming (DP):**Policy Evaluation, Value Iteration, Policy Iteration, DP Extensions and Convergence using Contraction Mapping.**Model-free Prediction:** Monte-Carlo (MC) Learning, Temporal-Difference (TD) Learning, TD-Lambda and Eligibility Traces.	
UNIT – II	**10 Hrs**
Model-free Control: On-Policy MC Control, On-Policy TD Learning and Off-Policy Learning. **Value Function Approximation:** Incremental Methods and Batch Methods, Deep Q-Learning, Deep Q-Networks and Experience Replay.**Policy Gradient Methods** Finite-Difference, Monte-Carlo and Actor-Critic Methods.	
UNIT - III	**10 Hrs**
Integrating Planning with Learning: Model-based RL, Integrated Architecture and Simulation-based Search.**Exploration and Exploitation (Bandits):** Multi-arm Bandits, Contextual Bandits and MDP Extensions.**Integrating AI Search and Learning**: Classical Games: Combining Minimax Search and RL.	
UNIT - IV	**10 Hrs**
Hierarchical RL: Semi-Markov Decision Process, Learning with Options, Abstract Machines and MAXQ Decomposition**Deep RL:** PPO, DDPG, Double Q-Learning, Advanced Policy Gradients etc.**Multi-Agent RL:** Cooperative vs. Competitive Settings, Mixed Setting, Games, MARL Algorithms.	

Text Books:

1. Richard S. **Sutton** and Andrew G. **Barto**; Reinforcement Learning: An Introduction; 2nd Edition, MIT Press, 2020.

Reference Books:

1. Csaba **Szepesvári**; Algorithms of Reinforcement Learning; Synthesis Lectures on Artificial Intelligence and Machine Learning, vol. 4, no. 1, 2010.
2. Dimitri P. **Bertsekas**; Reinforcement Learning and Optimal Control; 1st Edition, Athena Scientific, 2019.
3. Dimitri P. **Bertsekas**; Dynamic Programming and Optimal Control (Vol. I and Vol. II); 4th Edition, Athena Scientific, 2017.

Course Outcomes:

CO1: Define RL tasks and the core principles behind the RL, including policies, value functions, deriving Bellman equations.
CO2: Implement in code common algorithms following code standards and libraries used in RL.
CO3: Understand and work with tabular methods to solve classical control problems.
CO4: Understand and work with approximate solutions (deep Q network-basedalgorithms).
CO5: Learn the policy gradient methods from vanilla to more complex cases.

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UAI704E	Optimization Techniques for Machine Learning L:T:P:3:0:0	03-Credits
Hrs/Week: 03		CIE Marks: 50
Total Hours: 40		SEE Marks: 50

Prerequisite: Basic linear algebra, probability, and knowledge of a programming language like Python (Google CoLab) to conduct simulation exercises

UNIT - I	10 Hrs
Foundation: Function Optimization, Candidate solutions, Objective functions, Evaluation costs. **Optimization and Machine Learning**: Introduction to ML and Optimization, Learning as optimization, Optimization in ML project. **How to Choose an Optimization Algorithm**: Optimizing algorithms, Differentiable objective function, Non differentiable objective function. **Background:** No Free Lunch Theorem for Machine Learning, Implications for optimization and Machine learning. **Local Optimization vs. Global Optimization**: Local Optimization, Global Optimization, Local Optimization vs. Global Optimization. **Premature Convergence:** Convergence in ML, Premature convergence, Addressing premature convergence. **Creating Visualization for Function Optimization**: Visualization for function optimization, Visualize 1D function optimization, **Visualize 2D function optimization**, **Stochastic Optimization Algorithms**: Stochastic optimization and algorithms, Practical considerations for Stochastic Optimization. **Random Search and Grid Search:** Naïve function optimization algorithms, Random search for function optimization, Grid search for function optimization.	
UNIT – II	**10 Hrs**
Local Optimization: Gradient in Machine Learning, Derivative and gradient, Worked examples of calculating derivatives, Interpreting derivatives, Calculating derivative of a function. **Univariate Function Optimization**: Univariate function optimization, Convex univariate function optimization, Non convex univariate function optimization. **Pattern Search**: Nelder-Mead Optimization Algorithm, Nelder-Mead example in Python, Nelder-Mead on challenging functions. **Second Order optimization algorithms**: The BFGS and L-BFGS-B Optimization Algorithms, Worked examples of BFGS. **Stochastic Hill Climbing algorithms:** Stochastic Hill Climbing algorithm and its implementation, Examples of applying Stochastic Hill Climbing algorithms. **Iterated Local Search:** Introduction to iterative local search, Ackley objective function, Stochastic Hill Climbing algorithm with random restarts, Iterated local search algorithms.	
UNIT - III	**10 Hrs**
Global Optimization: **Simple Genetic Algorithm:** Genetic algorithm from scratch, genetic algorithm for Onemax, Genetic algorithm for function optimization. **Evolution Strategies**: Develop a (μ,λ)-ES, develop $(\mu+\lambda)$-ES. **Differential Evolution:** Differential evolution algorithm from scratch, Differential evolution	

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algorithm on the sphere function.
Simulated Annealing : Implement simulated annealing and worked wxample.

UNIT - IV	10 Hrs

Gradient Descent:
Gradient Descent Optimization: Gradient descent and worked example. Gradient descent optimization, Gradient descent with momentum and its visualization. Gradient Descent with AdaGrad,Gradient Descent with RMSProp,Gradient Descent with Adadelta, Adam Optimization Algorithm

Projects:

Use Optimization Algorithms to Manually Fit Regression Models: Optimize linear and logistic regression models,

Optimize Neural Network Models: Optimize a perceptron and a multi layer perceptron.

Feature Selection using Stochastic Optimization: Optimization for feature selection, Enumerate all feature subsets.

Manually Optimize Machine Learning Model: Mannual hyper parameter optimization, Perceptron hyper parameter optimization, XGBOOST hyper parameter optimization.

Text Books:

1. Optimization Techniques for Machine Learning, Jayson Brownlee,Machine learning mastery,2021.

Reference Books:

1. Linear Algebra and Learning from Data, Gilbert Strang
2. Convex Optimisation by Stephen Boyd
3. Optimisation for Machine Learning by Suvrit Sra, MIT Press.

Course Outcomes:

CO1: Grasp essential concepts in function optimization and Connect Optimization with Machine Learning
CO2:Develop the skill to pick the right optimization algorithm based on the problem
CO3:Create visualizations for function optimization
CO4 :Apply optimization techniques to ML based real-world problems

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22UBT340C/22UBT440C	BIOLOGY FOR ENGINEERS	02 - Credits (2: 0 : 0)
Hours / Week : 02		CIE Marks : 50
Total Hours : 26		SEE Marks : 50

UNIT-I	06 Hrs.

Bio Inspiration Models Used In Engineering:

Bio inspiration - Introduction, Alliance between Engineering and Biology, Biomimicry - Science mimicking nature.

Bird flying (GPS and aircrafts), Lotus leaf effect (Super hydrophobic and self-cleaning surfaces), Gecko Feet, Plant burrs (Velcro), Shark skin (Friction reducing swimsuits), Kingfisher beak (Bullet train), Fire fly LED.

UNIT–II	06 Hrs.

Nature Bioinspired Materials And Mechanisms

BioEcholocation (ultrasonography, sonars), Photosynthesis (photovoltaic cells, bionic leaf), Respiration (MFCs)
Human Blood substitutes-hemoglobin based oxygen carriers (HBOCs) and perflourocarbons (PFCs). Artificial Intelligence for disease diagnosis. Bioichips & their applications.

Biosensors & their applications. Nanobiomolecules in medical science. Biofilms in dental treatment

UNIT–III	07 Hrs.

Human Organ Systems And Bio Designs

Brain as a CPU system (architecture, CNS and Peripheral Nervous System, signal transmission, EEG, Robotic arms for prosthetics. Engineering solutions for Parkinson's disease).

Heart as a pump system (architecture, electrical signalling - ECG monitoring and heart related issues, reasons for blockages of blood vessels, design of stents, pace makers, defibrillators).

Lungs as purification system gas exchange mechanisms, spirometry, Ventilators, Heart-lung machine).

Eye as a Camera system, bionic eye. **Kidney** as a filtration system - dialysis systems. **Muscular and Skeletal Systems** as scaffolds, bioengineering solutions for muscular dystrophy and osteoporosis.

UNIT–IV	07 Hrs.

Trends In Bioengineering

Bioprinting techniques and materials, 3D printing of ear, bone and skin. 3D printed foods, electrical tongue and electrical nose in food science, DNA origami and Biocomputing, Bioimaging and Self-healing Bioconcrete (based on bacillus spores, calcium lactate nutrients

and biomineralization processes) and Bioremediation and Biomining via microbial surface adsorption (removal of heavy metals like Lead, Cadmium, Mercury, Arsenic). Bio-bleaching.

Reference Books *

1. Human Physiology, Stuart Fox, Krista Rompolski, McGraw-Hill eBook. 16th Edition, 2022
2. Biology for Engineers, Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi S., and Jaganthan M.K., Tata McGraw-Hill, New Delhi, 2012
3. Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis, 2011
4. Biomedical Instrumentation, Leslie Cromwell, Prentice Hall 2011
5. Biology for Engineers, Sohini Singh and Tanu Allen, Vayu Education of India, New Delhi, 2020.
6. Biomimetics: Nature-Based Innovation, Yoseph Bar-Cohen, 1st edition, CRC Press, 2012
7. Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies, D. Floreano and C. Mattiussi, MIT Press, 2008
8. Bioremediation of heavy metals: bacterial participation, by C R Sunilkumar, N GeethaA C Udayashankar Lambert Academic Publishing, 2019
9. 3D Bioprinting: Fundamentals, Principles and Applications by Ibrahim Ozbolat, Academic Press, 2016
10. Electronic Noses and Tongues in Food Science, Maria Rodriguez Mende, Academic Press, 2016

Web links and Video Lectures (e-Resources)

- VTU EDUSAT / SWAYAM / NPTEL / MOOCS / Coursera / MIT-open learning resource
- https://nptel.ac.in/courses/121106008
- https://freevideolectures.com/course/4877/nptel-biology-engineers-other-non-biologists
- https://ocw.mit.edu/courses/20-020-introduction-to-biological-engineering-design-spring-2009
- https://ocw.mit.edu/courses/20-010j-introduction-to-bioengineering-be-010j-spring-2006
- https://www.coursera.org/courses?query=biology
- https://onlinecourses.nptel.ac.in/noc19_ge31/preview
- https://www.classcentral.com/subject/biology
- https://www.futurelearn.com/courses/biology-basic-concepts

Course Outcomes**
After completion of the course student will be able to 1. Corroborate the concepts of biomimetics for specific requirements. 2. Understand the concept of bioinspired materials and mechanisms. 3. Evaluate the principles of design and development of biodesigns based on human organ systems. 4. Explore innovative biobased solutions for ecofriendly and socially relevant problems.

Course Outcomes	Programme Outcomes												Programme Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO 1	3		1									1			
CO 2	3		1									1			
CO 3	3		1									1			
CO 4	3		1		3	1	1					1			

22UCS309L	Data Analytics Using R	Credits: 01
L:T:P -0:1:1		CIE Marks: 50
Total Hours: 24		SEE Marks: 50

UNIT-I	3(T)+3(P)
Introduction to Data Analytics: Overview of Data Analytics, Need of Data Analytics, Nature of Data, Classification of Data: Structured, Semi-Structured, Unstructured,Characteristics of Data, Applications of Data Analytics **Introduction to R:**Overview of R programming, Data Types in R, Few Commands for Data Exploration Loading and Handling Data in R:Expression, Variables and Functions,Missing Values Treatment in R, Using the 'as' Operator to Change the Structure of Data	
UNIT–II	**3(T)+3(P)**
Vectors: Sequence Vector, rep function, Vector Access, Vector Names, Vector Math, Vector Recycling, **Matrices:** Matrix Access, **Factors:**Creating Factor, **List:**List Tags and Values, Add/Delete Element to or from a List, Size of a List, **Few Common Analytical Tasks,Aggregating and Group Processing of a Variable, Simple Analysis Using R** **Methods for Reading Data:** CSV and Spreadsheets, Reading Data from Packages	
UNIT–III	**3(T)+3(P)**
Exploring Data in R: Introduction, Data Frames,R Functions for Understanding Data in Data Frames,R Functions for Understanding Data in Data Frames,Load Data Frames,Exploring Data,Data Summary, Finding the Missing Values, Invalid Values and Outliers, Descriptive Statistics, Spotting Problems in Data with Visualization	
UNIT–IV	**3(T)+3(P)**
Linear Regression using R: Introduction, Model Fitting, Linear Regression, Assumptions of Linear Regression **Case study:** Exploring the appropriate data sets from Kaggle web site and perform the data analytics using linear regression.	

Reference Books

1. Seema Acharya, Data analytics using R,2018, McGraw Hill Education (India).
2. Owen Jones, Robert Maillardet, and Andrew Robinson, Introduction to Scientific Programming and Simulation Using R, 2014,CRC Press
3. Daniel Bell, RProgramminga Step-by-Step Guide for Absolute Beginners,Second Edition May 2020, KDP Amazon Publishing
4. Mark Gardener, BeginningRThe Statistical Programming Language,2012, John Wiley & Sons, Inc

Course Outcomes

After completion of the course student will be able to

1. Demonstrate proficiency in using R's data structures,data reading functions (e.g., read.csv, read.table) and preprocessing the data.
2. Construct different graphs for visualizations of the data (e.g., histograms, scatter plots, bar charts) to interpret the insights they provide
3. Develop R scripts to conduct exploratory data analysis (EDA) to uncover patterns, trends, outliers in data and interpret the insights they provide

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	1	1		1							1	1		1
CO2	1	2	1		1							1	2	1	1
CO3	1	2	3	2	1							1	2	2	2

22UCS403C	System Software	Credits: 03
L:T:P - 2:0:2		CIE Marks: **50**
Lecture Hours/Week : **02** Practical Hours/Week : **02**		SEE Marks: **100**

UNIT-I	07 Hrs.
Machine Architecture: Introduction, System Software and Machine Architecture, Simplified Instructional Computer (SIC) - SIC Machine Architecture, SIC/XE Machine Architecture, SIC Programming Examples, Traditional (CISC) Machines - VAX Architecture, RISC Machines - Ultra SPARC Architecture. **Assemblers**: Basic Assembler Function - A Simple SIC Assembler, Assembler Algorithm and Data Structures	
UNIT–II	**07 Hrs.**
Assemblers: Machine Dependent Assembler Features - Instruction Formats & Addressing Modes, Program Relocation. **Machine Independent Assembler Features:** Literals, Symbol-Definition Statements, Expression, Program Blocks, Control Sections and Programming Linking.	
UNIT–III	**07 Hrs.**
Loaders And Linkers: Basic Loader Functions - Design of an Absolute loader, A Simple Bootstrap Loader, Machine-Dependent Loader Features - Relocation, Program Linking, Algorithm and Data Structures for a Linking Loader, Machine-Independent Loader Features - Automatic Library Search, Loader Options, Loader Design Options - Linkage Editor, Dynamic Linkage, Bootstrap Loaders.	
UNIT–IV	**07 Hrs.**
Lex and Yacc: The Simplest Lex Program, Recognizing Words with LEX, Grammars, Parser-Lexer Communication, A YACC Parser, The Rules Section, Running LEX and YACC, LEX and Hand-Written Lexers, Using LEX - Regular Expression, Examples of Regular Expressions, A Word Counting Program, **Using YACC** - Grammars, Recursive Rules, Shift/Reduce Parsing, What YACC Cannot Parse, A YACC Parser - The Definition Section, The Rules Section, Symbol Values and Actions, The LEXER, Compiling and Running a Simple Parser, Arithmetic Expressions and Ambiguity, Variables and Typed Tokens.	

Reference Books *

1. System Software – An Introduction to Systems Programming, Leyland. L. Beck, Pearson Education, 3rd Edition, 2012
2. Lex and Yacc, John. R. Levine, Tony Mason and Doug Brown, O'Reilly, SPD. 1999
3. System Programming and Operating Systems, D. M. Dhamdhere, McGraw Hill Education, 3rd Edition.

Course Outcomes**

After completion of the course student will be able to

1. List and define features/concepts of machine architectures and system softwares.
2. Explain characteristics/concepts/basic operations of machines architectures, system softwares.
3. Write programs to implement simple assembler, loader, linker, lexical analyzer and syntactic analyzer.
4. Compare and contrast types of software, machine architectures, system software and Lexical and syntactic analyzer.
5. Modify assembler and loader algorithms to incorporate machine independent features and feasible alternative designs.

*** Books to be listed as per the format with decreasing level of coverage of syllabus**
**** Each CO to be written with proper action word and should be assessable and quantifiable**

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1		2	2	2									1		1
CO2		2	2	2									2		1
CO3		3	3	2									3		1
CO4		2	2	2									3		1
CO5		2	2	2									3		1

SUBJECT CODE 21UCS036E	ADHOC WIRELESS NETWORKS	Credits: 03
L:T:P - N_L : N_T: N_P 3:0:0		CIE Marks: 50
Total Hours/Week: 03		SEE Marks: 50

UNIT-I	10 Hrs.
INTRODUCTION, Cellular and Ad Hoc Wireless Networks, Applications of Ad Hoc Wireless Networks, ISSUES IN AD HOC WIRELESS NETWORKS, MAC PROTOCOLS FOR AD HOC WIRELESS NETWORKS: ISSUES IN DESIGNING A MAC PROTOCOL, DESIGN GOALS OF A MAC PROTOCOL, CLASSIFICATIONS OF MAC PROTOCOLS, CONTENTION-BASED PROTOCOLS: MACAW: A Media Access Protocol, Floor Acquisition Multiple Access Protocols, Busy Tone Multiple Access Protocols, MACA-By Invitation, Media Access with Reduced Handshake	

UNIT–II	10Hrs.
ROUTING PROTOCOLS FOR AD HOC WIRELESS NETWORKS: ISSUES IN DESIGNING A ROUTING PROTOCOL FOR AD HOC WIRELESS NETWORKS, CLASSIFICATIONS OF ROUTING PROTOCOLS, TABLE-DRIVEN ROUTING PROTOCOLS: Destination Sequenced Distance-Vector Routing Protocol, Wireless Routing Protocol, Cluster-Head Gateway Switch Routing Protocol, Source-Tree Adaptive Routing Protocol ON-DEMAND ROUTING PROTOCOLS: Dynamic Source Routing Protocol, Ad Hoc On-Demand Distance-Vector Routing Protocol, Temporally Ordered Routing Algorithm, Location-Aided Routing	

UNIT–III	10 Hrs.
TRANSPORT LAYER PROTOCOLS FOR AD HOC WIRELESS NETWORKS: ISSUES IN DESIGNING A TRANSPORT LAYER PROTOCOL, DESIGN GOALS OF A TRANSPORT LAYER PROTOCOL, CLASSIFICATION OF TRANSPORT LAYER SOLUTIONS, TCP OVER AD HOC WIRELESS NETWORKS, Brief Revisit to Traditional TCP and its performance in ADhoc network, Feedback-Based TCP, TCP with Explicit Link Failure Notification, TCP-BuS, Ad Hoc TCP , SplitTCP,	

UNIT–IV	10 Hrs.
WIRELESS SENSOR NETWORKS, Applications of Sensor Networks, Comparison with Ad Hoc Wireless Networks, 3 Issues and Challenges, SENSOR NETWORK ARCHITECTURE, Layered Architecture, Clustered Architecture, Data Dissemination, Data Gathering, Mac Protocols For Sensor Networks	

Reference Books *

1. C. Siva Ram Murthy and B.S.Manoj - AdHoc Wireless Networks: Architectures and Protocols, 2004, PHI
2. Jagannathan Sarangapani - Wireless Ad-hoc and Sensor Networks: Protocols, Performance and Control, CRC Press.

Course Outcomes**

After completion of the course student will be able to

1. Know the AdHoc wireless network operation and applications.
2. Identify design of MAC protocols for Ad Hoc Wireless Networks.
3. Analyze Routing protocols for Ad Hoc Wireless Networks .
4. Know the need for TCP protocol in Ad Hoc Wireless Networks.
5. Identify issues and challenges in Wireless sensor network.

*** Books to be listed as per the format with decreasing level of coverage of syllabus**

**** Each CO to be written with proper action word and should be assessable and quantifiable**

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	-	3	2	-	2	2	-	-	-	-	-	-	1	-	-
CO2	-	2	1	-	2	1	-	-	-	-	-	-	-	1	-
CO3	3	2	-	-	1	-	-	-	1	-	-	-	1	1	3
CO4	2	1	1	-	2	1	-	-	1	-	-	1	-	2	1
CO5	1	2	1	-	1	-	-	-	1	-	-	1	1	-	2

Department of Information Science and Engineering
3rd Semester

Sl. No.	Course			Credits	Examination						
	Category	Code	Title		Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks
					L	T	P				
1	BSC	22UMA301C	Numerical Techniques and Integral Transforms	3	3	0	0	3	50	50	100
2	AEC	22UIS305C	Advanced Web Programming (Integrated)	4	3	0	2	5	50	50	100
3	PCC	22UIS304C	Logic Design(integrated)	4	3	0	2	5	50	50	100
4	PCC	22UIS314C	Computer Organization	4	4	0	0	4	50	50	100
5	PCC	22UIS303C	Data Structures	4	3	2	0	5	50	50	100
6	PCC	22UIS381L	Data Structures Lab	1	0	0	2	2	50	50	100
7	BSC	22UMA300M	Bridge Course Mathematics - I	0	2	0	2	4	50	50	100
8	MC	UHS002M UHS003M UHS001M	National Service Scheme Physical Education(Sports and Athletics) Yoga	0	0	0	2	2	100	0	100
9		AAP	AICTE Activity Points								
			Total	**20**	**17**	**2**	**10**	**29**	**400**	**400**	**800**

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Department of Information Science and Engineering
4th Semester

Sl. No.	Course			Credits	Examination						
	Category	Code	Title		Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks
					L	T	P				
1	BSC	22UMA401C	Engineering Mathematics - IV	3	3	0	0	3	50	50	100
2	HSSM	22UHSXXC	Universal Human Values - II	1	1	0	0	1	50	50	100
3	PCC	22UIS403C	Analysis and Design of Algorithms(Integrated)	4	3	0	2	5	50	50	100
4	PCC	22UIS412C	Object Oriented Modelling and Design (Integrated)	4	3	0	2	5	50	50	100
5	PCC	22UIS413C	Database Management Systems	4	3	2	0	5	50	50	100
6	PCC	22UIS417C	Software Engineering	3	3	0	0	3	50	50	100
7	PCC	22UIS421L	Database Application Laboratory	1	0	0	2	2	50	50	100
8	BSC	22UMA400C	Bridge course Mathematics - II	0	2	0	0	2	50	50	100
9	MC	NSS PE YO	National Service Scheme Physical Education(Sports and Athletics) Yoga	0	0	0	2	2	0	0	0
10		AAP	AICTE Activity Points								
			Total	**20**	**18**	**2**	**6**	**26**	**400**	**400**	**800**

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Department of Information Science and Engineering
5th Semester

Sl. No.	Course			Credits	Examination						
	Category	Code	Title		Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks
					L	T	P				
1	HSSM	22UBT523C	Environmental Studies	1	1	0	0	1	50	50	100
2	AEC	22UHS521C	Soft Skills	2	2	0	0	2	50	50	100
3	PCC	22UIS504C	Advanced Java Programming (Integrated)	3	2	0	2	4	50	50	100
4	PCC	22UIS509C	Operating Systems	3	3	0	0	3	50	50	100
5	PCC	22UBT540C	Biology For Engineers	3	2	0	2	4	50	50	100
6	PEC	22UIS050E	Advanced Cyber Security	3	3	0	0	3	50	50	100
7	OEC		Open Elective Course - I	3	3	0	0	3	50	50	100
8	PROJ	22UIS531P	Mini project	2	0	0	2	2	50	50	100
9	MC	NSS PE YO	National Service Scheme Physical Education(Sports and Athletics) Yoga	0	0	0	2	2	0	0	0
10		AAP	AICTE Activity Points								
			Total	**20**	**16**	**0**	**6**	**22**	**400**	**400**	**800**

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6th Semester

Sl. No.	Course			Credits	Examination						
	Category	Code	Title		Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks
					L	T	P				
1	PCC	22UIXXXC	Computer Networks(Integrated)	4	3	0	2	5	50	50	100
2	PCC	22UIXXXC	Discrete Mathematical Structures	3	3	0	0	3	50	50	100
3	PCC	22UIXXXC	AI & Machine Learning using Python (Integrated)	4	3	0	2	5	50	50	100
4	PCC	22UIXXXC	Theory of Computations	3	3	0	0	3	50	50	100
5	PEC	22UIXXXC	Professional Elective Course - II	3	3	0	0	3	50	50	100
6	OEC	22UIXXXC	Open Elective Course - II	3	3	0	0	3	50	50	100
7	PROJ.	22UIXXXC	Pre-Project Work	0	0	0	0	0	0	0	0
8	MC	NSS PE YO	National Service Scheme Physical Education(Sports and Athletics) Yoga	0	0	0	2	2	0	0	0
9		AAP	AICTE Activity Points								
			Total	**20**	**18**	**0**	**4**	**22**	**350**	**350**	**700**

Note:

Pre-Project Work – 1) Batch Formulation, 2) Project Allocation and Guide Allotment, 3) Problem Identification and Formulation, and 4) Literature Survey – Minimum 10 papers are to be surveyed.

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7th Semester

Sl. No.	Course			Credits	Examination						
	Category	Code	Title		Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks
					L	T	P				
1	HSSM	22UIXXXC	Management and Entrepreneurship	**3**	3	0	2	5	50	50	100
2	PCC	22UIXXXC	Cryptography and Network Security	**3**	2	0	2	4	50	50	100
3	PEC	22UIXXXC	Professional Core Elective – III (Integrated)	**3**	2	0	2	4	50	50	100
4	PEC	22UIXXXC	Professional Core Elective - IV	**3**	3	0	0	3	50	50	100
5	PROJ	22UIXXXC	Project Work	**12**	0	0	12	12	50	50	100
			Total	**24**	**10**	**0**	**18**	**28**	**250**	**250**	**500**

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8th Semester

Sl. No.	Course			Credits	Examination						
	Category	Code	Title		Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks
					L	T	P				
1	AEC	22UIXXXC	MOOCS	3	3	0	0	3	50	50	100
2	OEC	22UIXXXC	MOOCS	3	3	0	0	3	50	50	100
3	INT	22UIXXXC	Internship	10	0	0	10	10	50	50	100
			Total	**16**	**6**	**0**	**10**	**16**	**150**	**150**	**300**

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BVVS

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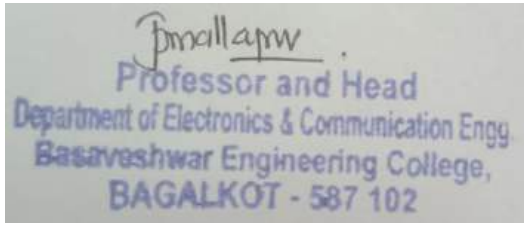
Department of Electronics and Communication Engineering

Details of the Courses Introduced During the Year 2023-24

Sl. No	Semester	Title of the Course	Course Code	Credits
01	IV	Analog Circuit Design	22UEC403C	04
02	VI	Indian Knowledge Systems	21UHS600C	01
03	VI	Aircraft Electronics and Systems	UEC632N	03



Semester: 04	ANALOG CIRCUIT DESIGN	Course Code	22UEC403C
Credits	04	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:3	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 10 - 12 Lab slots	Total Marks	100
Course	IPCC	Exam Hours	03

Course objectives:

1. To introduce MOSFET differential amplifier circuit , its frequency response and effects of negative feedback on amplifier circuits
2. To study Operational Amplifier and its applications
3. To acquaint the concepts of waveform generators, filter configurations
4. To study different data converters and SE/NE 555 and SE/NE 565 ICs

Unit - 1 (10 Hrs)

MOS Differential Amplifiers: Introduction to Current Mirror – Basic, Wilson and Cascode Current Mirror, MOSFET Basic Differential Pair, Large Signal and Small Signal Analysis of Differential Amplifier, Differential Amplifier with Active Load, Differential Amplifier Frequency Response.

MOS Feedback Amplifiers: Introduction to Feedback, Basic Feedback Concepts, Ideal Feedback Topologies - Series – Shunt ,Shunt - Series, Series - Series, Shunt - Shunt Amplifiers.

Unit - 2 (10 Hrs)

Operational Amplifier and Applications: Introduction to op-amp, DC and AC amplifiers, op-amp as summing, scaling, and averaging amplifiers, differential amplifiers, instrumentation amplifier, I/V and V/I converter, precision rectifier, peaking amplifier

Unit - 3 (10 Hrs)

Comparators and Waveform Generators: Comparator and its applications - Schmitt trigger, Oscillators- Barkhausen Criterion ,Phase-shift and Wein-bridge oscillators, Square, Triangular and Saw-tooth wave function generators

Active filters: Filter classifications: First and second order Low-pass and High pass filter designs, Band pass filter, band reject, all pass filter

Unit - 4 (10 Hrs)

Data Converters: Sample-and-hold circuits, **DAC:** Basics, D/A conversion using binary weighted resistors and R-

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2R resistors, **ADC:** DAC based ADC, Successive approximation ADC.

Special Function ICs: IC 555 timer, block diagram, Astable and Monostable operations and applications.

PLL: Block diagram, IC 565 pin diagram

PRACTICAL COMPONENT OF IPCC

Suggested Simulation/Modeling/Design/Verification/Hardware Boards/etc. (preferably open sources):

Demonstrate the operation of the following circuits using suitable simulation software (Open source such as Proteus, Simulink, eSim, Psim)

Sl. No.	Experiments
1	Design of Feedback Amplifiers for the given Specifications- Series -Shunt and Shunt-Shunt Feedback Amplifier.
2	Design and verification of summing, scaling and averaging, substractor circuits using op-amp
3	Design and verification of second order active low pass filter
4	Design and verification of second order active high pass filter
5	Design and verification of second order active band pass filter
6	Design of Oscillators for the given Specifications - RC Phase shift Oscillator
7	Design of Oscillators for the given Specifications – Wein bridge Oscillator
8	Design and verification of integrator and differentiator for given specifications
9	Design and verification of Schmitt trigger
10	Generation of square wave using SE/NE 555 timer for given specifications
11	Design and verification of monostable multivibrator for given specifications
12	Convert the given digital signal in to analog signal using R-2R resistors

Course outcomes

After completion of the course student will be able to

1. Analyze the different active biasing techniques and MOSFET-based differential amplifiers and their frequency response characteristics.
2. Apply the feedback topologies and approximations in the design of amplifiers using op-amps
3. Design and analyze different waveform generators and filters using op-amps
4. Develop the skill to analyze data converter circuits using op-amps and multivibrators using 555 timer

Reference Books

1. Ramakant A Gayakwad, "Op-Amps and Linear Integrated Circuits", 4thEdition, Pearson Education, 2018
2. Adel S. Sedra, Kenneth C. Smith and Arun N. Chandorkar, "Microelectronic Circuits: Theory and Applications", 7th Edition, Oxford University Press, New York, 2014
3. J. D. Roy Choudhury, "Linear Integrated Circuits", 5th Edition, New-Age International Publishers, New Delhi, 2018

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Web links and Video Lectures (e-Resources):

1. https://nptel.ac.in/courses/108/105/108105158/
2. https://archive.nptel.ac.in/courses/108/108/108108111/
3. https://spoken-tutorial.org/tutorial-search/?search_foss=eSim&search_language=English
4. https://psim.software.informer.com/11.1/

Course Articulation Matrix:

Course Outcomes	POs												PSOs		
	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
CO1: Analyze the different active biasing techniques and MOSFET-based differential amplifiers and their frequency response characteristics	3	2	1	2	1	0	0	1	1	1	1	1	3	0	0
CO2: Apply the feedback topologies and approximations in the design of amplifiers using op-amps	3	3	1	2	1	0	0	1	1	1	1	1	3	0	0
CO3: Design and analyze different waveform generators and filters using op-amps	3	3	1	2	1	0	0	1	1	1	1	1	3	0	0
CO4: Develop the skill to analyze data converter circuits using op-amps and multivibrators using 555 timer	3	2	1	2	1	0	0	1	1	1	1	1	3	0	0
Course Contribution to POs	3.00	2.5	1.00	2	1	0	0	1	1	1	1	1	3	0	0

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21UHS600C	Indian Knowledge Systems (Common to All Branches)	Credit:01
Hrs/Week: 1:0:0		**CIE Marks:**50
Total Hours: 15Hrs		**SEE Marks:**50

UNIT - I	3Hrs

Indian Knowledge Systems (IKS)
Overview, Vedic Corpus, Philosophy, Character, scope and importance, traditional knowledge vis-a-vis Indigenous knowledge, traditional knowledge vs. western knowledge.

UNIT – II	4Hrs

Traditional Knowledge in Mathematics and Humanities
Introduction to Indian Mathematics, Unique aspects of Indian Mathematics, Indian Mathematicians and their
Contribution. Number Systems and Units of Measurement.
Linguistics, Art, Craft and Trade in India, Number Systems and Units of Measurement

UNIT - III	4Hrs

Traditional Knowledge in Physics and Chemistry
Measurements for time, distance and weight, Astronomy, Indian contributions in astronomy, Astrology, The celestial coordinate system, Elements of the Indian calendar, Notion of years and month, Panchanga – The Indian calendar system, Metals and Metalworking: The rise and fall of a great Indian technology, Mining and ore extraction, Zinc extraction, Copper and it's alloys, Iron and steel in ancient India

UNIT - IV	4Hrs

Traditional Knowledge in Professional domain
Town Planning and Architecture, Agriculture, Governance and Public Administration, United Nations Sustainable development goals

Reference books:

1. Mahadevan, B., Bhat Vinayak Rajat, Nagendra Pavana R.N. "Introduction to Indian Knowledge System: Concepts and Applications", PHI Learning Private Ltd. Delhi (2022**).** Pride of India: A Glimpse into India's Scientific Heritage, Samskrita Bharati, New Delhi.
2. Sampad and Vijay "The Wonder that is Sanskrit", Sri Aurobindo Society, Puducherry. (2011).
3. Acarya, P.K. Indian Architecture, Munshiram Manoharlal Publishers, New Delhi. (1996).
4. Kapoor Kapil, Singh Avadhesh "Indian Knowledge Systems Vol – I & II", Indian Institute of Advanced Study, Shimla, H.P. (2021).
5. Dasgupta,S. A History of Indian Philosophy- Volume 1, Motilal Banarsidass, New Delhi. (1975).
6. PLofker, K. (1963). Mathematics in India, Princeton University Press, New Jeresy, USA"

Suggested Web Links:

1. https://www.youtube.com/watch?v=LZP1StpYEPM
2. http://nptel.ac.in/courses/121106003/
3. http://www.iitkgp.ac.in/department/KS;jsessionid=C5042785F727F6EB46CBF432D7683B63 (Centre of Excellence for Indian Knowledge System, IIT Kharagpur)
4. https://www.wipo.int/pressroom/en/briefs/tk_ip.html
5. https://unctad.org/system/files/official-document/ditcted10_en.pdf
6. http://nbaindia.org/uploaded/docs/traditionalknowledge_190707.pdf

developmentgoals/?gclid=EAIaIQobChMInpJtb_p8gIVTeN3Ch2

7. https://unfoundation.org/what-we-do/issues/sustainable-developmentgoals/?gclid=EAIaIQobChMInp-Jtb_p8gIVTeN3Ch27LAmPEAAYASAAEgIm1vD_BwELAmPEAAYASAAEgIm1vD_BwE

Course Outcomes:

At the end of the course student will be able to:

CO1: Provide an overview of the concept of the Indian Knowledge System and its importance

CO2: Appreciate the need and importance of protecting traditional knowledge.

CO3: Recognize the relevance of Traditional knowledge in different domains.

CO4: Establish the significance of Indian Knowledge systems in the contemporary world.

Course Outcomes	Programme Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	2	-	-	-	-	-	-	3	-	-	-	1
CO2	-	-	-	-	-	2	-	-	-	-	-	-
CO3	-	-	2	2	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	3	2	-	-	-	-	-

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SUBJECT CODE: UEC632N	Aircraft Electronics and Systems	Credits: 03
L:T:P - 3 : 0 : 0		CIEMarks:50
Total Hours/Week: 03		SEEMarks:50

Course Description:

Aircraft Electronics and Systems is designed to provide students with a comprehensive understanding of the electronic systems utilized in aircraft, including their principles, functionalities, and applications. The course covers various types of electronic systems crucial for flight control, navigation, communication, and avionics, enabling students to analyze, design, and troubleshoot aircraft electronics effectively.

Course Objectives:

1. To introduce students to the fundamental principles of aircraft electronics and systems.
2. To familiarize students with the different types of electronic systems employed in aircraft and their respective functionalities.
3. To develop students' skills in analyzing and interpreting aircraft parameters measuring instruments.
4. To enable students to understand the integration of electronic systems in modern aircraft for improved safety, efficiency, and performance.
5. To provide hands-on experience with aircraft electronic components, devices.

UNIT-I	10 Hrs.
Basics of Aircraft, forces, moments and angle of attack, engines avionics, history of aircraft design and characteristics, modern aircraft systems.	
UNIT–II	**10 Hrs.**
Aircraft Instruments, display types, grouping of displays, glass cockpit of modern aircraft, electronic flight instrument system (EFIS), introduction to air data instruments, types of air data instruments, two types viz pneumatic and air data instruments, temperature compensation, errors in ALTI, VSI and IVSI.	
UNIT–III	**10 Hrs.**
Engine instruments, engine speed measurement, torque measurement, pressure measurement, EGT indicator, Engine vibration measurement and monitoring.	
UNIT–IV	**10 Hrs.**
Engine fuel indicator, fuel quantity indicator, fuel quantity by weight, fuel flow rate indicator, electronic flight instrument system, FDS, ADI, HIS.	

Reference Books *

1. “Aircraft Instrumentation and systems”, S.Nagabhushana, L.K.Sudha. I.K. International Publishing House Pvt., Ltd., S-25, Green Park Extensions, Uphaar Cinema Market, New Delhi – 110016(India), Info@ik international .com, ISBN : 978-93-80578-35-4

2. Pallett, E.B.J ., : “Aircraft Instruments -Principles and applications”, Pitman and sons, 1981.

Course Outcomes**

After completion of the course student will be able to

1. Explain the fundamental principles underlying aircraft electronics and systems.
2. Identify and describe the various types of electronic systems utilized in aircraft.
3. Evaluate the functionalities and applications of different electronic systems in aircraft operations.
4. Collaborate effectively in team-based projects involving the design, implementation, and testing of aircraft electronic systems.
5. Demonstrate effective communication skills in presenting technical concepts related to aircraft electronics and systems.

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	3	1	0	0	0	0	0	0	0	0	3	2	1
CO2	3	3	1	1	0	0	0	0	0	0	0	0	2	2	1
CO3	3	2	2	1	0	0	0	0	0	0	0	0	3	3	1
CO4	1	1	1	2	0	0	0	0	1	2	1	2	2	2	1
CO5	0	0	0	0	2	1	2	3	2	3	3	3	2	2	1

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