NOTIFICATION

No. 145 /2022 Dated : 29 /09/2022

Subject : (I) Minor changes in the subjects of existing syllabus of Semester III, IV, V & VII of B.E. Computer Science & Engineering and Computer Engineering (C.B.C.S.)

(II) Chances / Absorption for the Old Course subjects.

Ref'ce : i) SGBAU Gazette Part II Notification No. 80 /2020 dtd. 26.10.2020.

ii) SGBAU Gazette Part II Notification No. 135/2021 dtd. 02.12.2021.

It is notified for general information of all concerned that the authorities of the University have accepted to implement the minor changes in the existing syllabi of the subjects of Semester **III, IV, V & VII of B.E. Computer Science & Engineering and Computer Engineering (C.B.C.S.)** to be implemented from the academic session 2022-2023 onwards in phase wise manner as under :

(I) Syllabus of Semester III, IV, V & VII of B.E. (Computer Science & Engg. / Computer Engg.) [C.B.C.S.]

3KS02 DISCRETE STRUCTURES AND GRAPH THEORY (L-3, T-0, P-0, C-3)

Course Pre-requisite: Basic knowledge of Mathematics

Course Objectives: Throughout the course, students will be expected to demonstrate their understanding of Discrete Structure by being able to do each of the following:

1. Use mathematically correct terminology and notation.
2. Construct correct direct and indirect proofs.
3. Apply logical reasoning to solve a variety of problem

Course Outcomes (Expected Outcome): On completion of the course, the students will be able to:

1. Analyze and express logic sentence in terms of predicates, quantifiers, and logical connectives.
2. Derive the solution for a given problem using deductive logic and prove the solution based on logical inference.
3. Classify algebraic structure for a given mathematical problem.
4. Perform combinatorial analysis to solve counting problems.
5. Perform operation on trees data structures.
6. Develop the given problem as graph networks and solve with techniques of graph theory

Unit I: The Foundations: Logic and Proofs: (Hours: 8)
Propositions, Truth Tables, Compound Propositions, Logical Operators, Logic and Bit Operations; Logical Equivalences, De Morgan's Laws, Satisfiability: Applications and Solving Problems; Predicates, Quantifiers: Restricted Domains, Precedence, Logical Equivalences; Rules of Inference for Propositional Logic, Use to Build Arguments, Resolution, Combination for Propositions and Quantified Statements;

Unit II: Sets, Functions and Relation (Hours:8)
Introduction, Venn Diagrams, Subsets, Size of a Set, Power Sets, Cartesian Products, Set Notation with Quantifiers, Truth Sets and Quantifiers, Set Operations ,Functions, Inverse Functions, Compositions and Graphs of Functions, Partial Functions; Sequences, Recurrence Relations, Special Integer Sequences, Summations; Countable Sets, An Uncountable Set; Functions as Relations, Relations on a Set, Properties of Relations, Combining Relations; n-ary Relations, Operations on n- ary Relations; Representing Relations Using Matrices;
Relations and Their Properties, n-ary Relations and Their Applications, Representing Relations, Closures of Relations, Equivalence Relations, Partial Orderings.

Unit III: Algebraic Structures (Hours:8)
Algebraic Systems: Examples and General Properties; Semigroups and Monoids: Homomorphism of Semigroups and Monoids, Subsemigroups and Submonoids; Groups: Definitions, Subgroups and Homomorphisms, Cosets and Lagrange's Theorem, Normal Subgroups, algebraic Systems with Two Binary Operations; Group Codes: The Communication Model and Basic Notions of Error Correction, Hamming Distance.

Unit IV: Boolean Algebra (Hours:7)
Lattices,Boolean Algebra: Boolean Functions, Representing Boolean Functions, sum of product expansions, Functional Completeness, Logic Gates, Combinations of Gate, Minimization of Circuits, Karnaugh Maps.

Unit V: Tree (Hours:7)
Introduction, Rooted Tree, ordered rooted tree, tree as model, Properties of Trees, Applications of tree, Binary Search Trees, Decision Trees, Prefix Codes, Huffman Coding, Game Trees, Tree traversal, Preorder Traversing, In order Traversing, Post order Traversing, Spanning Tree, Minimum spanning tree

Unit VI: Graph (Hours:7)

Graph Models; Basic Terminology, Special Simple Graphs, Bipartite Graphs, Matchings, Applications of Special Types of Graphs, New Graphs from Old; Graph Representation, Adjacency and Incidence Matrices, Isomorphism of Graphs, Determining Isomorphism; Paths, Connectedness in Undirected Graphs and Directed Graphs, Paths and Isomorphism, Counting Paths Between Vertices; Euler Paths and Circuits, Hamilton Paths and Circuits, Applications of Hamilton Circuits; Planar Graphs: Euler's Formula, Kuratowski's Theorem; Graph Coloring: Introduction, Applications of Graph Colorings;

Text Books:

1. Kenneth H. Rosen: Discrete Mathematics and Its Applications, 7th Edition, McGraw-Hill.
2. J. P. Tremblay and R. Manohar: Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw-Hill Edition, McGraw-Hill.

Reference Books:

1. Norman L. Biggs: Discrete Mathematics, 2nd Edition, Oxford University Press.
2. Seymour Lipschutz and Marc Lars Lipson: Schaum's Outline of Theory and Problems of Discrete Mathematics, 3rd Edition, Schaum's Outlines Series, McGraw-Hill.
3. C. L. Liu and D. P. Mohapatra: Elements of Discrete Mathematics: A Computer Oriented Approach, 3rd Edition, Tata McGraw-Hill, McGraw-Hill.

4KS02 DATA COMMUNICATION AND NETWORKING (L-3, T-0, P-0, C-3)

Course Pre-requisite: Computer and Data Communication Requirements

Course Objectives: Throughout the course, students will be expected to demonstrate their understanding of Data Communication and Networking by being able to do each of the following:

1. Study the basic taxonomy and terminology of the digital communication system & computer networking and enumerate the layers of OSI model and TCP/IP model.
2. Acquire knowledge of Application layer paradigms and protocols.
3. Study Transport layer design issues, Transport layer services, and protocols.
4. Gain core knowledge of Network layer routing protocols and IP addressing.
5. Study data link layer concepts, design issues, and protocols.
6. Study various network security issues and firewalls.

Course Outcomes (Expected Outcome): On completion of the course, the students will be able to:

1. Describe the functions of each layer in OSI and TCP/IP model.
2. Describe the Transport layer and Transport layer services.
3. Classify the routing protocols and analyze how to assign the IP addresses for the given network.
4. Explain the functions of Application layer and Presentation layer paradigms and Protocols.
5. Describe the functions of data link layer and explain the protocols.
6. Explain the types of transmission media with real time applications.

Unit I: Introduction: (Hours: 7)

Introduction: Data Communication, Components, Networks, Network types, Switching, The Internet, Accessing the Internet, Internet Standards & Administration, Layered architecture, Network Models: TCP/IP Protocol Suite, The OSI Model, Transmission media: Introduction, Guided media & Unguided Media-Wireless. Switching: Introduction, Circuit Switched Networks, Packet Switching.

Unit II: Application Layer: (Hours: 7)

Introduction to Application layer, Application-Layer Paradigms & Services, Client-Server Programming, Application Programming Interface, Principles of Application-Layer protocols: HTTP, FTP, SMTP and DNS.

Unit III: Transport Layer: (Hours: 7)

Introduction to Transport layer, Transport Layer services & principles, multiplexing & de-multiplexing applications, Connectionless and Connection Oriented Protocols, UDP Protocol, principles of reliable data transfer, TCP Protocol, principles of congestion control, TCP congestion control, Flow Control, Error Control.

Unit IV: Network Layer: (Hours: 6)

Introduction to Network layer, Network Layer Services, Datagram & Virtual-Circuit Approach, Network Layer performance, IPV4 Addressing, Dynamic Host Configuration Protocol (DHCP), Network Address Resolution (NAT), Forwarding of IP packets, Internet Protocol (IP), Datagram Format, Fragmentation, ICMPV4: Messages, ICMP Checksum, Routing algorithms: Distance Vector routing & Link State Routing, IPV6 Addressing, Transition from IPV4 to IPV6.

Unit V: Link Layer: (Hours: 6)

Introduction to Link Layer, Link layer Services, Categories of links, Error detection and correction: Block Coding, Cyclic codes, Checksum, Forward Error Correction, Data link control: DLC services, Data-Link Layer Protocol, HDLC, Point-To-Point Protocol, Media Access Control (MAC), LAN addresses & ARP, CSMA / CD, PPP details.

Unit VI: Network Management & Security: (Hours: 7)

Introduction to Network Management, Configuration Management, Fault Management, Performance Management, Security Management, Accounting Management, SNMP: Managers and Agents, Management Components, Introduction to Network security, Principles of cryptography, authentication and authentication protocol, version, integrity, digital signatures, message digests, hash function algorithm, key distribution & certification, secure e-mail, E-Commerce: SSL & SET.

Text Books:

[1] Behrouz A. Forouzan: Data Communication and Networking, (5/e) (TMH)
[2] James F. Kurose & K W Ross: Computer Networking, Pearson Education (LPE)

Reference Books:

[1] William Stallings: Data & Computer Communications, 6/e, Pearson Education
[2] William L. Schweber : Data Communication, McGraw Hill
[3] Douglas E. Comer: Computer Network & Internet, Addison Wesley.
[4] Andrew S. Tanenbaum: Computer Networks, PHI (5E)
[5] Leon Garcia & Widjaja: Communication Networks, TMH

5KS04 (Prof. Elect. – I) (ii) DATA SCIENCE AND STATISTICS (L-3, T-0, C-3)

Course Objectives: Throughout the course, students will be expected to demonstrate their understanding of Data Science and Statistics by being able to do each of the following:

1. To understand the need of data science and Statistics
2. To understand the knowledge of statistics data analysis techniques utilized in business decision making.
3. To understand and apply the different data modelling strategies.
4. To apply the learned concept for the skillful data management.

Course Outcomes (Expected Outcome): On completion of the course, the students will be able to:

1. Explain basics and need of data science
2. Demonstrate proficiency with statistical analysis of data.
3. Perform linear and multiple linear regression analysis.
4. Develop the ability to build and assess classification-based models
5. Evaluate outcomes and make decisions based on data.
6. Compare machine learning techniques to solve data science business problems.

Unit I: Introduction to Data Science: (Hours:6)

Data Science: Where and relation with other fields, Relationship between Data Science and Information Science, Computational Thinking , Skills for Data Science , Tools for Data Science, Issues of Ethics, Bias, and Privacy in Data Science Data: Data types, Data Collection, Data Pre-processing.

Unit II: Statistical Learning & Inference : (Hours: 8)

Need of Statistics in Data Science, Measures of central tendency: Mean, Median, Mode, Mid-range. Measures of Dispersion: Range, variance, Mean deviation, standard deviation.

Techniques: Introduction, Data Analysis and Data Analytics, Descriptive Analysis , Diagnostic Analytics ,Predictive Analytics, Prescriptive Analytics, Exploratory Analysis, Mechanistic Analysis, Regression.

Unit III: Regression and its Techniques: (Hours: 6)

Linear Regression, Multiple Linear Regression, Other Considerations in the Regression Model Comparison of Linear Regression with K-Nearest Neighbours.

Unit IV: Classification: (Hours: 6)

An Overview of Classification, Why Not Linear Regression? Logistic Regression, Linear Discriminant Analysis, Comparison of Classification Methods.

Unit V: Tree Based Methods: (Hours: 6)

Tree-Based Methods: The Basics of Decision Trees, Regression and Classification Trees, Trees Versus Linear Models, Advantages and Disadvantages, Bagging, Random Forests, Boosting.

Unit VI: Supervised and Unsupervised Learning: (Hours: 8)

Supervised Learning: Introduction, Logistic Regression, Softmax Regression, Classification with KNN, Decision Tree,252 9.5.1 Decision Rule, Random Forest Naïve Bayes, Support Vector Machine (SVM)

Unsupervised Learning: Introduction, Agglomerative Clustering, Divisive Clustering, Expectation Maximization (EM) Introduction to Reinforcement Learning.

Text Books:

1. Chirag Shah," A Hands-on Introduction to Data Science ", Cambridge University Press (2020) ISBN:978-1-108-47244-9.
2. Data Mining: Concepts and Techniques By Jiawei Han, Jian Pei, Micheline Kamber (Chapter 2: point 2.2)
3. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani: An Introduction to Statistical Learning with Applications in R, First Edition, 2013, Springer-Verlag New York, ISBN: 978-1- 4614-7137-0.

Reference Books:

1. Cathy O'Neil and Rachel Schutt: Doing Data Science, First Edition, 2014, O'reilly Publications, ISBN:978-1-449-35865-5.
2. DT Editorial Services, "Big Data, Black Book", DT Editorial Services, ISBN: 9789351197577, 2016 Edn.

7KS05 (Prof. Elect. - IV (i)) BLOCKCHAIN FUNDAMENTALS (L-3, T-0, C-3)

Course Pre-requisite:Basic Knowledge of Distributed systems and Networking, Basic knowledge of Data Structure

Course Objectives: Throughout the course, students will be expected to demonstrate their understanding of blockchain fundamental by being able to do each of the following:

1. A comprehensive understanding of how blockchain systems (mainly Bitcoin and Ethereum) work,
2. To securely interact with them
3. Design, build, and deploy smart contracts and distributed applications,
4. Integrate ideas from blockchain technology into applications.

Course Outcomes (Expected Outcome): On completion of the course, the students will be able to:

1. Understand the concept of decentralization of the block chain with different layers of blockchain
2. Apply basic cryptographic primitives with encryption standards.
3. Analyze & Design Consensus Algorithms.
4. Examine fundamentals of Bitcoin, how Bitcoin transactions are constructed and used with Bitcoin addresses, accounts, and mining
5. Understand foundation, architecture, and use of the Ethereum blockchain.
6. Execute & build block chain application/ transaction

Unit I: Blockchain Fundamentals (Hours: 7)
Introduction to Blockchain, History, Centralised versus Decentralised systems, Layers of blockchain, Importance of blockchain, Blockchain uses and use cases.

Unit II:Blockchain Working with Cryptography (Hours: 7)
Laying the Blockchain Foundation, Cryptography, Symmetric Key Cryptography, DES cryptography, Advanced Encryption Standard, Cryptographic Hash Functions, MAC and HMAC, Asymmetric Key Cryptography, Diffie-Hellman Key Exchange, Symmetric vs. Asymmetric Key Cryptography

Unit III:Consensus Algorithms (Hours: 6)
Introducing the consensus problem, Analysis and design, Classification, Algorithms: CFT algorithms, BFT algorithms, Choosing an algorithm

Unit IV:Bitcoin & Its Working (Hours: 7)
The History of Money, Dawn of Bitcoin: What Is Bitcoin, Working with Bitcoins. The Bitcoin Blockchain: Block Structure, The Genesis Block. The Bitcoin Network: Network Discovery for a New Node Bitcoin Transactions, Bitcoin Wallets

Unit V: Ethereum (Hours: 7)
From Bitcoin to Ethereum, Ethereum as a Next-Gen Blockchain Design Philosophy of Ethereum Enter the Ethereum Blockchain Ethereum Blockchain Ethereum Accounts Trie Usage Merkle Patricia Tree RLP Encoding Ethereum Transaction and Message Structure. Ethereum Smart Contracts Contract Creation

Unit VI: Blockchain Application Development (Hours: 6)
Decentralized Applications, Blockchain Application Development, interacting with the Bitcoin Blockchain, Interacting Programmatically with Ethereum, Sending Transactions

Text Books:

1. Beginning Blockchain : A Beginner's Guide to Building Blockchain Solutions Bikramaditya Singhal, Gautam Dhameja, Priyansu Sekhar Panda Apress 2018
2. Mastering Blockchain, Imran Bashir: Packt- Birmingham-Mumbai Third Edition A deep dive into distributed ledgers, consensus protocols, smart contracts, DApps, crypto currencies, Ethereum, and more

Reference Books:

1. Blockchain – Blueprint for new Economy Melanie Swan - O'reilly
2. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press, 2016.
3. Sainul Abideen, Blockchain- ebook, Cybrosys Private Limited.

(II) CHANCES / ABSORPTION FOR THE OLD COURSE SUBJECTS:

It is further notified for general information of all concerned that the authorities of the University have accepted that there is no need to provide chances or equivalence scheme for the old course failure students of the same as there are very minor changes in the existing syllabi of Semester III, IV, V & VII of B.E. (Computer Science & Engineering) and B.E. (Computer Engineering) (C.B.C.S.).

Sd/-
(Dr.T.R.Deshmukh)
Registrar

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NOTIFICATION

No. 146 /2022 Dated : 29 /09/2022

Subject : (I) Minor changes in the existing syllabus of the subjects of Semester II of M.C.A. (Two Years Semester Pattern Course) (C.B.C.S.)

(II) Chances / Absorption for the Old Course subjects.

Ref'ce : SGBAU Gazette Part II Notification No. 37 /2021 dtd. 01.04.2021.

It is notified for general information of all concerned that the authorities of the University have accepted to implement minor changes in the existing syllabus of the subjects of Semester **II of M.C.A. (Two Years Semester Pattern Course) (C.B.C.S.)** to be implemented from the academic session 2022-2023 onwards in phase wise manner as under :

(I) Syllabus of Semester II of M.C.A. (Two Years Semester Pattern Course) [C.B.C.S.]

(i) Course Code **MCA20301**

Course Name **Data Analytics**

Credits **04**

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

1. Explain data analytics and analysis
2. Describe the need of python in analytics
3. Create array to store data
4. Analyze the data using pandas
5. Apply data preprocessing operations to clean the data
6. Perform operations to visualize the data

Unit I: Introduction of Data Analytics and Data Analysis: The difference between Data Analytics and Data Analysis. The role of Data Engineers, Data Analysts, Data Scientists and Business Analysts. The different types of data analysis. The key steps in a data analytics process.

A modern data ecosystem: The different components of a modern data ecosystem. The role of Business Intelligence Analysts in this ecosystem. The role, responsibilities, and skillsets required to be a Data Analyst.

Unit II: Basics of Python Programming: Why Python? Variables, strings, functions, loops, and conditions in Python. The nuances of collection, lists, tuples, sets, dictionaries, iterating over all these, Arrays, Vectors, Strings in Python, String methods, Iterating over range of objects, triple nested loops, List comprehensions, Anonymous(Lambda) functions

Unit III: Numpy: Introduction, Creating arrays: single to multi dimensional, attributes of Numpy Array:ndim, shape, size, dtype, item size, Numpy functions: zeroes, ones, empty, zeros like, ones, ones_like, empty, set_print options. arrange, reshape, Basic Array Operations :min, max, cumsum, sqrt, exp, add, Statistical order functions, averages , variance, covariance, correlation, Nan equivalent functions, Indexing, slicing and iterating arrays, changing the shape, stacking, splitting of arrays, Random Generators and seeds, Basic Random functions, Probably distributions in Numpy, Reading data from csv, excel, text files.

Unit IV: Pandas: Introduction to Pandas, data structures in pandas: Series, Data Frame, reading excel, csv, tsv data into a data frame, reading data from a Data Frame, Deleting external data, selecting rows and columns from Data Frame, Creating new columns from existing, rename row/column names, Summary statistics: mean, median, aggregating statistics by category: group by, value counts, count, loc, iloc, reshape table layout: sort_values, long to wide format(pivot) and vice versa(melt),Concatenating and merging objects, Handling Time Series Data, textual Data

Unit V: Data Preprocessing: Handling Missing values (using Simple Imputer), reshaping, sorting shuffling, striping values, concatenating, finding unique values in and Arrays,
Encoding categorical data: One Hot Encoding, Label Encoding (suggested modules-> sklearn.preprocessing.One Hot Encoder, sklearn. compose. Column Transformer, sklearn.preprocessing. Label Encoder), splitting the dataset into train and test data (preparing data for ML), suggested module->sklearn. model_selection, Feature scaling(suggested Standard Scaler class)

Unit VI: Data Visualization: Understanding and interpreting regression plots, scatter plots, box plots, bar charts, histograms, stack plots. Creating these plots and combination plots using matplotlib or seaborn. Analyzing plots.

Text Books:

1. Python Programming for Data Analysis, Springer by José Unpingco
2. Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython, 2nd Edition Paperback, by William McKinney.

Reference Books:

1. "Core Python Programming", R. Nageswara Rao, dream tech press.
2. "Python Programming A Modular Approach With Graphics, Database, Mobile and Web Applications", Sheetal Taneja, Naveen Kumar, Pearson.
3. Python Web Development with Django By Jeff Forcier, Paul Bissex, Wesley J Chun, Addison-Wesley Professional.
4. Kenneth A. Lambert, The Fundamentals of Python: First Programs, 2011, Cengage Learning
5. Allen B. Downey , " Think Python: How to Think Like a Computer Scientist", Second Edition, Shroff/O"Reilly Publishers

Resources at: https://www.python.org

(ii) Course Code **MCA20307**

Course Name **Lab 7 - Data Analytics using Python language**

Credits **01**

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

1. Explain data analytics and analysis
2. Describe the need of python in analytics
3. Create array to store data
4. Analyze the data using pandas
5. Apply data preprocessing operations to clean the data
6. Perform operations to visualize the data

The sample list of programs is given below. This list can be used as a guideline but the scope of the laboratory should not be limited to the same. Aim of the list is to inform about minimum expected outcomes.

1. Create a list, set, dictionary in python. Perform Add, modify, delete, sort, display operations on the elements of these structures.
2. Perform various manipulation and formatting operations on Python Strings
3. Read data from csv file using numpy. Perform statistical operations on the data.
4. Perform various operations like Indexing, slicing, iterating, changing the shape, stacking, splitting on Numpy arrays. Use ready datasets
5. Apply Statistical order functions, like averages, variance, covariance, correlation, Nan equivalent functions on Numpy Arrays. Use ready datasets
6. Read a data set using pandas. Handle missing values. Encode categorical and nominal data. Use sklearn.
7. Read a data set usinpadas. Handle missing values. Apply encoding if needed and apply feature scaling.
8. Read a data set suitable for Linear regression using pandas. Apply preprocessing on the data and plot a regression line and also a scatter plot for the same. Properly label the plot. Make some predictions from the plot
9. Read a data which will give a proper distribution curve using pandas. Apply preprocessing on the data and plot a histogram for the same. Properly label the plot . Analyze the plot
10. Read a data using pandas. Apply preprocessing on the data and plot a box plot for the same. Properly label the plot. Analyze the plot

Text Books:

1. Python Programming for Data Analysis, Springer by José Unpingco
2. Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython, 2nd Edition Paperback, by William McKinney

Reference books:

1. "Core Python Programming", R. NageswaraRao, dreamtech press.
2. "Python Programming A Modular Approach With Graphics, Database, Mobile and Web Applications", Sheetal Taneja, Naveen Kumar, Pearson.
3. Python Web Development with Django By Jeff Forcier, Paul Bissex, Wesley J Chun, Addison-Wesley Professional.
4. Kenneth A. Lambert, The Fundamentals of Python: First Programs, 2011, Cengage Learning
5. Allen B. Downey , " Think Python: How to Think Like a Computer Scientist", Second Edition, Shroff/O"Reilly Publishers

Resources at: https://www.python.org

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(iii) Course Code **MCA20303**

Course Name **Web Technology**

Credits **04**

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

1. Understand the concepts of different web technologies.
2. Use various types of scripting and markup languages like HTML5, CSS3.
3. Understand how to work in UI/UX design.
4. Acquire skills for Angular environments.
5. Learn to work on Type Script.

Unit I: HTML5 and XHTML– Introduction & Basics, Layout, Editors, Heading, Paragraph, Links, Images, Mapping Image, Lists, Text Formatting, Attributes, Iframes, Class Attribute, Id Attributes, style attribute, Color Styles and HSL, Spell Check, Quotations, Geolocation, Drag and Drop, URL Encoding, File Paths, Tables, Audio Tag, Video Tag, Comments, Doctypes, Design Form, Canvas Basics, SVG-Basics, Charsets.

Unit II: CSS 3 : CSS3 Introduction, Positioning Elements, Centering Elements, Background, Borders, Links, Fonts, Text Formatting, Height and Width, Overflow, Combinators, flex-wrap property, Pagination, Types of CSS (Cascading Style Sheet), Opacity / Transparency, Advance CSS layout with flexbox, Display property, align-content property, 2D Transforms, empty-cells Property, Units, Gradients, Drop Downs, Margins and Padding, Box model, Animations, Counters, Colors, 3D Transforms, Multiple Columns, Attribute Selector, resize Property, align-self Property, word-break Property, Shadow Effect.

Unit III: Introduction to Typescript, Setup and installation, IDE support, Scoping using let and const Keywords (ES6), Template Literals (ES6), Rest and Spread Parameters (ES6), Destructuring (ES6), Introduction to Types: Type inference, Type Annotations, Number, Boolean, String, Array, Tuple, Enum, Any Void, Null and Undefined, Never, Introduction to Functions: Using types in functions, Function as types, Optional and default parameters, Arrow functions.

Unit IV: Introduction to Classes: Inheritance, Access modifiers, Getters and setters, Read-only & static, Introduction to Interfaces, Optional properties and methods, Strict structural contract, Extending interface, Implementing interface, Introduction to Modules, Import / Export, Default, Decorators.

Unit V: ANGULAR 10: Introduction to Angular Framework, History & Overview, Environment Setup, Angular CLI, Installing Angular CLI, NPM commands &json, Bootstrapping Angular App, Components, AppModule, Project Setup, Editor Environments, Building Angular App, Directory Structure, Angular Fundamentals, Building Blocks, MetaData Component Basics.

Templates setup, Creating Components using CLI, Nesting Components, Data Binding – Property & Event Binding, String Interpolation, Style binding, Two-way data binding, Input Properties, Output Properties, Passing Event Data.

Unit VI: Angular CLI : Anatomy of the project, Setting up a workspace, Updating Angular apps using ng update, Adding support for external libraries using ng add, Directives, Pipes, Routing, Services, Angular Forms, Debugging Angular apps

Text Book: HTML 5 Black Book, Covers CSS3, JavaScript, XML, XHTML, AJAX, PHP and jQuery, 2nd Edition 2016.

Reference Books: Angular 11: by Example 2021 by John & Michael Kocer.

Useful Links:

1. https://angular.io/
2. https://developer.mozilla.org/en-US/docs/Learn/HTML
3. https://developer.mozilla.org/en-US/docs/Web/CSS/Tutorials.

(II) Chances / Absorption for the Old Course subjects:

It is further notified for general information of all concerned that the authorities of the University have accepted that there is no need to provide chances or equivalence scheme for the old course failure students of Semester II of M.C.A. (Two Years Semester Pattern Course) (C.B.C.S.) as there are very minor changes in the existing syllabi of Semester II of M.C.A. (Two Years Semester pattern Course) (C.B.C.S.).

Sd/-
(Dr.T.R.Deshmukh)
Registrar

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NOTIFICATION

No. 147 /2022 Date : 29/09//2022

Subject: Implementation of new Syllabus of Semester VII & VIII of B.E. (Artificial Intelligence & & Data Science) (C.B.C.S.) as per A.I.C.T.E. Model Curriculum from the session 2023-24 onwards.

It is notified for general information of all concerned that the authorities of the University have accepted to implement the new Syllabus of Semester VII & VIII of B.E. (Artificial Intelligence & Data Science) (C.B.C.S.) as per A.I.C.T.E. Model Curriculum to be implemented from the **academic session 2023-2024** onwards as per "**Appendix – A**" as given below:

Sd/-
(Dr.T.R.Deshmukh)
Registrar

"**Appendix – A**"

SYLLABUS OF SEMESTER VII & VIII OF B.E. (ARTIFICIAL INTELLIGENCE & DATA SCIENCE)

7AD01 SOCIAL SCIENCE & ENGINEERING ECONOMICS (L-3, T-0, C-3)

Course Prerequisite: Basics of Economics

Course Objectives: Throughout the course, students will be expected to demonstrate their understanding of **Social Science & Engineering Economics** by being able to do each of the following:

1. To know the fundamental concepts of Social Science.
2. To understand work of Indian Parliament.
3. To know about the banking economics.

Course Outcomes (Expected Outcome): On completion of the course, the students will be able to:

1. Explain social science basics
2. Describe working of Indian Parliament
3. Examine impact of science and technology on culture.
4. Illustrate Production scenario
5. Compare functioning of different banks
6. Explain the nature and scope of economics.

Unit I: (Hours: 8)
Study of Social Science: Importance to Engineer, Salient features of Indian constitution. Fundamental Rights and Duties, Directive Principles of State Policy.

Unit II: (Hours: 8)
Indian Parliament: Composition and powers, President of India: Election and Powers. Council of Ministers and Prime Minister

Unit III: (Hours: 8)
Impact of Science and Technology on culture and Civilization. Human Society: Community Groups. Marriage and Family: Functions, Types and problems.

Unit IV: Production: Factors of production, Laws of return, Forms of Business Organization. (Hours: 8)

Unit V: (Hours: 8)
Banking: Functions of Central and Commercial Banks. Introduction to GST, Market: Forms, perfect, imperfect competition and monopoly.

Unit VI: (Hours: 8)
Nature and scope of Economics: Special significance of Economics to Engineers. Economics of Development: Meaning, Characteristics of under development, obstacles to Economic growth and vicious circle of poverty.

Books Recommended:

1. Pylee M.V.: Constitutional Govt. in India, S. Chand and Co.
2. C N Shankar Rao: Sociology, S. Chand and Co.
3. Dewett and Varma J.D. : Elementary Economic Theory, S. Chand and Co.
4. A. N. Agrawal : Indian Economy, Problem of Development and Planning (Wiley Eastern Ltd), New Delhi.

5. S. K. Mishra: Indian Economy, Its Development Experience. Himalaya Pub.House, Bombay.
6. E. Kuper: Economics of W.R. Development, McGraw Hill Co.,
7. Brij Kishore Sharma: The Constitution of India, PHI.
8. Mahajan: The Constitution of India, S.Chand, New Delhi.
9. Maclaver and Page: Principle of Sociology.
10. Dav

is K: Human Society
11. Datt R.K.: Indian Economy, S.Chand and Comp. New Delhi P.M.Sundharam
12. Dhingra I.C.: Indian Economy
13. Jemes L.E., R.R.Lee : Economics of W.R.Planning, McGraw Hill Co.

7AD02 DEEP LEARNING (L-3, T-0, P-0, C-3)

Course Pre-requisite: Knowledge of basic computer science principles and skills, Programming, Artificial Intelligence, Data Structure & Algorithms, Data Science & Machine Learning, Data Analytics & Artificial Neural Networks.

Course Objectives: Throughout the course, students will be expected to demonstrate their understanding of Deep Learning by being able to do each of the following:

1. To know the fundamental concepts of Deep Learning.
2. To explore tools and practices for working with Deep Learning.
3. To know about the research that requires.

Course Outcomes (Expected Outcome): On completion of the course, the students will be able to:

1. Understand basics of AI Learning
2. Explain anatomy of neural network
3. Describe deep learning for computer vision
4. Apply deep learning on text and sequence.
5. Learn Kera's to implement deep learning
6. Discuss future of deep learning techniques.

Unit I: (Hours-08)
Artificial intelligence, machine learning, and deep learning, A brief history of machine learning, why deep learning? Why now? Neural network, Data representations for neural networks, The gears of neural networks: tensor operations, The engine of neural networks: gradient-based optimization.

Unit II: (Hours-08)
Anatomy of a neural network, Introduction to Keras, Setting up a deep-learning workstation, Classifying movie reviews: a binary classification example, Classifying newswires: a multiclass classification example, Predicting house prices: a regression example ,Four branches of machine learning, Evaluating machine-learning models, Data pre-processing, feature engineering, and feature learning, Overfitting and under fitting, The universal workflow of machine learning.

Unit III: (Hours-06)
Deep learning for computer vision, Introduction to convents, training a convnet from scratch on a small dataset, using a pretrained convent, visualizing what convnets learn.

Unit IV: (Hours-06)
Deep learning for text and sequences, working with text data, Understanding recurrent neural networks, Advanced use of recurrent neural networks, Sequence processing with convents.

Unit V: (Hours-08)
Advanced deep-learning, going beyond the Sequential model: the Keras functional API, Inspecting and monitoring deep-learning models using Keras call-backs and Tensor Board, Getting the most out of your models, Generative deep learning, Text generation with LSTM 271, Deep Dream, Neural style transfer, Generating images with variational auto encoders,

Unit VI: (Hours-06)
Key concepts in review, the limitations of deep learning, the future of deep learning, Staying up to date in a fast-moving field

Text Book: Francois Chollet, "Deep Learning with Python", ©2018 by Manning Publications Co.ISBN 9781617294433.

Reference Books:

1. Nikhil Ketkar, "Deep Learning with Python: A Hands-on Introduction" Apress, ISBN-13(pbk): 978-1-4842-2765-7 ISBN-13 (electronic): 978-1-4842-2766-4
2. Abhijit Ghatak, "Deep Learning with R" © Springer Nature Singapore Pte Ltd. 2019 ISBN 978-981-13-5849-4 ISBN 978-981-13-5850-0 (eBook) https://doi.org/10.1007/978-981-13-5850-0
3. Taweh Beysolow II, "Introduction to Deep Learning Using R, A step-by-step guide to learning and implementing Deep Learning Models using R" Apress, ISBN-13 (pbk): 978-1-4842-2733-6 ISBN-13 (electronic): 978-1-4842-2734-3 DOI 10.1007/978-1-4842-2734-3
4. Charu C Agrawal, " Neural Networks and Deep Learning: A textbook" Springer International Publishing ISBN 978-3-319-94462-3 ISBN 978-3-319-94463-0 (eBook) https://doi.org/10.1007/978-3-319-94463-0

7AD03 BIG DATA ANALYTICS& HADOOP (L-4, T-0, P-0, C-4)

Course Prerequisite: Knowledge of basic computer science principles and skills, Basic knowledge of Linear Algebra and Probability Theory, Basic knowledge of Data Base Management Systems.

Course Objectives: Throughout the course, students will be expected to demonstrate their understanding of Big Data Analytics & Hadoop by being able to do each of the following:

1. To know the fundamental concepts of big data and analytics.
2. To explore tools and practices for working with big data.
3. To know about the research that requires the integration of large amounts of data.

Course Outcomes (Expected Outcome): On completion of the course, the students will be able to:

1. Understand big data tools and its analysis techniques.
2. Describe Basic Data Analytics Methods, Clustering and Association Rules
3. Explain working of regression and classification algorithms.
4. Analyze different algorithms for large volumes of data.
5. Examine algorithms on big data tools.
6. Use No SQL databases and management.

Unit I: Big Data Analytics and Life-cycle (Hours-08)

Big Data Analytics: Big Data Overview, State of the Practice in Analytics, Key Roles for the New Big Data Ecosystem, Examples of Big Data Analytics, Data Analytics Lifecycle: Overview, Phase 1:Discovery, Phase 2: Data Preparation, Phase 3: Model Planning, Phase 4: Model Building, Phase 5:Communicate Results, Phase 6: Operationalize, Case Study: Global Innovation Network and Analysis(GINA).

Unit II: Review of Basic Data Analytics Methods, Clustering and Association Rules: (Hours – 08)

Exploratory Data Analysis, Statistical Methods for Evaluation: Hypothesis Testing, Difference of Means, Wilcoxon Rank-Sum Test, Type I and II Errors, ANOVA, Overview of Clustering, K-means: Use Cases, Overview, Number of Clusters, Diagnostics, Apriori Algorithm, Evaluation of Candidate Rules, Applications of Association Rules, An Example: Transactions in a Grocery Store, The Groceries Dataset, Frequent Item set Generation, Rule Generation and Visualization, Validation and Testing, Diagnostics.

Unit III: Regression and Classification: (Hours-08)

Linear Regression: Use Cases, Model Description, Diagnostics, Logistic Regression: Use Cases, Model Description, Diagnostics, Reasons to Choose and Cautions, Additional Regression Models, Decision Trees: Overview of a Decision Tree, The General Algorithm, Decision Tree Algorithms, Evaluating a Decision Tree, Decision Trees, Naïve Bayes: Bayes' Theorem, Naïve Bayes classifier, Smoothing, Diagnostics, Naïve Bayes, Diagnostics of Classifiers, Additional Classification Methods.

Unit IV: Time Series Analysis and Text Analysis (Hours-08)

OverviewofTimeSeriesAnalysis:Box-JenkinsMethodology,ARIMAModel:AutocorrelationFunction (ACF), Autoregressive Models, Moving Average Models, ARMA and ARIMA Models, Building and Evaluating an ARIMA Model, Reasons to Choose and Cautions, Additional Methods, Text Analysis Steps, A Text Analysis Example, Collecting Raw Text, Representing Text, Term Frequency—Inverse Document Frequency (TFIDF), Categorizing Documents by Topics, Determining Sentiments, Gaining Insights.

Unit V: Tool and Techniques: Map Reduce & Hadoop: (Hours-08)

Big DataToolandTechniques:BigDataStorage,High-PerformanceArchitecture,HDFS,MapReduce and YARN, Big Data Application Ecosystem, Zookeeper, HBase, Hive, Pig, Mahout, Developing Big Data Applications: Parallelism, Myth, Application Development Framework, Map Reduce Programming Model, Simple Example, More on Map Reduce, Other Frameworks, The Execution Model, Analytics for Unstructured Data: Use Cases, Map Reduce, Apache Hadoop, The Hadoop Ecosystem: Pig, Hive, HBase, Mahout, No SQL

Unit VI: Database Analytics, No SQL and Graph Analytics: (Hours-08)

SQL Essentials, In-Database Text Analysis, Advanced SQL, NoSQL Data Management: What is NoSQL, Schema-less Models, Key-Value Stores, Document Stores, Tabular Stores, Object Data Stores, Graph Database, Communicating and Operationalizing an Analytics Project, Creating the Final Deliverables, Graph Analytics: Model, Triples, Graphs and Network Organization, Graph Analytics and Use Cases, Graph Analysis Algorithms, Technical Complexity, Features of Graph Analytic Platform, Data Visualization Basics.

Text Books:

1. EMC Education Services, "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", 2015, JohnWiley & Sons, Inc., ISBN:978-1-118-87613-8.
2. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", First Edition, 2013, Morgan Kaufmann/Elsevier Publishers, ISBN: 978-0-12-417319-4.

Reference Books:

1. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", First Edition, 2014,Wiley Publishers, ISBN: 978-1-118-89271-8.
2. Mohammad Guller, "Big Data Analytics with Spark A Practitioner's Guide to Using Spark for Large-Scale Data Processing, Machine Learning, and Graph Analytics, and High-Velocity Data Stream Processing", First Edition,2015,ApressPublisher,ISBN-13(pbk): 978-1-4842-0965-3.
3. Arshdeep Bahga & Vijay Madisetti, "Big Data Science & Analytics: A Hands-On Approach", First Edition, 2019, ISBN: 978-1-949978-00-1.

7AD04 BLOCK CHAIN WITH AI (L-3, T-0, C-3)

Course Pre-requisite:Basic Knowledge of Distributed systems and Networking, Basic knowledge of Data Structure

Course Objectives: Throughout the course, students will be expected to demonstrate their understanding of block chain fundamental by being able to do each of the following:

1. A comprehensive understanding of how block chain systems (mainly Bitcoin and Ethereum) work,
2. To securely interact with them
3. Design, build, and deploy smart contracts and distributed applications,
4. Integrate ideas from block chain technology into applications

Course Outcomes (Expected Outcome): On completion of the course, the students will be able to:

1. Understand the concept of decentralization of the block chain with different layers of block chain
2. Apply basic cryptographic primitives with encryption standards.
3. Analyze & Design Consensus Algorithms.
4. Examine fundamentals of Bitcoin, how Bitcoin transactions are constructed and used with Bitcoin addresses, accounts, and mining
5. Understand foundation, architecture, and use of the Ethereum block chain.
6. Execute & build block chain application/ transaction

Unit I: Block chain Fundamentals: (Hours: 7)
Introduction to Blockchain, History, Centralised versus Decentralised systems, Layers of blockchain, Importance of blockchain, Blockchain uses and use cases.

Unit II: Blockchain Working with Cryptography: (Hours: 7)
Laying the Blockchain Foundation, Cryptography, Symmetric Key Cryptography, DES cryptography, Advanced Encryption Standard, Cryptographic Hash Functions, MAC and HMAC, Asymmetric Key Cryptography, Diffie-Hellman Key Exchange, Symmetric vs. Asymmetric Key Cryptography

Unit III: Consensus Algorithms: (Hours: 6)
Introducing the consensus problem, Analysis and design, Classification, Algorithms: CFT algorithms, BFT algorithms, Choosing an algorithm

Unit IV:Bitcoin & Its Working: (Hours: 7)
The History of Money, Dawn of Bitcoin: What Is Bitcoin, Working with Bitcoins. The Bitcoin Blockchain: Block Structure, The Genesis Block. The Bitcoin Network: Network Discovery for a New Node Bitcoin Transactions, Bitcoin Wallets

Unit V:Ethereum: (Hours: 7)
From Bitcoin to Ethereum, Ethereum as a Next-Gen Blockchain Design Philosophy of Ethereum Enter the Ethereum Blockchain Ethereum Blockchain Ethereum Accounts Trie Usage Merkle Patricia Tree RLP Encoding Ethereum Transaction and Message Structure. Ethereum Smart Contracts Contract Creation

Unit VI: Blockchain Application Development: (Hours: 6)
Decentralized Applications, Blockchain Application Development, interacting with the Bitcoin Blockchain, Interacting Programmatically with Ethereum, Sending Transactions

Text Books:

[1] Beginning Blockchain : A Beginner's Guide to Building Blockchain Solutions Bikramaditya Singhal, Gautam Dhameja, Priyansu Sekhar Panda Apress 2018
[2] Mastering Blockchain, Imran Bashir: Packt- Birmingham-Mumbai Third Edition A deep dive into distributed ledgers, consensus protocols, smart contracts, DApps, crypto currencies, Ethereum, and more

Reference Books:

[1] Blockchain – Blueprint for new Economy Melanie Swan - O'reilly
[2] Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press, 2016.
[3] Sainul Abideen, Blockchain-ebook,Cybrosys Private Limited

7AD05 NATURAL LANGUAGE PROCESSING (L-3, T-0, C-3)

Course Pre-requisite: Fundamentals of Artificial Intelligence.

Course Objectives: Throughout the course, students will be expected to demonstrate their understanding of Natural Language Processing by being able to do each of the following:

1. To learn the fundamentals of natural language processing
2. To understand the use of CFG and PCFG in NLP
3. To understand the role of semantics of sentences and pragmatics
4. To gain knowledge in Information Extraction.

Course Outcomes (Expected Outcome): On completion of the course, student will be able to:

1. Understand morphological analysis for lexeme
2. Describe role of different model in lexical analysis
3. Construct the parse tree based on context free grammar
4. Create the representation of meaning to perform semantic analysis
5. Apply the classification algorithm to perform prediction
6. Explain how to extract information from text

Unit I: Overview and Morphology (Hours: 6)
Introduction, Models and Algorithms, Regular Expressions Basic Regular Expression Patterns, Finite State Automata, Morphology, Inflectional Morphology, Derivational Morphology, Finite-State Morphological Parsing

Unit II: Word Level Analysis (Hours: 6)
Role of language models. Simple N-gram models. Estimating parameters and smoothing. Evaluating language models. Part Of Speech Tagging and Sequence Labeling Lexical syntax. Hidden Markov Models. Maximum Entropy models.

Unit III: Syntactic Analysis (Hours:6)
Context-Free Grammars, Grammar rules for English, Treebanks, and Normal Forms for grammar, Dependency Grammar, Syntactic Parsing, Ambiguity, Probabilistic CFG, and Probabilistic Lexicalized CFGs.

Unit IV: Semantic Analysis (Hours: 6)
Representing Meaning, Meaning Structure of Languages, First Order Predicate Calculus, Syntax-Driven Semantic Analysis, Semantic Attachments, Syntax-Driven Analyzer, Robust Analysis, Relations among Lexemes and their Senses, Word Sense Disambiguation

Unit V: Learning to Classify Text: (Hours: 6)
Supervised classification, further examples of supervised classification, Evaluation, Decision Trees, Naïve Bayes classifiers, Modelling Linguistic Patterns.

Unit VI: Extraction Information from Text: (Hours: 6)
Information Extraction, Chunking, Developing and Evaluating Chunks, Recursion in Linguistic Structure, Named Entity Recognition, Relation Extraction.

Text Books:

1. Daniel Jurafsky, James H. Martin - Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2014.
2. Steven Bird, Ewan Klein and Edward Loper - Natural Language Processing with Python, First Edition, OReilly Media, 2009.
3. Christopher D.Manning and Hinrich Schuetze - Foundations of Statistical Natural Language Processing, MIT press, 1999.

Reference Books:

1. Breck Baldwin, Language Processing with Java and LingPipe Cookbook, Atlantic Publisher, 2015.
2. Richard M Reese, Natural Language Processing with Java, OReilly Media, 2015.
3. Nitin Indurkhya and Fred J. Damerau, Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010.
4. Roland R.Hausser - Foundations of Computational Linguistics: Human Computer Communication in Natural Language, Paperback, MIT press,2011
5. Tanveer Siddiqui, U.S. Tiwary, Natural Language Processing and Information Retrieval, Oxford University Press, 2008
6. Daniel Jurafsky and James H. Martin - Speech and Language Processing, 2nd Edition , Prentice Hall,2008.
7. Charu C.Aggarwal - Machine Learning for Text, Springer,2018 edition

7AD05 DATA MINING (L-3, T-0, C-3)

Course Pre-requisite: Discrete Structures, Programming Methodology, Data Structures, Statistical Methods, Data Science, Database Management Systems.

Course Objectives: Throughout the course, students will be expected to demonstrate their understanding of Data Mining by being able to do each of the following:

1. To learn about the concepts of data mining.
2. To understand the need for, and the applications of data mining
3. To differentiate between data mining and machine learning
4. To understand the process of data mining.
5. To comprehend the concept, types and working of classification, cluster analysis, Association Mining, Web Mining and Search Engine, Big Data & No SQL.

Course Outcomes (Expected Outcomes): On completion of the course, the students will be able to:

1. Describe the basics of Machine Learning, Data Mining and Data Processing.
2. Explain classification, Decision Tree Classifier.
3. Describe the clustering, its types and applications.
4. Examine the different Association Mining techniques
5. Discuss the Web Mining, Search Engine and Data Warehouse.
6. Apply concepts related to big data on tools.

UNIT I: (Hours: 6)

Beginning with Machine Learning: Introduction to Machine Learning, Applications of Machine Learning, Defining Machine Learning, Classification of Machine Learning Algorithms, **Introduction to Data Mining**: Introduction to Data Mining, Need of Data Mining, What Can Data Mining Do and Not Do? Data Mining Applications, Data Mining Process, Data Mining Techniques, **Data Preprocessing**: Need for Data Preprocessing, Data Preprocessing Methods.

UNIT II: (Hours: 8)

Classification: Introduction to Classification, Types of Classification, Input and Output Attributes, Working of Classification, Guidelines for Size and Quality of the Training Dataset, Introduction to the Decision Tree Classifier, Naïve Bayes Method, Understanding Metrics to Assess the Quality of Classifiers.

UNIT III: (Hours: 6)

Cluster Analysis: Introduction to Cluster Analysis, Applications of Cluster Analysis, Desired Features of Clustering, Distance Metrics, Major Clustering Methods/Algorithms, Partitioning Clustering, Hierarchical Clustering Algorithms (HCA).

UNIT IV: (Hours: 8)

Association Mining: Introduction to Association Rule Mining, Defining Association Rule Mining, Representations of Items for Association Mining, The Metrics to Evaluate the Strength of Association Rules, The Naïve Algorithm for Finding Association Rules, Approaches for Transaction Database Storage, The Apriori Algorithm, Closed and Maximal Itemsets, The Apriori–TID Algorithm for Generating Association Mining Rules, Direct Hashing and Pruning (DHP), Dynamic Item set Counting (DIC).

UNIT V: (Hours 8)

Web Mining and Search Engines: Introduction, Web Content Mining, Web Usage Mining Web Structure Mining, Hyperlink Induced Topic Search (HITS) algorithm, Introduction to Modern Search Engines, Working of a Search Engine, PageRank Algorithm Precision and Recall. **Data Warehouse:** The Need for an Operational Data Store (ODS), Operational Data Store, Data Warehouse, Data Marts, Comparative Study of Data Warehouse with OLTP and ODS. **Data Warehouse Schema:** Introduction to Data Warehouse Schema, Star Schema, Snowflake Schema, Fact Constellation Schema (Galaxy Schema), Comparison among Star, Snowflake and Fact Constellation Schema.

UNIT VI: (Hours:8)

Online Analytical Processing: Introduction to Online Analytical Processing, Representation of Multi-dimensional Data, Implementing Multi-dimensional View of Data in Oracle, Improving efficiency of OLAP by pre-computing the queries, Types of OLAP Servers, OLAP Operations **Big Data and NoSQL**: The Rise of Relational Databases, Major Issues with Relational Databases, Challenges from the Internet Boom, Emergence of Big Data due to the Internet Boom, Possible Solutions to Handle Huge Amount of Data,The Emergence of Technologies for Cluster Environment,Birth of NoSQL, Defining NoSQL from the Characteristics it Shares, Some Misconceptions about NoSQL,Data Models of NoSQL,Consistency in a Distributed Environment,CAP Theorem,Future of NoSQL,Difference between NoSQL and Relational Data Models (RDBMS).

Text Book: Parteek Bhatia, "Data Mining and Data Warehousing, Principles and Practical Techniques", Cambridge University Press 2019, ISBN 978-1-108-72774-7 Paperback.

Reference Books:

1. Arun K Pujari, "Data Mining Techniques" University Press (India) Pvt Ltd, ISBN-13 978 81 7371 380 4
2. Charu C Agrawal, "Data Mining: The Texbook", © Springer ISBN 978-3-319-14141-1 ISBN 978-3-319-14142-8 (eBook) DOI 10.1007/978-3-319-14142-8
3. Ian H Witten & Eibe Frank, "Data Mining, Practical Machine Learning Tools and Techniques"Margaun Kaufman Publishers, Second Edition, © 2005 by Elsevier Inc.ISBN: 0-12-088407-0

7AD05 EMBEDDED SYSTEM (L-3, T-0, C-3)

Course Pre-requisite: Microprocessor and Assembly Language Programming, Computer Architecture and Organization

Course Objectives: Throughout the course, students will be expected to demonstrate their understanding of Embedded System by being able to do each of the following:

1. Introduce the fundamentals and building blocks of Embedded System.
2. Impart the knowledge of basic embedded programming in various languages as well as data structures.
3. Introduce hardware units, bus communication in processors and input/output interfacing.
4. Impart knowledge of real-time operating system and various task scheduling algorithms.
5. Introduce basics of real-time operating system and case study example to elaborate importance of real-time operating system.

Course Outcomes (Expected Outcomes): On completion of the course, the students will be able to:

1. Describe the basics of embedded systems and structural core units as well as memory organization for embedded system.
2. Explain components of embedded system, characteristics and quality attributes of embedded systems.
3. Discuss role of 8051 microcontroller and its architecture in design of embedded systems
4. Examine the different Addressing modes and Instruction Set of 8051 microcontrollers.
5. Use knowledge of C programming to do embedded programming.
6. Assess the Real-Time Operating System concepts with VxWorks RTOS.

UNIT I: (Hours: 7)

Introduction to Embedded System: What is Embedded System, Embedded Systems Vs General Computing Systems, History, classification, major application areas and purpose of Embedded Systems, Wearable Devices. The Typical Embedded System: Core of the Embedded System, Memory.

UNIT II: (Hours: 7)

The Typical Embedded System: Sensors & Actuators, Communication Interface, Embedded Firmware, Other System Components, PCB and Passive Components. Characteristics of an Embedded System, Quality Attributes of Embedded Systems. Embedded Systems Application and Domain Specific Examples: Washing machine, Automotive.

UNIT III: (Hours: 7)

Designing Embedded Systems with 8-bit Microcontroller - 8051: Factors to be considered in Selecting a Controller. Why 8051 Microcontroller. Designing with 8051 Microcontroller: 8051 Architecture, 8051 Memory Organization, Registers, Oscillator Unit, Ports, 8051 Interrupt System, Timer units, the Serial Port, 8051 Power Saving Modes.

UNIT IV: (Hours: 7)

Programming the 8051 Microcontroller: Different Addressing modes supported by 8051. The 8051 Instruction Set: Data transfer instructions, Arithmetic instructions, Logical instructions, Boolean instructions, and Program Control Transfer instructions. Embedded Firmware Design Approaches, Assembly Language based Embedded Firmware development.

UNIT V: (Hours: 7)

Programming in Embedded C: Review of various constructs in C. Constant declarations, 'volatile' type qualifier, Delay generation and Infinite loops in Embedded C. Coding Interrupt Service Routines, Recursive and Re-entrant Functions, Dynamic memory allocation.

UNIT VI: (Hours: 7)

VxWorks Real Time Operating System (RTOS): How to choose an RTOS, Characteristics, Real Time Kernel, Hard/Soft Real time. VxWorks Task Creation, Management and Task Scheduling, Kernel Services, Inter Task Communication, VxWorks Task Synchronization and Mutual Exclusion, Interrupt Handling, Watchdog for task Execution monitoring, Timing and Reference in VxWorks.

The Embedded Product Development Life Cycle (EDLC): What is EDLC, Why EDLC, Objectives of EDLC, Different Phases of EDLC, EDLC approaches.

Textbook: Shibu K V "Introduction to Embedded Systems", Second Edition, McGraw-Hill.

References:

1. Rajkamal, "Embedded Systems, Architecture, Programming & Design", Third Edition, TMH.
2. Tammy Noergaard, "Embedded Systems Architecture" Elsevier Newness Publication.
3. Vahid and Givargis, "Embedded System Design" John Wiley & Sons P Ltd.
4. Peter Marwedel, "Embedded Systems Design" Springer, Netherland.
5. Jane W. S. Liu, "Real Time Systems", Pearson Education.
6. Mohammad Ali Mazidi, "The 8051 Microcontroller and Embedded System using Assembly and C" Pearson

7AD06 DEEP LEARNING LAB.:

Minimum Eight experiments/ programming assignments must be completed based on the respective syllabus (7AD02) covering each of the units.

7AD07 BIG DATA ANALYTICS & HADOOP LAB.:

Minimum Eight experiments/ programming assignments must be completed based on the respective syllabus (7AD03) covering each of the units.

7AD08 BLOCK CHAIN WITH AI LAB:

Minimum Eight experiments/programming assignments must be completed based on the respective syllabus (7AD04) covering each of the units.

7AD09 PROJECT AND SEMINAR (P-8, C-4)

Seminar shall be based on the advanced topic in the field. It may be related to domain of the project. The seminar should be conducted in seventh semester and evaluated. Each candidate shall submit a seminar report, deliver the seminar and face the viva-voce. The distribution of internal 50 marks shall be as follows:

1. Seminar report preparation and submission :- 10 marks
2. Seminar delivery/ presentation:- 20 marks
3. Seminar viva-voce:- 10 marks
4. Attendance in all seminar sessions:- 10 marks

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SEMESTER VIII

8AD01 DATA MODELLING & VISUALIZATION (L-3, T-0, C-3)

Course Prerequisite: Working knowledge of Programming Language, DBMS, JavaScript and HTML5.

Course Objectives: Throughout the course, students will be expected to demonstrate their understanding of Data Modelling & Visualization by being able to do each of the following:

1. Understand the fundamental concepts of database management system.
2. Describe the importance of information within an organization.
3. Understand the query processing and optimization.
4. Use knowledge of perception and cognition to evaluate visualization design alternatives.

Course Outcomes (Expected Outcome): On completion of the course, the students will be able to:

1. Explain Principles of Data Modelling
2. Understand need of normalization for modelling and visualization.
3. Analyze user information requirements to develop an entity relationship model.
4. Learn different visualization techniques
5. Apply core skills for visual analysis on tools.
6. Apply visualization techniques for various data analysis tasks.

Unit I: Data Modeling (Hours: 8)

Introduction, A Data-Centered Perspective, Design, Choice, and Creativity, Importance of Data Model, Good Data Model, Database Design Stages and Deliverables, Where Do Data Models Fit In, Involvement in Data Modeling, Relevance of Data Modeling, Alternative Approaches to Data Modeling

Unit II : Normalization (Hours: 8)

Introduction, An Informal Example of Normalization, Relational Notation, Determining Columns, Repeating Groups and First Normal Form, Second and Third Normal Forms, Definitions and a Few Refinements, Choice, Creativity, and Normalization.

Unit III: The Entity-Relationship Approach (Hours: 8)

Introduction, A Diagrammatic Representation, The Top-Down Approach: Entity-Relationship Modeling, Entity Classes, Relationships, Attributes, Myths and Folklore, Creativity and E-R Modeling.

Unit IV: Introduction and Basics of Data Visualization (Hours: 8)

Acquiring and Visualizing Data, Simultaneous acquisition and visualization, Applications of Data Visualization, Keys factors of Data Visualization (Control of Presentation, Faster and Better JavaScript processing, Rise of HTML5, Lowering the implementation Bar) Exploring the Visual Data Spectrum: charting Primitives (Data Points, Line Charts, Bar Charts, Pie Charts, Area Charts), Exploring advanced Visualizations (Candlestick Charts,Bubble Charts, Surface Charts, Map Charts, Infographics). Making use of HTML5 CANVAS. Integrating SVG,

Unit V: Basic of Data Visualization – Tables (Hours:8)

Reading Data from Standard text files (.txt, .csv, XML), Displaying JSONcontent Outputting Basic Table Data (Building a table, Using Semantic Table,Configuring the columns), Assuring Maximum readability (Styling yourtable, increasing readability, adding dynamic Highlighting), Includingcomputations, using data tables library, relating data table to a chart.

Unit VI: Visualizing data Programmatically & Introduction to D3.js (Hours: 8)

Creating HTML5 CANVAS Charts (HTML5 Canvas basics, Linearinterpolations, A Simple Column Chart, Animations), Starting with Googlecharts (Google Charts API Basics, A Basic bar chart, A basic Pie chart,Working with Chart Animations), Getting setup with D3, Making selections, changing selection's attribute,Loading and filtering External data : Building a graphic that uses all of thepopulation distribution data, Data formats you can use with D3, Creating aserver to upload your data, D3's function for loading data, Dealing withAsynchronous requests, Loading and formatting Large Data Sets.

Text Book: Graeme C. Simsion and Graham C. Witt "Data Modeling Essentials" Third Edition.

Reference Books:

1. Jon Raasch, Graham Murray, Vadim Ogievetsky, Joseph Lowery, "JavaScript and jQuery for Data Analysis and Visualization", WROX
2. Ritchie S. King, Visual story telling with D3" Pearson
3. Ben Fry, "Visualizing data: Exploring and explaining data with the processing environment", O'Reilly, 2008.
4. A Julie Steele and Noah Iliinsky, Designing Data Visualizations: Representing Informational Relationships, O'Relly
5. Andy Kirk, Data Visualization: A Successful Design Process, PAKT
6. Scott Murray, Interactive Data Visualization for Web, O'Relly
7. Nathan Yau, "Data Points: Visualization that means something", Wiley, 2013.
8. Tamara Munzner, Visualization Analysis and Design, AK Peters Visualization Series, CRC Press, Nov. 2014.

8AD02 ETHICS IN DATA SCIENCE (L-3, T-0, C-3)

Course Prerequisite: Data Science & Statistics

Course Objectives: Throughout the course, students will be expected to demonstrate their understanding of EthicS in Data Science by being able to do each of the following:

1. To understand the fundamental concepts of ethics in data science
2. Describe the importance of information within an organization.
3. To understand the query processing and optimization.
4. Use knowledge of perception and cognition to evaluate visualization design alternatives.

Course Outcomes (Expected Outcome): On completion of the course, the students will be able to:

1. Understand need of ethics in rising data science
2. Explain ethical form of data gathering
3. Describe ethical data preprocessing procedure.
4. Discuss ethical modeling in AI.
5. Examine evaluation of ethics in data science
6. Deploy ethics with respect to applications belongs to data science.

Unit I: Introduction to Data Science Ethics: (Hours: 7)

The Rise of Data Science (Ethics), Why Care? Right and Wrong, Data Science, Data Science Ethics Equilibrium, The FAT Flow Framework for Data Science Ethics

Unit II: Ethical Data Gathering: (Hours:7)

Privacy as a Human Right, Regulations,Privacy Mechanisms, Cautionary Tales: Backdoors and Messaging Encryption, Bias, Cautionary Tales: Bumps, Gorillas, and Resumes, Human Experimentation, Cautionary Tales: Dating, Happiness, and Ads.

Unit III: Ethical Data Preprocessing: (Hours: 7)

Defining and Measuring Privacy, Cautionary Tales: Re-identification, Defining and Selecting Variables, Cautionary Tale: Pregnancy and Face Recognition, Fair Relabelling , Cautionary Tale: Biased Language , Summary

Unit IV: Ethical Modeling: (Hours: 7)

Privacy-Preserving Data Mining, Discrimination-Aware Modeling, Cautionary Tale: Predicting Recidivism and Redlining, Comprehensible Models and Explainable AI, Cautionary Tale: Explaining Webpage Classifications, Including Ethical Preferences: Self-Driving Cars

Unit V: Ethical Evaluation: (Hours: 5)
Ethical Measurement, Ethical Interpretation of the Results, Ethical Reporting, Cautionary Tales, Summary.

Unit VI: Ethical Deployment: (Hours:7)
Access to the System, Different Treatments for Different Predictions, Cautionary Tales: Censoring Search and Face Recognition, Honesty and DeepFake , Governance , Unintended Consequences ,Summary

Text Book: Data Science Ethics: Concepts, Techniques, and Cautionary Tales, Oxford University Press.

Reference Books:

1. Ethics and Data Science O'Reilly Media, Inc.MikeLoukides& Hilary Mason & DJ Patil.
2. 97 Things About Ethics Everyone in Data Science Should Know O'Reilly Media Bill Franks.

8AD03 COGNITIVE TECHNOLOGY (L-3, T-0, C-3)

Course Pre-requisite: Basic knowledge of Artificial Intelligence, Programming and Data Structures.

Course Objectives: Throughout the course, students will be expected to demonstrate their understanding of Cognitive Technology by being able to do each of the following:

1. This course intends to introduce concept of cognitive technologies and important approaches of cognitive technologies.
2. Student will learn and analyze key concept of cognitive technologies.
3. Students will gain an understanding of innovation concepts, terminology, current and future trends in cognitive technologies.
4. Introduces students to IBM Watson platform, an artificially intelligent computer system capable of answering questions posed in natural language, developed in IBM's Deep QA project.

Course Outcomes (Expected Outcome): On completion of the course, the students will be able to:

1. Describe the Cognitive computing and principles of cognitive systems.
2. Identify role of Natural Language Processing in cognitive system.
3. Outline application of advanced analytics in cognitive computing.
4. Justify role of Cloud and Distributed Computing in Cognitive Computing.
5. Assess the process of building a Cognitive Application.
6. Identify the Emerging Areas and Future Applications of Cognitive Computing.

Unit I: Foundation of Cognitive Computing & Design Principle of Cognitive Systems: (Hours: 07)
The Foundation of Cognitive Computing: Cognitive Computing as a New Generation, The Uses of Cognitive Systems, What Makes a System Cognitive, Gaining Insights from Data, Domains Where Cognitive Computing Is Well Suited, Artificial Intelligence as the Foundation of Cognitive Computing, Understanding Cognition, Two Systems of Judgment and Choice, Understanding Complex Relationships Between Systems, The Elements of a Cognitive System, Infrastructure and Deployment Modalities. Design Principles for Cognitive Systems: Components of a Cognitive System, Building the Corpus, Bringing Data into the Cognitive System, Machine Learning, Hypotheses Generation and Scoring, Presentation and Visualization Services.

Unit II: NLP and Big Data in Cognitive System: (Hours: 07)
Natural Language Processing in Support of a Cognitive System: The Role of NLP in a Cognitive System, Semantic Web, Applying Natural Language Technologies to Business Problems. The Relationship Between Big Data and Cognitive Computing**:** Dealing with Human□Generated Data, Defining Big Data, The Architectural Foundation for Big Data, Analytical Data Warehouses, Hadoop, Data in Motion and Streaming Data, Integration of Big Data with Traditional Data.

Unit III: Knowledge Representation and Advance Analytics in Cognitive Computing: (Hours: 06)
Representing Knowledge in Taxonomies and Ontologies: Representing Knowledge, Developing a Cognitive System, Defining Taxonomies and Ontologies, Explaining How to Represent Knowledge, Models for Knowledge Representation. Applying Advanced Analytics to Cognitive Computing: Advanced Analytics Is on a Path to Cognitive Computing, Key Capabilities in Advanced Analytics, Using Advanced Analytics to Create Value, Impact of Open Source Tools on Advanced Analytics.

Unit IV: Role of Cloud and Distributed Computing in Cognitive Computing: (Hours: 07)
The Role of Cloud and Distributed Computing in Cognitive Computing: Leveraging Distributed Computing for Shared Resources, Why Cloud Services Are Fundamental to Cognitive Computing Systems, Characteristics of Cloud Computing, Cloud Computing Models, Delivery Models of the Cloud, Managing Workloads, Security and Governance, Data Integration and Management in the Cloud. The Business Implications of Cognitive Computing: Preparing for Change, Advantages of New Disruptive Models, What Does Knowledge Mean to the Business?, The Difference with a Cognitive Systems Approach, Meshing Data Together Differently, Using Business Knowledge to Plan for the Future, Answering Business Questions in New Ways, Building Business Specific Solutions, Making Cognitive Computing a Reality, How a Cognitive Application Can Change a Market.

Unit V: IBM Watson and Process of Building a Cognitive Application: (Hours: 07)

IBM's Watson as a Cognitive System: Watson Defined, Advancing Research with a "Grand Challenge", Preparing Watson for Jeopardy, Preparing Watson for Commercial Applications, The Components of Deep QA Architecture. The Process of Building a Cognitive Application: The Emerging Cognitive Platform, Defining the Objective, Defining the Domain, Understanding the Intended Users and Defining their Attributes, Defining Questions and Exploring Insights, Creating and Refining the Corpora, Training and Testing. Building a Cognitive Healthcare Application: Foundations of Cognitive Computing for Healthcare, Constituents in the Healthcare Ecosystem, Learning from Patterns in Healthcare Data, Building on a Foundation of Big Data Analytics, Cognitive Applications across the Healthcare Ecosystem, Starting with a Cognitive Application for Healthcare, Using Cognitive Applications to Improve Health and Wellness, to Enhance the Electronic Medical Record and to Improve Clinical Teaching.

Unit VI: Emerging Areas and Future Application: (Hours: 06)
Smarter Cities: Cognitive Computing in Government: How Cities Have Operated, The Characteristics of a Smart City, The Rise of the Open Data Movement Will Fuel Cognitive Cities, The Internet of Everything and Smarter Cities, Understanding the Ownership and Value of Data, Smarter Approaches to Preventative Healthcare, Building a Smarter Transportation Infrastructure, Using Analytics to Close the Workforce Skills Gap, Creating a Cognitive Community Infrastructure, The Next Phase of Cognitive Cities. Emerging Cognitive Computing Areas: Characteristics of Ideal Markets for Cognitive, Computing Vertical Markets and Industries. Future Applications for Cognitive Computing: Requirements for the Next Generation, Technical Advancements That Will Change the Future of Cognitive Computing, What the Future Will Look Like, Emerging Innovations.

Text Book: Judith Hurwitz, Marcia Kaufman and Adrian Bowles, "Cognitive Computing and Big Data Analytics", publicationJohn Wiley & Sons, Inc, 2015.

Reference Books:
1. José Luis Bermúdez, Cognitive Science: An Introduction to the Science of the Mind, publication Cambridge University Press, New York, Second Edition.
2. Jay Friedenberg and Gordon Silverman, Cognitive Science: An Introduction to the Study of Mind, SagePublications, Inc. London, 2014.
3. Huimin Lu (Editor), Cognitive Internet of Things: Frameworks, Tools and Applications, Springer NatureSwitzerland AG 2020.
4. Danish Contractor and AadityaTelang (Editors), Applications of Cognitive Computing Systems and IBMWatson, 8th IBM Collaborative Academia Research Exchange, publication Springer Nature Singapore PteLtd., 2017.
5. S. Bird, E. Klein, E. Loper (2009), Natural Language Processing with Python, O' Reilly Media.

8AD04 VIRTUAL AND AUGMENTED REALITY (L-3, T- 0, C-3)

Course Pre-requisite: Basics of Computers & Multimedia.

Course Objectives: Throughout the course, students will be expected to demonstrate their understanding of Virtual and Augmented Reality by being able to do each of the following:

1. To introduce the relevance of this course to the existing technology through demonstrations, case studies and applications with a futuristic vision along with socioeconomic impact and issues
2. To understand virtual reality, augmented reality and using them to build Biomedical engineering applications
3. To know the intricacies of these platform to develop PDA applications with better optimality.

Course Outcomes (Expected Outcome): On completion of the course, the students will be able to:

1. Describe Virtual reality & its applications.
2. Discuss virtual reality world and types.
3. Examine geometry of virtual world and the physiology of human vision
4. Investigate Visual Perception, Motion and Tracking
5. Inspect Physics of Sound and the Physiology of Human Hearing.
6. Explain Augmented reality & examples based on Augmented reality

Unit I: (Hours: 07)

Introduction to Virtual Reality: Defining Virtual Reality, History of VR, Human Physiology and Perception, Key Elements of Virtual Reality Experience, Virtual Reality System, Interface to the Virtual World-Input & output-Visual, Aural & Haptic Displays, Applications of Virtual Reality.

Unit II: (Hours: 07)

Representing the Virtual World: Representation of the Virtual World, Visual Representation in VR, Aural Representation in VR and Haptic Representation in VR

Unit III: (Hours: 07)
The Geometry of Virtual Worlds &The Physiology of Human Vision: Geometric Models, Changing Position and Orientation, Axis- Angle Representations of Rotation, Viewing Transformations, Chaining the Transformations, Human Eye, eye movements & implications for VR.

Unit IV: (Hours: 07)
Visual Perception, Motion & Tracking: Visual Perception -Perception of Depth, Motion, & Color, Ray Motion in Real and Virtual Worlds- Velocities and Accelerations, Tracking 2D & 3D
Orientation, Tracking Position and Orientation.

Unit V: (Hours: 07)
Interaction & Audio: Interaction - Motor Programs and Remapping, Locomotion, Manipulation, Social Interaction. Audio -The Physics of Sound, The Physiology of Human Hearing, Auditory Perception, Auditory Rendering.

Unit VI: (Hours:07)
Basics of Augmented Reality: Introduction to Augmented Reality , Examples based on Augmented reality , Mixed Reality Continuum ,Computer Vision for Augmented Reality , Confluence of Virtual Reality and Augmented Reality , Requirements of AR Authoring ,Taking AR Outdoors.

Text Books:

1. M. LaValle, "Virtual Reality, Steven", Cambridge University Press, 2016.
2. Augmented Reality: Principles and Practice (Usability) by Dieter Schmalstieg & Tobias Hollerer, Pearson Education (US), Addison-Wesley Educational Publishers Inc, New Jersey, United States, 2016. ISBN: 9780321883575

Reference Books:

1. William R Sherman and Alan B Craig, "Understanding Virtual Reality", Interface, Application and Design, (The Morgan Kaufmann Series in Computer Graphics)". Morgan Kaufmann Publishers, San Francisco, CA, 2002
2. Alan B Craig, William R Sherman and Jeffrey D Will, "Developing Virtual Reality Applications: Foundations of Effective Design", Morgan Kaufmann, 2004
3. Burdea, Grigore C and Philippe Coiffet, "Virtual Reality Technology", Wiley Inter science, India, 2008
4. Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, 2013.
5. Gerard Jounghyun Kim, "Designing Virtual Systems: The Structured Approach", 2005.
6. Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, "3D User Interfaces, Theory and Practice", Addison Wesley, USA, 2005.
7. Oliver Bimber and Ramesh Raskar, "Spatial Augmented Reality: Merging Real and Virtual Worlds", 2005
8. Jason Jerald - The VR Book: Human-Centred Design for Virtual Reality. Association for Computing Machinery and Morgan and Claypool, New York, NY, USA.
9. Dieter Schmalstieg and Tobias Hollerer - Augmented Reality: Principles and Practice (Usability), Pearson Education (US), Addison-Wesley Educational Publishers Inc, New Jersey, United States, 2016.
10 Steve Aukstakalnis - Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR (Usability), Addison-Wesley Professional; 1st edition, 2016.
11. Robert Scoble and Shel Israel - The Fourth Transformation: How Augmented Reality and Artificial Intelligence Will Change Everything, Patrick Brewster Press; 1st edition, 2016.
12. Tony Parisi - Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile, OReilly Media; 1st edition, 2015.
13. Programming 3D Applications with HTML5 and WebGL: 3D Animation and Visualization for Web Pages, Tony Parisi, OReilly Media; 1st edition, 2014.
14. John Vince - Virtual Reality Systems, Addison Wesley, 1995.
15. Howard Rheingold - Virtual Reality: The Revolutionary Technology and how it Promises to Transform Society, Simon and Schuster, 1991.

Supplementary Resources:
1. http://lavalle.pl/vr/book.html

Mapped with MOOCS/other Courses:
1. https://nptel.ac.in/courses/106/106/106106138/
2. https://nptel.ac.in/courses/106105195/13
3. https://www.coursera.org/learn/introduction-virtual-reality.

8AD04 WIRELESS SENSOR NETWORKS (L-3, T-0, C-3)

Course Prerequisite: Computer Networks, Internet of Things, Sensors and Actuators.

Course Objectives: Throughout the course, students will be expected to demonstrate their understanding of Wireless Sensor Network by being able to do each of the following:

1. To understand the fundamentals of wireless sensor networks and its application tocritical real time scenarios.
2. To study the various protocols at various layers and its differences with traditionalprotocols.
3. To understand the issues pertaining to sensor networks and the challenges involved inmanaging a sensor network.

Course Outcomes (Expected Outcome): On completion of the course, the students will be able to:

1. Describe Network of Wireless Sensor Nodes
2. Explain Node Architecture and Physical Layer.
3. Discuss Medium Access Control and its related properties.
4. Analyze the protocols and algorithms used at different network protocol layers in sensorsystems.
5. Compare different power management techniques and clocks and the Synchronizationproblems.
6. Explain time synchronization and its problems.

Unit I: (Hours: 07)
Network of Wireless Sensor Nodes- Definitions and Background, Sensing and Sensors, WirelessSensor Networks, Challenges and Constraints, Energy, Self-Management, Wireless Networking, Decentralized Management, Design Constraints, Security, Other Challenges. Applications: Structural Health Monitoring, Traffic Control, Health Care, Pipeline Monitoring, Precision Agriculture, Active Volcano, Underground Mining.

Unit II: (Hours: 07)
Node Architecture: The Sensing Subsystem, The Processor Subsystem, Communication Interfaces, Prototypes. Physical Layer: Basic Components, Source Encoding, Channel Encoding, Modulation, Signal Propagation.

Unit III: (Hours: 07)
Medium Access Control: Contention-Free Medium Access, Contention-Based Medium Access, Wireless MAC Protocols, Characteristics of MAC Protocols in Sensor Networks, Contention-Free MAC Protocols, Contention-Based MAC Protocols, Hybrid MAC Protocols.

Unit IV: (Hours: 07)
Network Layer: Routing Metrics, Flooding and Gossiping, Data-Centric Routing, Proactive Routing, On-Demand Routing, Hierarchical Routing, Location-Based Routing, QoS-Based Routing Protocols.

Unit V: (Hours: 07)
Power Management: Local Power Management Aspects, Dynamic Power Management, Conceptual Architecture. Time Synchronization: Clocks and the Synchronization Problem, Time Synchronization in Wireless Sensor Networks, Basics of Time Synchronization, Time Synchronization Protocols.

Unit VI: (Hours: 07)
Localization: Ranging Techniques, Range-Based Localization, Range-Free Localization, Event-Driven Localization Security: Fundamentals of Network Security, Challenges of Security in Wireless Sensor Networks, Security Attacks in Sensor Networks, Protocols and Mechanisms for Security, IEEE 802.15.4 and Zig Bee Security.

Text Book: Fundamentals of Wireless Sensor Networks: Theory and Practice / Waltenegus Dargie, Christian Poellabauer, 2010 John Wiley & Sons Ltd.

Reference Books:

1. Wireless Sensor Networks: technology, protocols, and applications by Kazem Sohraby, Daniel Minoli, TaiebZnati, Copyright _ 2007 by John Wiley & Sons, Inc.
2. Wireless Sensor Network Designs by Anna Hac, John Wiley & Sons Ltd.
3. Wireless Sensor Networks by Ian F. Akyildiz, Mehmet Can Vuran, 2010 John Wiley &Sons Ltd.
4. Wireless Sensor Networks: An Information Processing Approach by Feng Zhao,Leonidas J. Guibas, The Morgan Kaufmann Series in Networking.

8AD04 PREDICTIVE ANALYTICS (L-3, T-0, C-3)

Course Prerequisite: Big Data Analytics.

Course Objectives: Throughout the course, students will be expected to demonstrate their understanding of Predictive Analytics by being able to do each of the following: The course enables students to:

1. Learn, how to develop models to predict categorical and continuous outcomes, using such techniques as neural networks, decision trees, logistic regression, support vector machines and Bayesian network models.
2. Know the use of the binary classifier and numeric predictor nodes to automate model selection.
3. Advice on when and how to use each model. Also learn how to combine two or more models to improve prediction.

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

1. Understand the basics of analytics technology.
2. Explain the need of understanding of data.
3. Describe preparation required for data predication.
4. Discuss descriptive modelling techniques.
5. Compare the underlying predictive modelling techniques.
6. Select appropriate predictive modelling approaches to identify cases to progress with.

Unit I: (Hours: 6)
Overview of Predictive Analytics: Predictive Analytics Definition, Business Intelligence, Predictive Analytics vs. Business Intelligence, Predictive Analytics vs. Statistics, Statistics and Analytics, Predictive Analytics vs. Data Mining, Defining Data for Predictive Modelling, Defining the Columns as Measures, Defining the Unit of Analysis, Defining the Target Variable.

Unit II: (Hours: 6)
Data Understanding: Single Variable Summaries, Mean, Standard Deviation, The Normal Distribution, Uniform Distribution, Skewness, Categorical Variable Assessment, Data Visualization in One Dimension, Histograms, Multiple Variable Summaries, Correlations, Crosstabs, Data Visualization, Two or Higher Dimensions

Unit III: (Hours: 6)
Data Preparation: Variable Cleaning, Incorrect Values, Consistency in Data Formats, Outliers, Multidimensional Outliers, Missing Values, Fixing Missing Data, Feature Creation, Simple Variable Transformations, Fixing Skew, Binning Continuous Variables, Numeric Variable Scaling, Nominal Variable Transformation, Ordinal Variable Transformations, Date and Time Variable Features, ZIP Code Features, Multidimensional Features, Variable Selection Prior to Modeling, Sampling

Unit IV: (Hours: 6)
Descriptive Modeling: Principal Component Analysis, Clustering Algorithms, The K-Means Algorithm, Standard Cluster Model Interpretation, Problems with Interpretation Methods, Identifying Key Variables in Forming Cluster Models, ANOVA, Hierarchical Clustering, Cluster Outliers.

Unit V: (Hours: 6)
Predictive Modeling: Decision Trees, Building Decision Trees, Logistic Regression, Interpreting Logistic Regression Models, Neural Networks, Building Blocks: The Neuron, Neural Network Training, Neural Network Settings, Neural Network Pruning, The k-NN Learning Algorithm, Naïve Bayes.

Unit VI: (Hours: 6)
Assessing Predictive Models: Regression Models, Linear Regression, Linear Regression Assumptions, Variable Selection in Linear Regression, Interpreting Linear Regression Models, Using Linear Regression for Classification, Confusion Matrices, Bagging, Boosting, Random Forests.

Text Book: Dean Abbott, "Applied Predictive Analytics: Principles and Techniques for the Professional Data Analyst" Wiley 2014.

Reference Books:

1. John D. Kelleher, Brian Mac Namee, Aoife D'Arcy, "Fundamentals of Machine Learning for Predictive Data Analytics" The MIT Press 2015
2. EMC Education Services, "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", John Wiley & Sons, Inc, 2015.

8AD05 DATA MODELING & VISUALIZATION LAB:

Minimum Eight experiments/ programming assignments must be completed based on the respective syllabus (8AD01) covering each of the units.

8AD06 COGNITIVE TECHNOLOGY LAB:

Minimum Eight experiments/ programming assignments must be completed based on the respective syllabus (8AD03) covering each of the units.

8AD07 PROJECT & SEMINAR (P-12, C-6)

The student batch size for project may be preferably 04. The project shall be internally evaluated (for 75 Internal Marks) in three phases based on the progress of the project work. Each phase shall be internally evaluated for 25 marks as follows:
Phase I: - Problem Definition and Design
Phase II: - Problem Implementation and Testing
Phase III: - Project Demonstration & Report submission.
The external evaluation of the project shall be based on demonstration of the project and viva-voce.

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