NOTIFICATION

No. 107 /2025 Date: 19 /07/2025

Subject : Implementation of new syllabus of Semester VII & VIII of the new Under-graduate Course B.E. (Computer Science & Engineering) (Data Science) as per C.B.C.S. Pattern.

It is notified for general information of all concerned that the authorities of the University have accepted to implement the new syllabus along of the Subjects of **VII & VIII of the new Under-graduate Course B.E. (Computer Science & Engineering) (Data Science) as per C.B.C.S. Pattern** to be implemented from the academic session 2025-2026 & onwards as mentioned below:

Sd/-
(Dr.Avinash Asanare)
Registrar
Sant Gadge Baba Amravati University

SYLLABUS OF SEMESTER VII & VIII B.E. (Computer Science & Engg.) (DATA SCIENCE) CBCS pattern

SYLLABUS FOR VII AND VIII SEMESTER

SEMESTER VII

SUBJECTS:

1. 7KD01/7KS01 Social Science & Engineering Economics
2. 7KD02/7AD03 Big Data Analytics & Hadoop
3. 7KD03/7KS03 Cloud Computing
4. 7KD04/7AD02 Deep Learning
5. 7KD05 PE III - Cryptography
6. 7KD05 PE III – Data Wrangling
7. 7KD05 PE III - Predictive Analytics
8. 7KD06 Deep Learning Lab
9. 7KD07 Big Data Analytics & Hadoop Lab
10. 7KD08 Emerging Technology Lab# III
11. 7KD09 Project & Seminar

7KD01/7KS01 SOCIAL SCIENCE & ENGINEERING ECONOMICS

Course Objectives:

Course objectives are:
- To help students to understand the importance of economics to engineers
- To let them know about the Indian Parliament
- To enhance their knowledge about culture and civilization
- To help students to get an understanding of Market Trends, Economic Transformations, Changes in the Laws & equip them to have a better understanding of Market
- To critically examine the market trends.

Course Outcomes:

At the end of the course, students will have-
1. An ability to understand the importance of social science and economics in professionallife.
2. An ability to utilize high-level interpersonal skills to negotiate with stakeholders and maintain cordialrelationships with them reflecting theprofessional ethics and responsibilities.
3. Understanding of professional responsibility with socioeconomic constraints and norms
4. An ability to understand the need of society and design the system to fulfil it with deep analysis.
5. An ability to understand the social science and engage in a lifelong learning process performing better inthe group as well as individually.

Syllabus:

Unit I : (08 Hrs.)
Study of Social Science: Importance to Engineer, salient features of Indian constitution. Fundamental Rights and Duties. Directive Principles of State Policy.

Unit II : (08 Hrs.)
Indian Parliament: Composition and powers, President of India: Election and Powers. Council ofMinisters and Prime Minister

Unit III : (07 Hrs.)
Impact of Science and Technology on culture and Civilization. Human Society: Community Groups. Marriage and Family: Functions, Types and problems.

Unit IV: (07 Hrs.)
Production: Factors of production, Laws of return, Forms of Business Organization.

Unit V: (07 Hrs.)
Banking: Functions of Central and Commercial Banks. Introduction to GST, Market: Forms, perfect, imperfect competition and monopoly.

Unit VI: (08 Hrs.)
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. Davis 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

7KD02/7AD03 BIG DATA ANALYTICS & HADOOP

Course Pre-requisite:
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.

Syllabus:

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 theNew Big Data Ecosystem, Examples of Big Data Analytics, Data Analytics Lifecycle: Overview, Phase1: Discovery, Phase 2: Data Preparation, Phase 3: Model Planning, Phase 4: Model Building, Phase 5:CommunicateResults, Phase 6:Operationalize, Case Study: Global Innovation Network and Analysis (GINA).

Unit II: Review of Basic Data Analytics Methods, Clustering and Association Rules: (Hrs – 07)
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: UseCases, Model Description,Diagnostics, Reasons to Choose and Cautions, Additional Regression Models, Decision Trees:Overview of aDecision 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 ofClassifiers, Additional Classification Methods.

Unit IV: Time Series Analysis and Text Analysis (Hours-07)
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 Data Tool and Techniques: Big Data Storage, High Performance Architecture, HDFS, Map Reduce and YARN, Big Data Application Ecosystem, Zookeeper, H Base, 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, H Base, Mahout, No SQL

Unit VI: Database Analytics, No SQL and Graph Analytics: (Hours-07)
SQL Essentials, In-Database Text Analysis, Advanced SQL, NoSQL Data Management: What is No SQL, Schemaless 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, John Wiley & 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:
3. 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.
4. Mohammad Guller, "Big Data Analytics with Spark A Practitioner's Guide to Using Spark for Large-ScaleData Processing, Machine Learning, and Graph Analytics, and High-Velocity Data Stream Processing", FirstEdition,2015,ApressPublisher,ISBN-13(pbk): 978-1-4842-0965-3.
5. Arshdeep Bahga & Vijay Madisetti, "Big Data Science & Analytics: A Hands-On Approach", First Edition, 2019, ISBN: 978-1-949978-00-1.

7KD03/7KS03 CLOUD COMPUTING

Course Pre-requisite:
Data Communication and Networks

Course Objectives:
Throughout the course, students will be expected to demonstrate their understanding of Cloud Computing by being able to do each of the following:
- To provide students with the fundamentals and essentials of Cloud Computing.
- To provide students a foundation of Cloud Computing, Cloud Computing services and tools in real life scenarios.
- To enable student to explore some important Cloud Computing driven commercial systems and applications.
- To provide students with essentials of Cloud Computing architecture, Virtualization, Storage and Network concepts.

Course Outcomes (Expected Outcomes):
On completion of the course, the students will be able to:
1. Describe the fundamental concept, architecture and applications of Cloud Computing.
2. Discuss the problems related to cloud deployment model.
3. Examine the concept of virtualization.
4. Identify the role of network connectivity in the cloud.
5. Assess different Cloud service providers.
6. Inspect the security issues in cloud service models.

Syllabus:

Unit I: Cloud Computing Fundamental, Architecture and Management: (Hours: 8)
Computing Paradigm and various computing types, Cloud Computing Fundamentals: Motivation for Cloud Computing, The need for Cloud Computing, Defining Cloud Computing, Principles of Cloud Computing, Requirements of Cloud Services, Cloud Applications, Benefits and Drawbacks. Cloud Computing Architecture and Management: Introduction, Cloud Architecture, Network connectivity in Cloud Computing, Applications on the cloud, Managing Cloud, Migrating Application to cloud.

Unit II: Cloud Deployment and Service Models: (Hours: 7)
Cloud Deployment Models: Introduction, Private Cloud, Public Cloud, Community Cloud, Hybrid Cloud. Cloud Service Models: Introduction, Infrastructure as a Service, Platform as a Service, Software as a Service, Other Cloud Service Models.

Unit III: Operating System and Virtualization: (Hours: 7)
Types of Operating Systems, Role of OS in Cloud Computing, Features of Cloud OS. Application Environment: Need for Effective ADE, Application Development Methodologies, Cloud Application Development Platforms and Cloud Computing API's. Virtualization: Introduction, Virtualization Opportunities, Approaches to Virtualization, Hypervisors, Virtualization to Cloud Computing.

Unit IV: Software Development in Cloud and Networking for Cloud Computing: (Hours: 8)
Introduction, Different Perspectives on SaaS Development, New Challenges, Cloud-Aware Software DevelopmentUsing PaaS Technology. Networking for Cloud Computing: Introduction, Overview of Data Center Environment, Networking Issues in Data Centers, Transport Layer Issues in DCNs.

Unit V: Cloud Service Providers: (Hours: 7)
Introduction, EMC: IT, and captive cloud toolkit, Google: Platform, Storage, Cloud connects, Cloud Print and App Engine, Amazon Web Services: Elastic Compute Cloud, Simple storage, Simple Queue Service, Microsoft: Windows Azure, IBM Cloud models and IBM Smart Cloud, SAP Labs: SAP HANA Cloud Platform, Virtualization Services Sales force: Sales Cloud and Service Cloud, Rack space and VMware.

Unit VI: Open-Source Support for Cloud and Security in Cloud Computing: (Hours: 8)
Open-Source Support for Cloud: Introduction, Open Source Tools for IaaS, Open Source Tools for PaaS, Open Source Tools for SaaS, Open Source Tools for Research, Distributed Computing Tools for Management of Distributed Systems. Security in Cloud Computing: Introduction, Security Aspects: Data, Virtualization and Network Security, Platform-Related Security: Security issues in Cloud Service Models, SaaS, PaaS, IaaS security issues, Audit and Compliance: Disaster Recovery, Privacy and Integrity.

Text Book:
K. Chandrasekaran: Essentials of Cloud Computing, Edition, CRC Press Taylor & Francis Group.

Reference Books:
1. Shrinivasan, J. Suresh: Cloud computing a practical approach for learning and implementation, Pearsonpublication.
2. M. N. Rao: Cloud Computing, PHI Learning Pvt. Ltd, 2015.
3. Dr. Kumar Saurabh: Cloud computing, 2nd Edition, Wiley India 2012.
4. Rajkumar Buyya, James Broberg and Andrzej M. Goscinski: Cloud Computing: Principles and Paradigms,John Wiley & Sons, Inc. 2011.
5. Anthony T. Velte , Toby J. Velte and Robert Elsenpeter, Cloud computing a practical approach, TataMcGraw- Hill , New Delhi – 2010.
6. Judith Hurwitz, Robin Bloor, Marcia Kaufman and Fern Halper, "Cloud computing for dummies" WileyPublishing, Inc, 2010

7KD04/7AD02 DEEP LEARNING

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:
- To know the fundamental concepts of Deep Learning.
- To explore tools and practices for working with Deep Learning.
- 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.

Syllabus:

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 moviere views: 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, Datapre-processing, feature engineering, and feature learning, Over fitting and under fitting, The universal workflow of machine learning.

Unit III: (Hours-07)
Deep learning for computer vision, Introduction to convents, training a convnet from scratch on a small dataset, using a pretrained convent, visualizing what convents learn.

Unit IV: (Hours-07)
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-07)
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 978-981-13-5849-4ISBN 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 A
4. Charu C Agrawal, “ Neural Networks and Deep Learning: A textbook” Springer International Publishing ISBN978-3-319-94462-3 ISBN 978-3-319-94463-0 (eBook) https://doi.org/10.1007/978-3-319-94463-0

7KD05 PE III - CRYPTOGRAPHY

Course Pre-requisite:
Discrete Structure & Graph Theory, Data Communication and Networking, Introductionto Cyber security

Course Objectives:
Throughout the course, students will be expected to demonstrate their understanding ofCryptography by being able to do each of the following:
- Understand Security Concepts.
- Know about various encryption techniques.
- Understand the concept of public key cryptography.
- Study about message authentication and hash functions.
- Impart knowledge on Network security, Internet Security Protocols.

Course Outcomes (Expected Outcome):
On completion of the course, the students will be able to
1. Classify the symmetric encryption techniques
2. Illustrate various public key cryptographic techniques
3. Evaluate the authentication and hash algorithms.
4. Discuss authentication applications
5. Summarize the intrusion detection and its solutions to overcome the attacks.
6. Understand basic concepts of system level security

Syllabus:

Unit I: (Hours: 8)
Attacks on Computers and Computer Security: Introduction, Need for Security, Security Approaches, Principles of Security, Types of Attacks. Cryptography: Concepts and Techniques Introduction, Plain Text and Cipher Text, Substitution and Transposition Techniques, Encryption and Decryption, Symmetric and Asymmetric Key Cryptography, Stenography, Key Range and Key Size, Possible Types of Attacks.

Unit II: (Hours: 7)
Symmetric Key Algorithms and AES: Introduction, Algorithm Types and Modes, An Overview of Symmetric Key Cryptography, Data Encryption Standard(DES), International Data Encryption Algorithm(IDEA), RC4, RC5,Blowfish, Advanced Encryption Standard(AES).

Unit III: (Hours:8)
Asymmetric Key Algorithms, Digital Signatures and RSA: Introduction, History and Overview of Asymmetric Key Cryptography, The RSA Algorithm, Symmetric and Asymmetric Cryptography, Digital Signatures, Knapsack and other Algorithms.

Unit IV: (Hours:8)
Digital Certificates and Public Key Infrastructure (PKI): Introduction, Digital Certificates, Private Key Management, The PKIX Model, Public Key Cryptography Standards (PKCS), XML,PKI and Security, Creating Digital Certificate.

Unit V: (Hours:7)
Internet Security Protocols: Introduction, Concepts, Secure Socket Layer(SSL), Transport Layer Security(TLS),Secure Hypertext Transport Protocol(SHTTP), Time Stamping Protocol(TSP), Secure Electronic Transaction(SET),SSL Versus SET, 3-D Secure Protocol, Electronic Money, Email Security, Wireless ApplicationProtocol(WAP)Security, Security in GSM, Security in 3G.

Unit VI: (Hours:7)
User Authentication and Kerberos: Introduction, Authentication Basics, Passwords, Authentication Tokens, Certificate-based-Authentication, Biometric Authentication, Kerberos, Key Distribution Center(KDC), Security Handshake Pitfalls, Single Sign On (SSO) Approaches.

Text Book: Atul Kahate, " Cryptography and Network Security", McGraw Hill, Second Edition.

Reference Books:
1. William Stallings, "Cryptography and Network Security, Principles and Practice", PHI Fourth Edition.
2. Behrouz A. Forouzan and Debdeep Mukhopadhyay, "Cryptography and Network Security", McGraw Hill, Second Edition.
3. Matt Bishop, "Computer Security Arts and Science", Pearson Education.
4. Douglas R Stinson, "Cryptography, Theory and Practice" CRC Press.
5. Keith M Martin, "Everyday Cryptography, Fundamental Principles and Applications", Oxford UniversityPress, Second Edition.

7KD05 PE III – DATA WRANGLING

Pre-requisite:
- Fundamentals of Programming Methodology (Python)
- Database Management Systems
- Probability and Statistics

Course Objectives:
- To provide a comprehensive understanding of data preparation and cleaning techniques for real-world datasets.
- To explore methods for handling missing, inconsistent, and corrupted data.
- To enable students to use Python libraries and frameworks for effective data manipulation and preprocessing.
- To introduce tools for data integration, transformation, and feature engineering.
- To equip students with skills for preparing data for advanced analytical and machine learning applications.

Course Outcomes:
By the end of this course, students will be able to:
1. Identify and resolve data quality issues like missing values, duplicates, and inconsistencies.
2. Utilize Python libraries such as Pandas, NumPy, and Scikit-learn for data pre processing and transformation.
3. Implement data integration techniques to combine heterogeneous datasets.
4. Perform exploratory data analysis (EDA) to gain insights and prepare data for modeling.
5. Apply feature engineering techniques to enhance data for predictive analytics.
6. Prepare real-world datasets for machine learning and analytics workflows.

Syllabus:

Unit I: Introduction to Data Wrangling (7 hours)
Overview of Data Wrangling: Definition, Importance, and Workflow, Types of Data: Structured, Semi-structured, and Unstructured, Challenges in Real-world Data, Tools for Data Wrangling: Python, Jupyter Notebook, Pandas, NumPy.

Unit II: Handling Missing and Inconsistent Data (8 hours)
Identifying Missing Values and Data Inconsistencies, Techniques to Handle Missing Data: Dropping, Imputation, and Advanced Methods, Handling Outliers: Detection using Statistical Techniques (Z-score, IQR), Resolving Duplicates and Data Type Issues.

Unit III: Data Transformation and Integration (8 hours)
Data Normalization and Standardization, Data Encoding: One-Hot, Label Encoding, and Custom Encoding, Combining Multiple Datasets: Merging, Concatenation, and Join Operations, Handling Time-series and Text Data for Integration.

Unit IV: Exploratory Data Analysis (7 hours)
Descriptive Statistics and Visual Summaries, Data Profiling using Python: Pandas Profiling, Sweetviz, Identifying Patterns, Trends, and Anomalies in Data, Data Reduction Techniques: Dimensionality Reduction (PCA).

Unit V: Feature Engineering and Selection (8 hours)
Feature Extraction: Text, Images, and Time-series Data, Feature Scaling and Transformation Techniques, Feature Selection Techniques: Filter, Wrapper, and Embedded Methods, Using Python Libraries (Scikit-learn, Feature Tools).

Unit VI: Preparing Data for Machine Learning (7 hours)
Splitting Data: Training, Validation, and Test Sets, Data Augmentation and Re-sampling, Creating Pipelines for Data Pre-processing, Real-world Case Studies: Preparing Public Datasets (Kaggle, UCI).

Text Books:
1. McKinney, Wes. Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython, 2nd Edition, O'Reilly Media, 2017.
2. VanderPlas, Jake. Python Data Science Handbook: Essential Tools for Working with Data, O'Reilly Media, 2016.

Reference Books:
1. Han, Jiawei, et al. Data Mining: Concepts and Techniques, 3rd Edition, Morgan Kaufmann, 2011.
2. Géron, Aurélien. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 2nd Edition, O'Reilly Media, 2019.
3. Grus, Joel. Data Science from Scratch: First Principles with Python, 2nd Edition, O'Reilly Media, 2019.

7KD05 PE III - PREDICTIVE ANALYTICS

Course Pre-requisite: 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:
- 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.
- Know the use of the binary classifier and numeric predictor nodes to automate model selection.
- 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 to understand data.
3. Describe preparation required for data prediction.
4. Discuss descriptive modelling techniques.
5. Compare the underlying predictive modelling techniques.
6. Select appropriate predictive modelling approaches to identify cases to progress with.

Syllabus:

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, Multi-dimensional 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 forPredictive Data Analytics" The MIT Press 2015
2. EMC Education Services, "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizingand Presenting Data", John Wiley & Sons, Inc, 2015.

7KD06 DEEP LEARNING - Lab.

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

7KD07 BIG DATA ANALYTICS & HADOOP – Lab
Minimum Eight experiments/ programming assignments must be completed based on the respective syllabus (7KD07) covering each of the units.

7KD08 EMERGING TECHNOLOGY Lab# III

7KD09 PROJECT & SEMINAR

SEMESTER VIII

Subjects:

1. 8KD01/8KS01 Object Oriented Analysis & Design
2. 8KD02/8KS02 Professional Ethics & Management
3. 8KD03/8AD01 Data Modelling & Visualization
4. 8KD04 PE IV - Internet of Things
5. 8KD04 PE IV - Block Chain Technologies
6. 8KD04 PE IV – Robotics
7. 8KD05 Data Modelling & Visualization Lab
8. 8KD06 Emerging Technology Lab# VI
9. 8KD07 Project & Seminar

8KD01/8KS01 OBJECT ORIENTED ANALYSIS & DESIGN

Course Pre-requisite:
Data Structures and algorithms, Basic Mathematics, Geometry, linear algebra, vectors andmatrices

Course Objectives:
Throughout the course, students will be expected to demonstrate their understanding of Object Oriented Analysis and Design by being able to do each of the following:
- To learn the basic concepts of Object-Oriented Analysis and Design, UML, Software Development Processes and Design pattern.
- To study requirement analysis in the Inception phase of software development and relate
- To present Object Oriented Analysis and Design through case studies.
- To introduce design patterns that can be used for development of object-oriented software systems.
- To study UML notation and frequently used UML diagrams for designing Object Oriented software.

Course Outcomes (Expected Outcome):
On completion of the course, the students will be able to:
1. Describe Object Oriented principles, for performing object-oriented analysis and design.
2. Explain the basic concepts of UML, Software Development Processes and Design pattern.
3. Illustrate requirements for developing a software.
4. Create initial domain model & system sequence diagram for use case scenario.
5. Design static and dynamic objects for modeling.
6. Construct UML and Design Patterns for developing object-oriented software.

Syllabus:

Unit I: (Hours: 08)
Introduction to Object Oriented Analysis and Design: Analysis and Design, Object-Oriented Analysis and Design; UML, Iterative, Evolutionary and Agile: UP, Iterative and Evolutionary Development, Waterfall Life cycle, Iterative and Evolutionary Analysis and Design, Risk-Driven and Client-Driven Iterative Planning, Agile Methods and Attitudes, Agile Modeling, Agile UP, UP Phases, UP Disciplines.

Unit II: (Hours: 07)
Defining Inception: Inception, Artifacts Start in Inception, Evolutionary requirements: Requirements, Evolutionary vs. Waterfall Requirements, Types and Categories of Requirements, Requirements Organized in UP Artifacts Use cases: Actors, Scenarios and Use Case, Use Cases and the Use-Case Model, Importance of Use Cases, Three Kinds of Actors, Three Common Use Case Format, Sections Mean, Take an Actor and Actor-goal perspective, Use Case Diagrams, Activity Diagrams

Unit III: (Hours:07)
Domain Models: Domain Model, Need of Create a Domain Model, create a Domain Model, Conceptual Classes, Sketching a Class Diagram, Common Mistake with Attributes vs. Classes, Associations, Attributes. System Sequence Diagrams: System Sequence Diagrams, Need of SSD, Relationship between SSDs and Use Cases, Naming System Events and Operations, Model SSDs Involving Other External Systems, Process: Iterative and Evolutionary SSDs, Operation Contracts.

Unit IV: (Hours:08)
Logical Architecture and UML Package Diagrams: Logical Architecture, Layers, Software Architecture, UML Package Diagrams, Design with Layers, Benefits of Using LayersOn to Object Design: Designing Objects: Static and Dynamic Modeling, The Importance of Object Design Skillover UML Notation Skill UML Interaction Diagrams: Sequence and Communication Diagrams, Common UML Interaction Diagram Notation, Basic Sequence Diagram Notation, Basic Communication Diagram Notation.UML Class Diagram: Common Class Diagram Notation, Design Class Diagram, Attribute Text and Association Lines, Notes, Comments, Constrains and Method Bodies, Operations and Methods, Keywords, Stereotypes, Profiles and Tags

Unit V: (Hours:08)
GRASP: Designing Objects with Responsibilities: Object Design: Example Inputs, Activities and Outputs, Responsibilities and Responsibility-Driven Design, GRASP: A Methodological Approach to Basic OO Design, the Connection between Responsibilities, GRASP and UML Diagrams, Patterns, A Short Example of Object Design with GRASP Designing for Visibility: Visibility between Objects Mapping Designs to Code: Creating Class Definitions from DCDs, Creating Methods from Interaction Diagrams, Collection Classes in Code.

Unit VI: (Hours:07)
Applying GoF Design Patterns: Adapter(GoF), Factory, Singleton(GoF), Strategy (GoF), Composite (GoF) andOther Design Principles, Façade (GoF), Observer (GoF).UML State Machine Diagrams and Modeling: Event, State and Transition, Apply State Machine Diagrams, More UML State Machine Diagram Notation, State Machine Diagrams in UP.Relating Use Cases: The include Relationship, The extend Relationship, The Generalize Relationship, Use Case Diagrams.

Text Books:
1. Craig Larman: ”Applying UML and Patterns: An Introduction to Object Oriented Analysis and Design andIterative Development, Third Edition, Addison Wesley Professional.
2. Erich Gamma et al., Design Patterns, Elements of Reusable OO Software, Addison-Wesley.

Reference Books:
1. Blaha, Rumbaugh: “Object Oriented Modeling and Design with UML” (2/e) Pearson Education.
2. Arlow, Jim, “UML and the Unified Process”, Pearson Education.
3. McRobb& Farmer: “Object Oriented System Analysis & Design” Mc Graw Hill.
4. Booch, Rumbaugh & Jacobson: “ The UML User guide” Pearson Education.
5. Whitten & Bentley: “System Analysis & Design Methods” Tata McGraw Hill.
6. Booch: “Object Oriented Analysis & Design with Applications”, Pearson Education.

8KD02/8KS02 PROFESSIONAL ETHICS & MANAGEMENT

Course Objectives:
Throughout the course, students will be expected to demonstrate their understanding ofProfessional Ethics and Management by being able to do each of the following:
- To enable the students to create an awareness of engineering and professional ethics
- To instill moral, social values and appreciate the rights of others
- To regulate the student’s behavior in a professional environment
- To conscious about the impact of non-ethical engineering decisions
- To comprehend ‘mind and desire control’ needs for being ethical

Course Outcomes (Expected Outcomes):
On completion of the course, the students will be able to:
1. Relate ethical and non-ethical situations
2. Outline ethics in the society & environment
3. Examine the moral judgment & correlate the concepts in addressing the ethical dilemmas
4. Identify risk and safety measures in various engineering fields
5. Justify ethical issues related to engineering responsibilities and rights
6. Synthesize cognitive skills in solving social problems

Syllabus:

Unit I: Introduction to Ethics (Hours: 08)
Senses of Engineering and professional ethics, Engineering profession & its view, Ethical issues for engineers, distinction between ethics, morals and laws, opinions vs. judgments, Ethical theories: utilitarianism, duty, right,virtue; Cost-benefit analysis in engineering, McCuen's ethical dimensions, IEEE: Code of conducts & Code ofethics

Unit II: Professional Practices in Engineering (Hours: 07)
Professional attributes, Difference in engineering and other professions; Ethical dilemma: right-wrong or betterworse; Code of ethics for engineers in India: need and its roles; abuse of codes, ethical relativism, well-being andprofession, Ethics as Design - Doing Justice to Moral Problems, Kohlberg's theory – Gilligan's theory.

Unit III: Central Professional Responsibilities of Engineers (Hours: 08)
Confidentiality and Proprietary Information, Conflict of interest, Competitive bidding, rights of Engineers:fundamental, professional conscience, conscientious refusal, professional recognition, employee, privacy; types ofconflict of interest, avoiding conflict of interest, competitive bidding, situations for conflict ofinterest, ethicalcorporate climate & its features.

Unit IV: Intellectual Property Rights and Ethics (Hours: 07)
Patent: IP chain of activities, IP as intangible property, protection offered by patent, right of patent owner; Trademarks (TM): purpose, what can be registered under trademark, categories of TM, industrial design, geographical indications; Copyright & related rights: advances in technology and copyright, benefits, World IP organization, TRIPS & WTO.

Unit V: Computers, Software and Digital Information (Hours: 08)
Emergence of Computer ethics, issues in Computer ethics: distribution of power issues, property issues, issues ofprivacy, professional issues, Computer crimes, Computer Software and Digital Information: Characteristics ofdigital information, s/w as IP, and challenges in information age, IEEE code of conduct and codeof ethics.

Unit VI: Responsibilities and Management (Hours: 07)
Responsibility for the Environment, Engineering as Social Experimentation, Safety and Risk management, IT Professional relationship management with: Employers, Clients, Suppliers, IT Users, other professionals, and society at large.

Text Books:
1. D. G. Harkut and G. R. Bamnote "Professional Ethics for Engineers", Notion Press, India.
2. Prof. Susmita Mukhopadhyay, 'Ethics in Engineering Practice' IIT Kharagpur.

Reference Books:
1. Mike Martin and Roland Schinzinger, 'Ethics in Engineering', Tata Mc-Graw Hill, New York, 2005.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, 'Engineering Ethics – Concepts and Cases',Cengage Learning, 2009 & Thompson Learning, 2000.
3. Govindarajan M., Natarajan, 'Engineering Ethics', Prentice Hall of India, New Delhi, 2004.
4. Stephen Byars, 'Business Ethics', USC Marshal School of Business Kurt Stanberry, University of Houston(https://openstax.org/details/books/business-ethics)

8KD03/8AD01 DATA MODELLING & VISUALIZATION

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

Course Objectives:
Throughout the course, students will be expected to demonstrate their understanding ofData Modelling & Visualization by being able to do each of the following:
- Understand the fundamental concepts of database management system.
- Describe the importance of information within an organization.
- Understand the query processing and optimization.
- 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.

Syllabus:

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: 7)
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: 7)
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 ofHTML5, 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:7)
Reading Data from Standard text files (.txt, .csv, XML), Displaying JSON content Outputting Basic Table Data(Building a table, Using Semantic Table, Configuring the columns), Assuring Maximum readability (Stylingy ourtable, increasing readability, adding dynamic Highlighting), Including computations, 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, Linear interpolations, A Simple Column Chart, Animations), Starting with Google charts (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 the population distribution data, Data formats you can usewith D3, Creating aserver to upload your data, D3's function for loading data, Dealing with Asynchronous 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 andVisualization", WROX
2. Ritchie S. King, Visual story telling with D3" PearsonBen Fry, "Visualizing data: Exploring and explaining data with the processing environment", O'Reilly, 2008.
3. A Julie Steele and Noah Iliinsky, Designing Data Visualizations: Representing Informational Relationships, O'Relly
4. Andy Kirk, Data Visualization: A Successful Design Process, PAKT
5. Scott Murray, Interactive Data Visualization for Web, O'Relly
6. Nathan Yau, "Data Points: Visualization that means something", Wiley, 2013.
7. Tamara Munzner, Visualization Analysis and Design, AK Peters Visualization Series, CRC Press, Nov. 2014.

8KD04 Prof. Elective IV - INTERNET OF THINGS

Course Pre-requisite:
Basic knowledge of Internet and Microprocessor & Assembly Language Programming

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

- To learn and understand fundamental of IoT
- To study the design methodology and different IoT platform
- To understand usefulness of IoT for society
- To design and implement application of IoT using various sensor

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

1. Understand the basics of IoT
2. Understand design methodology and platforms involved in IoT
3. Apply the knowledge to interface various sensors with IoT development
4. Design and Implement IoT system for real time application.

Syllabus:

Unit I: (Hours: 8)
Introduction to Internet of Things, Definition & Characteristics of IoT, Physical Design of IoT Logical Design ofIoT, IoT Enabled Technologies like Wireless Sensor Networks, Cloud Computing, Big data analytics,Communication protocols, Embedded Systems, IoT Levels & Deployment Templates, Domain Specific IoTs:Home, Cities, Environment, Energy systems, Logistics, Agriculture, Health & Lifestyle.

Unit II: (Hours: 7)
IOT & M2M: Introduction, M2M, Difference between IoT and M2M, SDN and NFV for IoT, Software definednetworks, network function virtualization, IoT Systems Management, Simple Network Management Protocol(SNMP),Limitations of SNMP, Network Operator Requirements, NETCONF, YANG, IoT Systems Managementwith NETCONF-YANG, NETOPEER.

Unit III: (Hours: 7)
IoT Platforms Design Methodology, Case Study on IoT System for Weather Monitoring, Motivation for UsingPython, IoT Systems - Logical Design using Python ,Installing Python, Python Data Types & Data Structures,Control Flow, Functions, Modules, Packages, File Handling l, Date/Time Operations, Classes, Python Packages ofInterest for IoT

Unit IV: (Hours: 8)
IoT Physical Devices & Endpoints, Raspberry Pi, About the Board, Linux on Raspberry Pi,Raspberry Pi Interfaces serial, SPI, I2C, Programming Raspberry Pi with Python, Controlling LED with RaspberryPi, Interfacing an LED and switch with Raspberry Pi, Interfacing Light Sensor with Raspberry Pi Other IoTDevices, pcDuino, BeagleBone Black, Cubieboard.

Unit V: (Hours: 7)
IoT Physical Servers & Cloud Offerings, Introduction to Cloud Storage Models & Communication APIs , WAMP – AutoBahn for IoT , Xively Cloud for IoT , Python Web Application Framework - Django , Designing a RESTfulWeb API , Amazon Web Services for SkyNet IoT Messaging Platform.

Unit VI: (Hours: 8)
Case Studies Illustrating IoT Design, Introduction, Home Automation: Smart Lighting, Home Intrusion detection, Cities: Smart parking, Environment: Weather Monitoring System, Weather reporting Bot, Air pollution monitoring, Forest fire detection, Agriculture: Smart Irrigation, Productivity Applications: IoT printer.

Text Book:
Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press,ISBN:0: 0996025510, 13: 978-0996025515.

Reference Books:
1. Fundamentals of Python, K.A.Lambert and B.L.Juneja, Cengage Learning, 2012.
2. David Hanes, IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet ofThings, Cisco Press, ISBN-13: 978-1-58714-456-1, ISBN-10: 1-58714-456-5, 2017
3. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle,"From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014.

8KD04 Prof. Elective IV - BLOCK CHAIN TECHNOLOGIES

Course Prerequisite:
Expertise in Programming, Basic Knowledge of Computer Security, Cryptography,
Networking, Computer Systems Security

Course Objectives:
Throughout the course, students will be expected to demonstrate their understanding of Block
Chain Fundamentals by being able to do each of the following:
- To provide conceptual understanding of the function of Block chain as a method of securing distributed ledgers.
- To understand the structure of a block chain and why/when it is better than a simple distributed database
- To understand the technological underpinnings of block chain operations as distributed data structures and decision-making systems.
- To gain understanding of a "smart" contract and its legal implications.
- To provide a critical evaluation of existing "smart contract" capabilities and platforms, and examine their future directions, opportunities, risks and challenges.

Course Outcomes (Expected Outcome):
On completion of the course, the students will be able to
1. Describe Crypto currency as an application of block chain technology
2. Examine Basic Cryptographic primitives used in Block chain
3. Illustrate Consensus in a Blockchain
4. Discuss empirical study oof bitcoin the mining
5. Compare and contrast Ethereum and Bitcoin
6. Use concepts of Block chain technology that are commonly used across multiple industries to solvelarge scale problems.

Syllabus:

Unit I: Introduction to Block Chain: (Hours: 7)
Introduction to Block chain, Structure of a Block, Types of Block chain, Public Ledgers, Blockchain as public ledgers, Crypto currency as application of block chain technology

Unit II: Basic Cryptographic primitives used in Block chain: (Hours: 8)
Basic Cryptographic primitives used in Block chain – Secure, Collision-resistant hash functions, Digital signature, Public key cryptosystems, Zero-knowledge proof systems Cryptographic Hash Function, SHA-256,Properties of a hash function, Hash pointer and Merkle tree.

Unit III: Consensus: (Hours: 8)
Consensus, Distributed consensus in open environments, Consensus in a Bitcoin network, Types of consensus algorithm: Proof of Work (PoW), Proof of Stake (PoS), Delegated Proof of Stake (DPoS),Ripple, Proof of Burn

Unit IV: Introduction to Bitcoin: (Hours: 7)
Introduction to Bitcoin, History of Bitcoin, Bitcoin Transactions, Bitcoin Mining, Bitcoin Address.

Unit V: Introduction to Ethereum: (Hours: 7)
Introduction to Ethereum - Ethereum Virtual Machine (EVM), Wallets for Ethereum,Differences between Ethereumand Bitcoin, Block format, Mining algorithm, Solidity, Smart Contracts, Some attacks on smartcontracts.

Unit VI: Block chain Technology (Hours: 8)
Blockchain Technology: Hyper ledger Fabric: System architecture, ledger format, chain code execution, transaction flow and ordering, private channels, membership service providers, Fabric Peer and Certificate Authority, Case studies of applications.

Text Book:
S. Shukla, M. Dhawan, S. Sharma, S. Venkatesan, 'Block chain Technology: Cryptocurrency and Applications', Oxford University Press, 2019.

Reference Books:
1. Mastering Bitcoin: Unlocking Digital Crypto currencies, by Andreas Antonopoulos, O'Reilly publisher
2. Blockchain Blueprint for a New Economy, by Melanie Swan, O'Reilly.
3. Narayanan, Arvind, et al. Bitcoin and Cryptocurrency Technologies: A ComprehensiveIntroduction. Princeton University Press, 2016.
4. Antonopoulos, Andreas M. Mastering Bitcoin: Programming the Open Blockchain. O'Reilly Media,Inc., 2017
5. Antonopoulos, Andreas M. and Wood, Gavin. Mastering Ethereum. O'Reilly Media, Inc., 2018. (Freedraft available at https://github.com/ethereumbook/ethereumbook)
6. Ethereum project documentation. Online: http://www.ethdocs.org/en/latest/
7. Zero to Blockchain - An IBM Redbooks course, by Bob Dill, David Smits - https://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/crse0401.html

8KD04 Prof. Elective IV – ROBOTICS

Course Pre-requisite: Mathematics

Course Objectives:
Throughout the course, students will be expected to demonstrate their understanding ofRobotics by being able to do each of the following:
- To introduce the functional elements of Robotics
- To impart knowledge on the direct and inverse kinematics
- To introduce the manipulator differential motion and control
- To educate on various path planning techniques
- To introduce the dynamics and control of manipulators

Course Outcomes (Expected Outcome):
On completion of the course, the students will be able to-
1. Describe basic concept of robotics.
2. Explain Components of a Robot System & Mechanical Systems.
3. Illustrate Control of Actuators in Robotic Mechanisms
4. Compare and contrast Robotic Sensory Devices
5. Recommend Robotics Hardware & Software Considerations in Computer Vision
6. Design Robotic system by taking real time considerations.

Syllabus:

Unit I: (Hours: 7)
Introduction to Robotics: Objectives, Motivation, Historical Perspective of Robots, Classification of Robots, Classification by Control Method, Continuous-path servo-controlled robots, Major Components of a Robot, Fixed versus Flexible Automation.

Unit II: (Hours: 8)
Components of a Robot System & Mechanical Systems: Basic Components of a Robot System, Functions of a Robot System Specifications of Robot Systems, Kinematic Chains the Manipulator End Effectors, Resolution, Forces Encountered in Moving Coordinate Systems Lagrangian Analysis of a Manipulator.

Unit III: (Hours: 7)
Control of Actuators in Robotic Mechanisms: Closed-Loop Control in a Position Servo, the Effect of Friction and Gravity, Frequency-Domain Considerations, Control of a Robotic Joint Brushless DC Motors, Direct Drive Actuator, Hydraulic Actuators.

Unit IV: (Hours: 8)
Robotic Sensory Devices: Non-Optical-Position Sensors, Optical Position Sensors, Robot Calibration Using an Optical Incremental Encoder, Instability Resulting from Using an Incremental Encoder, Velocity Sensors, Accelerometers.

Unit V: (Hours: 7)
Computer Vision for Robotics Systems: A Functional Approach: Imaging Components, Image Representation, Hardware Considerations, Picture Coding, Object Recognition and Categorization, Software Considerations, Need for Vision Training and Adaptations.

Unit VI: (Hours: 8)
Computer Considerations for Robotic Systems: Architectural Considerations, Hardware Considerations, Computational Elements in Robotic Applications Real-Time Considerations, Robot Programming, Path Planning, The Robot's Computer System.

Text Books:
1. Richard D.Klafter Thomas, Achmielewski and Michael Negin Robotic Engineering- An Integrated Approach Prentice Hall India – New Delhi.
2. Saeed B Nikku Introduction to Robotics , analysis control and applications Wiley-India 2nd Edition-2011

Reference Books:
1. B.K.Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers, Chennai,1998.
2. S.Ghoshal, “Embedded Systems & Robotics” – Projects using the 8051 Microcontroller”, Cengage Learning, 2009.
3. David Jefferis, “Artificial Intelligence: Robotics and Machine Evolution”, Crabtree Publishing Company, 1992.
4. Robin Murphy, Robin R. Murphy, Ronald C. Arkin, “Introduction to AI Robotics”, MIT Press, 2000.
5. Francis.X.Govers, “Artificial Intelligence for Robotics”, Packt Publishing, 2018.
6. Huimin Lu, Xing Lu, “Artificial Intelligence and Robotics”, Springer, 2017.
7. Lentin Joseph, “Robot Operating Systems (ROS) for Absolute Beginners, A press, 2018
8. Aaron Martinez, Enrique Fernández, “Learning ROS for Robotics Programming”, Packt Publishing Ltd, 2013.
9. Wyatt Newman, “A Systematic Approach to learning Robot Programming with ROS”, CRCPress, 2017.
10. Ashitava Ghoshal, Robotics-Fundamental Concepts and Analysis’, Oxford University Press, Sixth impression, 2010.
11. K. K.AppuKuttan, Robotics, I K International, 2007.
12. Edwin Wise, Applied Robotics, Cengage Learning, 2003.
13. Richard D. Klafter, Thomas .A, ChriElewski, Michael Negin - Robotic Engineering–An IntegratedApproach, Prentice Hall of India, New Delhi, 2009.
14. S.R. Deb, Robotics Technology and flexible automation, Tata McGraw-Hill Education., 2009
15. Mikell P Groover & Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, Industrial Robotics,Technology programming and Applications, McGraw Hill, 2012
16. Deb. S. R. “Robotics technology and flexible automation”, Tata McGraw Hill publishing company.

8KD05 DATA MODELLING & VISUALIZATION - Lab.

Minimum Eight experiments/ programming assignments must be completed based on the respective syllabus (8KD01) covering each of the units.

8KD06 EMERGING TECHNOLOGY Lab# VI

8KD07 PROJECT & SEMINAR

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