Department of Artificial Intelligence and Data Science
Minutes of Second Board of Studies

The Second Board of Studies meeting of Department of Artificial Intelligence and Data Science was held on 10th April 2021 at 10:00 A.M in the GD Hall, Training and Placement Cell, Sri Manakula Vinayagar Engineering College with the Head of the Department in the Chair.

The following members were present for the BoS meeting

Sl.No	Name of the Member with Designation and official Address	Responsibility in the BoS
1	**Dr. J. Madhusudanan,** Professor and Head, Department of AI&DS, SMVEC.	Chairman
2	**Dr. M. Thangaraj,** Professor & Head, Madurai Kamaraj University, Madurai.	Subject Expert (Academic Council Nominee)
3	**Dr. Chandra Mouli P.V.S.S.R,** Associate Professor & Head Central University of Tamil Nadu, Tiruvarur, Tamil Nadu.	Subject Expert (Academic Council Nominee)
4	**Dr. C. Muthu,** Professor & Head, Loyola College, Chennai.	Subject Expert (University Nominee)
5	**Dr. Mohanraj Vengadachalam,** Machine Learning Lead, Standard Chartered GBS, Chennai.	Representative from Industry
6	**Dr. J. Uthayakumar,** Research Head, Genesys Academy, Puducherry.	Postgraduate Alumnus (nominated by the Principal)
7	**Dr. V. Vijayalakshmi** Assistant Professor, Department of AI&DS, SMVEC	Internal Member
8	**Dr. K.Kishore Anthuvan Sahayaraj** Assistant Professor, Department of AI&DS, SMVEC	Internal Member
9	**Prof. M. Ganesan** Assistant Professor, Department of CSE, SMVEC	Internal Member
10	**Prof. M. Shanmugam** Assistant Professor, Department of CSE, SMVEC	Internal Member
11	**Dr. T. Gayathri** Professor, Department of Maths, SMVEC	Internal Member

12	**Dr. R. Sivakumar** Associate Professor, Dept. of MBA, SMVEC	Internal Member
13	**Prof. P. Rajeswari** Associate Professor, Dept. of English, SMVEC	Internal Member
14	**Dr. D. Mohan Radheep** Associate Professor, Dept. of Physics, SMVEC	Internal Member

Agenda of the Meeting

1. Discuss about the Vision and Mission of B.Tech – Artificial Intelligence and Data Science.
2. Discussion and Review of first BoS meeting.
3. To discuss the students admitted in the Academic Year 2020-21. (First Year)
4. To discuss and approve the syllabi for III to IV Semesters under R2020 Regulations for UG Programme B.Tech Artificial Intelligence and Data Science for the students admitted in the year 2020-21.
5. To discuss and approve Evaluation Systems.
6. To discuss and approve the syllabi for Professional Electives of IV semester and Open Electives offered to other departments.
7. To discuss and approve the panel of examiners.
8. Any other item with the permission of chair.

Minutes of the Meeting

Dr. J. Madhusudanan, Chairman, BoS opened the meeting by welcoming and introducing the external members, to the internal and co-opted members and thanked them for accepting to become the member of the Board of Studies and the meeting thereafter deliberated on agenda items that had been approved by the Chairman.

Item:1	Got approved for Mission statement and Vision statement (**given in Annexure – I).**
Item:2	Discussion and review of the first BoS.
Item:3	Discussed about the details of the admitted students for academic year 2020-2021 (**given in Annexure – II).**
Item:4	Syllabi from III to IV semesters for the B.Tech – Artificial Intelligence and Data Science approved with the following suggestions. i) In Probability and Statistics, suggested to add IQR, Hypotheis testing, ANOVA, Empirical rule and suggested a book "Practical Statistics for Data Scientist" and also recommended to rename as "Probability and Statistics for Data Science". ii) In Algorithm Design and Analysis, in Unit-II suggested to add Activity Selection Problem and in unit-V Decidability and Undecidability concepts. iii) In Fundamental of Artificial Intelligence, suggested to change the subject name as Fundamentals of Artificial Intelligence. iv) In Basic Machine Learning Techniques, Swap the unit-II and unit-III. Suggested to add performance metrics in unit II and III. v) In Discrete Mathematics and Automata, suggested to change the subject name as Discrete Mathematics and graph theory and keep automata

subject in professional elective by removing the data mining.

vi) In Data Visualization, recommended to use Python libraries instead of R for the second and third units.

vii) In Advanced Machine Learning Techniques, suggested to add Hidden Markov model in Unit-I and Light GBM in unit-III.

viii) In Data Visualization Laboratory, recommended to use python instead of R.

The above corrections are approved by BoS members and the details are given in Annexure - III.

Item:5 Discussed about Evaluation Systems and got approved.

Item:6 Discussed about the Professional electives of IV semester and Open electives opted by the students from IV to VII semester and gave the following suggestions.

i) In Principles of Data Analytics, suggested to remove 5th unit, and to introduce the basics of R programming in Unit-III to V.

ii) In Building Blocks of Artificial Intelligence, recommended to rename the subject name as Soft Computing and swap Unit-I and Unit-II.

iii) In GPU Computing, CUDA Programming can be added.

iv) Scripting Language can be moved to fifth semester and in fourth semester Microprocessors and Microcontrollers can be added.

v) Data Mining subject can be removed and Automata and Compiler Design can be added.

The above corrections are approved by BoS members and the details are given in Annexure - IV.

Item:7 Discussed about panel of examiners and got approved (**given in Annexure – V).**

Item:8 Suggested to incorporate the case study in fifth unit in the forthcoming semesters.

The meeting was concluded at 12:00 PM with vote of thanks by **Dr. J. Madhusudanan**, Head of Department, Artificial Intelligence and Data Science.

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4	**Dr. C. Muthu,** Professor & Head, Loyola College, Chennai.	Subject Expert	
5	**Dr. Mohanraj Vengadachalam,** Machine Learning Lead, Standard Chartered GBS, Chennai.	Industrial Expert	
6	**Dr. J. Uthayakumar,** Research Head, Genesys Academy, Puducherry.	Member	
7	**Dr. V. Vijayalakshmi** Assistant Professor, Department of AI&DS, SMVEC	Internal Member	
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14	**Dr. D. Mohan Radheep** Associate Professor, Dept. of Physics, SMVEC	Internal Member	

Dr. J. Madhusudanan,
HOD/AI&DS
Chairman-BoS (AI&DS)

Director cum Principal
Chairman Academic Council

		L	T	P	C	Hrs
U20ADO401	KNOWLEDGE REPRESENTATION AND REASONING (Common to EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics)	3	0	0	3	45

Course Objectives

- To investigate the key concepts of knowledge representation (KR) techniques and different notations.
- To integrate the KR view as knowledge engineering approach to model organizational knowledge.
- To introduce the study of ontologies as a KR paradigm and applications of ontologies.
- To understand various processes based on its context techniques.
- To understand process, knowledge acquisition and sharing of ontology.

Course Outcomes

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

CO1 - Analyze and design knowledge based systems intended for computer implementation. **(K3)**

CO2 - Acquire theoretical knowledge about principles for logic-based representation and reasoning. **(K2)**
CO3 - Ability to understand knowledge-engineering process. **(K2)**
CO4 - Ability to implement the process according to the context. **(K3)**
CO5 - Learn the process, knowledge acquisition and sharing of ontology. **(K2)**

UNIT I EVOLUTION OF KNOWLEDGE REPRESENTATION **(9 Hrs)**

The Key Concepts: Knowledge, Representation, Reasoning, Why knowledge representation and reasoning, Role of logic. Logic: Historical background, Representing knowledge in logic, Varieties of logic, Name, Type, Measures, Unity Amidst diversity

UNIT II ONTOLOGY AND ITS CLASSIFICATION **(9 Hrs)**

Ontology: Ontological categories, Philosophical background, Top-level categories, Describing physical entities, Defining abstractions, Sets, Collections, Types and Categories, Space and Time.

UNIT III KNOWLEDGE REPRESENTATION **(9 Hrs)**

Knowledge Representations: Knowledge Engineering, Representing structure in frames, Rules and data, Object-oriented systems, Natural language Semantics, Levels of representation.

UNIT IV PROCESSES, CONTEXTS AND AGENTS **(9 Hrs)**

Processes: Times, Events and Situations, Classification of processes, Procedures, Processes and Histories, Concurrent processes, Computation, Constraint satisfaction, Change Contexts: Syntax of contexts, Semantics of contexts, First-order reasoning in contexts, Modal reasoning in contexts, Encapsulating objects in contexts.

UNIT V KNOWLEDGE SOUP, ACQUISITION AND SHARING **(9 Hrs)**

Knowledge Soup: Vagueness, Uncertainty, Randomness and Ignorance, Limitations of logic, Fuzzy logic, Nonmonotonic Logic, Theories, Models and the world, Semiotics. Knowledge Acquisition and Sharing: Sharing Ontologies, Conceptual schema, Accommodating multiple paradigms, Relating different knowledge representations, Language patterns, Tools for knowledge acquisition.

Text Books

1. John F. Sowa, Thomson Learning "Knowledge Representation logical, Philosophical, and Computational Foundations", Course Technology Inc. publication, 1999.
2. Ronald J. Brachman, Hector J. Levesque, "Knowledge Representation and Reasoning", Morgan Kaufmann; 1st edition, 2004.
3. Eileen Cornell Way "Knowledge Representation and Metaphor" Springer; 1st edition, 1991.

Reference Books

1. Trevor Bench-Capon, "Knowledge representation: an approach to artificial intelligence", Academic Press, 2014.
2. Yulia Kahl, Michael Gelfond "Knowledge Representation, Reasoning, and the Design of Intelligent Agents The Answer-Set Programming Approach", Cambridge University Press; 1st edition, 2014.
3. Arthur B. Markman, "Knowledge representation" Psychology Press; 1st edition, 1998.
4. Sanida Omerović, Grega Jakus, V. Milutinovic, Sašo Tomažič "Concepts, Ontologies, and Knowledge Representation" Springer; 2013.
5. Bernhard Nebel, Gerhard Lakemeyer "Foundations of Knowledge Representation and Reasoning" Springer, 1994.

Web References

1. https://www.javatpoint.com/knowledge-representation-in-ai
2. https://nptel.ac.in/courses/106/106/106106140/
3. https://www.youtube.com/watch?v=kXlr6ydiPAQ

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2	2	1	2	-	-	-	-	-	-	-	1	-	-
2	2	2	2	2	2	-	-	-	-	-	-	-	1	-	-
3	1	2	1	2	2	-	-	-	-	-	-	-	-	-	-
4	1	2	1	2	1	-	-	-	-	-	-	-	-	-	-
5	2	1	2	1	2	-	-	2	-	-	-	-	-	-	-

U20ADO402	INTRODUCTION TO DATA SCIENCE (Common to EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To learn the basics of data science
- To enable the students to understand the statistics and probability.
- To understand the tools in developing and visualizing data.
- To gain good knowledge in the application areas of data science.
- To inculcate the perceiving, ethics surrounding privacy and acting of data science applications.

Course Outcomes

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

CO1 - Explore the fundamental concepts of data science. **(K2)**
CO2 - To understand the Mathematical Knowledge for Data Science. **(K2)**
CO3 - Visualize and present the inference using various tools. **(K3)**
CO4 - To expose the different opportunities in Industries. **(K3)**
CO5 - Learn to think through the ethics surrounding privacy, data sharing and decision-making. **(K2)**

UNIT I INTRODUCTION TO DATA SCIENCE **(9 Hrs)**

Definition – Big Data and Data Science Hype – Why data science – Getting Past the Hype – The Current Landscape – Who is Data Scientist - Data Science Process Overview – Defining goals – Retrieving data – Data preparation – Data exploration – Data modeling – Presentation.

UNIT II MATHEMATICAL PRELIMINARIES **(9 Hrs)**

Probability: Probability vs. Statistics – Compound Events and Independence – Conditional Probability – Probability Distribution. Descriptive Statistics: Centrality Measures – Variability Measures - Interpreting Variance – Characterizing Distributions. Correlation Analysis: Correlation Coefficient – The Power and Significance – Detection Periodicities.

UNIT III DATA SCIENCE TOOLS **(9 Hrs)**

Introduction to Data Science Tool – Data Cleaning Tools – Data Munging and Modelling Tools – Data Visualization Tools – Tools for Data Science.

UNIT IV INDUSTRIALIZATION, OPPORTUNITIES AND APPLICATIONS **(9 Hrs)**

Data Economy and Industrialization – Introduction: Data Economy, Data Industry, Data Services – Data Science Application: Introduction, General Application Guidance - Different Domain – Advertising – Aerospace and Astronomy – Arts, Creative Design and Humanities – Bioinformatics – Consulting Services – Ecology and Environment – Ecommerce and Retail - Education – Engineering – Finance and Economy – Gaming.

UNIT V ETHICS AND RECENT TRENDS **(9 Hrs)**

Data Science Ethics – Doing good data science – Owners of the data - Valuing different aspects of privacy - Getting informed consent - The Five Cs – Diversity – Inclusion – Future Trends.

Text Books

1. Davy Cielen, Arno D. B. Meysman, Mohamed Ali, "Introducing Data Science", Manning Publications Co., 1st edition, 2016.
2. Chirag Shah, "A Hands on Introduction to Data Science", Cambridge University Press, 2020.
3. SinanOzdemir, "Principles of Data Science", Packt Publication, 2016.
4. D J Patil, Hilary Mason, Mike Loukides, "Ethics and Data Science", O' Reilly, 1st edition, 2018.

Reference Books

1. Hector Guerrero, "Excel Data Analysis: Modeling and Simulation", Springer International Publishing, 2nd Edition, 2019.
2. Paul Curzon, Peter W. Mc Owan, "The Power of Computational Thinking", World Scientific Publishing, 2017.
3. Steven S. Skiena, "Data Science Design Manual", Spring International Publication, 2017.
4. Rajendra Akerkar, Priti Srinivas Sajja, "Intelligence Techniques for Data Science", Spring International Publication, 2016.

5. Longbing Cao "Data Science Thinking: The Next Scientific, Technological and Economic Revolution", Spring International Publication, 2018.

Web References

1. https://www.youtube.com/watch?v=-ETQ97mXXF0&ab_channel=edureka%21
2. https://www.javatpoint.com/data-science
3. https://www.coursera.org/browse/data-science /

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COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
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1	1	2	2	2	2	-	-	-	-	-	-	-	-	-	-
2	2	2	2	1	1	-	-	-	-	-	-	-	-	-	-
3	2	1	2	2	1	-	-	-	-	-	-	-	-	1	-
4	1	2	2	1	1	-	-	-	-	-	-	-	-	-	-
5	2	1	1	2	1	-	-	1	-	-	-	-	-	1	-

		L	T	P	C	Hrs
U20ADOX03	**PRINCIPLE OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING** (Common to EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE)	3	0	0	3	45

Course Objectives

- To understand basic principles of Artificial Intelligence
- To learn and design Knowledge representation
- To understand the concept of reasoning
- To master the fundamentals of machine learning, mathematical framework and learning algorithms
- To understand the reinforcement and statistical learning.

Course Outcomes

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

CO1 - Understand foundational principles of artificial intelligence. **(K2)**
CO2 - Understand formal methods of knowledge representation. **(K2)**
CO3 - Understand the fundamental issues and challenges of Reasoning. **(K2)**
CO4 - Analyze the underlying mathematical relationships with Machine Learning algorithms. **(K3)**
CO5 - Apply various models for Artificial Intelligence programming techniques. **(K4)**

UNIT I INTRODUCTION **(9 Hrs)**

Introduction to Artificial Intelligence - Artificial Intelligence Problems -Timelines of Artificial Intelligence - Production Systems - State Space Representation - Branches of Artificial Intelligence - Application of Artificial Intelligence.

UNIT II KNOWLEDGE REPRESENTATION **(9 Hrs)**

Knowledge Management - Types of Knowledge - Knowledge representation - Approaches to Knowledge representation - Issues in Knowledge representation - Knowledge base. First order Logic – Frames — Conceptual Dependency.

UNIT III REASONING **(9 Hrs)**

Types of reasoning - reasoning with Fuzzy Logic - Rule based Reasoning - Diagnosis Reasoning.

UNIT IV LEARNING **(9 Hrs)**

Types of Learning - Machine Learning - Intelligent agents - Association Learning: Apriori Algorithm - Case Study: Customer Sequence and SCADA Application – k-Means Clustering - Fuzzy Clustering - Cluster Similarity

UNIT V REINFORCEMENT AND STATISTICAL LEARNING **(9 Hrs)**

Markov Decision Problem - Hidden Markov Model - Linear Classifier - decision Trees: Random forest - Bayesian Network – ANN - ANN Learning process - Types of Network – Perceptron - RBF Network - Case studies: Character recognition.

Text Books

1. Anand Hareendran S., Anand Hareendran, And Vinod Chandra S.S. "Artificial Intelligence and Machine Learning" PHI Publication, 2014.
2. Tom M. Mitchell, "Machine Learning", McGraw-Hill Science, 1997.
3. Peter Harrington, "Machine Learning in action", Manning Publication, 2012.

Reference Books

1. Charu C. Aggarwal "Data Classification Algorithms and Applications", Chapman & Hall/CRC Data Mining and Knowledge Discovery Series.
2. Andreas C. Mueller and Sarah Guido, "Introduction to Machine Learning with Python", O'Reilly Media, Inc. First Edition, 2016.
3. Eremy Watt, Reza Borhani, and Aggelos K. Katsaggelos "Machine Learning Refined Foundations, Algorithms, and Applications", Cambridge University Press, 2016.
4. Shai Shalev-Shwartz and Shai Ben-David, "Understanding Machine Learning: From Theory to Algorithms", Cambridge University Press, 2014.

Web Resources

1. https://www.coursera.org/learn/machine-learning
2. https://ml-cheatsheet.readthedocs.io/en/latest/regression_algos.html
3. https://machinelearningmastery.com/a-tour-of-machine-learning-algorithms

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2	1	2	2	–	–	-	-	-	-	-	-	-	1	1	-
3	2	2	1	2	–	-	-	-	-	-	-	-	-	1	1
4	3	2	2	2	1	-	-	-	-	-	-	-	1	-	1
5	2	2	2	2	1	-	-	-	-	-	-	-	1	1	2

		L	T	P	C	Hrs
U20ADOX04	**DATA SCIENCE APPLICATION OF VISION** (Common to EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics)	3	0	0	3	45

Course Objectives

- To understand the capability of a machine to get and analyze visual information and makedecisions
- To learn methods and algorithms for Vision
- To learn how to use deep learning for Vision tasks
- To understand the neural network concepts
- To study the real world applications using computer vision

Course Outcomes

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

CO1 - Understand the methods and algorithms for image processing. **(K2)**
CO2 - Apply object detection and segmentation concepts for image processing. **(K4)**
CO3 - Apply scalable algorithms for large datasets in vision. **(K4)**
CO4 - Analyze deep learning and neural network architectures for image and video processing. **(K3)**
CO5 - Apply vision-based solutions for specific real-world applications. **(K4)**

UNIT I IMAGE FUNDAMENTALS **(9 Hrs)**

Pixels - The Building Blocks of Images - The Image Coordinate System - RGB and BGR Ordering - Scaling and Aspect Ratios. Image filters - Gaussian blur - Median filter - Dilation and erosion - Custom filters - Image thresholding - Edge detection - Sobel edge detector - Canny edge detector.

UNIT II OBJECT DETECTION AND SEGMENTATION **(9 Hrs)**

Image Features - Harris corner detection - Local Binary Patterns - Image stitching - Segmentation: Contour detection - The Watershed algorithm - Super pixels - Normalized graph cut.

UNIT III MACHINE LEARNING WITH COMPUTER VISION **(9 Hrs)**

Data pre-processing - Image translation through random cropping - Image rotation and scaling - Applications of machine learning for computer vision - Logistic regression - Support vector machines - K-means clustering.

UNIT IV IMAGE CLASSIFICATION USING NEURAL NETWORKS **(9 Hrs)**

Image Classification Basics Types of Learning - The Deep Learning Classification Pipeline - Introduction to Neural Networks - The Perceptron Algorithm - Backpropagation and Multi-layer Networks - The Four Ingredients in a Neural Network Recipe - Weight Initialization - Constant Initialization - Uniform and Normal Distributions - LeCun Uniform and Normal - Understanding Convolutions - CNN Building Blocks - Common Architectures and Training Patterns.

UNIT V COMPUTER VISION AS A SERVICE **(9 Hrs)**

Computer vision as a service – architecture - Developing a server-client model - Computer vision engine.

Text Books

1. Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", Third Edition, Pearson Education, 2009.
2. Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis and Machine Vision", Third Edition, Cengage Learning, 2007.
3. Gary Bradski, "Learning OpenCV", First Edition, 2008.

Reference Books

1. Alok Kumar Singh Kushwaha, Rajeev Srivastava, "Recognition of Humans and Their Activitiesfor Video Surveillance", IGI Global, 2014.
2. Ying-li Tian, Arun Hampapur, Lisa Brown, Rogerio Feris, Max Lu, Andrew Senior, " Event Detection, Query, and Retrieval for Video Surveillance", IGI Global, 2009.
3. Matthew Turk, Gang Hua, "Vision-based Interaction", First Edition, Morgan Claypool, 2013.
4. Ian Goodfellow, Yoshuo Bengio, Aaron Courville, "Deep Learning (Adaptive Computation andMachine Learning series)", MIT Press, 2017.
5. Fan Jiang, "Anomalous Event Detection from Surveillance Video", ProQuest, 2012.

Web Resources

1. https://www.kaggle.com/learn/computer-vision
2. https://machinelearningmastery.com/what-is-computer-vision/
3. https://www.udemy.com/course/pythoncv/
4. https://www.analyticsvidhya.com/blog/2019/03/opencv-functions-computer-vision-python/
5. https://www.youtube.com/watch?v=N81PCpADwKQ&ab_channel=ProgrammingKnowledge

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2	2	1	1	2	–	-	-	-	-	-	-	-	1	1	1
3	2	2	2	1	–	-	-	-	-	-	-	-	-	-	1
4	1	2	2	2	1	-	-	-	-	-	-	-	1	2	-
5	2	1	2	2	1	-	-	-	-	-	-	-	1	1	1

		L	T	P	C	Hrs
U20ADO705	**DATA SCIENCE APPLICATION OF NLP** (Common to EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics)	3	0	0	3	45

Course Objectives

- To introduce the fundamental concepts and techniques of Natural language Processing(NLP)
- To analyzing words based on Text processing.
- To analyzing words based on Morphology.
- To examine the syntax and language modeling
- To get acquainted with syntax and semantics

Course Outcomes

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

CO1 - Understand the principles and process the Human Languages such as English using computers. **(K2)**
CO2 - Creating CORPUS linguistics based on digestive approach (Text Corpus method). **(K2)**
CO3 - Demonstrate the techniques for text-based Processing of NLP with respect to morphology. **(K4)**
CO4 - Perform POS tagging for a given natural language. **(K3)**
CO5 - Check the syntactic and semantic correctness of sentences using grammars and labelling. **(K3)**

UNIT I INTRODUCTION TO NLP **(9 Hrs)**

Introduction to various levels of natural language processing, Ambiguities and computational challenges in processing various natural languages. Introduction to Real life applications of NLP such as spell and grammar checkers, information extraction, and machine translation.

UNIT II TEXT PROCESSING **(9 Hrs)**

Character Encoding, Word Segmentation, Sentence Segmentation, Introduction to Corpora, Corpora Analysis.

UNIT III MORPHOLOGY **(9 Hrs)**

Inflectional and Derivation Morphology, Morphological Analysis and Generation using finite state transducers.

UNIT IV LEXICAL SYNTAX AND LANGUAGE MODELING **(9 Hrs)**

Introduction to word types, POS Tagging, Maximum Entropy Models for POS tagging, Multi-word Expressions- The role of language models. Simple N-gram models. Estimating parameters and smoothing. Evaluating language models.

UNIT V SYNTAX AND SEMANTICS **(9 Hrs)**

Introduction to phrases, clauses and sentence structure, Shallow Parsing and Chunking, Shallow Parsing with Conditional Random Fields (CRF), Lexical Semantics, Word Sense. Disambiguation, WordNet, Thematic Roles, Semantic Role Labelling with CRFs. Applications of NLP.

Text Books

1. Dan Jurafsky, James H. Martin, "Speech and Language Processing", Third Edition, Prentice Hall, 2018.
2. Emily Bender, "Linguistics Fundamentals for NLP", Morgan Claypool Publishers, 2013.
3. Jacob Eisenstein, "Introduction to Natural Language Processing", MIT Press, 2019.

Reference Books

1. Chris Manning, Hinrich Schuetze, "Foundations of Statistical Natural Language Processing", MIT Press, 1999.
2. Cole Howard, Hobson Lane, Hannes Hapke, "Natural Language Processing in Action" Manning Publication 2019.
3. Li Deng, Yang Liu "Deep Learning in Natural Language Processing" Springer, 2018.
4. Tom Hoobyar, Tom Dotz, Susan Sanders, "NLP The Essential Guide to Neuro-Linguistic Programming", William Morrow Paperbacks, 2013.
5. Kate Burton, "Coaching With NLP For Dummies", Wiley, 2011.

Web Resources

1. https://machinelearningmastery.com/natural-language-processing/
2. https://towardsdatascience.com/your-guide-to-natural-language-processing-nlp-48ea2511f6e1

3. https://www.nlp.com/what-is-nlp/

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1	2	2	2	–	1	-	-	-	-	-	-	-	2	1	-
2	2	2	1	–	–	-	-	-	-	-	-	-	1	1	1
3	2	2	1	2	–	-	-	-	-	-	-	-	-	1	1
4	1	2	2	2	1	-	-	-	-	-	-	-	1	-	2
5	2	1	2	2	1	-	-	-	-	-	-	-	1	1	1

U20ADO706	ARTIFICIAL INTELLIGENCE APPLICATIONS (Common to EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To study the basic design concept of AI.
- To understand the Machine learning concepts.
- To learn the concept of Deep learning and its applications
- To learn the concept of RPA.
- To acquire the skill to design a chatbot using NLP.

Course Outcomes

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

CO1 - Apply the concept of data science. **(K4)**

CO2 - Understand the concept of Machine learning. **(K2)**

CO3 - Understand the concept of Deep Learning. **(K2)**

CO4 - Apply the design ideas in RPA. **(K4)**

CO5 - Make use of NLP concepts to create chatbot. **(K3)**

UNIT I INTRODUCTION **(9 Hrs)**

Introduction – Alan Turing and Turing test - The rise and fall of expert system - technological drivers of modern AI - Structure of AI - Data: types of Data - Big Data - Database and other tools - Data Process - Ethics and Governance - Data terms.

UNIT II MACHINE LEARNING **(9 Hrs)**

Machine learning - Standard deviation - the normal distribution - Naive Bayes Classifier - K-Nearest Neighbor - Linear regression - K-Means Clustering.

UNIT III DEEP LEARNING **(9 Hrs)**

Deep Learning - Difference between Deep Learning and Machine learning – ANN – Backpropagation – RNN – CNN – GAN - Deep Learning Applications - Use Case: detecting Alzheimer's Disease - Deep Learning Hardware - When to use Deep Leaning? - Drawbacks of deep learning.

UNIT IV ROBOTIC PROCESS AUTOMATION **(9 Hrs)**

RPA - pros and cons of RPA - Determine the right function to automate - assess the processes - RAP and AI - RPA in the real world.

UNIT V NATURAL LANGUAGE PROCESSING **(9 Hrs)**

Challenges of NLP - Understanding How AI translated Language - NLP in real World - Voice Commerce - Virtual assistants – Chatbot - Future of NLP - The Future of AI.

Text Books

1. Daniel Jurafsky, James H. Martin, "Speech and Language Processing" Third Edition. 2000.
2. S. Kanimozhi Suguna, M. Dhivya, Sara Paiva, "Artificial Intelligence (AI) Recent Trends and Applications" CRC Press, 2021.
3. Navin Sabharwal; Amit Agrawal, "Cognitive Virtual Assistants Using Google Dialogflow" Apress, 2020.

Reference Books

1. Durkin, J., "Expert systems Design and Development", Macmillan, 1994.
2. Peter Jackson, "Introduction to Expert Systems", Addison Wesley Longman, 1999.
3. Amir Shevat," Designing Bots: Creating Conversational Experiences" O'Reilly, 2017.
4. Anik Das and Rashid Khan,"Build Better Chatbots: A Complete Guide to Getting Started with Chatbots" Apress,2017.
5. Akhil Mittal "Getting Started with Chatbots: Learn and create your own chatbot with deep understanding of Artificial Intelligence and Machine Learning" BPB Publications,2019

Web Resources

1. https://www.javatpoint.com/application-of-ai
2. https://pytorch.org/tutorials/beginner/chatbot_tutorial.html

3. https://www.mygreatlearning.com/blog/basics-of-building-an-artificial-intelligence-chatbot/
4. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-034-artificial-intelligence-fall-2010/lecture-videos/lecture-3-reasoning-goal-trees-and-rule-based-expert-systems/
5. http://www.umsl.edu/~joshik/msis480/chapt11.htm

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	2	1	1	-	-	-	-	-	-	-	-	1	2
2	2	1	1	1	2	-	-	-	-	-	-	-	1	1	1
3	2	2	1	2	2	-	-	-	-	-	-	-	-	1	1
4	1	2	2	2	1	-	-	-	-	-	-	-	2	-	1
5	2	2	2	2	1	-	-	-	-	-	-	-	1	1	-

U19ECO41	ENGINEERING COMPUTATION WITH MATLAB	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand basic representation of Matrices and vectors in MATLAB
- To learn various programming structures in MATLAB
- To study built in and user defined functions in MATLAB.
- To become conversant with 2D as well as 3D graphics in MATLAB
- To make a Graphical User Interface (GUI) in MATLAB in order to achieve interactivity

Course Outcomes

After completion of the course, students will be able to

CO1 - State the basics of MATLAB **(K1)**

CO2 - Explain how to work with matrices, and their operations **(K2)**

CO3 –Use the MATLAB functions relevant to communication engineering, **(K3)**

CO4 –Demonstrates various file operations in MATLAB **(K3)**

CO5 - Applying the plotting capabilities of MATLAB effectively to various systems. **(K3)**

UNIT I INTRODUCTION TO MATLAB **(9Hrs)**

Menus & Tool bars, Variables - Matrices and Vectors - initializing vectors - Data types- Functions – User defined functions - passing arguments - writing data to a file-reading data from a file - using functions with vectors and matrices- cell arrays & structures - Strings - 2D strings-String comparing - Concatenation - Input and Output statements - Script files .

UNIT II LOOPS & CONTROL STATEMENTS **(9Hrs)**

Introduction; Relational & Logical operations - Example programs - Operator precedence - Control & Decision statements- IF - IF ELSE - NESTED IF ELSE - SWITCH - TRY & CATCH - FOR -WHILE - NESTED FOR - FOR with IF statements, MATLAB program organization, Debugging methods - Error trapping using eval&lastern commands.

UNIT III PLOTS IN MATLAB & GUI **(9Hrs)**

Basic 2D plots, Labels, Line style, Markers, plot, subplot, LOG, LOG-LOG, SEMILOG-POLARCOMET, Grid axis, labeling, fplot, ezplot, ezpolar, polyval, exporting figures, HOLD, STEM, BAR, HIST, Interactive plotting, Basic Fitting Interface – Polyfit - 3D plots – Mesh - Contour - Example programs. GUI - Creation Fundamentals – Capturing mouse actions

UNIT IV MISCELLANEOUS TOPICS **(9 Hrs)**

File & Directory management - Native Data Files - Data import & Export - Low Level File I/O – Directory management - FTP File Operations - Time Computations -Date & Time – Format Conversions - Date & Time, Functions - Plot labels - Optimization - zero Finding - Minimization in one Dimension - Minimization in Higher Dimensions- Practical Issues. Differentiation & Integration using MATLAB, 1D & 2D Data Interpolation

UNIT V SIMULINK & APPLICATIONS **(9Hrs)**

How to create & run Simulink, Simulink Designing - Using SIMULINK Generating an AM signal & 2nd order systems - Designing of FWR & HWR using Simulink - Creating a subsystem in Simulink. Applications Programs -Frequency response of filters. Open Loop gain of OPAMP, I/P characteristics of BJT, Plotting the graph between Breakdown voltage & Doping Concentration.

Text Books

1. RudraPratap, Getting Started with MATLAB 6.0, 1st Edition, Oxford University Press-2004.
2. Duane Hanselman ,Bruce LittleField, "Mastering MATLAB 7", Pearson Education Inc, 2005
3. William J.Palm, "Introduction to MATLAB 6.0 for Engineers", McGraw Hill & Co, 2001.

Reference Books

1. M.Herniter, "Programming in MATLAB", Thomson Learning, 2001
2. John OkyereAltla, "Electronics and circuit analysis using MATLAB", CRC press, 1999
3. K.K.Sharma, "MATLAB Demustifyied", Vikas Publishing House Pvt Ltd. 2004

Web References

1. https://www.mathworks.com/products/matlab.html
2. https://www.tutorialspoint.com/matlab/index.htm
3. https://www.cmu.edu/computing/software/all/matlab/
4. https://ctms.engin.umich.edu/CTMS/index.php?aux=Home

COs Mapping with POs and PSOs

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	-	2	3	-	-	-	-	-	-	-	2	1	2
CO2	2	2	-	2	3	-	-	-	-	-	-	-	2	1	2
CO3	2	2	-	2	3	-	-	-	-	-	-	-	2	1	2
CO4	2	2	-	2	3	-	-	-	-	-	-	-	2	1	2
CO5	2	2	-	2	3	-	-	-	-	-	-	-	2	1	2

U20ICO401	SENSORS AND TRANSDUCERS (Artificial Intelligence and Data Science)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- Get to know the methods of measurement, classification of transducers and to analyze error.
- Get exposed to different types of resistive transducers and their application areas
- To acquire knowledge on capacitive and inductive transducers.
- To gain knowledge on variety of transducers
- To introduce about advancements in sensor technology.

Course Outcomes

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

CO1 - Understand the concepts of classification of Transducers. **(K2)**
CO2 - Familiar with the working of resistance Transducer. **(K3)**
CO3 - Familiar with the principle and working of various Inductive and Capacitive transducer. **(K1)**
CO4 - Able to design signal conditioning circuit for various transducers **(K3)**
CO5 - Able to identify or choose a transducer for a specific measurement application. **(K4)**

UNIT I CLASSIFICATION OF TRANSDUCERS **(9 Hrs)**

General concepts and terminology of measurement systems, transducer classification, general input-output configuration, static and dynamic characteristics of a measurement system, Statistical analysis of measurement data.

UNIT II RESISTANCE TRANSDUCERS **(9 Hrs)**

Resistive transducers: Potentiometers, metal and semiconductor strain gauges and signal conditioning circuits, strain gauge applications: Load and torque measurement, Digital displacement sensors.

UNIT III INDUCTIVE AND CAPACITIVE TRANSDUCERS **(9 Hrs)**

Transducers: – Principle of operation, construction details, characteristics and applications of LVDT, Induction potentiometer – Variable reluctance transducers – Synchros – Microsyn – Principle of operation, construction details, characteristics of capacitive transducers – Different types & Signal Conditioning – Applications:- Capacitor microphone, Capacitive pressure sensor, Proximity sensor.

UNIT IV OTHER TRANSDUCERS **(9 Hrs)**

Piezoelectric transducers and their signal conditioning, Seismic transducer and its dynamic response, photoelectric transducers, Hall effect sensors, Magnetostrictive transducers. Eddy current transducers. Hall effect transducers – Optical sensors, IC sensor for temperature – signal conditioning circuits, Introduction to Fiber optic sensors – Temperature, pressure, flow and level measurement using fiber optic sensors

UNIT V SMART TRANSDUCER **(9 Hrs)**

Introduction to semiconductor sensor, materials, scaling issues and basics of micro fabrication. Smart sensors,Intelligent sensor, Mems Sensor, Nano-sensors, SQUID Sensors,- Environmental Monitoring sensors

Text Books

1. Doebelin E.O. and Manik D.N., "Measurement Systems", 6th Edition, McGraw-Hill Education Pvt. Ltd., 2011.
2. Neubert H.K.P., Instrument Transducers – An Introduction to their Performance and Design, Oxford University Press, Cambridge, 2003.
3. Neubert H.K.P., Instrument Transducers – An Introduction to their Performance and Design Clarendon, Oxford2nd edition JacobFraden - 2010
4. DoeblinE..O. "Measurement System Applications and Design", TMH, 5th Edition, 2004

Reference Books

1. BelaG. Liptak, Instrument Engineers' Handbook, Process Measurement and Analysis, 4th Edition, Vol.1 ISA/CRC Press, 2003.
2. BelaG. Liptak, Instrument Engineers' Handbook, Process Measurement and Analysis, 4th edition, Vol.2 ASME PTC ,2018
3. D. Patranabis, Sensors and Transducers, 2nd edition, Prentice Hall of India, 2010. E.A.
4. John P. Bentley, Principles of Measurement Systems, III Edition, Pearson Education, 2000.

Web References

1. www.electrical4u.com
2. https://nptel.ac.in/courses/108108147/
3. https://www.youtube.com/watch?v=1uPTyjxZzyo

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	-	2	-	-	1	2	-	-	-	2	-	-	-	1
2	2	-	3	-	-	1	2	-	-	-	2	-	-	-	1
3	2	-	2	-	-	1	2	-	-	-	2	-	-	-	1
4	2	-	3	-	-	1	2	-	-	-	-	-	-	-	1
5	2	-	3	-	2	2	3	-	-	-	2	-	-	-	1

U20ICO402	CONTROL SYSTEM ENGINEERING	L	T	P	C	Hrs
	(Artificial Intelligence and Data Science)	3	0	0	3	45

Course Objectives

- To understand the use of transfer function models for analysis physical systems and introduce the control system components.
- To provide adequate knowledge in the time response of systems and steady state error analysis
- To accord basic knowledge in obtaining the open loop and closed–loop frequency responses of systems
- To introduce stability analysis of control systems.
- To introduce compensation technique.

Course Outcomes

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

CO1 - Categorize different types of system and identify a set of algebraic equations to represent and model a complicated system into a more simplified form. **(K2)**

CO2 - Perform time domain analysis of various models of linear system **(K3)**

CO3 - Do frequency domain analysis of various models of linear system **(K4)**

CO4 - Determine and analyse the stability of the system **(K4)**

CO5 - Design the compensation technique that can be used to stabilize control systems. **(K3)**

UNIT I SYSTEM CONCEPTS **(9 Hrs)**

Types of system – open loop systems, closed loop systems, Basic elements in control system – Mathematical models of physical system: Differential equation- transfer functions of simple electrical networks – D.C and A.C servo motor – Mechanical system- Translational and Rotational system – Block diagram reduction techniques – Signal flow graphs.

UNIT II TIME RESPONSE ANALYSIS **(9 Hrs)**

Standard test signals -Time response of first and second order system, Time domain- specifications- Generalized error series – Steady state error and error constants

UNITIII FREQUENCY RESPONSE ANALYSIS **(9 Hrs)**

Frequency response of the system – Correlation between time and frequency response – Gain and Phase margin – Bode plot, Polar Plot.

UNIT IV STABILITY ANALYSIS **(9 Hrs)**

Characteristics equation – Location of roots in S plane for stability – Routh Hurwitz criterion – Root locus construction – Nyquist stability criterion.

UNIT V COMPENSATION NETWORKS **(9 Hrs)**

Introduction to compensation networks - Lag, Lead and Lag Lead networks - Effect of providing Lag, Lead and Lag-Lead compensation on system performance and design using bode plot

Text Books

1. Nagrath I J and Gopal M, Control System Engineering, New Age International Pvt Ltd, Sixth Edition, 2017

2. Ogata K, —Modern Control Engineering‖, Prentice-Hall of India Pvt Ltd., New Delhi, Fifth Edition, 2015.

Reference Books

1. Norman S Nise, Control System Engineering , John Wiley and sons, inc., Seventh Edition, 2015
2. Benjamin C Kuo, —Automatic Control Systems‖, Prentice Hall India Pvt. Ltd, Ninth Edition, 2015
3. Smarajith Ghosh, —Control Systems Theory and Applications‖, Pearson Education, Singapore, Sixth Edition, 2015
4. Richard C. Dorf, Robert H Bishop, —Modern Control Systems‖, Pearson Education, Twelfth Edition, 2017

Web References

1. https://lecturenotes.in/notes/6579-note-for-control-system-engineering-cse-by-gyana-ranjan-biswal
2. https://www.smartzworld.com/notes/control-systems-pdf-notes-cs/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	-	2	2	1	-	-	1	1	1	2	-	-	-
2	2	3	2	2	1	2	1	1	1	1	1	2	-	-	-
3	2	2	1	2	2	1	1	-	-	1	-	1	-	-	-
4	2	2	1	2	2	1	1	-	-	1	-	1	-	-	-
5	3	3	2	2	2	1	1	-	1	-	1	2	-	-	-

		L	T	P	C	Hrs
U20BMO401	**MEDICAL ELECTRONICS** (Common to EEE, ECE, CSE, IT, ICE, CCE, MECH, Mechatronics, AI&DS)	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To gain knowledge about the various physiological parameters measurements
- To understand the various biochemical and nonelectrical sensors
- To study about the assist devices
- To gain knowledge on surgical equipments and telemetry in healthcare
- To understand the concepts of recent advancements in healthcare

Course Outcomes

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

CO1 - Explain the electro- physiological parameters and bio-potentials recording **(K2)**
CO2 - Measure the biochemical and non-electrical physiological parameters **(K2)**
CO3 - Interpret the various assist devices used in the hospitals **(K3)**
CO4 - Identify physical medicine methods and biotelemetry **(K3)**
CO5 - Analyse recent trends in medical instrumentation **(K3)**

UNIT I ELECTRO-PHYSIOLOGY AND BIO-POTENTIAL RECORDING (9 Hrs)

Sources of bio medical signals, Bio-potentials, Bio potential electrodes, biological amplifiers, ECG, EEG, EMG, PCG, typical waveforms and signal characteristics

UNIT II BIO-CHEMICAL AND NON ELECTRICAL PARAMETER MEASUREMENT (9 Hrs)

pH, PO2, PCO2, Colorimeter, Blood flow meter, Cardiac output, respiratory, blood pressure, temperature and pulse measurement, Blood Cell Counters.

UNIT III ASSIST DEVICES (9 Hrs)

Artificial kidney, Dialysis action, hemodialyser unit, membrane dialysis, portable dialyser monitoring and functional parameters, Heart-Lung Machine.

UNIT IV PHYSICAL MEDICINE AND BIOTELEMETRY (9 Hrs)

Diathermies - Shortwave, ultrasonic and microwave type and their applications, Surgical Diathermy, Biotelemetry - Single Channel and Multiple Channel.

UNIT V RECENT TRENDS IN MEDICAL INSTRUMENTATION (9 Hrs)

Telemedicine, Insulin Pumps, Radio pill, Endo-microscopy, Brain machine interface, Lab on a chip, Cryogenic Technique.

Text Books

1. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Prentice Hall of India, New Delhi, 2011.
2. Khandpur, R.S., "Handbook of Biomedical Instrumentation", TATA McGraw-Hill, New Delhi, 2017.
3. John G.Webster, "Medical Instrumentation Application and Design", Third Edition, Wiley India , 2012.

Reference Books

1. Joseph J.Carr and John M.Brown, "Introduction to Biomedical Equipment Technology", John Wiley and Sons, New York, 2011.
2. R.Anandanatarajan, "Biomedical Instrumentation and Measurements", Second Edition, PHI Learning, 2016.

3. Mandeep singh, "Introduction to Biomedical Instrumentation", Second Edition, Prentice Hall of India, New Delhi,2014
4. Shakti Chatterjee, Aubert Miller, "Biomedical Instrumentation Systems", Cengage Learning, 2012
5. C.Raja Rao, Sujoy K.Guha, " Principles of Medical Electronics and Biomedical Instrumentation", Universities Press, 2010

Web References

1. https://www.nap.edu/read/21794/chapter/7
2. https://www.embs.org/about-biomedical-engineering/our-areas-of-research/diagnostic-therapetic systems
3. https://nptel.ac.in/courses/127/106/127106136/
4. medicinenet.com/script/main/art.asp?articlekey=6414
5. https://www.verywellhealth.com/cardiopulmonary-bypass-machine-used-for-surgery-3157220

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	-	2	2	2	-	1	-	-	-	-	-	-	-
2	3	2	-	2	2	2	-	1	-	-	-	-	-	-	-
3	3	-	-	2	3	3	-	1	-	-	-	-	-	-	-
4	3	-	2	2	3	2	-	1	-	-	-	-	1	-	-
5	3	2	2	3	3	2	-	1	-	-	-	-	1	-	-

U20BMO402	TELEMEDICINE (Common to EEE, ECE, CSE, IT, ICE, CCE, AI&DS)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives:

- To understand the classification of telemetry.
- To gain knowledge about biotelemetry principles
- To know about the applications of telemetry in various fields
- To provide the idea about the value of telemedicine
- To know the various applications in telemedicine.

Course Outcomes:

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

CO1 - Categorize the telemetry systems **(K2)**
CO2 - Understand the principles of biotelemetry in transmission of biological signals **(K3)**
CO3 - Apply the various Biotelemetry applications for diagnostics **(K3)**
CO4 - Acquire clear idea about the fundamentals of telemedicine **(K2)**
CO5 - Know about various applications of telemedicine **(K3)**

UNIT I INTRODUCTION TO TELEMETRY **(9 Hrs)**

Basic system, Classification, Non electrical telemetry systems, Mechanical and Pneumatic type, Voltage and Current telemetry systems, Local transmitters and Converters, Frequency telemetry system, Power Line carrier communication (PLCC).

UNIT II BIOTELEMETRY **(9 Hrs)**

Radio Telemetry principles, FM, AM, PCM, Transmission of biological data through radio telemetry.

UNIT III APPLICATION OF BIOTELEMETRY **(9 Hrs)**

Wireless Telemetry - Single Channel and Multi-channel Telemetry systems, Multi Patient Telemetry, Implantable Telemetry Systems, Ambulatory patient monitoring.

UNIT IV FUNDAMENTALS OF TELEMEDICINE **(9 Hrs)**

History and advancements in telemedicine, Benefits of telemedicine, Functional Block of a telemedicine system, Use of computers in distance mode of healthcare delivery, Familiarizing with technology of telemedicine, scanner, electro stethoscope, data reception equipment, Scope for telemedicine, Limitations of telemedicine.

UNIT V APPLICATIONS OF TELEMEDICINE **(9 Hrs)**

Telemedicine in Neuroscience, Telecardiology, Telepathology, Telepediatrics, Telepharmacy, Telepsychiatry and mental health, Veterinary.

Text Books

1. Marilyn J. Field , "A Guide to Assessing Telecommunications in Health Care", Fourth Edition, Academy Press,2011.
2. Bashshur , R. L. , Sanders, J. H and Shannon, G, "Telemedicine: Theory and Practice", Eight Edition, Springer,2014.
3. Olga (EDT), Ferre Roca, M. Sosa, "Handbook of Telemedicine", Third Edition, IOS press 2009.

Reference Books

1. Bemmel, J.H. van, Musen, M.A. (Eds.), "Handbook of Medical Informatics", Second Edition, Springer, 2010.
2. Simpson, W, "Video over IP. A practical guide to technology and applications'", Ninth Edition, Focal Press, Elsevier, 2009.
3. Ferrer-Roca, O., Sosa-Iudicissa, , "Handbook of Telemedicine", IOS Press, 2012

4. Norris, A.C, "Essentials of Telemedicine and Telecare", Eight Edition, Wiley, 2017
5. Wotton, R., Craig, J., Patterson, V. (Eds.), "Introduction to Telemedicine", Fifth Edition, Royal Society of Medicine Press Ltd., 2014.

Web Resources

1. https://en.wikipedia.org/wiki/Biotelemetry
2. https://www.who.int/goe/publications/goe_telemedicine_2010.pdf
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5927731/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	-	-	-	2	1	-	1	-	2	-	-	1	-	-
2	3	2	-	-	2	1	-	1	-	2	-	-	1	-	-
3	3	2	3	2	2	1	-	1	-	2	-	-	1	-	-
4	3	2	-	2	2	1	-	1	-	2	-	-	1	-	-
5	3	2	3	2	2	1	-	1	-	2	-	-	1	-	-

SRI MANAKULA VINAYAGAR ENGINEERING COLLEGE

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B.TECH.

ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
ACADEMIC REGULATIONS 2020
(R-2020)

CURRICULUM AND SYLLABI

20 years of ACADEMIC EXCELLENCE

COLLEGE VISION AND MISSION

Vision

To be globally recognized for excellence in quality education, innovation and research for the transformation of lives to serve the society.

Mission

M1: Quality Education:

To provide comprehensive academic system that amalgamates the cutting edge technologies with best practices.

M2: Research and Innovation:

To foster value- based research and innovation in collaboration with industries and institutions globally for creating intellectuals with new avenues.

M3: Employability and Entrepreneurship:

To inculcate the employability and entrepreneurial skills through value and skill based training.

M4: Ethical Values:

To instill deep sense of human values by blending societal righteousness with academic professionalism for the growth of society.

DEPARTMENT VISION AND MISSION

Vision

Incorporating the Data Science skills and applying the acquired analytical knowledge in the heterogeneous domains through Artificial Intelligence

Mission

M1: Understand Data Science:

Amalgamation of Programming Knowledge, Mathematical Skill Set and Knowledge of Business Domains to face the challenges of the real world requirement

M2: Applying the Acquired Knowledge:

Inculcating the spirit of applying the acquired knowledge, innovation and creativity among students to work in heterogeneous domains

M3: Capstone Project:

Providing forum to carry out a capstone project through collaborations with the industries

M4: Be socially beneficial and other moral concerns:

Inspiring the educational experience in the field of application development and ensure the design, principle and ethic to be followed in the society.

M5: Continuous Learning for keen Initiative:

Affording continuous learning in the field of current trends in Artificial Intelligence and Data Science for keen initiative and enterprise focused.

PROGRAMME OUTCOMES (POs)

PO1: Engineering knowledge:

Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis:

Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions:

Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems:

Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage:

Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society:

Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability:

Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of and need for sustainable development.

PO8: Ethics:

Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work:

Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication:

Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance:

Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning:

Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Acquiring the data:

To create an essential knowledge for extracting data from heterogeneous domains.

PEO2: Information Inferring and Knowledge representation:

To equip the student with knowledge, through different programming skills and creating a knowledge representation for the inferred data, so that it can be applied in the real time scenario.

PEO3: Design method:

To enable the student as a Data Analyst by designing a right Machine Learning algorithm and seamless programming skill to solve any sort of application.

PEO4: Systematic Enhancement:

To provide them with a keen knowledge on current trends and to enhance its impact periodically on the existing applications to meet the future scenario.

PROGRAM SPECIFIC OBJECTIVES (PSOs)

PSO 1: Mathematical Foundation and Data Procuring:

To utilize the knowledge of Mathematical concept in procured Data from various Data sources.

PSO 2: Intellect Applications and Research Technologies:

To utilize the technical concepts, ideas, methodologies and the new emerging technologies in Artificial Intelligence and use this knowledge in their analytic skill to solving the current and future Data Analytics real time applications.

PSO 3: Developments of Real Time Applications:

To utilize the knowledge acquired and create a forum to carry out a capstone project through collaborations with the industries

STRUCTURE FOR UNDERGRADUATE ENGINEERING PROGRAM

Sl.No	Course Category	Breakdown of Credits
1	Humanities and Social Sciences (HS)	7
2	Basic Sciences(BS)	16
3	Engineering Sciences (ES)	35
4	Professional Core (PC)	67
5	Professional Electives (PE)	18
6	Open Electives (OE)	9
7	Project Work and Internship	12
8	Employability Enhancement Courses (EEC)	-
9	Mandatory courses (MC)	-
Total		**164**

SCHEME OF CREDIT DISTRIBUTION – SUMMARY

Sl.No	Course Category	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	Humanities and Social Sciences (HS)	-	-	1	1	-	3	1	1	07
2	Basic Sciences(BS)	3	3	4	3	3	-	-	-	16
3	Engineering Sciences (ES)	11	14	10	-	-	-	-	-	35
4	Professional Core (PC)	4	4	8	12	12	15	9	3	67
5	Professional Electives (PE)	-	-	-	3	3	3	3	6	18
6	Open Electives (OE)	-	-	-	3	3	-	3	-	9
7	Project Work (PW)	-	-	-	-	-	-	2	8	10
8	Internship (PW)	-	-	-	-	-	-	2	-	02
9	Employability Enhancement Courses (EEC)*	-	-	-	-	-	-	-	-	-
10	Mandatory Courses (MC)*	-	-	-	-	-	-	-	-	-
Total		**18**	**21**	**23**	**22**	**21**	**21**	**20**	**18**	**164**

** EEC and MC course Credits are not included for CGPA calculation

SEMESTER – I										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20BST101	Engineering Mathematics – I Calculus and Linear Algebra	BS	2	2	0	3	25	75	100
2	U20EST117	Basic Electrical and Electronics Engineering	ES	3	0	0	3	25	75	100
3	U20EST125	Digital System Design	ES	3	0	0	3	25	75	100
4	U20EST127	Computer Programming – I (Programming In C)	ES	3	0	0	3	25	75	100
5	U20ADT101	Fundamental of Data Science	PC	3	0	0	3	25	75	100
Practical										
6	U20ESP126	Digital System Design Laboratory	ES	0	0	2	1	50	50	100
7	U20ESP128	Computer Programming - I Laboratory (Programming in C)	ES	0	0	2	1	50	50	100
8	U20ADP101	Fundamental of Data Science Laboratory	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
9	U20ADC1XX	Certification Course-I	EEC	0	0	4	-	100	-	100
Mandatory Course										
10	U20ADM101	Induction Program	MC	-	-	-	-	-	-	-
							18	375	525	900

SEMESTER – II										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20BST215	Engineering Mathematics – II (Multiple Integrals and Transforms)	BS	2	2	0	3	25	75	100
2	U20EST243	Computer Programming – II (Programming in Python)	ES	3	0	0	3	25	75	100
3	U20EST245	Data Structure and Applications	ES	3	0	0	3	25	75	100
4	U20EST247	Object Oriented Programming	ES	3	0	0	3	25	75	100
5	U20EST248	Computer and Communication Networks	ES	3	0	0	3	25	75	100
6	U20ADT202	Database Management Systems	PC	3	0	0	3	25	75	100
Practical										
7	U20ESP244	Computer Programming – II Laboratory (Programming in Python)	ES	0	0	2	1	50	50	100
8	U20ESP246	Data Structure and Applications Laboratory	ES	0	0	2	1	50	50	100
9	U20ADP202	Database Management Systems Laboratory	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U20ADC2XX	Certification Course-II	EEC	0	0	4	-	100	-	100
11	U20ADS201	SDC 1*	EEC	0	0	2	-	100	-	100
Mandatory Course										
12	U20ADM202	Environmental Science	MC	2	0	0	-	100	-	100
							21	600	600	1200

**** Skill Development Courses (SDC 1) are to be selected from the list given in Annexure IV***

SEMESTER – III										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20BST337	Probability and Statistics for Data Science	BS	2	2	0	3	25	75	100
2	U20EST363	Software Engineering and Agile software Development	ES	3	0	0	3	25	75	100
3	U20EST364	Operating system Internals	ES	3	0	0	3	25	75	100
4	U20EST365	Algorithm Design and Analysis	ES	3	0	0	3	25	75	100
5	U20ADT303	Fundamentals of Artificial Intelligence	PC	3	0	0	3	25	75	100
6	U20ADT304	Basic Machine Learning Techniques	PC	2	2	0	3	25	75	100
Practical										
7	U20HSP301	General Proficiency – I	HS	0	0	2	1	100	0	100
8	U20BSP326	Statistical Laboratory	BS	0	0	2	1	50	50	100
9	U20ESP366	Algorithm Design and Analysis Laboratory	ES	0	0	2	1	50	50	100
10	U20ADP303	Artificial Intelligence Laboratory	PC	0	0	2	1	50	50	100
11	U20ADP304	Basic Machine Learning Techniques Laboratory	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
12	U20ADC3XX	Certification Course-III	EEC	0	0	4	-	100	-	100
13	U20ADS302	SDC 2*	EEC	0	0	2	-	100	-	100
Mandatory Course										
14	U20ADM303	Physical Education	MC	0	0	2	-	100	-	100
							23	750	650	1400

SEMESTER – IV										
Sl. No	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20BST432	Discrete Mathematics and Graph Theory	BS	2	2	0	3	25	75	100
2	U20ADT405	Data Visualization	PC	3	0	0	3	25	75	100
3	U20ADT406	Advanced Machine Learning Techniques	PC	2	2	0	3	25	75	100
4	U20ADT407	Expert system and Decision Making	PC	3	0	0	3	25	75	100
5	U20ADE4XX	Professional Elective - I	PE	3	0	0	3	25	75	100
6	U20XXO4XX	Open Elective - I	OE	3	0	0	3	25	75	100
Practical										
7	U20HSP402	General Proficiency – II	HS	0	0	2	1	100	0	100
8	U20ADP405	Data Visualization Laboratory	PC	0	0	2	1	50	50	100
9	U20ADP406	Advanced Machine Learning Techniques Laboratory	PC	0	0	2	1	50	50	100
10	U20ADP407	Expert system and Decision Making Laboratory	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
11	U20ADC4XX	Certification Course-IV	EEC	0	0	4	-	100	-	100
12	U20ADS403	SDC 3*	EEC	0	0	2	-	100	-	100
Mandatory Course										
13	U20ADM404	National Service Scheme	MC	0	0	2	-	100	-	100
							22	700	600	1300

** Skill Development Courses (SDC 2 and SDC 3) are to be selected from the list given in Annexure IV*

SEMESTER – V										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20BST551	Operational Research	BS	2	2	0	3	25	75	100
2	U20ADT508	Deep Learning	PC	2	2	0	3	25	75	100
3	U20ADT509	NLP and Chatbot	PC	3	0	0	3	25	75	100
4	U20ADT510	IoT Systems and Analytics	PC	3	0	0	3	25	75	100
5	U20ADE5XX	Professional Elective - II	PE	3	0	0	3	25	75	100
6	U20XXO5XX	Open Elective-II	OE	3	0	0	3	25	75	100
Practical										
7	U20ADP508	Deep Learning Laboratory	PC	0	0	2	1	50	50	100
8	U20ADP509	NLP and Chatbot Laboratory	PC	0	0	2	1	50	50	100
9	U20ADP510	IoT Systems and Analytics Laboratory	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U20ADC5XX	Certification Course-V	EEC	0	0	4	-	100	-	100
11	U20ADS504	Foreign Language/ IELTS	EEC	0	0	2	-	100	-	100
12	U20ADS505	Presentation Skills using ICT	EEC	0	0	2	-	100	-	100
Mandatory Course										
13	U20ADM505	Indian Constitution	MC	2	0	0	-	100	-	100
							21	600	600	1200

SEMESTER – VI										
Sl. No	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20ADT611	Data Science and its Application	PC	3	0	0	3	25	75	100
2	U20ADT612	AI and Automation	PC	3	0	0	3	25	75	100
3	U20ADT613	Robotic Process Automation – UI Path	PC	2	2	0	3	25	75	100
4	U20ADT614	Web Technology	PC	3	0	0	3	25	75	100
5	U20ADE6XX	Professional Elective - III	PE	3	0	0	3	25	75	100
6	U20XXO6XX	Open Elective - III	HS	3	0	0	3	25	75	100
Practical										
7	U20ADP611	Data Science and its Application Laboratory	PC	0	0	2	1	50	50	100
8	U20ADP612	AI and Automation Laboratory	PC	0	0	2	1	50	50	100
9	U20ADP613	Robotic Process Automation – UI Path Laboratory	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U20ADC6XX	Certification Course-VI	EEC	0	0	4	-	100	-	100
11	U20ADS606	Foreign Language/ IELTS	EEC	0	0	2	-	100	-	100
12	U20ADS607	Technical Seminar	EEC	0	0	2	-	100	-	100
13	U20ADS608	NPTEL / MOOC	EEC	-	-	-	-	100	-	100
Mandatory Course										
14	U20ADM606	Essence of Indian Traditional Knowledge	MC	2	0	0	-	100	-	100
							21	700	600	1300

SEMESTER – VII											
Sl. No	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20ADT715	Robotic and Automation	PC	3	0	0	3	25	75	100
2	U20ADT716	Big Data Tools and Techniques	PC	3	0	0	3	25	75	100
3	U20ADE7XX	Professional Elective – IV	PE	3	0	0	3	25	75	100
4	U20XXO7XX	Open Elective – IV	OE	3	0	0	3	25	75	100
Practical										
5	U20HSP703	Business Basics for Entrepreneur	HS	0	0	2	1	100	-	100
6	U20ADP714	Big Data Tools and Techniques Laboratory	PC	0	0	2	1	50	50	100
7	U20ADP715	Robotic and Automation Laboratory	PC	0	0	2	1	50	50	100
8	U20ADP716	Comprehensive Viva-Voce	PC	0	0	2	1	100	-	100
Project Work										
9	U20ADW701	Project Phase – I	PW	0	0	4	2	100	-	100
10	U20ADW702	Internship / Inplant Training	PW	0	0	0	2	100	-	100
Mandatory Course										
11	U20ADM707	Professional Ethics	MC	2	0	0	-	100	-	100
							20	700	400	1100

SEMESTER – VIII										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20ADT817	Block chain and Cryptography	PC	3	0	0	3	25	75	100
2	U20ADE8XX	Professional Elective – V	PE	3	0	0	3	25	75	100
3	U20ADE8XX	Professional Elective – VI	PE	3	0	0	3	25	75	100
Practical										
4	U20HSP804	Entrepreneurship Management	HS	0	0	2	1	100	-	100
Project Work										
5	U20ADW803	Project Phase – II	PW	0	0	16	8	40	60	100
Employability Enhancement Course										
6	U20ADS809	NPTEL / MOOC	MC	-	-	-	-	100	-	100
							18	355	245	600

ANNEXURE - I

PROFESSIONAL ELECTIVE COURSES (18 CREDITS)

Sl. No.	Course Code	Course Title
Professional Elective – I (Offered in Semester IV)		
1	U20ADE401	Automata and Compiler Design
2	U20ADE402	Principles of Data Analytics
3	U20ADE403	Soft Computing
4	U20ADE404	GPU Computing
5	U20ADE405	Microprocessors and Microcontrollers
Professional Elective – II (Offered in Semester V)		
1	U20ADE506	Big Data Analytics
2	U20ADE507	Exploratory Data Analysis
3	U20ADE508	Digital Image Processing
4	U20ADE509	Regression Analysis
5	U20ADE510	Web Technologies And Services
Professional Elective – III (Offered in Semester VI)		
1	U20ADE611	Text Analytics
2	U20ADE612	Social Network Analysis
3	U20ADE613	Natural Language & Text Mining
4	U20ADE614	Speech Recognition
5	U20ADE615	Mobile Application Development
Professional Elective – IV (Offered in Semester VII)		
1	U20ADE716	Image and Video Analytics
2	U20ADE717	Business Analytics
3	U20ADE718	Time Series Analysis and Forecasting
4	U20ADE719	Computer Vision
5	U20ADE720	Web Analytics And Development
Professional Elective – V (Offered in Semester VIII)		
1	U20ADE821	Bio-inspired Artificial Intelligence
2	U20ADE822	Recommender Systems
3	U20ADE823	Multivariate Analysis
4	U20ADE824	Multi-Agent Systems
5	U20ADE825	Scalable Computing-(Distributed computing, cloud computing and Big Data)
Professional Elective – VI (Offered in Semester VIII)		
1	U20ADE826	Data Security and Privacy
2	U20ADE827	Adhoc and Sensor Networks
3	U20ADE828	Compiler Design
4	U20ADE829	Mixed Reality
5	U20ADE830	Cyber Security and Laws

ANNEXURE - II

OPEN ELECTIVE COURSES (12 CREDITS)

S. No	Course Code	Course Title	Offering Department	Permitted Departments
Open Elective – I (Offered in Semester IV)				
1	U20EEO401	Solar Photovoltaic Fundamental and applications	EEE	ECE, ICE, MECH, CIVIL, Mechatronics, CCE
2	U20EEO402	Electrical Safety	EEE	ECE, ICE, MECH, CIVIL, Mechatronics, CCE, BME, IT, CSE, FT
3	U20ECO401	Engineering Computation with MATLAB	ECE	EEE, ICE, MECH, CIVIL, CCE, BME, AI&DS, Mechatronics
4	U20ECO402	Consumer Electronics	ECE	EEE, ICE, CSE, MECH, IT, CIVIL, CCE, BME, Mechatronics, FT
5	U20CSO401	Web Development	CSE	EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics
6	U20CSO402	Analysis of Algorithms	CSE	EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics
7	U20ITO401	Database System: Design & Development	IT	EEE, ECE, ICE, CCE, BME
8	U20ITO402	R programming	IT	EEE, ECE, ICE, CCE, BME, MECH, Mechatronics
9	U20ICO401	Sensors and Transducers	ICE	ECE, CSE, IT, MECH, CIVIL, CCE, AI&DS, FT
10	U20ICO402	Control System Engineering	ICE	CSE, IT, MECH, CCE, AI&DS
11	U20MEO401	Rapid Prototyping	MECH	EEE, ECE, ICE, CIVIL, BME, FT
12	U20MEO402	Material Handling System	MECH	EEE, ICE, CIVIL, Mechatronics
13	U20MEO403	Industrial Engineering for Textile	MECH	FT
14	U20CEO401	Energy and Environment	CIVIL	EEE, ECE, MECH, BME, IT, Mechatronics, FT
15	U20CEO402	Building Science and Engineering	CIVIL	EEE, MECH, BME
16	U20BMO401	Medical Electronics	BME	EEE, ECE, CSE, IT, ICE, CCE, MECH, Mechatronics, AI&DS

17	U20BMO402	Telemedicine	BME	EEE, ECE, CSE, IT, ICE, CCE, AI&DS
18	U20CCO401	Basic DBMS	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME
19	U20CCO402	Introduction to Communication Systems	CCE	EEE, CSE, IT, MECH, CIVIL, ICE, Mechatronics
20	U20ADO401	Knowledge Representation and Reasoning	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics
21	U20ADO402	Introduction to Data Science	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics
Open Elective – II / Open Elective – III				
1	U20HSO501/ U20HSO601	Product Development and Design	MBA	**Common to B. Tech** (Offered in Semester V for **EEE, ECE, ICE, CIVIL, BME, CCE, FT**) (Offered in Semester VI for **CSE, IT, MECH, Mechatronics, AI&DS**)
2	U20HSO502/ U20HSO602	Intellectual Property and Rights	MBA	
3	U20HSO503/ U20HSO603	Marketing Management and Research	MBA	
4	U20HSO504/ U20HSO604	Project Management for Engineers	MBA	
5	U20HSO505/ U20HSO605	Finance for Engineers	MBA	
Open Elective – II / Open Elective – III (Offered in Semester V for **CSE, IT, MECH, Mechatronics, AI&DS**) (Offered in Semester VI for **EEE, ECE, ICE, CIVIL, BME, CCE, FT**)				
1	U20EEO503/ U20EEO603	Conventional and Non-Conventional Energy Sources	EEE	ECE, ICE, MECH, CIVIL, BME, Mechatronics, CCE, AI&DS, FT
2	U20EEO504/ U20EEO604	Industrial Drives and Control	EEE	ECE, ICE, MECH, Mechatronics, AI&DS
3	U20ECO503/ U20ECO603	Electronic Product Design and Packaging	ECE	EEE, CSE, IT, ICE, MECH, CCE, BME, Mechatronics
4	U20ECO504/ U20ECO604	Automotive Electronics	ECE	EEE, ECE, ICE, MECH
5	U20CSO503/ U20CSO603	Platform Technology	CSE	EEE, ECE, ICE, MECH, CIVIL, CCE, BME, AI&DS
6	U20CSO504/ U20CSO604	Graphics Designing	CSE	EEE, ECE, ICE, MECH, CIVIL, BME, FT
7	U20ITO503/ U20ITO603	Essentials of Data Science	IT	EEE, ECE, ICE, MECH, CIVIL, BME
8	U20ITO504/ U20ITO604	Mobile App Development	IT	EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics, AI&DS

9	U20ICO503/ U20ICO603	Fuzzy logic and neural networks	ICE	CSE, IT, CIVIL, BME, AI&DS
10	U20ICO504/ U20ICO604	Measurement and Instrumentation	ICE	ECE, Mechatronics
11	U20MEO504/ U20MEO604	Heating, ventilation and air conditioning system (HVAC)	MECH	EEE, ECE, ICE, CIVIL
12	U20MEO505/ U20MEO605	Creativity Innovation and New Product Development	MECH	EEE, ECE, ICE, CIVIL, BME, Mechatronics
13	U20CEO503/ U20CEO603	Disaster Management	CIVIL	EEE, ECE, CSE, IT, ICE, MECH, BME, CCE, AI&DS, FT
14	U20CEO504/ U20CEO604	Air Pollution and Solid Waste Management	CIVIL	EEE, ECE, CSE, IT, ICE, MECH, BME, CCE, AI&DS, FT
15	U20BMO503/ U20BMO603	Biometric Systems	BME	EEE, ECE, CSE, IT, ICE, CCE, MECH, Mechatronics
16	U20BMO504/ U20BMO604	Medical Robotics	BME	EEE, ECE, CSE, IT, ICE, CCE, MECH, CIVIL , Mechatronics
17	U20CCO503/ U20CCO603	Network Essentials	CCE	EEE, MECH, CIVIL, ICE, Mechatronics, BME
18	U20CCO504/ U20CCO604	Web Programming	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME
19	U20ADO503/ U20ADO603	Principle of Artificial Intelligence and Machine Learning	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE
20	U20ADO504/ U20ADO604	Data science Application of Vision	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics
21	U20MCO501/ U20MCO601	Industrial Automation for Textile	Mechatronics	FT
Open Elective – IV (Offered in Semester VII)				
1	U20EEO705	Hybrid and Electrical Vehicle	EEE	ECE, Mechatronics , MECH
2	U20EEO706	Electrical Energy Conservation and auditing	EEE	ECE, ICE, MECH, CIVIL, BME, Mechatronics, CCE, AI&DS
3	U20ECO705	IoT and its Applications	ECE	EEE, ICE, CSE, MECH, IT, CIVIL, CCE, FT
4	U20ECO706	Cellular and Mobile Communications	ECE	EEE, ICE, CSE, MECH, IT, CIVIL, CCE, BME, Mechatronics
5	U20CSO705	Artificial Intelligence	CSE	EEE, ICE, CIVIL, CCE, MECH, FT

6	U20CSO706	Cloud Technology and its Applications	CSE	EEE, ICE, MECH, CIVIL, CCE, BME, Mechatronics
7	U20ITO705	Automation Techniques & Tools- DevOps	IT	EEE, ECE, ICE, CSE, MECH, CIVIL, CCE, BME, Mechatronics, AI&DS
8	U20ITO706	Augmented and Virtual Reality	IT	EEE, ICE, MECH, CIVIL, CCE, BME, AI&DS
9	U20ICO705	Process Automation	ICE	EEE, ECE, CSE, MECH, IT, CIVIL, CCE, BME, Mechatronics
10	U20ICO706	Virtual Instrumentation	ICE	EEE, ECE, MECH, Mechatronics
11	U20MEO706	Principles of Hydraulic and Pneumatic System	MECH	EEE, ECE, ICE, CIVIL
12	U20MEO707	Supply Chain Management	MECH	EEE, ECE, CIVIL, Mechatronics
13	U20CEO705	Energy Efficient Buildings	CIVIL	EEE, ECE, MECH
14	U20CEO706	Global Warming and Climate Change	CIVIL	EEE, ECE, CSE, IT, ICE, MECH, BME, CCE, AI&DS, FT
15	U20MCO702	Building Automation	Mechatronics	MECH, CIVIL
16	U20MCO703	Automation in Manufacturing Systems	Mechatronics	MECH, CIVIL
17	U20BMO705	Internet of Things for Healthcare	BME	EEE, ECE, ICE, CCE
18	U20BMO706	Telehealth Technology	BME	EEE, ECE, ICE, CCE
19	U20CCO705	Data Science using python	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME
20	U20CCO706	Mobile Applications Development using Android	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME
21	U20ADO705	Data Science Application of NLP	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics.
22	U20ADO706	Artificial Intelligence Applications	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME
23	U20HSO706	Industrial Safety and Human Resource Management	MBA	FT
24	U20HSO707	Operation Research in Textile Industry	MBA	FT

25	U20HSO708	Global marketing and Sourcing Strategies	MBA	FT
26	U20HSO709	Fashion Advertising and sales promotions	MBA	FT
27	U20HSO710	Luxury Brand management	MBA	FT
28	U20HSO711	Fashion Retail Store Operations	MBA	FT

ANNEXURE - III

EMPLOYABILITY ENHANCEMENT COURSES-(A) CERTIFICATION COURSES

Sl. No.	Course Code	Course Title
1	U20ADCX01	3ds Max
2	U20ADCX02	Advance Structural Analysis of Building using ETABS
3	U20ADCX03	Advanced Java Programming
4	U20ADCX04	Advanced Python Programming
5	U20ADCX05	Analog System Lab Kit
6	U20ADCX06	Android Medical App Development
7	U20ADCX07	Android Programming
8	U20ADCX08	ANSYS -Multiphysics
9	U20ADCX09	Artificial Intelligence
10	U20ADCX10	Artificial Intelligence and Edge Computing
11	U20ADCX11	Artificial Intelligence in Medicines
12	U20ADCX12	AutoCAD for Architecture
13	U20ADCX13	AutoCAD for Civil
14	U20ADCX14	AutoCAD for Electrical
15	U20ADCX15	AutoCAD for Mechanical
16	U20ADCX16	Azure DevOps
17	U20ADCX17	Basic Course on ePLAN
18	U20ADCX18	Basic Electro Pneumatics
19	U20ADCX19	Basic Hydraulics
20	U20ADCX20	Bio Signal and Image Processing Development System
21	U20ADCX21	Blockchain
22	U20ADCX22	Bridge Analysis
23	U20ADCX23	Building Analysis and Construction Management
24	U20ADCX24	Building Design and Analysis Using AECO Sim Building Designer
25	U20ADCX25	CATIA
26	U20ADCX26	CCNA (Routing and Switching)
27	U20ADCX27	CCNA (Wireless)
28	U20ADCX28	Cloud Computing
29	U20ADCX29	Computer Programming for Medical Equipments
30	U20ADCX30	Corel Draw
31	U20ADCX31	Creo (Modeling and Simulation)

32	U20ADCX32	Cyber Security
33	U20ADCX33	Data Science and Data Analytics
34	U20ADCX34	Data Science using Python
35	U20ADCX35	Data Science using R
36	U20ADCX36	Deep Learning
37	U20ADCX37	Design and Documentation using ePLAN Electric P8
38	U20ADCX38	Design of Biomedical Devices and Systems
39	U20ADCX39	Digital Marketing
40	U20ADCX40	Digital Signal Processing Development System
41	U20ADCX41	DigSILENT Power Factory
42	U20ADCX42	Electro Hydraulic Automation with PLC
43	U20ADCX43	Embedded System using Arduino
44	U20ADCX44	Embedded System using C
45	U20ADCX45	Embedded System with IoT
46	U20ADCX46	ePLAN Data Portal
47	U20ADCX47	ePLAN Electric P8
48	U20ADCX48	ePLAN Fluid
49	U20ADCX49	ePLAN PPE
50	U20ADCX50	Fusion 360
51	U20ADCX51	Fuzzy Logic and Neural Networks
52	U20ADCX52	Google Analytics
53	U20ADCX53	Hydraulic Automation
54	U20ADCX54	Industrial Automation
55	U20ADCX55	Industry 4.0
56	U20ADCX56	Internet of Things
57	U20ADCX57	Introduction to C Programming
58	U20ADCX58	Introduction to C++ Programming
59	U20ADCX59	IoT using Python
60	U20ADCX60	Java Programming
61	U20ADCX61	Machine Learning
62	U20ADCX62	Machine Learning and Deep Learning
63	U20ADCX63	Machine Learning for Medical Diagnosis
64	U20ADCX64	Mechatronics
65	U20ADCX65	Medical Robotics
66	U20ADCX66	Microsoft Dynamics 365 ERP for HR , Marketing and Finance
67	U20ADCX67	Mobile Edge Computing
68	U20ADCX68	Modeling and Visualization using Micro station
69	U20ADCX69	MX Road
70	U20ADCX70	Photoshop
71	U20ADCX71	PLC
72	U20ADCX72	Pneumatics Automation
73	U20ADCX73	Project Management
74	U20ADCX74	Python Programming
75	U20ADCX75	Revit Architecture
76	U20ADCX76	Revit Inventor
77	U20ADCX77	Revit MEP

78	U20ADCX78	Robotics
79	U20ADCX79	Search Engine Optimization
80	U20ADCX80	Software Testing
81	U20ADCX81	Solar and Smart Energy System with IoT
82	U20ADCX82	Solid Works
83	U20ADCX83	Solid Works with Electrical Schematics
84	U20ADCX84	Speech Processing
85	U20ADCX85	STAAD PRO V8i
86	U20ADCX86	Structural Design and Analysis using Bentley
87	U20ADCX87	Total Station
88	U20ADCX88	Video and Image Processing Development System
89	U20ADCX89	VLSI Design
90	U20ADCX90	Web Programming - I
91	U20ADCX91	Web Programming - II

ANNEXURE - IV

EMPLOYABILITY ENHANCEMENT COURSES-(B) SKILL DEVELOPMENT COURSES

Sl. No.	Course Code	Course Title
1.	U20ADS201	SDC 1* a) Clean code b) Exploring of GITHUB c) Aptitude - I
2.	U20ADS302	SDC 2* a) API design - I b) Exploring of Research Tools c) Aptitude - II
3.	U20ADS403	SDC 3* a) API design - II b) Dynamic Programming c) Aptitude - III
4.	U20ADS504	SDC 4: Foreign Language/ IELTS-I
5.	U20ADS505	SDC 5: Presentation Skills Using ICT
6.	U20ADS606	SDC 6: Foreign Language/ IELTS-II
7.	U20ADS607	SDC 7: Technical Seminar
8.	U20ADS608	SDC 8: NPTEL/MOOC-I
9.	U20ADS809	SDC 9: NPTEL/MOOC-II

**** Choose any one skill development course in the list for SDC 1, SDC 2 and SDC 3***

		L	T	P	C	Hrs
U20BST101	**ENGINEERING MATHEMATICS - I** **CALCULUS AND LINEAR ALGEBRA** (Common to EEE, ECE, CSE, IT, ICE, Mech., Civil, BME, Mechatronics, CCE, AI&DS, FT)	2	2	0	3	60

Course Objectives

- To familiarize the concept of matrices.
- To introduce mathematical tools to solve first order differential equations.
- To learn linear differential equations of higher order with constant coefficients.
- To understand the concept of partial differentiation.
- To introduce the concepts of curl, divergence and integration of vectors in vector calculus.

Course Outcomes

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

CO1 – Able to Understand the Eigen values and Eigen vectors, diagonalization of a matrix. **(K2)**
CO2 – Solve differential equations. **(K3)**
CO3 – Solve higher order differential equations. **(K3)**
CO4 – Solve different types of partial differential equation. **(K3)**
CO5 – Understand the use of vector calculus. **(K2)**

UNIT I MATRICES **(12 Hrs)**

Rank of a Matrix- Consistency of system of equations. Eigen values and Eigen vectors of a real matrix - Characteristic equation - Properties of Eigen values and Eigen vectors. Cayley-Hamilton Theorem -Diagonalization of matrices.

UNIT II DIFFERENTIAL EQUATIONS **(12 Hrs)**

Exact equations, First order linear equations, Bernoulli's equation, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

UNIT III DIFFERENTIAL EQUATIONS (HIGHER ORDER) **(12 Hrs)**

Linear differential equations of higher order with constant coefficients, the operator D,
Euler's linear equation of higher order with variable coefficients, Solution by variation of parameter method.

UNIT IV PARTIAL DIFFERENTIAL EQUATIONS **(12 Hrs)**

Partial derivatives, Total derivatives, Differentiation of implicit functions, Maxima and Minima of two variables. Partial differential equations of higher order with constant coefficients.

UNIT V VECTOR CALCULUS **(12 Hrs)**

Gradient, divergence and curl - Directional derivative- Irrotational and Solenoidal vector fields - Gauss Divergence Theorem and Stoke's Theorem.

Text Books

1. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley, 10th Edition, 2019.
2. B. V. Ramana, "Higher Engineering Mathematics", Tata McGraw-Hill, New Delhi, 6th Edition, 2018.
3. N.P. Bali and Manish Goyal, "A Text Book of Engineering Mathematics", Lakshmi Publications, New Delhi, 9th Edition, 2018.

Reference Books

1. C W. Evans, "Engineering Mathematics", A Programmed Approach, 3rd Edition, 2019.
2. A.Singaravelu., "Engineering Mathematics - I", Meenakshi publications, Tamil Nadu, 2019.
3. M.K. Venkataraman, "Engineering Mathematics", The National Publishing Company, Madras, 2016.
4. S. Narayanan," Differential Equations and Its Applications", Viswanathan, S., Printers & Publishers Pvt Ltd, 2009
5. Dr. G Balaji., "Engineering Mathematics-I", G. Balaji publishers, 2017.

Web References

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2. https://nptel.ac.in/courses/111/106/111106051/
3. https://nptel.ac.in/courses/111/108/111108081/
4. http://www.yorku.ca/yaoguo/math1025/slides/chapter/kuttler-linearalgebra –slides-systemsofquation-handout.pdf
5. http://www.math.cum.edu/~wn0g/2ch6a.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	1	1	-	-	-	-	1	3	2	2
2	3	2	1	1	-	1	1	-	-	-	-	1	3	2	2
3	3	2	1	1	-	1	1	-	-	-	-	1	3	2	2
4	3	2	1	1	-	1	1	-	-	-	-	1	3	2	2
5	2	1	-	-	-	-	1	-	-	-	-	1	3	2	2

		L	T	P	C	Hrs
U20EST117	**BASIC ELECTRICAL AND ELECTRONICS ENGINEERING** (Common to Mech., Civil, FT, AI&DS)	3	0	0	3	45

Course Objectives

- To introduce fundamental concepts, various laws and principles associated with electrical circuits and its analysis.
- To provide knowledge about the various factors in AC circuits and resonance condition.
- To introduce the concept of electrical safety, power system and working of transformers and motors.
- To understand the characteristics and applications of semiconductor devices
- To provide the basic knowledge in analog electronics
- To understand the purpose of communication and acquire knowledge on different communication systems.

Course Outcomes

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

CO1 – Analyze the basic concepts, various laws and theorems used in DC circuits.**(K3)**
CO2 – Analyze and solve the AC circuits and develop resonance circuits for transmitter and receiver.**(K4)**
CO3 – Gain the knowledge of power system, importance of electrical safety measures and application of transformers and motors in real time.**(K2)**
CO4 – Understand the operator of semiconductor diode and its applications. **(K2)**
CO5 – Distinguish the characteristics and operation of BJT and FET. **(K2)**
CO6 – Introduce about different Communication Systems. **(K2)**

PART A - ELECTRICAL ENGINEERING

UNIT I D.C CIRCUITS AND NETWORK THEOREMS (8 Hrs)

Concept of Potential difference, voltage, current, work, Power, Energy, Electric networks, voltage source and current sources, linear passive and active elements, current-voltage relation, ideal and practical sources, concept of dependent and independent sources, Kirchhoff-s laws and applications to network solutions using mesh and nodal analysis, Simplifications of networks using series-parallel, Star/Delta transformation. Network Theorem – Superposition, Thevenin's, Norton's and Maximum Power Transfer.

UNIT II AC CIRCUITS (8 Hrs)

AC waveform- definitions, form factor, peak factor, study of R-L, R-C,RLC series circuit, R-L-C parallel circuit, phasor representation in Polar and rectangular form, concept of impedance, admittance, active, reactive, apparent and complex power, power factor, Resonance in series and parallel circuits, bandwidth and quality factors, 3 phase Balanced AC Circuits (Y-Δ and Y-Y) – power Measurement – two Wattmeter method.

UNIT III ELECTRICAL SAFETY AND ELECTRICAL MACHINES (7 Hrs)

Layout of electrical power system and its functions, Safety devices and systems, Types of domestic wiring, Wiring Accessories, Necessity of earthing, insulators, cables, fuse and circuit breakers - Sensors and its types.

Law of Electromagnetic induction, Auto transformer, Single phase transformer- load test – Open Circuit and Short Circuit test, Fleming's Right and Left hand rule – construction, principle, load test and performance characteristics of rotating machines – DC Motor and DC Generator - single phase/three phase induction motor, Alternator and synchronous motor (Qualitative approach only).

PART B - ELECTRONICS ENGINEERING

UNIT IV SEMICONDUCTOR DIODES AND APPLICATIONS (7 Hrs)

Introduction semiconductor materials-Doping-Intrinsic and Extrinsic Semiconductor – PN junction diode, structure, characteristics-diffusion and depletion capacitance-Rectifier, Half wave and Full wave rectifier-zener diode characteristics-zener diode as regulator – Light Emitting Diode(LED) – Solar Panel.

UNIT V TRANSISTORS (7 Hrs)

Bipolar Junction Transistor-construction-operation-Common Base, Common Emitter, Common collector Configuration-characteristics – Biasing – numerical application – Junction Field Effect Transistor(JFET), Metal

oxide semiconductor Field Effect Transistor, EMOSFET-DMOSFET operation characteristics-Numerical applications.

UNIT VI COMMUNICATION SYSTEMS **(8 Hrs)**

Need for Modulation – Block diagram of analog communication System – AM, FM, PM Definitions and Waveforms – Comparison of digital and analog communication system – Block diagram of digital communication system – Electromagnetic Spectrum. Wired and wireless Channel – Block diagram of communication systems – satellite communication – Cellular Mobile Communication – Fibre Optical Communication System.

Text Books

1. Sudhakar.A and Shyam Mohan.S.P, "Circuits and Networks Analysis and Synthesis", Tata McGraw Hill Publishing Company Ltd., New Delhi, 4th Edition, 2010.
2. D.P.Kothari and I.J. Nagrath, "Electric Machines", Tata McGraw Hill, New Delhi, 5th Edition, 2017.
3. A.E.Fitzgerald, Charles Kingsley, Stephen. D. Umans, "Electric Machinery", Tata Mcgraw Hill, New Delhi, 7th Edition, 2013.
4. Theraja B. L and Theraja A. K., "A Textbook of Electrical Technology", Vol. II, S Chand & Co. Ltd., New Delhi, 2009
5. V. K. Metha, Rohit Metha, "Basic Electrical Engineering", S. Chand & Co, 5th Edition, 2012.
6. Edward Hughes, John Hiley, Keith Brown, Ian McKenzie Smith, "Electrical and Electronics Technology", Pearson Education Limited, New Delhi, 2010.

Reference Books

1. V. Del Toro, "Electrical Engineering Fundamentals", Pearson Education India, New Delhi, 2nd Edition, 2015.
2. A.E.Fitzgerald, Charles Kingsley, Stephen. D. Umans, "Electric Machinery", Tata Mcgraw Hill, New Delhi, 7th Edition, 2013.
3. William H Hayt, J. E. Kemmerly and Steven M Durbin, "Engineering Circuit Analysis", McGraw Hill, 8th Edition, 2012.
4. D.Patranabis, "Sensors and Transducers", Prentice Hall of India, 2nd Edition, 2010.
5. A T. K. Nagsarkar and M. S. Sukhija, Basic of Electrical Engineering, Oxford University Press, 2011
6. S.K. Sahdev, "Fundamentals of Electrical Engineering and Electronics", DhanpatRai and Co, 2013.
7. Wayne Tomasi, "Electronic Communication Systems- Fundamentals Theory Advanced", Fourth Edition, Pearson Education, 2001.

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2. https://www.electrical4u.com/
3. https://nptel.ac.in/courses/108/102/108102146/
4. http://electrical-engineering-portal.com/
5. http://www.electronics-tutorials.ws
6. http://www.eeweb.com/articles

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	3	2	1	3	-	-	-	-	-	-	-	-	1	1
2	2	3	2	1	3	-	-	-	-	-	-	-	-	1	1
3	2	3	2	1	3	-	-	-	-	-	-	-	-	3	3
4	2	3	2	3	3	-	-	-	-	-	-	-	1	-	-
5	2	3	2	3	3	-	-	-	-	-	-	-	1	-	-
6	2	3	2	3	3	-	-	-	-	-	-	-	-	-	-

U20EST125	DIGITAL SYSTEM DESIGN	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To Gain knowledge on Boolean algebra and various simplifications of Boolean functions.
- To acquire the ability to develop any combinational logic functions and design combinational circuit.
- To understand the behavior of sequential circuits.
- To gain the knowledge of memory and other reconfiguration circuits.
- To design the both combinational and sequential circuits using VHDL.

Course Outcomes

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

CO1 – Review the knowledge of Number systems and simplifications of Boolean functions. **(K2)**
CO2 – Design and understand the various combinational logic circuits. **(K2)**
CO3 – Design and understand the various sequential circuits. **(K2)**
CO4 – Analyze and design the reconfiguration circuits. **(K3)**
CO5 – Experimental with the VHDL. **(K3)**

UNIT I REVIEW OF NUMBER SYSTEMS **(9 Hrs)**

Review of Number systems – Conversion of Number systems – Binary addition and subtractions – Binary representation: Signed magnitude representation and Compliment representations – Binary codes – Boolean Algebra – Boolean functions – canonical forms.

UNIT II BOOLEAN FUNCTION AND COMBINATIONAL LOGIC DESIGN **(9 Hrs)**

Simplifications of Boolean function: Theorems and laws – K"Map and QuineMcCluskey method – Introduction to combinational circuits – Design procedures of Combinational circuits – Adders - Subtractors – Binary parallel Adder – Decoder – Encoder – Priority Encoder. Multiplexer – Demultiplexer.

UNIT III SEQUENTIAL LOGIC DESIGN **(9 Hrs)**

Introduction to Sequential Circuits – Latches – Types of Latches: SR Latch and D Latch – Flip-Flop – Types of Flip-Flops: RS, JK, D, and T Flip-Flops – Excitation table of Flip-Flops. Counters: Asynchronous Counters – Synchronous counters – Mod counters. Shift registers – Types of Shift registers.

UNIT IV RECONFIGURATION DIGITAL CIRCUITS **(9 Hrs)**

Introduction to Reconfiguration Digital Circuits – Memory – Hierarchy of Memory – RAM – Types of Ram – Memory Decoding of RAM – ROM. Programmable Logic Devices: Programmable Logic Array – Programmable Array Logic – Implementation of combinational circuits using RAM, ROM, PLA and PAL.

UNIT V VHDL **(9 Hrs)**

Introduction to Hardware Description Language and VHDL – Design flow – Entity, architecture, process, configuration and package declarations – Signals and data types.

Text Books

1. M. Morris Mano and Michael Ciletti, "Digital Design", Pearson India Education Services, Pvt. Ltd., Sixth Edition, 2018.
2. Stephen Brown and ZvonkoVranesic, "Fundamentals of Digital Logic with VHDL Design", Tata McGrawHill Education Pvt. Ltd., 3rd Edition, 2012.
3. Charles H Roth, "Fundamentals of Logic Design", Thomas Publication Company, 7th Edition, 2011.

Reference Books

1. Tocci R J and Widmer N S, "Digital Systems - Principles and Applications", Prentice Hall of India, 11th Edition, 2010.
2. John.F.Wakerly, "Digital Design Principles and Practices", Pearson Education, 4th Edition, 2006.
3. Roger Tokhiem, "Schaum's Outline of Digital Principles", McGraw Hill publication, 3rd Edition, 1994.
4. John. M. Yarbrough, "Digital Logic: Applications and Design", Cengage Learning, Reprint 2009.
5. D.A.Godse A.P.Godse, "Digital System Design", Technical Publications, 1st Edition, 2008.

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1. https://nptel.ac.in/courses/117/105/117105080/1.
2. https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/ 2.
3. https://www.coursera.org/learn/digital-systems
4. https://academic.csuohio.edu/chu_p/rtl/chu_rtL_book/silde/chap01_1.pdf
5. https://bohr.wlu.ca/nznotinas/pc319/lectures/01%20digital_system_design.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	2	2	1	-	-	-	-	-	-	-	2	3	2
2	3	3	3	3	2	-	-	-	-	-	-	-	3	3	2
3	3	3	3	3	3	-	-	-	-	-	-	-	2	2	2
4	3	3	3	3	3	-	-	-	-	-	-	-	2	3	3
5	2	2	2	2	1	-	-	-	-	-	-	-	3	3	2

U20EST127	COMPUTER PROGRAMMING – I (PROGRAMMING IN C)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the Fundamentals of Computers and introduction to C language.
- To study the Decision Making, Looping and arrays
- To learn about Searching and Sorting.
- To understand the concepts of Functions and Pointers.
- To study about Structure and File Management Operations in C.

Course Outcomes

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

CO1 – Develop simple applications in C using basic constructs. **(K2)**
CO2 – Make use of sequential, selection and repetition of control structures and arrays into program. **(K2)**
CO3 – Develop simple programs using Searching and Sorting. **(K3)**
CO4 – Design and develop programs using Functions and Pointers. **(K3)**
CO5 – Apply the File management Operations and Pre-processor Directives. **(K3)**

UNIT I INTRODUCTION TO C **(9 Hrs)**

C programming: Overview of C – Constants – Compiling a C Program – Variables and Data Types – C Tokens – Types of C Qualifiers and Format Specifiers – Operators and Expressions – Operators Precedence – Type Conversion – Input-Output Statements – Storage Classes.

UNIT II DECISION MAKING, LOOPING AND ARRAYS **(9 Hrs)**

Decision Making and Branching: if – if else – if else if – nested if – Switch-case. Looping: while – do while – for – break – continue – nested loop. Arrays: One Dimensional Array – Two-Dimensional Array – Multi-Dimensional Array – Dynamic arrays. String – String Library Functions.

UNIT III SEARCHING AND SORTING **(9 Hrs)**

Searching: Linear Search – Binary Search Techniques. Sorting: Bubble Sort – Selection Sort – Insertion Sort – Shell Sort – Radix Sort.

UNIT IV FUNCTIONS AND POINTERS **(9 Hrs)**

Functions: Introduction - Definition – Declaration – Categories of Functions – Nesting of Functions – Recursive functions – Passing Arrays to Functions. Pointers: Introduction – Declaring Pointer Variables – Initialization of Pointer Variables – Accessing the address of a variable – Accessing a variable through Pointer – Chain of Pointers – Pointer Expressions – Pointers and arrays – Pointers and Functions – Call by Value – Call by Reference – Pointers and Character strings – Array of Pointers.

UNIT V STRUCTURES, FILE MANAGEMENT AND PREPROCESSOR **(9 Hrs)**

User Defined data types: Introduction – Structure – Definition – Declaration – Array of Structures – Nested Structures – Passing Structures to Functions – Union – Enumeration and Typedef. Introduction to File Handling in C – Input and Output operations on a file – Error Handling – Random access to files – Command Line Arguments. Introduction to Pre-processor – Macro Substitution Directives – File Inclusion Directives – Conditional Compilation Directives – Miscellaneous Directives.

Text Books

1. Byron S Gottfried and Jitendar Kumar Chhabra, "Programming with C", Tata McGraw Hill Publishing Company, Fourth Edition, 2015.
2. Kernighan,B.W and Ritchie,D.M, "The C Programming language", Pearson Education, 2nd Edition, 2006.
3. Herbert Schildt,"C: The Complete Reference", McGraw Hill, Fourth Edition, 2014.
4. YashwantKanetkar, "Let us C", BPB Publications, 16th Edition, 2017.
5. Balagurusamy. E, "Programming in ANSI C", Tata McGraw Hill, 8th Edition, 2019.
6. ReemaThareja, "Fundamentals of Computing & C Programming", Oxford University Press, 2012.

Reference Books

1. Ashok N Kamthane, "Computer Programming", Pearson education, Second Impression, 2012.

2. VikasVerma, "A Workbook on C", Cengage Learning, Second Edition, 2012.
3. P.Visu, R.Srinivasan and S.Koteeswaran, "Fundamentals of Computing and Programming", Sri Krishna Publications, Fourth Edition, 2012.
4. PradipDev, ManasGhoush, "Programming in C", Oxford University Press, Second Edition, 2011.
5. Stephen G.Kochan, "Programming in C", Pearson Education India, Third Edition, 2005.

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3. https://www.udemy.com/course/c-programming-for-beginners-/
4. https://www.programiz.com/c-programming
5. https://www.tutorialspoint.com/cprogramming
6. https://www.assignment2do.wordpress.com/.../solution-programming-in-ansi-c

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	2	-	-	-	-	-	-	-	2	3	2
2	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3
3	3	3	3	3	3	-	-	-	-	-	-	-	3	2	3
4	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3
5	3	3	3	3	2	-	-	-	-	-	-	-	3	3	3

U20ADT101	FUNDAMENTAL OF DATA SCIENCE	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the concepts of Real world data representations.
- To learn the various Excel function to solve Data Science.
- To understand the Mathematical Knowledge for Data Science.
- To gain knowledge in Data Science Tools.
- To expose the different opportunities in Industries.

Course outcomes

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

CO1 – Infer the Real world data and information. **(K2)**
CO2 – Applying Data Science using Excel. **(K3)**
CO3 – Make use of Mathematical Knowledge for problem solving. **(K2)**
CO4 – Interpret the various Tools and its advantage. **(K3)**
CO5 – Illustrate the different opportunities in Industries. **(K2)**

UNIT I INTRODUCTION TO DATA SCIENCE **(9 Hrs)**

Introduction to Data Science – History of Data Science – Relationship between Data Warehouse – Big Data and Data Science – Scope of Data Science – Data Science with other Fields – Relationship between Data Science and Information Science. Data: Data types – Structured vs Unstructured data – Quantitative vs Qualitative data – The four levels of data – Data Collection – Data Preprocessing.

UNIT II DATA SCIENCE IN EXCEL **(9 Hrs)**

Introduction to Excel basic functions – Data Collection and Preparation – Importing Data into Excel from Different Data Sources – Data Cleaning and Preliminary Data Analysis – Correlation and Importance of Variables Technical Requirements. Data Visualization in Excel – Pivot Tables and Charts – VLOOKUP – Dashboard in Excel.

UNIT III MATHEMATICAL PRELIMINARIES **(9 Hrs)**

Probability: Probability vs. Statistics – Compound Events and Independence – Conditional Probability – Probability Distribution. Descriptive Statistics: Centrality Measures – Variability Measures – Interpreting Variance – Characterizing Distributions. Correlation Analysis: Correlation Coefficient – The Power and Significance – Detection Periodicities. Logarithms: Logarithms and Multiplying Probabilities – Logarithms and Ratios – Logarithms and Normalizing Skewed Distributions.

UNIT IV DATA SCIENCE TOOLS **(9 Hrs)**

Introduction to Data Science Tool – Data Cleaning Tools – Data Munging and Modelling Tools – Data Visualization Tools – Tools for Data Science.

UNIT V INDUSTRIALIZATION, OPPURTUNITIES AND APPLICATIONS **(9 Hrs)**

Data Economy and Industrialization – Introduction: Data Economy – Data Industry – Data Services – Data Science Application: Introduction – General Application Guidance – Different Domain – Advertising – Aerospace and Astronomy – Arts – Creative Design and Humanities – Bioinformatics – Consulting Services – Ecology and Environment – Ecommerce and Retail – Education – Engineering – Finance and Economy – Gaming.

Text Books

1. Chirag Shah, "A Hands on Introduction to Data Science", Cambridge University Press, 2020.
2. SinanOzdemir, "Principles of Data Science", Packt Publication, 2016.
3. Julio Cesar Rodriguez Martino, "Hands-on Machine Learning with Microsoft Excel", Packt Publication, 2019.

Reference Books

1. Hector Guerrero, "Excel Data Analysis: Modeling and Simulation", Springer International Publishing, 2nd Edition, 2019.
2. Paul Curzon, Peter W. McOwan, "The Power of Computational Thinking", World Scientific Publishing, 2017.
3. Steven S. Skiena, "Data Science Design Manual", Spring International Publication, 2017.
4. RajendraAkerkar, PritiSrinivasSajja, "Intelligence Techniques for Data Science", Spring International Publication, 2016.
5. Longbing Cao "Data Science Thinking: The Next Scientific, Technological and Economic Revolution", Spring International Publication, 2018.

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2. https://www.tutorialspoint.com/excel_data_analysis/index.htm
3. https://www.coursera.org/learn/open-source-tools-for-data-science
4. https://www.jeremyjordan.me/data-science
5. https://www.ngdata.com/top-data-science-resourrces

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	2	1	1	-	-	-	-	-	-	-	2	2	2
2	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3
3	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3
4	2	2	2	2	3	-	-	-	-	-	-	-	2	2	2
5	3	2	2	2	2	-	-	-	-	-	-	-	3	2	2

U20ESP126 DIGITAL SYSTEM DESIGN LABORATORY

L	T	P	C	Hrs
0	0	2	1	30

Course Objectives

- To provide the basic operation and applications of electronic devices.
- To design and implementations of the digital combinational circuits.
- To design and implementations of the digital sequential circuits.
- To implement the concept of Multiplexer and De-multiplexer Circuits.
- To design and implement Encoders and Decoders.

Course Outcomes

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

CO1 – Familiar about electronic components and able to apply in rectifier and amplifiers circuits. **(K2)**
CO2 – Analyze and construct the combinational logic circuits. **(K3)**
CO3 – Analyze and construct the sequential logic circuits. **(K3)**
CO4 – Construct the Multiplexer and De-multiplexer Circuits. **(K3)**
CO5 – Design the Encoders and Decoders. **(K3)**

List of Experiments

1. Verification of Kirchhoff's Laws and Network Theorems (Hardware and simulation).
2. Characteristics of PN junction diode and Half and Full wave Rectifier.
3. Characteristics of Zener diode, design and implementation of Zener diode voltage regulator.
4. Characteristics of BJT.
5. Characteristics of FET.
6. Frequency Response of RC Coupled Amplifiers.
7. Simplification of Boolean expression using Karnaugh map and QuineMcCluskey Methods.
8. Design and Implementation of Adder and Subtractor using Logic Gates.
9. Design and Implementation of Code Converters.
10. Design and Implementation of 3 bit odd/even parity generator/checker.
11. Design and Implementation of Multiplexer and De-multiplexer Circuits.
12. Design and Implementation of Encoders and Decoders.
13. Study of Flip-Flops.
14. Design and implementations of Shift Registers.

Reference Books

1. Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory", Pearson Education, Eleventh Edition, 2015.
2. M. Morris Mano, "Digital Design", Pearson Education, 6th Edition, 2017.
3. David A Bell, "Fundamentals of Electronic Devices and Circuits", Oxford Press, Fifth Edition, 2009.
4. Thomas L. Floyd, "Digital Fundamentals", Pearson Education, NewDelhi, Tenth Edition, 2009.
5. D.A.Godse A.P.Godse, "Digital System Design", Technical Publications, 1st Edition, 2008.

Web References

1. https://nptel.ac.in/courses/117106114/
2. https://nptel.ac.in/courses/117106086/
3. https://www.coursera.org/learn/digital-systems
4. http://www.electronics-tutorials.ws
5. https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	2	2	1	-	-	-	-	-	-	-	2	3	2
2	3	3	3	3	2	-	-	-	-	-	-	-	3	3	2
3	3	3	3	3	3	-	-	-	-	-	-	-	2	2	2
4	2	2	2	2	2	-	-	-	-	-	-	-	2	3	2
5	2	3	3	2	2	-	-	-	-	-	-	-	3	2	3

U20ESP128	COMPUTER PROGRAMMING – I LABORATORY(PROGRAMMING IN C)	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To study and understand the use of Basic Input / Output statements.
- To learn and apply branching and looping statements.
- To understand how to write various programs using C Language.
- To learn and implement sorting and searching concepts.
- To implement programs using pointers.

Course outcomes

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

CO1 – Describe the uses of Basic Input / Output statements. **(K2)**
CO2 – Experiment with branching and looping statements. **(K2)**
CO3 – Ability to develop own programs using C language. **(K2)**
CO4 – Implement programs using sorting and searching. **(K3)**
CO5 – Implement pointer programs. **(K3)**

List of Experiments

1. To find the total and average percentage obtained by a student for 6 subjects.
2. To read a 3 digit number and output as 1 hundreds 7 tens 2 units for 172 and print the reverse of the number.
3. To find the greatest among two numbers using if else and ternary operator.
4. To generating Prime Numbers between a given ranges.
5. To check whether a given character is vowel or not using Switch – Case.
6. To find the sum of "n" numbers using for, while and do – while statements.
7. To perform various string handling functions: strlen, strcpy, strcat, strcmp.
8. To remove all characters in a string except alphabets.
9. To find the smallest and largest element in an array.
10. To perform Matrix Addition, Subtraction and Multiplication.
11. To search a given number using linear and binary search.
12. To arrange the given set of numbers using Bubble sort, Selection sort and Insertion sort.
13. To find the factorial of a given number using Function and Recursion.
14. To swap two numbers using call by value and call by reference.
15. To find the sum of an integer array using pointers.
16. To find the Maximum element in an integer array using pointers.
17. To generate salary slip of employees using structures and pointers.
18. To create student details using Structures.
19. To display the contents of the file on the monitor screen.
20. To find the number of characters, words and lines of given text file.
21. To insert, update, delete and append telephone details of an individual or a company into a telephone directory using random access file.
22. To pass the parameter using Commands Line Arguments.

Reference Books

1. Ashok N Kamthane, "Computer Programming", Pearson education, Second Impression, 2012.
2. VikasVerma, "A Workbook on C", Cengage Learning, Second Edition, 2012.
3. Dr. P. Rizwan Ahmed, "Office Automation", Margham Publications, 2016.
4. YashwantKanetkar, "Let us C", BPB Publications, 16th Edition, 2017.
5. Balagurusamy. E, "Programming in ANSI C", Tata McGraw Hill, 8th Edition, 2019.

Web References

1. https://nptel.ac.in/courses/106/104/106104128/
2. https://www.coursera.org/courses?query=c%20programming
3. https://www.geeksforgeeks.org/c-language-set-1-introduction/
4. https://www.programiz.com/c-programming

5. https://www.tutorialspoint.com/cprogramming/index.htm

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	2	-	-	-	-	-	-	-	2	3	2
2	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3
3	3	3	3	3	3	-	-	-	-	-	-	-	3	2	3
4	3	3	3	3	3	-	-	-	-	-	-	-	2	3	3
5	3	3	3	3	3	-	-	-	-	-	-	-	3	2	3

U20ADP101	FUNDAMENTAL OF DATA SCIENCE LABORATORY	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To develop basic knowledge in Excel.
- To expose the various function in Excel.
- To extend the skill to use Data Visualization.
- To analysis the real time data sets.
- To develop Pivot tables and VLOOKUP functions.

Course Outcomes

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

CO1 – Describe common Excel functionality and features used for data science. **(K2)**
CO2 – Analyze and construct the Data Visualization. **(K3)**
CO3 – Configure the programming environment. **(K2)**
CO4 – Analyze real time data set. **(K3)**
CO5 – Implement Pivot tables and VLOOKUP functions. **(K3)**

List of Experiments

1. Study of basic Function in Excel.
2. Working with Range Names and Tables.
3. Cleaning Data with Text Functions.
4. Cleaning data containing Data Values.
5. Working with VLOOKUP functions.
6. Demonstration of Data Visualization.
7. Importing Data from external source into Excel.
8. Creating a Data Model.
9. Exploring Data with PivotTables and Charts.
10. Create a Dash board for a given requirement.
11. Implement a data analytics for the real time data set.

Reference Books

1. Julio Cesar Rodriguez Martino, "Hands-on Machine Learning with Microsoft Excel", Packt Publication, 2019.
2. Paul McFedries, "Excel Data Analysis for Dummies", John Wiley and Sons, 2019.
3. Gordon S. Linoff, "Data Analysis Using SQL and Excel", Wiley Publishing, 2008.
4. Hector Guerrero, "Excel Data Analysis: Modeling and Simulation", Springer International Publishing, 2nd Edition, 2019.
5. Steven S. Skiena, "Data Science Design Manual", Spring International Publication, 2017.

Web References

1. https://www.coursera.org/learn/excel-data-analysis
2. https://www.edx.org/course/introduction-to-data-analysis-using-excel-2
3. https://www.kaggle.com/datasets
4. https://www.tutorialspoint.com/excel_data_analysis/index.htm

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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3	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3
4	2	3	2	3	2	-	-	-	-	-	-	-	3	3	3
5	3	2	3	2	2	-	-	-	-	-	-	-	3	2	3

U20ADC1XX	CERTIFICATION COURSE-I	L	T	P	C	Hrs
		0	0	4	0	50

Students shall choose an International certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40-50 hours specified in the curriculum, which will be offered through Centre of Excellence.

Pass /Fail will be determined on the basis of participation, attendance, performance and completion of the course. If a candidate Fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.

U20ADM101

INDUCTION PROGRAM

Induction program for students to be offered right at the start of the first year

Duration of the Program	3 Weeks
Induction program	• Physical Activity • Creative Arts and Culture • Mentoring and Universal Human Values • Familiarization with College, Dept./Branch • Literary Activity • Proficiency Modules • Lectures and Workshops by Eminent People • Visits in Local Area • Extra-Curricular Activities in College

1. Physical Activity

This would involve a daily routine of physical activity with games and sports. There would be games in the evening or at other suitable times according to the local climate. These would help develop team work besides health. Each student could pick one game and learn it for the duration of the induction program and hopefully, continue with it later.

2. Creative Arts

Every student would choose one skill related to the arts whether visual arts or performing arts. Examples are painting, music, dance, pottery, sculpture etc. The student would pursue it every day for the duration of the program. These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, flow into engineering design later.

3. Mentoring and Universal Human Values

Mentoring and connecting the students with faculty members is the most important part of student induction. Mentoring takes place in the context and setting of Universal Human Values. It gets the student to explore oneself and experience the joy of learning, prepares one to stand up to peer pressure and take decisions with courage, be aware of relationships and be sensitive to others, understand the role of money in life and experience the feeling of prosperity. Need for character building has been underlined by many thinkers, universal human values provide the base. Methodology of teaching this content is extremely important. It must not be through do's and dont's, but by getting the students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing. The role of group discussions, however, with clarity of thought of the teachers cannot be over emphasized. It is essential for giving exposure, guiding thoughts, and realizing values. The teachers must come from all the departments rather than only one department like HSS or from outside of the Institute. Experiments in this direction at IIT(BHU) are noteworthy and one can learn from them. Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It is to open thinking towards the self. Universal Human Values discussions could even continue for rest of the semester as a normal course, and not stop with the induction program. Besides drawing the attention of the student to larger issues of life, it would build relationships between teachers and students which last for their entire 4-year stay and possibly beyond.

4. Other Activity

Activities that are not there on a daily basis, but are conducted for 3-4 days (typically in the afternoons) and change thereafter.

4.1. Familiarization with College, Department/Branch

The incoming students should be told about the credit and grading system, and about the examinations. They should be informed about how study in college differs from study in school. They should also be taken on a tour of the college and shown important points such as library, canteen, and other facilities. They should be shown their department, and told what it means to get into the branch or department. Describe what role the technology

related to their department plays in society and after graduation what role the student would play in society as an engineer in that branch. A lecture by an alumnus of the Dept. would be very helpful in this regard. They should also be shown the laboratories, workshops and other facilities. The above should be done right in the first two days, and then over the afternoons thereafter, as appropriate.

4.2. Literary Activity

Literary activity would encompass reading a book, writing a summary, debating, enacting a play etc.

4.3. Proficiency Modules

The induction program period can be used to overcome some critical lacunas that students might have, for example, English, computer familiarity etc. These should run like crash courses, so that when normal courses start after the induction program, the student has overcome the lacunas substantially. We hope that problems arising due to lack of English skills, wherein students start lagging behind or failing in several subjects, for no fault of theirs, would, hopefully, become a thing of the past.

4.4. Lectures and Workshops by Eminent People

Lectures by eminent people should be organized, say, once a week. It would give the students exposure to people who are eminent, in industry or engineering, in social service, or in public life. Alumni could be invited as well. Motivational lectures about life, meditation, etc. by Ramakrishna Mission, Art of Living, Vivekanand Kendras, S-VYASA, etc. may be organized. Workshops which rejuvenate or bring relief to students would also be welcome, such as, Art of Living workshops (3 sessions, 9 hours).

4.5. Visits in Local Area

A couple of visits to the local landmarks including historical monuments should be organized. This would familiarize the students with the area together with bonding with each other, like in a picnic. Visits should also be organized to a hospital, orphanage or a village. These would expose them to people in suffering or to different lifestyles. This might also sensitize them to engineering needs in these areas.

4.6. Extra-Curricular Activities in College

The new students should be introduced to the extra-curricular activities at the college/university. They should be shown the facilities and informed about activities related to different clubs etc. This is when selected senior students involved in or leading these activities can give presentations, under faculty supervision.

		L	T	P	C	Hrs
U20BST215	**ENGINEERING MATHEMATICS – II (MULTIPLE INTEGRALS AND TRANSFORMS)** (Common to EEE, ECE, CSE, IT, ICE, Mech., Civil, BME, Mechatronics, CCE, AI&DS, FT)	2	2	0	3	60

Course Objectives

- To develop logical thinking and analytic skills in evaluating multiple integrals.
- To equip them familiar with Laplace, transform and solve the differential equations using Laplace transform techniques.
- To enable the students to expand functions into Fourier series using change of intervals.
- To gain good knowledge in application of Fourier transforms.
- To inculcate the computational knowledge in Z-transforms.

Course Outcomes

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

CO1 – Understand the concept of double and triple integrals. **(K2)**
CO2 – Find Laplace transform and inverse transform of simple functions. **(K3)**
CO3 – Convert a periodic function into series form. **(K3)**
CO4 – Compute Fourier transforms of various functions. **(K3)**
CO5 – Solve difference equations using Z- transforms. **(K3)**

UNIT I MULTIPLE INTEGRALS **(12 Hrs)**

Multiple Integrals, change of order of integration and change of variables in double integrals (Cartesian to polar). Applications: Areas by double integration and volumes by triple integration (Cartesian and polar).

UNIT II LAPLACE TRANSFORMS AND INVERSE LAPLACE TRANSFORMS **(12 Hrs)**

Definition, Transforms of elementary functions, properties. Transform of derivatives and integrals. Multiplication by t and division by t. Transform of unit step function, transform of periodic functions. Initial and final value theorems, Methods for determining inverse Laplace Transforms, Convolution theorem, Application to differential equations and integral equations. Evaluation of integrals by Laplace transforms.

UNIT III FOURIER SERIES **(12 Hrs)**

Dirichlet's conditions – General Fourier series – Expansion of periodic function into Fourier series – Fourier series for odd and even functions – Half-range Fourier cosine and sine series – Change of interval – Related problems.

UNIT IV FOURIER TRANSFORMS **(12 Hrs)**

Fourier Integral theorem. Fourier transform and its inverse, properties. Fourier sine and cosine transforms, their properties, Convolution and Parseval's identity.

UNIT V Z - TRANSFORMS **(12 Hrs)**

Difference equations, basic definition, z-transform - definition, Standard z-transforms, Damping rule, Shifting rule, Initial value and final value theorems and problems, Inverse z-transform. Applications of z-transforms to solve difference equations.

Text Books

1. Ravish R Singh and Mukul Bhatt, "Engineering Mathematics", Tata McGraw Hill, 1st Edition, 2016.
2. P Siva Ramakrishna Das. and C Vijayakumar ., "Engineering Mathematics", Pearson's, 2017.
3. M.D.Petale, "A text book on Z- Transforms (Engineering Mathematics)", Bames and Noble, New Edition, 2020.

Reference Books

1. Dass.H. K, "Advanced Engineering Mathematics", S. Chand & co, 2019.
2. Bali N.P. and Dr. Manish Goyal, "Engineering Mathematics", Lakshmi Publications, 9th Edition, 2015.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 10th Edition. 2019.

4. Gupta.C. B, Shree Ram Singh, M. Kumar, "Engineering Mathematics for semester I & II", Tata McGraw Hill, 2015.
5. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill, 2018.

Web References

1. https://nptel.ac.in/courses/111105121/
2. https://nptel.ac.in/courses/111105035/
3. https://nptel.ac.in/courses/111107119/
4. https://swayam.gov.in/nd1_noc20_ma17/preview
5. https://nptel.ac.in/courses/111/103/111103021/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	1	1	1	2	1	-
2	3	2	1	1	-	-	-	-	-	1	1	1	2	1	-
3	3	2	1	1	-	-	-	-	-	1	1	1	2	1	-
4	3	2	1	1	-	-	-	-	-	1	1	1	2	1	-
5	3	2	1	1	-	-	-	-	-	1	1	1	2	1	-

U20EST243	COMPUTER PROGRAMMING – II (PROGRAMMING IN PYTHON)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To learn the basic concept of python programming.
- To infer the availability of various data types and Object Oriented Principles.
- To acquire and practice the knowledge of predefined packages Numpy.
- To understand Data Manipulation with Pandas.
- To infer the programming concept for Visualization with Matplotlib.

Course Outcomes

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

CO1 – Interpret the basic concepts of Python programs. **(K2)**
CO2 – Articulate the concepts of Sets, Dictionaries and Object Oriented concepts. **(K2)**
CO3 – Experiment with Numpy package. **(K3)**
CO4 – Apply and analyze Data Manipulation With Pandas. **(K3)**
CO5 – Illustrate programming concept for Visualization with Matplotlib. **(K2)**

UNIT I INTRODUCTION TO PYTHON **(9 Hrs)**

Structure of Python Program – Underlying mechanism of Module Execution – Branching and Looping – Problem Solving Using Branches and Loops – Functions – Lambda Functions – Lists and Mutability – Problem Solving Using Lists and Functions.

UNIT II SEQUENCE DATATYPES AND OBJECT ORIENTED PROGRAMMING **(9 Hrs)**

Sequences – Mapping and Sets – Dictionaries. Classes: Classes and Instances – Inheritance – Exception Handling – Introduction to Regular Expressions using "re" module.

UNIT III USING NUMPY **(9 Hrs)**

Basics of NumPy – Computation on NumPy – Aggregations – Computation on Arrays – Comparisons – Masks and Boolean Arrays – Fancy Indexing – Sorting Arrays – Structured Data: NumPy's Structured Array.

UNIT IV DATA MANIPULATION WITH PANDAS **(9 Hrs)**

Introduction to Pandas Objects – Data indexing and Selection – Operating on Data in Pandas – Handling Missing Data – Hierarchical Indexing – Combining Data Sets. Aggregation and Grouping – Pivot Tables – Vectorized String Operations – Working with Time Series – High Performance Pandas – eval() and query().

UNIT V VISUALIZATION WITH MATPLOTLIB **(9 Hrs)**

Basic functions of Matplotlib – Simple Line Plot – Scatter Plot – Density and Contour Plots – Histograms – Binnings and Density – Customizing Plot Legends – Colour Bars – Three-Dimensional Plotting in Matplotlib.

Text Books

1. Jake VanderPlas, "Python Data Science Handbook - Essential Tools for Working with Data", O'Reily Media Inc, 2016.
2. Zhang.Y, "An Introduction to Python and Computer Programming", Springer Publications, 2016.
3. Wesley J Chun, "Core Python Programming", Pearson Education, 2nd Edition, 2006.

Reference Books

1. John Paul Mueller, Luca Massaron, "Python for Data Science for Dummies", 2nd Edition, John Wiley& Sons, 2019.
2. Jesus Rogel-Salazar, "Data Science and Analytics with Python", CRC Press Taylor and Francis Group, 2017.
3. Brian Draper, "Python Programming A Complete Guide for Beginners to Master and Become an Expert in Python Programming Language", CreateSpace Independent Publishing Platform, 2016.

4. Mark Lutz, Laura Lewin, Frank Willison, "Programming Python", O'Reilly Media, 3rd Edition, 2006.
5. Gowrishankar S, Veena A, "Introduction to Python Programming", CRC Press, 2018.

Web References

1. https://nptel.ac.in/courses/106/106/106106212/
2. https://www.geeksforgeeks.org/data-analysis-visualization-python/
3. https://www.coursera.org/learn/python-data-analysis
4. https://www.python.org/
5. https://www.programiz.com/python-programming

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3	3	3	3	2	3	-	-	-	-	-	-	-	3	3	3
4	2	3	3	2	3	-	-	-	-	-	-	-	2	3	3
5	3	3	3	2	3	-	-	-	-	-	-	-	3	3	3

U20EST245	DATA STRUCTURE AND APPLICATIONS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To impart the basic concepts of Data Structures and its terminologies.
- To understand concepts about Stack and Queue operations.
- To understand basic concepts about linked list and its various operations.
- To understand concepts about Tree and its applications.
- To understand basic concepts about Hashing and Graph.

Course Outcomes

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

CO1 – Analyze Fundamentals of Data Structures. **(K2)**
CO2 – Illustrate Stack, Queue and its operation. **(K3)**
CO3 – Apply and analyze Linked List operation. **(K3)**
CO4 – Construct the Tree and its various applications. **(K2)**
CO5 – Summarize Hashing and Graph techniques. **(K2)**

UNIT I BASIC TERMINOLOGIES OF DATA STRUCTURES (9 Hrs)

Introduction: Basic Terminologies – Elementary Data Organizations. Data Structure Operations: Insertion – Deletion – Traversal. Array and its operations. Polynomial Manipulation.

UNIT II STACK AND QUEUE OPERATIONS (9 Hrs)

Stacks and Queues: ADT Stack and its operations. Applications of Stacks: Expression Conversion and evaluation. ADT Queue: Types of Queue – Simple Queue – Circular Queue – Priority Queue – Operations on each type of Queues.

UNIT III LINKED LIST OPERATIONS (9 Hrs)

Linked Lists: Singly linked lists – Representation in memory. Algorithms of several operations: Traversing – Searching – Insertion – Deletion in linked list. Linked representation of Stack and Queue. Doubly linked list: operations. Circular Linked Lists: operations.

UNIT IV TREES (9 Hrs)

Trees: Basic Tree Terminologies – Different types of Trees: Binary Tree – Threaded Binary Tree – Binary Search Tree – Binary Tree Traversals – AVL Tree. Introduction to B-Tree and B+ Tree. Heap – Applications of heap.

UNIT V HASHING AND GRAPHS (9 Hrs)

Hashing: Hash Table – Hash Function and its characteristics. Graph: Basic Terminologies and Representations – Graph traversal algorithms. Definition – Representation of Graph – Types of graph – Breadth-first traversal – Depth-first traversal – Topological Sort – Bi-connectivity – Cut vertex – Euler circuits – Applications of graphs.

Text Books

1. Ellis Horowitz, SartajSahni, "Fundamentals of Data Structures", Computer Science Press, Illustrated Edition, 2018.
2. Thomas H. Coreman, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", PHI, Third Edition, 2010.
3. Alfred V. Aho, Jeffrey D. Ullman, John E. Hopcroft, "Data Structures and Algorithms", 4th Edition, 2009.

Reference Books

1. Mark Allen Weiss, "Algorithms, Data Structures and Problem Solving with C++", Addison-Wesley Publishing Company, Illustrated Edition, 1995.
2. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Pearson Education, 2nd Edition, 1997.
3. Reema Thareja, "Data Structures Using C", Oxford University Press, Second Edition, 2011.

4. Aho, Hopcroft and Ullman, "Data Structures and Algorithms", Pearson Education, 1983.
5. Stephen G. Kochan, "Programming in C", Pearson Education, Third Edition, 2008.

Web References

1. https://nptel.ac.in/courses/106103069/
2. https://www.geeksforgeeks.org/data-structures/
3. https://www.javatpoint.com/data-structure-tutorial/
4. https://www.studytonight.com/data-structures/
5. https://www.tutorialspoint.com/data_structures_algorithms/

COs/POs/PSOs Mapping

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1	3	2	2	2	2	-	-	-	-	-	-	-	2	3	2
2	3	3	2	2	3	-	-	-	-	-	-	-	3	3	3
3	3	3	3	2	3	-	-	-	-	-	-	-	3	2	3
4	3	3	3	2	3	-	-	-	-	-	-	-	3	3	3
5	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3

U20EST247	OBJECT ORIENTED PROGRAMMING	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To learn the basic concepts of object oriented programming in C++.
- To explore the programing principles of Class, Object, and Constructors.
- To know the principles of Functions and Inheritance.
- To develop a C++ application using Polymorphism Concepts.
- To expertise the programming skills in Templates and Exception Handling.

Course Outcomes

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

CO1 – Develop programs using OOP principles. **(K2)**
CO2 – Experimental with the concepts of Class & Objects and Constructors & Destructors. **(K3)**
CO3 – Infer the concepts of Functions and Inheritance with its types. **(K2)**
CO4 – Develop C++programs using Polymorphism and Virtual Function. **(K3)**
CO5 – Construct interactive C++ programs using Templates and Exception Handling. **(K2)**

UNIT I OBJECT ORIENTED PROGRAMMING IN C++ (9 Hrs)

Object Oriented Programming Concepts: Basic Program Construction – Data Types – Type Conversion – Operators – Key Concepts of Object Oriented Programming. Introduction and Structure of the C++ program – Stream Classes – Formatted and Unformatted Data – Unformatted Console I/O Operations – Bit Fields – Manipulators. Decision making statements – jump statement – switch case statement – looping statements.

UNIT II CLASSES AND OBJECTS, CONSTRUCTORS AND DESTRUCTORS (9 Hrs)

Introduction to Classes and Objects – Constructors and its Types – Overloading Constructors – Copy Constructors – Destructors.

UNIT III FUNCTIONS AND INHERITANCE (9 Hrs)

Functions: Passing arguments – LValues and RValues – Library Functions – Inline functions – Friend Functions. Inheritance: Introduction – Types of Inheritance.

UNIT IV POLYMORPHISM AND VIRTUAL FUNCTION (9 Hrs)

Polymorphism: Compile Time and Run Time Polymorphism. Overloading: Function Overloading and Operator Overloading – Overloading Unary Operators – Overloading Binary Operators. Virtual Functions – Abstract Classes.

UNIT V TEMPLATES AND EXCEPTION HANDLING (9 Hrs)

Generic Functions – Need of Templates – Function Templates – Class Templates. Exception Handling: Need of Exceptions – Keywords – Simple and Multiple Exceptions.

Text Books

1. Ashok N.Kamthane, "Object Oriented Programming with ANSI and Turbo C++", Pearson, 1st Edition, 2011.
2. Paul J. Deitel, Harvey M. Deitel, "C++ How to Program", Deitel, 10th Edition, 2017.
3. BjarneStroustrup, "The C++ Programming Language", Addison Wesley, 4th Edition, 2015.

Reference Books

1. E. Balaguruswamy, "Object Oriented Programming with C++", Tata McGraw Hill Education, 6th Edition, 2015.
2. Joyce Farrell, "Object Oriented Programming", Cengage learning, 4th Edition, 2009.
3. Stanley Lippman, JoseeLajoie, Barbara E. Moo, "C++ Primer", Addison Wesley, 5th Edition, 2015.
4. Nicolai M. Jossutis, "Object-Oriented Programming in C++", Wiley Publications, 2002.

5. T. D. Malhotra, "C++ Made Easy", Laxmi Publications, First Edition, 2006.

Web References

1. http://www.cplusplus.com/doc/tutorial/
2. https://www.programiz.com/cpp-programming/examples
3. https://www.geeksforgeeks.org/cpp-tutorial/
4. https://www.tutorialspoint.com/cplusplus/index.htm
5. https://www.learncpp.com/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	2	1	2	-	-	-	-	-	-	-	3	1	2
2	2	2	3	2	3	-	-	-	-	-	-	-	2	2	3
3	2	2	3	2	3	-	-	-	-	-	-	-	2	2	3
4	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3
5	3	2	3	2	3	-	-	-	-	-	-	-	3	2	3

U20EST248	COMPUTER AND COMMUNICATION NETWORKS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the protocol layering and physical level communication.
- To analyze the basic functionality of datalink layer
- To learn the functions of network layer and the various routing protocols.
- To familiarize the functions and protocols of the Transport layer.
- To understand the concepts of application layer protocols.

Course Outcomes

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

CO1 – Apply the knowledge on principles of computer networks and physical layer signal transmission along with impairments and performance analysis. **(K2)**
CO2 – Explain the concepts and functionality of datalink layer **(K2)**
CO3 – List the functions and different routing algorithms of network layer. **(K3)**
CO4 – Classify the various functionalities of the protocols in transport layer. **(K3)**
CO5 – Examine the working of various application layer protocols. **(K3)**

UNIT I INTRODUCTION **(9 Hrs)**

Network Applications – Network Hardware and Software – OSI – TCP/IP model – Example Networks – Internet protocols and standards – Connection Oriented Network – X.25 – Frame Relay - Guided Transmission Media – Wireless Transmission – Mobile Telephone System – Transmission modes – Topologies. Case Study: Simple network communication with corresponding cables.

UNIT II DATA LINK LAYER **(9 Hrs)**

Framing – Error Detection and Correction – Checksum. DLC services – Sliding window protocols – Flow and Error control – HDLC – PPP – Multiple access protocols – Multiplexing – Ethernet – IEEE 802.11 – IEEE802.16 – Bluetooth – RFID.

UNIT III NETWORK LAYER **(9 Hrs)**

Network layer services – Packet Switching – IPV4 Addresses – subnetting – Routing algorithms. Network layer protocols: RIP – OSPF – BGP – ARP – DHCP – ICMP - IPv4 and IPv6 - Mobile IP – Congestion control algorithms – Virtual Networks and Tunnels-Global Internet. Case study – Different routing algorithms to select the network path with its optimum and economical during data transfer - Link State routing – Flooding – Distance vector.

UNIT IV TRANSPORT LAYER **(9 Hrs)**

Introduction – Transport layer protocol – UDP – Reliable byte stream (TCP) – Connection management – Flow control – Retransmission – TCP Congestion control – Congestion avoidance – Queuing – QoS – Application requirements.

UNIT V APPLICATION LAYER **(9 Hrs)**

DNS – E-Mail – WWW – Architectural Overview – Dynamic web document and http. Protocols: SSH – SNMP – FTP – SMTP – SONET/SDH – ATM – Telnet – POP.

Text Books

1. Behrouz A. Forouzan, "Data communication and Networking", McGraw-Hill, 5th Edition, 2013
2. S. Tanenbaum, "Computer Networks", Pearson Education/ PHI, 5th Edition, 2013.
3. James F. Kurose, Keith W. Ross, "Computer Networking: A top down approach", Pearson Education, India, 2020.

Reference Books

1. Davie Bruce S. and Peterson Larry L., "Computer Networks - A System Approach", Morgan Kaufmann, 5th Edition, 2012.
2. Godbole, Achyut S and KahateAtul, "Data Communication and Networks", Tata McGraw Hill Publishing Company, New Delhi, 2nd Edition, 2011.
3. William Stallings, "Data and Computer Communications", Pearson, 10th Edition, 2013.
4. Nader. F. Mir, "Computer and Communication Networks", Pearson Prentice Hall Publishers, 2010.
5. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, "Computer Networks: An Open Source Approach", Mc Graw Hill Publisher, 2011.

Web References

1. https://nptel.ac.in/courses/106/105/106105081/
2. https://www.geeksforgeeks.org/computer-network-tutorials/
3. https://www.tutorialspoint.com/data_communication_computer_network/
4. https://www.geeksforgeeks.org/last-minute-notes-computer-network/
5. https://www.javatpoint.com/types-of-computer-network

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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3	2	3	3	2	3	-	-	-	-	-	-	-	2	3	3
4	3	2	2	1	2	-	-	-	-	-	-	-	3	2	2
5	3	3	3	2	3	-	-	-	-	-	-	-	3	3	3

U20ADT202	DATABASE MANAGEMENT SYSTEMS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To learn about Database Structure and Data Models.
- To study SQL Commands for storing and retrieving data into the database.
- To study the Relational database system design.
- To understand the concept of Transactions.
- To understand the concept of Concurrency Control and Recovery System.

Course Outcomes

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

CO1 – Develop conceptual data model using Entity Relationship Diagram. **(K2)**
CO2 – Design conceptual and logical database models for an application. **(K2)**
CO3 – Analyze relational database design of an application. **(K3)**
CO4 – Explain the need for Indexing, Hashing and Transactions in database. **(K2)**
CO5 – Determine the strategies for providing security, privacy, and recovery of data. **(K3)**

UNIT I INTRODUCTION **(9 Hrs)**

Database System Application – Purpose of Database Systems – View of Data – Database Languages – Relational Database – Database Design – System Structure – Database Architecture. Database Design and E-R Model: Overview of the Design Process – The E-R Model – Constraints – E-R Diagrams – E-R Design Issues – Extended E-R features – Reduction to Relational Schemas – Other aspects of Database Design.

UNIT II RELATIONAL MODEL **(9 Hrs)**

Structure of Relational Database – Fundamental Relational Algebra Operations – Extended Relational Algebra Operations – Modification of the Database. Structured Query Language: Introduction – Basic Structure of SQL Queries – Set Operations – Additional Basic Operations – Aggregate Functions – Null Values – Nested Sub queries – Views – Join Expression.

UNIT III RELATIONAL DATABASE DESIGN **(9 Hrs)**

Features of Good Relational Designs – 1NF – 2NF – 3NF – 4NF with Examples. Atomic Domains and First Normal Form – Decomposition using Functional Dependencies – Functional Dependency Theory – Algorithm for Decomposition – Decomposition using Multivalued Dependencies.

UNIT IV INDEXING, HASHING AND TRANSACTION MANAGEMENT **(9 Hrs)**

Basic Concepts – Ordered Indices – B+ Tree Index Files – B-Tree Files – Multiples – Key Access – Static Hashing – Dynamic Hashing – Comparison of Ordered Indexing and Hashing – Bitmap Indices. Transaction Management: Transaction Concept – Storage Structure – Transaction Atomicity and Durability – Transaction Isolation and Atomicity – Serializability – Recoverability – Transaction Isolation Levels – Implementation of Isolation Levels.

UNIT V QUERY PROCESSING AND CONCURRENCY CONTROL **(9 Hrs)**

Query Processing: Measures of Query Cost – Selection Operation – Sorting-Join Operation – Other Operations – Evaluation of Expressions. Query optimization: Overview – Transformation of Relational Expressions – Estimating Statistics of Expression Results – Choice of Evaluation Plan. Concurrency Control: Lock Based Protocols – Timestamp Based Protocols – Validation Based Protocols. Recovery System: Failure Classification – Remote Backup Systems.

Text Books

1. Abraham Silberschatz, Henry F Korth, S Sudharshan, "Database System Concepts", McGraw-Hill 7th Edition, 2019.
2. RamezElmasri and ShamkantNavathe, Durvasula V L N Somayajulu, Shyam K Gupta, "Fundamentals of

Database Systems", Pearson Education, United States of America, 2018.
3. Atul Kahate, "Introduction to Database Management Systems", Pearson Education, New Delhi, 2006.

Reference Books

1. Date CJ, Kannan A, Swamynathan S, "An Introduction to Database System", Pearson Education, 8th Edition, 2006.
2. Raghu Ramakrishna, Johannes Gehrke, "Database Management Systems", McGraw Hill, 3rd Edition, 2014.
3. G.K.Gupta, "Database Management Systems", Tata McGraw Hill, 2011.
4. Jeffrey D. Ullman, "Principles of database systems", Computer Science Press, 1982.
5. Paul Beynon-Davies, "Database Systems", Palgrave Macmillan, 3rd Edition, 2003.

Web References

1. https://nptel.ac.in/courses/106/106/106106095/
2. https://docs.oracle.com/cd/E11882_01/server.112/e41084/toc.htm MySQL Online Documentation
3. http://dev.mysql.com/doc/
4. http://www.rjspm.com/PDF/BCA-428%20Oracle.pdf
5. https://www.tutorialspoint.com/dbms/index.htm

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	1	2	-	-	-	-	-	-	-	3	3	3
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3	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3
4	3	3	2	2	3	-	-	-	-	-	-	-	3	3	3
5	3	3	3	1	3	-	-	-	-	-	-	-	3	3	3

U20ESP244	COMPUTER PROGRAMMING – II LABORATORY (PROGRAMMING IN PYTHON)	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To get a clear understanding of Python Programming concepts.
- To understand Indexing and Sorting.
- To experiment with the process of data cleaning.
- To develop applications to use the concepts of data visualization.
- To apply the analysis concepts on real time data sets.

Course Outcomes

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

CO1 – Describe common Python functionality and features used for data science. **(K2)**
CO2 – Query Data Frame structures for cleaning and processing. **(K2)**
CO3 – Configure your programming environment. **(K3)**
CO4 – Experiment the concept using data visualization. **(K3)**
CO5 – Analyze real time datasets. **(K3)**

List of Exercises

Write a python program to demonstrate the following Concepts:

1. Aggregation
2. Indexing and Sorting
3. Handling of missing data
4. Hierarchical Indexing
5. Usage of Pivot table
6. Use of eval() and query()
7. Scatter Plot
8. 3D plotting
9. Implement an analytic application.
10. Implement an application to process a real time data.

Reference Books

1. Chirag Shah, "A Hands-On Introduction to Data Science", Cambridge University Press, 2020.
2. Siddhartha Chatterjee, Michal Krystyanczuk, "Python Social Media Analytics", Packt Publishing, 2017.
3. Jake VanderPlas, "Python Data Science Handbook - Essential Tools for Working with Data", O'Reily Media Inc, 2016.
4. Zhang.Y, "An Introduction to Python and Computer Programming", Springer Publications, 2016.
5. Wesley J Chun, "Core Python Programming", Pearson Education, 2nd Edition, 2006.

Web References

1. https://nptel.ac.in/courses/106/106/106106212/
2. https://www.geeksforgeeks.org/data-analysis-visualization-python/
3. https://www.coursera.org/learn/python-data-analysis
4. https://www.python.org/
5. https://www.programiz.com/python-programming

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	2	1	3	-	-	-	-	-	-	-	2	2	2
2	2	3	2	2	3	-	-	-	-	-	-	-	2	3	2
3	3	3	3	2	3	-	-	-	-	-	-	-	3	3	3
4	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3
5	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3

U20ESP246	DATA STRUCTURE AND APPLICATIONS LABORATORY	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To understand the basic concepts of Data Structures.
- To experiment the concepts of Searching.
- To implement Sorting Concepts.
- To study about the linear Data Structures.
- To learn the concept of non-linear Data Structures.

Course Outcomes

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

CO1 – Analyze the algorithm's / program's efficiency in terms of time and space complexity. **(K2)**
CO2 – Solve the given problem by identifying the appropriate Data Structure. **(K2)**
CO3 – Solve problems in linear Data Structures. **(K3)**
CO4 – Solve problems in non-linear Data Structures. **(K3)**
CO5 – Implement Sorting and Searching techniques. **(K3)**

List of Exercises

1. Write a C program to implement recursive and non-recursive
   i) Linear search
   ii) Binary Search.
2. Write a C program to implement
   i) Bubble sort
   ii) Selection sort
   iii) Insertion sort
   iv) Shell sort
   v) Heap sort.
3. Write a C program to implement the applications of Stack.
   a) Convert Expressions from Infix to Postfix
   b) Evaluation of Expressions
4. Write a C program to implement the following using an array.
   a) Stack ADT
   b) Queue ADT
5. Write a C program to implement list ADT to perform following operations
   a) Insert an element into a list.
   b) Delete an element from list
   c) Search for a key element in list
   d) Count number of nodes in list.
6. Write a C program to implement the following using a singly linked list.
   a) Stack ADT
   b) Queue ADT.
7. Write a C program to implement the dequeue (double ended queue) ADT using a doubly linked list and an array.
8. Write a C program to perform the following operations:
   a) Insert an element into a binary search tree.
   b) Delete an element from a binary search tree.
   c) Search for a key element in a binary search tree.
9. Write a C program that use recursive functions to traverse the given binary tree in
   a) Preorder
   b) Inorder and
   c) Postorder.

10. Write a C program to perform the AVL tree operations.
11. Write a C program to implement Graph Traversal Techniques.

Reference Books

1. Ellis Horowitz, SartajSahni, "Fundamentals of Data Structures", Illustrated Edition, Computer Science Press, 2018.
2. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Pearson Education, Second Edition, 1997.
3. Reema Thareja, "Data Structures Using C", Oxford University Press, Second Edition, 2011.
4. Aho, Hopcroft and Ullman, "Data Structures and Algorithms", Pearson Education, 1983.
5. Stephen G. Kochan, "Programming in C", Pearson Education, Third Edition,2008

Web References

1. https://nptel.ac.in/courses/106103069/
2. https://www.tutorialspoint.com/data_structures_algorithms/
3. https://www.w3schools.in/data-structures-tutorial/intro/
4. https://www.geeksforgeeks.org/data-structures/
5. https://www.javatpoint.com/data-structure-tutorial/

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4	3	3	3	3	3	-	-	-	-	-	-	-	3	2	3
5	3	3	3	2	3	-	-	-	-	-	-	-	3	3	3

U20ADP202	DATABASE MANAGEMENT SYSTEMS LABORATORY	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To learn and understand the DDL statements.
- To experiment the DML statements.
- To practice the DCL statements.
- To learn and understand the PL/SQL.
- To implement GUI applications using SQL.

Course Outcomes

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

CO1 – Implement the DDL statements. **(K2)**
CO2 – Experiment the DML commands. **(K2)**
CO3 – Infer the built in functions in SQL. **(K2)**
CO4 – Implement PL/SQL programs. **(K3)**
CO5 – Develop GUI applications in their known platform. **(K3)**

List of Experiments

1. Create Table using Data Definition Language (DDL).
2. Modify Table using Data Manipulation Language (DML).
3. Store and Retrieve data through Data Control Language (DCL).
4. Implement Constraints and Built-in functions in various tables.
5. Perform Joins and Group-by functions.
6. Implement Simple Programs in PL/SQL.
7. Create PL/SQL programs using functions.
8. Create PL/SQL programs using procedures.
9. Create PL/SQL programs using triggers.
10. Developing GUI applications.
    - Student Information System.
    - Inventory Management.
    - Payroll Processing.

Reference Books

1. Louis Davidson, StaciaVarga, "Exam Ref 70-762 Developing SQL Databases", Kindle, 1st Edition,2017.
2. James R. Groff, Paul N. Weinberg, Andrew J. Oppel, "SQL: The Complete Reference", 3rd Edition, 2011.
3. Date CJ, Kannan A, Swamynathan S, "An Introduction to Database System", Pearson Education, 8th Edition, 2006.
4. Raghu Ramakrishna, Johannes Gehrke, "Database Management Systems", McGraw Hill, 3rd Edition, 2014.

Web References

1. https://nptel.ac.in/courses/106/106/106106095/
2. https://www.geeksforgeeks.org/sql-tutorial/
3. https://www.coursera.org/specializations/learn-sql-basics-data-science
4. https://docs.oracle.com/cd/E11882_01/server.112/e41084/toc.htm MySQL Online Documentation
5. http://dev.mysql.com/doc/

COs/POs/PSOs Mapping

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4	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3
5	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3

U20ADC2XX	CERTIFICATION COURSE-II	L	T	P	C	Hrs
		0	0	4	0	50

Students shall choose an International certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40-50 hours specified in the curriculum, which will be offered through Centre of Excellence.

Pass /Fail will be determined on the basis of participation, attendance, performance and completion of the course. If a candidate Fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.

U20ADS201	SKILL DEVELOPMENT COURSE 1 (Choose anyone of the below three courses)	L	T	P	C	Hrs
		0	0	2	0	30

1. CLEAN CODE

Course Content:

1. Introduction to Clean Code.
2. Bad Code - The Total Cost of Owning a Mess: The Grand Redesign in the Sky – Attitude.
3. The Primal Conundrum.
4. The Art of Clean Code - Schools of Thought - The Boy Scout Rule - Prequel and Principles.
5. Introduction to Naming Convention - Meaningful Names – Introduction - Use Intention-Revealing Names - Avoid Disinformation - Make Meaningful Distinctions - Use Pronounceable Names - Use Searchable Names - Avoid Encodings.
6. Hungarian Notation - Member Prefixes - Interfaces and Implementations.
7. Avoid Mental Mapping - Class Names - Method Names - Use Solution Domain Names - Use Problem Domain Names.
8. Functions - Blocks and Indenting - Sections within Functions - One Level of Abstraction per Function.
9. Reading Code from Top to Bottom: The Stepdown Rule - Switch Statements - Use Descriptive Names.
10. Function Arguments - Common Monadic Forms - Flag Arguments - Dyadic Functions – Triads - Argument Objects.
11. Comments - Comments Do Not Make Up for Bad Code - Explain Yourself in Code - Good Comments - Legal Comments.
12. Formatting - The Purpose of Formatting - Different Formatting Types.
13. Error Handling - Use Exceptions Rather Than Return Codes.

2. EXPLORING OF GITHUB

Course Content:

1. Introduction to Version Control - Keeping Historical Copies - Diffing Files - Applying Changes.
2. Practical Application of diff and patch.
3. Version control - Version Control and Automation.
4. Git - Installing Git - Installing Git on Windows (Optional) - First Steps with Git - Tracking Files - The Basic Git Workflow - Anatomy of a Commit Message.
5. Introduction to Git Locally - Using Git Locally.
6. Skipping the Staging Area - Getting More Information About Our Changes - Deleting and Renaming Files.
7. Undoing Changes Before Committing - Amending Commits – Rollbacks - Identifying a Commit
8. Introduction to branch - Creating New Branches - Working with Branches.
9. Merging - Merge Conflicts. Working with Remotes.
10. Introduction to GitHub - Basic Interaction with GitHub – Introduction to remote - Working with Remotes - Fetching New Changes - Updating the Local Repository.
11. The Pull-Merge-Push Workflow - Pushing Remote Branches - Rebasing the Changes - Rebasing Example.
12. Collaboration Introduction to Collaboration - Simple Pull Request on GitHub - The Typical Pull Request Workflow on GitHub - Updating an Existing Pull Request - Squashing Changes.
13. Code reviews - Code Review Workflow - Uses of Code Reviews in GitHub. Managing Collaboration.
14. Tracking Issues.
15. Continuous Integration.
16. Collaboration.

3. APTITUDE - I

Course Content:

1. Number System - Basics, Properties & Type of Numbers - Divisibility Rules
2. LCM & HCF - Unit Digit Concept [Cyclicity Method]
3. Decimals, Simplification. Ratio & Proportion - Compounded & Duplicate Ratio - Inverse Ratio - Shortcut to Find Ratio - Continuous Proportion - Mean & Divisibility Proportion.

4. Ages - Both Data is in Ratio or Time Format - One Data in Ratio or Time Format & Other Data in Sum, Difference or Product
5. Logical [Puzzles] Method.
6. Average - Basics & Finding Average in Complex - Replacement & Alteration Method - Average Speed Finding Problems.
7. Allegation & Mixtures
8. Ratio of Mixture - Finding the Kilogram through Ratio
9. Mean Value Method
10. Ratio Mixture [Fraction Method] - Iteration Method.

U20ADM202	ENVIRONMENTAL SCIENCE	L	T	P	C	Hrs
		2	0	0	0	30

We as human being are not an entity separate from the environment around us rather we are a constituent seamlessly integrated and co-exist with the environment around us. We are not an entity so separate from the environment that we can think of mastering and controlling it rather we must understand that each and every action of ours reflects on the environment and vice versa. Ancient wisdom drawn from Vedas about environment and its sustenance reflects these ethos. There is a direct application of this wisdom even in modern times. Idea of an activity based course on environment protection is to sensitize the students on the above issues through following two type of activities.

(a) Awareness Activities:

i. Small group meetings about water management, promotion of recycle use, generation of less waste, avoiding electricity waste
ii. Slogan making event
iii. Poster making event
iv. Cycle rally
v. Lectures from experts

(b) Actual Activities:

i. Plantation
ii. Gifting a tree to see its full growth
iii. Cleanliness drive
iv. Drive for segregation of waste
v. To live some big environmentalist for a week or so to understand his work
vi. To work in kitchen garden for mess
vii. To know about the different varieties of plants
viii. Shutting down the fans and ACs of the campus for an hour or so

U20BST337	PROBABILITY AND STATISTICS FOR DATA SCIENCE	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

- To acquire skills in handling situation including more than one random variable.
- To familiarize the student about the continuous random variables and their Applications.
- To study the basic concepts of Statistics.
- To learn the concept of testing of hypothesis using statistical analysis.
- To learn the concept of Small sampling.

Course Outcomes

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

CO1 – Apply the concept of probability in random variables. **(K3)**
CO2 - Apply the basic rules of continuous random. **(K3)**
CO3 - Understand the basic concepts of Statistics. **(K2)**
CO4 - Derive the inference for various problems using testing of hypothesis in large Samples. **(K5)**
CO5 - Solve the problems related to Testing of Hypotheses in small sample. **(K5)**

UNIT I DISCRETE RANDOM VARIABLES **(12 Hrs)**

Random Variables and their event spaces - The probability mass function - Marginal density - Byes Theorem - Distribution functions - Binomial, Geometric, Negative Binomial and Poisson.

UNIT II CONTINUOUS RANDOM VARIABLES **(12 Hrs)**

Some important distributions - Exponential distribution – Gamma – Weibull - Gaussian distributions - normal distribution. Application of Distribution – Reliability - Failure density and Hazard function.

UNIT III STATISTICS **(12 Hrs)**

Measures of central tendency - Arithmetic Mean, Median and Mode - Measures of dispersion and Standard deviation – Quartile deviation - Skewness and Measures of Skewness - Pearson's coefficient of skewness - Moments - Correlation - Rank correlation and regression - Curve fitting by the method of least squares.

UNIT IV LARGE SAMPLES **(12 Hrs)**

Testing of hypothesis - Fitting of straight lines - Second degree parabolas and more general curves - Test of significance: Large samples test for single proportions, differences of proportions, single mean, difference of means and standard deviations.

UNIT V SMALL SAMPLES **(12 Hrs)**

Test for single mean - difference of means - Test for ratio of variances - Chi-square test for goodness of fit and independence of attributes - Analysis of variance.

Text Books

1. B.S. Grewal, "Higher Engineering Mathematics", KHANNA PUBLISHERS – 3rd edition Paperback 2017.
2. Veerarajan, "Probability, Statistics and Random Processes", Tata McGraw-Hill Education, 2008.
3. Andrew Bruce and Andrew Bruce, "Practical Statistics for Data Scientists ", O' Reilly Media, Second Edition, June 2017.

Reference Books

1. Ravish R. Singh, Mukul Bhatt "Engineering Mathematics", McGraw-Hill, 1st Edition, 2017.
2. William Mendenhall, Robert J. Beaver, Barbara M. Beaver: "Introduction to Probability and Statistics", Cengage Learning; 15th Edition 2019.
3. Richard A. Johnson, Irwin Miller and John E. Freund, "Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2018.
4. Vijay K. Roghatgi and A.K Md. EhsanesSaleh, "An Introduction to Probability and Statistics", Wiley 2008.
5. Dr. A. Singaravelu, "Probability and Statistics", Meenakshi Agency, Paperback – 2019.

Web Resources

1. http:// www.stat110.net
2. http://www.nptel.ac.in/courses/111105035 (R.V)
3. http:// www.probabilitycourse.com.
4. www.edx.org/Probability
5. http://www2.aueb.gr/users/demos/pro-stat.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-
2	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-
3	3	3	3	2	-	-	-	-	-	-	-	1	-	-	-
4	3	3	3	2	-	-	-	-	-	-	-	1	-	-	-
5	3	3	3	2	-	-	-	-	-	-	-	1	-	-	-

U20EST363	SOFTWARE ENGINEERING AND AGILE SOFTWARE DEVELOPMENT	L	T	P	C	Hrs
		3	0	0	3	60

Course Objectives

- To familiarize the concepts of Software Engineering.
- To understand Software Design concepts.
- To learn about Software testing.
- To study the Agile Methodology.
- To understand the process of Agile Methodology.

Course Outcomes

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

CO1 – Perform Software engineering processes. **(K2)**
CO2 – Make use of software design. **(K3)**
CO3 – Apply different software testing strategies. **(K3)**
CO4 – Illustrate different Agile Methodology. **(K2)**
CO5 – Make use of different process of Agile Methodology. **(K3)**

UNIT I SOFTWARE ENGINEERING PROCESSES **(12 Hrs)**

Software engineering concepts – Development activities – Software development lifecycle models –Software project management – Project planning – Estimation – Scheduling – Risk management – Software configuration management - Project Planning – Empirical Estimation Techniques – Staffing Level Estimation – Scheduling – Organization and Team structures – Staffing – Software Requirements specification.

UNIT II SOFTWARE DESIGN **(12 Hrs)**

Characteristics of a Good Software Design – Coupling and Cohesion – Structured Analysis – Data Flow Diagrams – Structured and Detailed Design – Object oriented concepts – UML Diagrams – Use case model – Class diagrams – Interaction diagrams – Activity diagrams – State chart diagrams – Object Oriented Analysis and Design methodology – Characteristics of a good User Interface – Types – A User Interface Design methodology.

UNIT III SOFTWARE TESTING **(12 Hrs)**

Introduction to Software testing – Psychology of Testing – Principles of Software Testing – Defects – Defect Prevention Strategies – Role of a tester – Software Testing Life Cycle.

UNIT IV AGILE METHODOLOGY **(12 Hrs)**

Theories for Agile Management – Agile Software Development – Traditional Model vs. Agile Model – Classification of Agile Methods – Agile Manifesto and Principles – Agile Project Management – Agile Team Interactions – Ethics in Agile Teams – Agility in Design, Testing – Agile Documentations – Agile Drivers, Capabilities and Values.

UNIT V AGILE PROCESSES **(12 Hrs)**

Lean Production – SCRUM, Crystal, Feature Driven Development – Adaptive Software Development – Extreme Programming: Method Overview – Lifecycle – Work Products, Roles and Practices.

Text Books

1. Ian Sommerville, "Software Engineering", Pearson Education, Eighth edition, 2008.
2. Craig Larman, "Agile and Iterative Development–A Manager"s Guide", Pearson Education, 2010.
3. Elisabeth Hendrickson, "Agile Testing" Quality Tree Software Inc, 2012.

Reference Books

1. Hazza and Dubinsky, "Agile Software Engineering, Series: Undergraduate Topics in Computer Science", Springer, 2009.
2. Roger S. Pressman, "Software Engineering: A Practitioner's Approach", McGraw-Hill International Edition, Seventh Edition, 2009.
3. David J. Anderson and Eli Schragenheim, "Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results", Prentice Hall, 2003.

4. Object-Oriented Systems Analysis and Design, McGraw-Hill Higher Education; 4th Edition, 2010.
5. Robert C Martin, "Agile Software Development, Principles, Patents and Practices", Prentice Hall, 2012.
6. James Shore and Shane Warden, "The art of Agile Development", O' Reiely, 2012.
7. Rajib Mall, "Fundamentals of Software Engineering", PHI Learning, Third Edition, 2013.

Web References

1. https://www.coursera.org/courses?query=software%20engineering
2. https://www.edx.org/learn/software-engineering
3. https://www.udemy.com/courses/development/software-engineering/
4. https://www.coursera.org/learn/agile-software-development
5. https://www.tutorialspoint.com/sdlc/sdlc_agile_model.htm

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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2	3	2	3	3	-	-	-	-	-	-	-	-	3	2	2
3	2	2	2	2	-	-	-	-	-	-	-	-	2	2	2
4	3	2	3	3	-	-	-	-	-	-	-	-	3	2	2
5	3	2	3	3	-	-	-	-	-	-	-	-	3	2	2

U20EST364	OPERATING SYSTEM INTERNALS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To analyze the role of OS in the overall computer system and to observe the operations performed by OS as a resource manager.
- To understand the scheduling policies of OS.
- To learn the different memory management techniques.
- To understand Mass storage systems and file system interfaces.
- To analyze the goals and principles of protection and to study different OS case studies and compares their features.

Course Outcomes

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

CO1 – Acquire the knowledge about operating systems objectives, functionalities and components. **(K2)**
CO2 – A clear understanding of program, process, thread and synchronization. **(K2)**
CO3 – Understand deadlock, prevention and avoidance algorithms. **(K2)**
CO4 – Compare and contrast various memory management schemes. **(K3)**
CO5 – Analyze the disk management and understand about the Linux OS. **(K4)**

UNIT I INTRODUCTION TO OPERATING SYSTEM INTERNALS (9 Hrs)

Introduction to System Software – Objectives and functions of OS – Evolution of OS – Distributed System – Real-Time systems – Operating system components – Interrupts – System calls – Virtual machines – Symmetric Multiprocessing – Microkernel. Working with LINUX commands.

UNIT II PROCESS MANAGEMENT (9 Hrs)

Process Management: Processes – Operations on Processes – Inter-process Communication – CPU Scheduling. Threads – Overview – Multithreading models – Threading issues – Process Synchronization. The Critical-section problem – Synchronization hardware – Mutex locks – Semaphores – Classic problems of synchronization – Critical regions – Monitors.

UNIT III SYSTEM MODEL (9 Hrs)

Deadlock Characterization – Methods for handling Deadlocks – Deadlock Detection – Deadlock Prevention – Deadlock Avoidance – Deadlock Recovery. Storage Management: Swapping – Contiguous Memory Allocation – Paging – Segmentation – Segmentation with paging.

UNIT IV VIRTUAL MEMORY (9 Hrs)

Virtual Memory: Background – Demand Paging – Page Replacement – Thrashing. File concept – Access methods – Directory Structure – File system mounting – File Sharing and Protection. File System Implementation: File System Structure – Directory implementation – Allocation Methods – Free Space Management.

UNIT V DISK MANAGEMENT, I/O SYSTEMS AND CASE (9 Hrs)

Kernel I/O Subsystems – Disk Structure – Disk Scheduling – Disk Management – Swap-Space Management. I/O Systems: I/O Hardware – Application I/O interface – Kernel I/O subsystem – Streams – Performance. Linux System: Design Principles – Kernel Modules – Process Management – Scheduling – Memory Management – File System – Inter-process Communication.

Text Books

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts Essentials", John Wiley & Sons (ASIA) Pvt. Ltd, 6th Edition, 2017.
2. William Stallings, "Operating Systems: Internals and Design Principles", Prentice Hall of India, 9th Edition, 2018.
3. William E. Shotts, William E. Shotts, Jr., "The Linux Command Line A Complete Introduction", No Starch Press, 2012.

Reference Books

1. Harvey M. Deitel, Paul J. Deitel, and David R. Choffnes, "Operating Systems", Prentice Hall, 3rd Edition, 2013.
2. Gary J. Nutt, "Operating Systems: A Modern Perspective", Addison-Wesley, 3rd Edition, 2003.
3. William Stallings, "Operating System", Pearson Education, Sixth Edition, 2015.
4. Silberschatz, Galvin, "Operating System Concepts", Wiley, Student Edition, 2006.
5. Andrew S. Tanenbaum, Modern Operating Systems,3rd Edition Prentice Hall of India Pvt. Ltd, 2015.

Web References

1. https://nptel.ac.in/courses/106108101/
2. http://www.tcyonline.com/tests/operating-system-concepts
3. http://www.galvin.info/history-of-operating-system-concepts-textbook
4. https://www.cse.iitb.ac.in/~mythili/teaching/cs347_autumn2016/index.html
5. https://www.cse.iitk.ac.in/pages/CS330.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	3	3	-	-	-	-	-	-	-	-	3	2	2
2	3	2	3	3	-	-	-	-	-	-	-	-	3	2	2
3	2	2	2	2	-	-	-	-	-	-	-	-	2	2	2
4	3	2	3	3	-	-	-	-	-	-	-	-	3	2	2
5	3	2	3	3	-	-	-	-	-	-	-	-	3	2	2

U20EST365 ALGORITHM DESIGN AND ANALYSIS

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To analysis the performance of Algorithms.
- To understand the problems based on Divide and Conquer and Greedy method.
- To infer the various methods to solve a problem using Dynamic method.
- To analyze and develop the suitable approach to solve the problems using Backtracking and Iterative improvement methods.
- To study the problems based on Branch and Bound and NP-Hard.

Course Outcomes

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

CO1 – Analyze and improve the efficiency of algorithms and estimate the performance of algorithm. **(K2)**
CO2 – Experiment the Divide and Conquer and Greedy method for various case studies. **(K3)**
CO3 – Determine the Dynamic programming paradigms and explain when an algorithmic design situation calls for it. **(K3)**
CO4 – Applying different approaches to solve a problem using Backtracking and Iterative Improvement. **(K3)**
CO5 – Interpret the Branch and Bound and NP-Hard paradigms. **(K3)**

UNIT I INTRODUCTION TO ALGORITHM AND NOTATIONS (9 Hrs)

Introduction – Algorithm – Pseudo code for expressing algorithms – Performance Analysis – Time complexity – Space complexity – Asymptotic Notation – Big oh notation – Omega notation – Theta notation and Little oh notation – Probabilistic analysis – Amortized analysis.

UNIT II DIVIDE AND CONQUER AND GREEDY METHOD (9 Hrs)

Divide and Conquer method: Solving recurrence relations – Applications – Binary search – Merge sort – Quick sort. Greedy method: General method – applications – Job sequencing with deadlines – Knapsack problem – Minimum cost spanning trees – Single source shortest path problem - Activity Selection Problem.

UNIT III DYNAMIC PROGRAMMING (9 Hrs)

Dynamic Programming: Applications – Rod cut – Longest Common Subsequence – Multistage graphs – Optimal binary search trees – 0/1 knapsack problem – All pairs shortest path problem – Traveling sales person problem.

UNIT IV BACKTRACKING AND ITERATIVE IMPROVEMENT (9 Hrs)

Backtracking: General method – Applications – N-queen problem – Sum of subsets problem – Graph coloring – Hamiltonian Cycle. Iterative Improvement: The Simplex Method – The Maximum-Flow Problem.

UNIT V BRANCH AND BOUND, NP-HARD PROBLEMS (9 Hrs)

General method – Applications – Traveling sales person problem – 0/1 knapsack problem – LC Branch and Bound solution – FIFO Branch and Bound solution. NP-Hard and NP-Complete problems – Basic concepts – Non deterministic algorithms – NP-Hard and NP-Complete classes - Decidability and Undecidability.

Text Books

1. T.H.Cormen, C.E.Leiserson, R.L.Rivest, and C.Stein, "Introduction to Algorithms", PHI/Pearson Education, 3rd Edition, 2009.
2. E. Horowitz and S.Sahni, "Fundamentals of Algorithms", Galgotia Publications, 2nd Edition, 2010.
3. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Pearson Education, Third Edition, 2012.

Reference Books

1. Michael T. Goodrich and Roberto Tamassia, "Algorithm Design: Foundations, Analysis and Internet Examples", Wiley India, 2006.
2. Sara Baase and Allen Van Gelder, "Computer Algorithms Introduction to Design and Analysis", Pearson Education Asia, 3rd Edition, 2010.
3. Donald E Knuth, "The Art of Computer Programming, Volume I & II", Addison Wessely, Third Edition, 2011.

4. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education, Reprint 2006.
5. Harsh Bhasin, "Algorithms Design and Analysis", Oxford university press, 2016.

Web References

1. https://swayam.gov.in/nd1_noc20_cs71/preview
2. https://www.tutorialspoint.com/design_and_analysis_of_algorithms/
3. https://www.javatpoint.com/daa-tutorial
4. https://www.guru99.com/design-analysis-algorithms-tutorial.html
5. https://www.geeksforgeeks.org/fundamentals-of-algorithms/

COs/POs/PSOs Mapping

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3	2	2	2	2	-	-	-	-	-	-	-	-	2	2	2
4	3	2	3	3	-	-	-	-	-	-	-	-	3	2	2
5	3	2	3	3	-	-	-	-	-	-	-	-	3	2	2

U20ADT303	FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To learn the basics of artificial intelligence concepts
- To understand the problem solving techniques.
- To enable the students to understand the reasoning and planning.
- To gain good knowledge in the concept of uncertainty.
- To inculcate the perceiving and acting of AI applications.

Course Outcomes

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

CO1 – Differentiate between various approaches to Artificial Intelligence. **(K2)**
CO2 – Design intelligent agents and distinguish between Utility based agents and Goal based agents. **(K3)**
CO3 – Apply concepts, methods, and theories of search, heuristics, games, knowledge representation and planning. **(K3)**
CO4 – Apply Natural language processing techniques. **(K3)**
CO5 – Understand the limitations of Artificial Intelligence techniques. **(K2)**

UNIT I INTRODUCTION TO AI **(9 Hrs)**

Introduction: Introduction to Artificial Intelligence – Various definitions of AI – AI Applications and Techniques – Turing Test and Reasoning – forward and backward chaining. Intelligent Agents: Introduction to Intelligent Agents – Rational Agent – their structure – reflex – model-based – goal-based and utility-based agents – behavior and environment in which a particular agent operates.

UNIT II PROBLEM-SOLVING **(9 Hrs)**

Problem Solving and Search Techniques: Problem Characteristics – Production Systems – Control Strategies – Breadth First Search – Depth First Search – iterative deepening – uniform cost search – Hill climbing and its Variations – simulated annealing – genetic algorithm search. Heuristics Search Techniques: Best First Search – A* algorithm – AO* algorithm – MinMax and game trees – refining MinMax – Alpha – Beta pruning – Constraint Satisfaction Problem – Means-End Analysis.

UNIT III KNOWLEDGE, REASONING AND PLANNING **(9 Hrs)**

Knowledge Representation: Introduction to First Order Predicate Calculus – Resolution Principle – Unification – Semantic Nets – Conceptual Dependencies – Semantic networks – Frames system – Production Rules – Conceptual Graphs – Ontologies. Planning: Basic representation for planning – symbolic-centralized vs. reactive- distributed – Partial order planning algorithm.

UNIT IV UNCERTAIN KNOWLEDGE AND REASONING **(9 Hrs)**

Reasoning with Uncertain Knowledge: Different types of uncertainty – Degree of belief and degree of truth – various probability constructs – Prior probability – Conditional probability – Probability axioms – Probability distributions and joint probability distributions – Bayes' rule – Other approaches to modeling uncertainty such as Dempster-Shafer theory and Fuzzy sets/logic.

UNIT V COMMUNICATING, PERCEIVING AND ACTING **(9 Hrs)**

Understanding Natural Languages: Components and steps of communication – Contrast between formal and natural languages in the context of grammar – Parsing and semantics – Parsing Techniques – Context-Free and Transformational Grammars. Computer Vision-Robotics.

Text Books

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach", Pearson Education, 3rd Edition, 2015.
2. Elaine Rich and Kelvin Knight, "Artificial Intelligence", Tata McGraw Hill, 3rd Edition, 2017.
3. DAN.W. Patterson, "Introduction to A.I. and Expert Systems", PHI, 2007.

Reference Books

1. Michael Wooldridge, "An Introduction to MultiAgent Systems", John Wiley & Sons, 2nd Edition, 2009.
2. Fabio Luigi Bellifemine, Giovanni Caire, Dominic Greenwood, "Developing Multi-Agent Systems with JADE", Wiley Series in Agent Technology, John Wiley & Sons, 2007.
3. W.F. Clocksin and C.S. Mellish, "Programming in PROLOG", Springer, 5th Edition, 2003.
4. Saroj Kaushik, "Logic and Prolog Programming", New Age International Publisher, 2012.
5. Ivan Bratko, "Prolog Programming for Artificial Intelligence", Addison-Wesley, Pearson Education, 4th Edition, 2011.

Web References

1. https://nptel.ac.in/courses/106/105/106105077/
2. https://www.tutorialspoint.com/artificial_intelligence/index.html
3. https://www.youtube.com/watch?v=JMUxmLyrhSk

COs/POs/PSOs Mapping

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3	2	2	2	2	-	-	-	-	-	-	-	-	2	2	3
4	3	2	2	3	-	-	-	-	-	-	-	-	3	2	3
5	3	2	2	2	-	-	-	-	-	-	-	-	2	3	2

U20ADT304	BASIC MACHINE LEARNING TECHNIQUES	L	T	P	C	Hrs
		2	2	0	3	45

Course Objectives

- To learn the basics of machine learning concepts.
- To understand the classification algorithms.
- To enable the students to understand the regression models.
- To gain good knowledge in the concept of clustering algorithms.
- To inculcate the dimensionality reduction techniques.

Course Outcomes

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

CO1 – Understand the concepts of machine learning algorithms. **(K2)**
CO2 – Explore the classification models. **(K2)**
CO3 – Acquire knowledge on regression models. **(K2)**
CO4 – Analyze the clustering algorithms. **(K3)**
CO5 – Demonstrate the dimensionality reduction techniques. **(K3)**

UNIT I INTRODUCTION TO MACHINE LEARNING (9 Hrs)

Basics of Machine Learning – Using data to make decisions – Types of Machine Learning Algorithms – Workflow: from data to deployment – Data Preprocessing and Feature Engineering – Outlier Detection – Performance Evaluation.

UNIT II REGRESSION MODELS (9 Hrs)

Introduction of Regression Algorithms – Linear Regression – Multivariate Linear Regression – Logistic Regression – sigmoid function – Applications - Performance Evaluation.

UNIT III CLASSIFICATION MODELS (9 Hrs)

Basics of Classification Algorithms – Building a Classifier and making Predictions – Support Vector Machine – separating data with maximum margin – Bayes theorem – Naive Bayes – classifying with conditional probabilities – K-Nearest Neighbor – Classifying with distance measurements – Applications - Performance Evaluation.

UNIT IV CLUSTERING MODELS (9 Hrs)

Basics of Clustering Algorithms – K-Means improving cluster performance with postprocessing – K-Medians – Expectation Maximization – Hierarchical Clustering – Applications.

UNIT V DIMENSIONALITY REDUCTION TECHNIQUES (9 Hrs)

Introduction– Subset Selection - Principal Component Analysis (PCA) – Factor analysis – Multidimensional Scaling - Linear Discriminant Analysis (LDA) – Generalized Discriminant Analysis(GDA) – Case Study.

Text Books

1. Henrik Brink, Joseph W. Richards, and Mark Fetherolf, "Real-World Machine Learning", Manning Publications, 2017.
2. Tom M. Mitchell, "Machine Learning", McGraw-Hill Science, 1997.
3. Peter Harrington, "Machine Learning in action", Manning Publication, 2012.

Reference Books

1. Charu C. Aggarwal, "Data Classification Algorithms and Applications", Chapman & Hall/CRC Data Mining and Knowledge Discovery Series.
2. Andreas C. Mueller and Sarah Guido, "Introduction to Machine Learning with Python", O'Reilly Media, Inc. First Edition, 2016.
3. Eremy Watt, Reza Borhani, and Aggelos K. Katsaggelos, "Machine Learning Refined Foundations, Algorithms, and Applications", Cambridge University Press, 2016.
4. Shai Shalev-Shwartz and Shai Ben-David, "Understanding Machine Learning: From Theory to Algorithms", Cambridge University Press, 2014.
5. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, "Foundations of Machine Learning", MIT Press, Second Edition, 2012.

Web References

1. https://www.coursera.org/learn/machine-learning
2. https://ml-cheatsheet.readthedocs.io/en/latest/regression_algos.html
3. https://machinelearningmastery.com/a-tour-of-machine-learning-algorithms/

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3	2	3	3	3	-	-	-	-	-	-	-	-	2	3	2
4	3	2	3	2	-	-	-	-	-	-	-	-	3	2	3
5	3	2	3	3	-	-	-	-	-	-	-	-	2	3	3

U20HSP301	GENERAL PROFICIENCY – I	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To enrich strong vocabulary and decoding skills *through comprehension analysis*
- To advance communication and leadership skills pragmatically
- To pronounce English sounds in isolation and in connected speech
- To expand effective written communication skills to meet organizational goals
- To extend knowledge on verbal aptitude and prepare for interviews

Course Outcomes

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

CO1 – Interpret *meaning and apply reading* strategies in technical and non-technical context. **(K3)**
CO2 – Develop interpersonal communication skills professionally. **(K5)**
CO3 – Infer the distinct speech sounds and overcome native language influence. **(K2)**
CO4 – Demonstrate various forms of formal writing. **(K3)**
CO5 – Apply the techniques of verbal aptitude in competitive exams. **(K3)**

UNIT I COMPREHENSION ANALYSIS **(6 Hrs)**

Listening: Listening Comprehension (IELTS based) – **Speaking**: Break the iceberg - **Reading:** Reading technical passage (IELTS based) - **Writing:** Writing Task: 1 (IELTS: Graph/ Process /Chart Description) **Vocabulary:** Synonyms (IELTS).

UNIT II PERSONALITY DEVELOPMENT **(6 Hrs)**

Listening: Interview Videos- **Speaking:** Extempore& Presentation (Soft Skills) - **Reading:** British & American Vocabulary, Read and review (Books, Magazines) - **Writing**: SWOT Analysis **Vocabulary:** Idioms (IELTS).

UNIT III INFERENTIAL LEARNING **(6 Hrs)**

Listening: Listening Speech sounds to overcome Mother Tongue Influence, Anecdotes– **Speaking**: Interpersonal Interaction and Situational attribution–**Reading**: Distinguish between facts & opinions - **Writing:** Writing Conversation to different context **Vocabulary:** Phrasal Verbs (IELTS).

UNIT IV INTERPRETATION AND FUNCTIONAL WRITING **(6 Hrs)**

Listening: Group Discussion videos - **Speaking:** Group Discussion Practice - **Reading:** Interpretation of data - Graph, table, chart, diagram (IELTS based) -**Writing**: Writing Task: 2 (IELTS) **Vocabulary:** Collocations (IELTS).

UNIT V APTITUDE **(6 Hrs)**

Language Enhancement: Articles, Preposition, Tenses. **Verbal Ability Enhancement:** Blood Relation, Completing Statements- Cloze test, Spotting Errors –Sentence Improvement, One Word Substitution, Word Analogy, Word Groups (**GATE**).

Reference Books

1 Jeff Butterfield, "Soft Skills for Everyone", Cengage Learning, New Delhi, 2012.
2 Mn,Taylor, and Grant Taylor. "English Conversation Practice", Tata McGraw-Hill Education, 1975.
3 Bailey, Stephen. "Academic writing: A practical guide for students", Psychology Press, 2003.
4 Aggarwal, R. S. "A Modern Approach to Verbal & Non Verbal Reasoning", S. Chand, 2010.
5 Wren, Percival Christopher, and Wren Martin. "High School English Grammar and Composition", S Chand, 2005.

Web References

1. https://www.ielts-exam.net/grammar/
2. https://ieltsfocus.com/2017/08/02/collocations-ielts/
3. https://www.fresherslive.com/online-test/blood-relations-questions-and-answers
4. https://www.toppr.com/guides/english-language/reading-comprehension/cloze-test/
5. https://www.examsbook.com/word-analogy-test-questions-with-answers

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	-	-	-	-	-	1	-	3	-	2	-	-	-
2	1	-	-	-	-	-	-	1	-	3	-	2	-	-	-
3	1	-	-	-	-	-	-	1	-	3	-	2	-	-	-
4	1	-	-	-	-	-	-	1	-	3	-	2	-	-	-
5	1	-	-	-	-	-	-	1	-	3	-	2	-	-	-

U20BSP326	STATISTICAL LABORATORY	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To familiarize the concept of Uni-variate, bi-variate frequency distributions.
- To understand the concept of Measures of location and dispersion.
- To learn Rank correlation.
- To understand the concept of Regression Equations.
- To introduce the concepts of curve fitting.

Course Outcomes

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

CO1 - Draw the different types of curves. **(K4)**

CO2 - Understand the concept of Skewness and Kurtosis. **(K2)**

CO3 – Compute the Correlation coefficient. **(K5)**

CO4 - Compute regression lines. **(K5)**

CO5 - Find the straight line and parabola. **(K5)**

List of Experiments

1. Construction of bar diagram
2. Construction of pie diagram
3. Construction of Mean, Median and Mode
4. Construction of standard deviation.
5. Measures of Skewness and Kurtosis for both grouped and ungrouped data.
6. Computation of Correlation co-efficient.
7. Computation Rank correlation.
8. Regression Equations.
9. Fit a straight line.
10. Fit a parabola.

Text Books

1. Irfan A Khan, "Fundamentals of Biostatistics" Ukaaz Publication, 5th Edition, 2016.
2. PSS Sunder Rao, "An introduction to Biostatistics" PHI Learning Pvt Ltd, 2012.
3. Moore and McCabe, "Introduction to the Practice of Statistics" WH Freeman, 9th Edition, 2009.

Reference Books

1. Marcello Pagano, "Principles of Biostatistics", 7th Edition, 2015.
2. Course Manuals: S-PLUS Command Line Essentials, the Analysis of Microarrays
3. Richard. A. Johnson, Irwin Miller and John E. Freund," Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2018
4. P. Kandasamy, Thilagavathy. K and Gunavathi. K, "Probability and Queuing Theory" S. Chand & Co. Pvt. Ltd.2015
5. Dr.G. Balaji, "Probability and Statistics", G. Balaji Publishers, 2017.

Web Resources

1. https://youtu.be/9pHi2vkz2_Y
2. https://youtu.be/4lAvbp-yVs8
3. https://youtu.be/B3pAD8ie3k0?list=PLoNoar1DlEikiPbM5cdpXOxDtQcrb4fQ5
4. https://youtu.be/6MEdP4zMLuQ

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	3	2	-	-	-	-	-	-	-	-	2	2	3
2	3	2	2	3	-	-	-	-	-	-	-	-	2	2	2
3	2	2	3	2	-	-	-	-	-	-	-	-	3	2	3
4	3	2	2	3	-	-	-	-	-	-	-	-	3	3	3
5	3	2	3	2	-	-	-	-	-	-	-	-	2	2	2

U20ESP366	ALGORITHM DESIGN AND ANALYSIS LABORATORY	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To familiarize the concept of Divide-and-Conquer technique.
- To understand the concept of Greedy Method.
- To learn Dynamic Programming.
- To understand the concept of Backtracking.
- To introduce the concepts of Branch-and-Bound technique.

Course Outcomes

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

CO1 – Implement concepts using Divide-and-Conquer technique. **(K2)**
CO2 – Understand the concept using Greedy Method. **(K2)**
CO3 – Experiment programs using Dynamic Programming. **(K3)**
CO4 – Implement concepts using Backtracking. **(K3)**
CO5 – Understand the Branch-and-Bound technique. **(K3)**

List of Experiments

Implement the following concepts:

1. Binary search using Divide-and-Conquer technique.
2. Merge and Quick sort using Divide-and-Conquer technique.
3. Finding Maximum and Minimum using Divide-and-Conquer technique.
4. Knapsack using Greedy technique.
5. Minimum Spanning Tree using Prim's and Kruskal's Algorithm using Greedy technique.
6. Single-Source Shortest Paths algorithms using Greedy technique.
7. Longest common subsequence using Dynamic Programming technique.
8. All Pairs Shortest Paths using Dynamic Programming technique.
9. 8 Queens with the design of Backtracking.
10. Sum of subsets with the design of Backtracking.
11. mcoloring with the design of Backtracking
12. Hamiltonian cycle with the design of Backtracking
13. 0/1 Knapsack problems with Branch-and-Bound technique.

Reference Books

1. T.H.Cormen, C.E.Leiserson, R.L.Rivest, and C.Stein, "Introduction to Algorithms", PHI/Pearson Education, 3rd Edition, 2009.
2. E. Horowitz and S.Sahni, "Fundamentals of Algorithms", Galgotia Publications, 2nd Edition, 2010.
3. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Pearson Education, Third Edition, 2012.
4. Michael T. Goodrich and Roberto Tamassia, "Algorithm Design: Foundations, Analysis and Internet Examples", Wiley India, 2006.
5. Sara Baase and Allen Van Gelder, "Computer Algorithms Introduction to Design and Analysis", Pearson Education Asia, 3rd Edition, 2010.

Web References

1. https://swayam.gov.in/nd1_noc20_cs71/preview
2. https://www.tutorialspoint.com/design_and_analysis_of_algorithms/
3. https://www.javatpoint.com/daa-tutorial
4. https://www.guru99.com/design-analysis-algorithms-tutorial.html
5. https://www.geeksforgeeks.org/fundamentals-of-algorithms/

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2	3	2	3	3	-	-	-	-	-	-	-	-	2	3	2
3	2	3	2	2	-	-	-	-	-	-	-	-	3	2	3
4	3	2	3	3	-	-	-	-	-	-	-	-	2	3	2
5	3	2	3	3	-	-	-	-	-	-	-	-	3	2	3

U20ADP303	ARTIFICIAL INTELLIGENCE LABORATORY	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To study about the PROLOG programming.
- To learn the basics of 8 queens problem.
- To develop the programs using DFS and BFS.
- To develop applications using Means End Analysis.
- To understand the concepts of Traveling salesman problem.

Course Outcomes

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

CO1 – Describe the basics of PROLOG programming. **(K2)**
CO2 – Implement the concepts using DFS and BFS. **(K2)**
CO3 – Implement the concepts using Means End Analysis. **(K2)**
CO4 – Ability to implement Genetic Algorithm. **(K3)**
CO5 – Experiment Traveling Salesman Problem. **(K3)**

List of Experiments

1. Study of PROLOG. Write the following programs using PROLOG.
2. Write simple fact for the statements using PROLOG.
3. Write a program to solve 8 queens problem.
4. Write a program to solve water jug problem using PROLOG.
5. Solve any problem using depth first search.
6. Solve any problem using best first search.
7. Solve 8-puzzle problem using best first search.
8. Solve Robot (traversal) problem using means End Analysis.
9. Tournament Selection Method – Genetic Algorithm.
10. Solve traveling salesman problem.

Reference Books

1. Russell & Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall, 1995.
2. Elain Rich and Kevin Knight, "Artificial Intelligence", TMH, 1991.
3. Staurt Russel and peter norvig, "Artificial Intelligence-A modern approach", PHI, 1998.
4. Patrick Henry Winston, "Artificial intelligence", Addition Wesley, 3rd Edition, 1992.
5. Patrick Saint-Dizier, "An Introduction to Programming in Prolog", Springer New York, 2012.

Web References

1. https://nptel.ac.in/courses/106/105/106105077/
2. https://www.tutorialspoint.com/artificial_intelligence/index.html
3. https://www.youtube.com/watch?v=JMUxmLyrhSk
4. https://www.geeksforgeeks.org/prolog-an-introduction/

COs/POs/PSOs Mapping

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3	2	2	2	2	-	-	-	-	-	-	-	-	2	2	2
4	3	2	3	3	-	-	-	-	-	-	-	-	2	2	3
5	3	2	3	3	-	-	-	-	-	-	-	-	3	2	3

U20ADP304	BASIC MACHINE LEARNING TECHNIQUES LABORATORY	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To study about the data preprocessing concepts.
- To learn the basics of supervised algorithms.
- To develop the unsupervised algorithms.
- To develop applications using Regression techniques.
- To understand the concepts of Dimensionality Reduction techniques.

Course Outcomes

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

CO1 – Describe the data preprocessing techniques. **(K2)**
CO2 – Implement the concepts using Supervised algorithms. **(K2)**
CO3 – Implement the concepts using Unsupervised algorithms. **(K2)**
CO4 – Ability to implement Regression Techniques. **(K3)**
CO5 – Experiment Dimensionality Reduction techniques. **(K3)**

List of Experiments

Implementation the following algorithms with suitable applications using Python.

1. Data preprocessing
2. Support Vector Machine
3. Naive Bayes
4. K-Nearest Neighbor
5. Linear Regression
6. Logistic Regression
7. K-Means
8. K-Medians
9. Principal Component Analysis
10. Linear Discriminant Analysis

Reference Books

1. Andreas C. Mueller and Sarah Guido, "Introduction to Machine Learning with Python", O'Reilly Media, Inc. First edition, 2016.
2. Henrik Brink, Joseph W. Richards, and Mark Fetherolf, "Real-World Machine Learning", Manning Publications, 2017.
3. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, "Foundations of Machine Learning", The MIT Press, 2nd Edition, 2012.

Web References

1. https://pythonprogramming.net/machine-learning-tutorial-python-introduction/
2. https://algorithmia.com/blog/machine-learning-algorithms-in-python
3. https://www.pyimagesearch.com/2019/01/14/machine-learning-in-python/
4. https://machinelearningmastery.com/machine-learning-in-python-step-by-step/

COs/POs/PSOs Mapping

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3	2	2	2	2	-	-	-	-	-	-	-	-	2	2	2
4	3	2	3	3	-	-	-	-	-	-	-	-	2	2	3
5	3	2	3	3	-	-	-	-	-	-	-	-	3	2	3

U20ADS302	SKILL DEVELOPMENT COURSE 2 (Choose anyone of the below three courses)	L	T	P	C	Hrs
		0	0	2	0	30

1. API DESIGN – I

Course Content:

1. REST – What You Didn't Know
2. A brief history of REST
3. Principle 1 – everything is a resource
4. Principle 2 – each resource is identifiable by a unique identifier
5. Principle 3 – use the standard HTTP methods
6. Principle 4 – resources can have multiple representations
7. Principle 5 – communicate statelessly
8. The REST goals
9. Separation of the representation and the resource
10. Visibility and Reliability
11. Scalability and performance
12. Working with WADL
13. Taking advantage of the existing infrastructure
14. Getting Started with Node.js
15. Installing Node.js
16. Node Package Manager
17. Installing the Express framework and other modules
18. Setting up a development environment
19. Handling HTTP requests
20. Modularizing code
21. Testing Node.js
22. Working with mock objects
23. Deploying an application

2. EXPLORING OF RESEARCH TOOLS

Course Content:

1. Bit.ai
2. elink.io
3. GanttPRO
4. Grammarly
5. Typeset.io
6. Scrivener
7. Endnote
8. Evernote
9. Mendeley
10. ContentMine
11. ResearchGate
12. Google Scholar

3. APTITUDE – II

Course Content:

1. Number System – II [Advanced Level].
2. Factors [Sum, Product, odd, Even].
3. Remainder Theorem - No of Zeros at End -Highest Power - Finding the Last two Digits.
4. Time & Work, Chain Rule - Working Together.
5. Combination Method - Before, After & Alternative Method.
6. Men & Days - Men, Days & Work - Efficiency & Wages.
7. Equation Method.

8. Profit & Loss - Basics & Short Cuts - Passing Through Successive Hands.
9. Purchase & Selling - Dishonest Shopkeeper.
10. Successive Discount into Single Equivalent Discount - Dealing with two or more Parts.
11. Percentage - Conversion & Shortcuts - Population, Depreciation Methods.
12. Percentage Savings & Expenditure - Reduction in Consumption - Percentage Relationship.
13. Time, Speed & Distance, Trains, Boats - Relationship between T/S/D.
14. Train in same Direction - Opposite Direction.
15. Boats along with Streams - Against the Stream

U20BST432	DISCRETE MATHEMATICS AND GRAPH THEORY (Common to CSE, IT and AI&DS)	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

- To learn the concept of symbolic logic and truth tables.
- To apply the rules of Inference and predicate calculus.
- Analyze the asymptotic performance of Lattices.
- To understand the fundamental concepts of Graph theory.
- Synthesize efficient algorithms in Graph theory and trees.

Course Outcomes

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

CO1 – Construct mathematical arguments using logical connectives and truth tables. **(K3)**

CO2 – Apply propositional and predicate logic and quantifiers. **(K3)**

CO3 – Solve the problems using counting techniques in Lattices. **(K3)**

CO4 – Familiarize the different types of Graphs. **(K3)**

CO5 – Understand various types of trees and methods for algorithms. **(K2)**

UNIT I MATHEMATICAL LOGIC AND STATEMENT CALCULUS (12 Hrs)

Introduction – Connectives – Statement formulae – Truth table – Tautologies – Equivalence of Statement formulae – NAND and NOR Connectives – Implications – Principal conjunctive and disjunctive normal forms.

UNIT II PREDICATE CALCULUS (12 Hrs)

Inference calculus – Derivation process – Conditional proof – Indirect method of proof – Automatic theorem proving – Predicate calculus.

UNIT III LATTICES (12 Hrs)

Boolean algebra – Lattices – Sub lattices – Complemented and Distributive lattices. Partially Ordered Relations – Lattices as Posets – Hasse Diagram – Properties of Lattices.

UNIT IV GRAPH THEORY (12 Hrs)

Graphs – Applications of graphs – Degree – Pendant and isolated vertices – Isomorphism – Sub graphs – Walks – Paths and Circuits – Connected graphs – Euler graphs – Hamilton paths and circuits – Complete graph.

UNIT V TREES (12 Hrs)

Trees – Properties of Trees – Pendant vertices in a Tree – Kruskal algorithm.

Text Books

1. P.Tremblay and R.Manohar, "Discrete Mathematical structures with applications to computer science", 13th reprint, Tata McGraw - Hill publishers, 2002.
2. Narsinghdeo, "Graph Theory with Applications to Engineering and Computer Science", Dover Publications New York, 1st Edition, 2016.
3. Kenneth H. Rosen, "Discrete Mathematics and its Applications", Tata McGraw - Hill Publishing Company, Pvt. Ltd., New Delhi, 5th Edition, 2003.

Reference Books

1. C.L. Liu, "Elements of Discrete Mathematics", Tata McGraw - Hill Education Pvt. Ltd., 3rd Edition, 2008.
2. F. Harary, "Graph theory", Narosa publishing house, New Delhi, 1988.
3. Douglas B. West, "Introduction to Graph theory", Pearson Education, 2nd Edition, 2002.
4. Oscar Levin, "Discrete Mathematics An Open Introduction", 3rd Edition, 4th Printing: 2019 ISBN: 978-1792901690
5. Edgar C Coodare and Michael M Parmenter, "Discrete Mathematics with Graph Theory", Pearson Education; 3rd Edition, 2015.

Web Resources

1. https://www.researchgate.net/publication/1922282_Discrete_Mathematics_for_Computer_Science_Some_Notes
2. https://nptel.ac.in/courses/111/107/111107058/
3. https://nptel.ac.in/courses/106/106/106106183/
4. https://www.pdfdrive.com/discrete-mathematics-for-computer-science-e17017833.html
5. https://www.cs.yale.edu/homes/aspnes/classes/202/notes.pdf

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	1	3	2	1
2	3	2	1	1	-	-	-	-	-	-	-	1	3	2	1
3	3	2	1	1	-	-	-	-	-	-	-	1	3	2	1
4	3	2	1	1	-	-	-	-	-	-	-	1	3	1	1
5	2	1	-	-	-	-	-	-	-	-	-	1	3	1	1

U20ADT405	DATA VISUALIZATION	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To explore the fundamental concepts of Visualization.
- To understand the various visualization techniques using Seaborn.
- An understanding of the key techniques and used in visualization, graphical perception and techniques using Bokeh.
- To understand the visualization concept using Tableau.
- To learn the Maps using Tableau.

Course Outcomes

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

CO1 – Design and create data visualizations. **(K3)**
CO2 – Understand the Seaborn library in Python. **(K2)**
CO3 – Analyze the visualization concepts using Bokeh. **(K2)**
CO4 – Apply the various Charts using Tableau. **(K3)**
CO5 – Understand and apply Maps in Tableau. **(K3)**

UNIT I INTRODUCTION TO VISUALIZATION (9 Hrs)

Introduction to data visualization - Importance of data visualization - data wrangling - tools and libraries for visualization - types of data – Plots – line - bar – radar - relation – scatter – bubble –heatmap – pie - Stacked Bar Chart - Venn diagram - distribution plot – histogram – density - box plot – geo - dot plot.

UNIT II INTRODUCTION TO SEABORN (9 Hrs)

Introduction to Seaborn - Advantages of Seaborn - Controlling Figure Aesthetics - Seaborn Figure Styles - Removing Axes Spines - Colour Palettes - Kernel Density Estimation - Plotting Bivariate Distributions - Visualizing Pairwise Relationships - Violin Plots - Multi-Plots in Seaborn - Facet Grid - Regression Plots - Squarify.

UNIT III INTRODUCTION TO BOKEH (9 Hrs)

Concepts of Bokeh - Interfaces in Bokeh - Bokeh Server – Presentation – Integrating - The Design Principles of Geoplotlib - Geospatial Visualizations - Tile Providers - Custom Layers.

UNIT IV VISUALIZATION USING TABLEAU (9 Hrs)

Connecting to data source – Creating Univariate Charts: Tables – Bar graphs – Pie charts – Sorting the graphs – Histograms – Line Charts – Using the Show Me toolbar – Stacked Bar Graphs – Box Plots – Showing Aggregate Measures. Creating Bivariate Charts: Tables – Scatter Plots – Swapping Rows and Columns – Adding trend lines – Selecting color Palettes – Using dates. Creating Multivariate Charts – Acets – Area Charts – Bullet Graphs – dual axes charts – Gantt charts – heat maps.

UNIT V MAPS USING TABLEAU (9 Hrs)

Setting Geographic Roles – Placing marks on a Map – Overlaying Demographic data – Creating choropleth Maps – Using polygon shapes – Customizing Maps – Creating Dashboards – Creating Storyboard.

Text Books

1. Ben Fry, "Visualizing Data", O"Reilly Media, Inc., 2007.
2. Mario Döbler and Tim Großmann, "Data Visualization with Python" Packt Publishing, 2019.
3. Ashutosh Nandeshwar, "Tableau Data Visualization Cookbook", Packt Publishing Ltd., 2013.

Reference Books

1. Scott Murray, "Interactive data visualization for the web", O"Reilly Media, Inc., 2013.
2. Tamara Munzner, "Visualization Analysis and Design", A K Peters Visualization Series, CRC Press, 2014.
3. Kieran Healy, "Data Visualization A Practical Introduction", Princeton University Press, 2018.
4. Seema Acharya, Subhashini Chellappan, "Pro Tableau A Step-by-Step Guide", Apress, 2016.
5. Alexander Loth, "Visual Analytics with Tableau", Wiley, 2019.

Web References

1. https://www.cs.ubc.ca/~tmm/vadbook/
2. https://www.tableau.com/
3. https://www.guru99.com/what-is-tableau.html

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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3	2	2	2	2	-	-	-	-	-	-	-	-	2	2	2
4	3	2	3	3	-	-	-	-	-	-	-	-	3	2	2
5	3	2	3	3	-	-	-	-	-	-	-	-	3	2	2

U20ADT406	ADVANCED MACHINE LEARNING TECHNIQUES	L	T	P	C	Hrs
		2	2	0	3	45

Course Objectives

- To learn the insight of decision learning concepts
- To enable the students to understand the Rule base Learning
- To understand the ensemble methods to boost the performance of models.
- To gain good knowledge in the concept of Neural Network.
- To inculcate Feed forward Neural Network.

Course Outcomes

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

CO1 – Understand the concepts of Decision learning algorithm. **(K2)**
CO2 – Explore the rule based learning. **(K2)**
CO3 – Acquire knowledge on ensemble learning. **(K2)**
CO4 – Explore and Analyze the Neural Network. **(K2)**
CO5 – Demonstrate the backpropogation Neural Network. **(K3)**

UNIT I DECISION TREES **(9 Hrs)**

Decision tree representation – Basic decision tree algorithm – Hypothesis space search – Inductive bias – Issues in decision tree – Case studies with C4.5 and CART – Incremental decision tree induction – ID3 – Hidden Markov Model.

UNIT II RULE BASED LEARNING **(9 Hrs)**

Rule Induction – One Rule in Rule Learning – Association rule mining – Association rules – Case studies with Apriori and Equivalence Class Transformation Algorithm.

UNIT III ENSEMBLE LEARNING **(9 Hrs)**

Introduction – Bayesian methods – Bagging: Random Forest – Boosting: Adaboost and XGBoost Algorithms Light GBM – Stacking.

UNIT IV ARTIFICIAL NEURAL NETWORK **(9 Hrs)**

Neural Network Representation – Types of activation functions - Network Topology – Perceptrons – Learning rule: Hebbian – Perceptron and Delta – Single Layer Neural Network.

UNIT V FEED FORWARD NEURAL NETWORK **(9 Hrs)**

Multi-Layer Feedforward Network – MLP Architecture – Error Metrics: Mean Square Error (MSE) – Cross-Entropy (CE) – Minimum Classification Error (MCE) – Learning by Backpropagation – Enhancing backpropagation –Generalization Issues.

Text Books

1. Tom M. Mitchell, "Machine Learning", McGraw Hill, 1997.
2. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, "Foundations of Machine Learning", The MIT Press, Second Edition, 2012.
3. Henrik Brink, Joseph W. Richards and Mark Fetherolf, "Real-World Machine Learning", Manning Publications Co, 2017.

Reference Books

1. Charu C. Aggarwal "Data Classification Algorithms and Applications" Chapman & Hall/CRC Data Mining and Knowledge Discovery Series.
2. Andreas C. Mueller and Sarah Guido, "Introduction to Machine Learning with Python", O'Reilly Media, Inc. First Edition, 2016.
3. Eremy Watt, Reza Borhani, and Aggelos K. Katsaggelos, "Machine Learning Refined Foundations, Algorithms, and Applications" Cambridge University Press, 2016.
4. Shai Shalev-Shwartz and Shai Ben-David, "Understanding Machine Learning: From Theory to Algorithms", Cambridge University Press, 2014.
5. John Hearty "Advanced Machine Learning with Python", Packt Publishing Ltd., 2016.

Web References

1. https://nptel.ac.in/courses/106/106/106106139/
2. https://www.coursera.org/learn/machine-learning.
3. https://www.youtube.com/watch?v=GwIo3gDZCVQ

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2	3	2	3	3	-	-	-	-	-	-	-	-	3	2	2
3	2	2	2	2	-	-	-	-	-	-	-	-	2	2	2
4	3	2	3	3	-	-	-	-	-	-	-	-	3	2	2
5	3	2	3	3	-	-	-	-	-	-	-	-	3	2	2

U20ADT407	EXPERT SYSTEM AND DECISION MAKING	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To learn the basics of Expert systems.
- To understand the concepts of Knowledge representation.
- To enable the students to understand the Inference methods.
- To gain good knowledge in the concept of Reasoning under uncertainty.
- To inculcate the design of expert system.

Course Outcomes

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

CO1 – Understand the concepts of Expert systems. **(K2)**
CO2 – Acquire knowledge on Knowledge representation techniques. **(K2)**
CO3 – Explore the Inference methods. **(K3)**
CO4 – Explore and Analyze the Reasoning under uncertainty. **(K2)**
CO5 – Demonstrate the design of expert system. **(K3)**

UNIT I INTRODUCTION TO EXPERT SYSTEMS **(9 Hrs)**

The meaning of an expert system - problem domain and knowledge domain - the advantages of an expert system - general stages in the development of an expert system - general characteristics of an expert system - history and uses of expert systems today - rule-based expert systems - procedural and nonprocedural paradigms - characteristics of artificial neural systems.

UNIT II THE REPRESENTATION OF KNOWLEDGE **(9 Hrs)**

The study of logic - difference between formal logic and informal logic - meaning of Knowledge - how knowledge can be represented - semantic nets - how to translate semantic nets into PROLOG - limitations of semantic nets – schemas - frames and their limitations - how to use logic and set symbols to represent knowledge - the meaning of propositional and first order predicate logic – quantifiers - imitations of propositional and predicate logic.

UNIT III METHODS OF INFERENCE **(9 Hrs)**

Trees – lattices - and graphs - state and problem spaces - AND-OR trees and goals - methods of inference - rules of inference - limitations of propositional logic - logic systems - resolution rule of inference - resolution systems - and deduction - shallow and causal reasoning - applying resolution to first-order predicate logic - forward and backward chaining - additional methods of Inference - Meta knowledge - the Markov decision process – Decision Making – Decision Making using ML, Decision Support System – Role of Artificial Intelligence in Intelligent Decision Support System.

UNIT IV REASONING UNDER UNCERTAINTY **(9 Hrs)**

The meaning of uncertainty and theories devised to deal with it - types of errors attributed to uncertainty - errors associate - with induction - features of classical probability - experimental and subjective probabilities - compound and conditional probabilities - hypothetical reasoning and backward induction - temporal reasoning - Markov chains - odds of belief - sufficiency and necessity - role of uncertainty in inference chains - implications of combining evidence - role of inference nets in expert systems - how probabilities are propagated.

UNIT V DESIGN OF EXPERT SYSTEMS **(9 Hrs)**

How to select an appropriate problem - the stages in the development of an expert system - types of errors to expect in the development stages - the role of the knowledge engineer in the building of expert systems - the expected life cycle of an expert system - how to do a life cycle model.

Text Books

1. Durkin, J., "Expert systems Design and Development", Macmillan, 1994.
2. Elias M. Awad, "Building Expert Systems", West Publishing Company, 1996.
3. Peter Jackson, "Introduction to Expert Systems", Addison Wesley Longman, 1999.

Reference Books

1. Gonzalez and D. Dankel, "The Engineering of Knowledge-Based Systems", Prentice Hall, 1994.
2. Nikolopoulos, "Expert Systems", Marcel Dekker Inc. 1997.
3. H. B. Verbruggen, Spyros G. Tzafestas, "Artificial Intelligence in Industrial Decision Making, Control and Automation", Springer, 2012.
4. Lakhmi C. Jain, Gloria Phillips-Wren, "Intelligent Decision Support Systems in Agent-mediated Environments", IOS Press, 2005.
5. Nilanjan Dey, Jitendra Kumar Rout, Himansu Das, Suresh Chandra Moharana "Applied Intelligent Decision Making in Machine Learning", CRC Press; 1st Edition, 2020.

Web References

1. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-034-artificial-intelligence-fall-2010/lecture-videos/lecture-3-reasoning-goal-trees-and-rule-based-expert-systems/
2. http://www.umsl.edu/~joshik/msis480/chapt11.htm
3. https://www.coursera.org/courses?query=decision%20making
4. https://www.slideshare.net/akhilrocker143/572-11293384
5. https://www.sciencedirect.com/science/article/abs/pii/0378720693900696

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	3	3	-	-	-	-	-	-	-	-	3	2	2
2	3	2	3	3	-	-	-	-	-	-	-	-	3	2	2
3	2	2	2	2	-	-	-	-	-	-	-	-	2	2	2
4	3	2	3	3	-	-	-	-	-	-	-	-	3	2	2
5	3	2	3	3	-	-	-	-	-	-	-	-	3	2	2

U20HSP402	GENERAL PROFICIENCY – II	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To examine various standardized test in English language.
- To recognize the key features of various technical writing.
- To integrate LSRW skills to endorse multifarious skill set in practical situation.
- To understand the factors that influences the usage of grammar.
- To understand the basic concepts of logical reasoning skills.

Course Outcomes

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

CO1 – Infer ideas to attend international standardized test by broadening receptive and productive skills. **(K2)**

CO2 – Interpret the types of writing in different state of affairs. **(K3)**

CO3 – Develop language skills professionally to groom the overall personality through sensitizing various etiquettes in real time situation. **(K3)**

CO4 – Identify the rules of grammar in academic discourse settings. **(K2)**

CO5 – Maximise the skills to compete in various competitive exams like GATE, GRE, CAT, UPSC, etc. **(K5)**

UNIT I CAREER SKILLS **(6 Hrs)**

Listening: Listening at specific contexts. **Speaking:** Mock interview (Personal and Telephonic). **Reading**: Read and Review - Newspaper, Advertisement, Company Handbooks, and Guidelines (IELTS based) **Writing:** Essay Writing (TOEFL) **Vocabulary:** Words at specified context (IELTS).

UNIT II CORPORATE SKILLS **(6 Hrs)**

Listening: Listening and replicating **Speaking**: Team Presentation (Work Place Etiquettes) **Reading:** Short texts (signs, emoticons, messages) **Writing:** E-mail writing - Hard skills - Resume' Writing, Job Application Letter, Formal Letter **Vocabulary:** Glossary (IELTS).

UNIT III FUNCTIONAL SKILLS **(6 Hrs)**

Listening: Listening TED Talks – **Speaking:** Brainstorming &Individual Presentation, Persuasive Communication – **Reading:** Text Completion (GRE Based) **Writing:** Expansion of Compound Words **Vocabulary:** Expansion of vocabulary (IELTS).

UNIT IV TRANSFERABLE SKILLS **(6 Hrs)**

Listening: Listening Documentaries and making notes – **Speaking:** Conversation practice at formal & informal context **Reading:** Read and transform- report, memo, notice and advertisement. **Writing:** Euphemism, Redundancy, and Intensifiers **Vocabulary:** Refinement of vocabulary (IELTS).

UNIT V APTITUDE **(6 Hrs)**

Transformational Grammar: Phrases & Clauses, Concord, Conditional Clauses, Voice, Modals. **Verbal Ability Enhancement:** Letter Series, Coding &Decoding, Sentence Completion (GATE), Critical Reasoning and Verbal Deduction (GATE), Syllogism.

Reference Books

1. Lougheed, Lin. "Barron's Writing for the TOEFL IBT: With Audio CD". Barron's Educational series, 2008.
2. Tulgan, Bruce. "Bridging the soft skills gap: How to teach the missing basics to today's young talent". John Wiley & Sons, 2015.
3. Sherfield, Robert M. "Cornerstone: Developing Soft Skills". Pearson Education India, 2009.
4. Cullen, Pauline, Amanda French, and Vanessa Jakeman. "The official Cambridge guide to IELTS for academic & general training".Cambridge, 2014.
5. Ramesh, Gopalaswamy. "The ace of soft skills: attitude, communication and etiquette for success". Pearson Education India, 2010.

Web References

1. https://www.englishclub.com/grammar/nouns-compound.htm
2. https://lofoya.com/Verbal-Test-Questions-and-Answers/Sentence-Completion/l3p1
3. https://www.grammarwiz.com/phrases-and-clauses-quiz.html
4. https://www.clarkandmiller.com/25-english-euphemisms-for-delicate-situations/

5. http://www.englishvocabularyexercises.com/general-vocabulary/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	-	-	-	-	-	1	-	3	-	2	-	-	-
2	1	-	-	-	-	-	-	1	-	3	-	2	-	-	-
3	1	-	-	-	-	-	-	1	-	3	-	2	-	-	-
4	1	-	-	-	-	-	-	1	-	3	-	2	-	-	-
5	1	-	-	-	-	-	-	1	-	3	-	2	-	-	-

U20ADP405	DATA VISUALIZATION LABORATORY	L	T	P	C	Hrs
		0	0	2	1	30

Course objectives

- To introduce the basic concepts of various Visualization techniques.
- Producing different types of Graphs, Charts and Maps.
- To understand the different types of plots.
- To learn the concept of maps and heat map.
- To work with dashboard concepts.

Course Outcomes

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

CO1 – Demonstrate various Visualization techniques used to display the data to understand easier. **(K2)**
CO2 – Analyze the different visualization diagrams. **(K3)**
CO3 – Experiment various charts. **(K2)**
CO4 – Implement plots and heat map. **(K2)**
CO5 – Experiment the concepts of dashboard. **(K3)**

List of Experiments

Implement the following Data visualization Techniques using Python and Tableau.

1. Bar Charts
2. Pie Charts
3. Line Charts
4. Dot Charts
5. Histograms
6. Box Plots
7. Density Plots
8. Scatter Plots
9. Radial Diagrams
10. Chart Tables
11. Heat Map
12. Pyramids
13. Maps
14. Dashboard

Reference Books

1. Thomas Rahlf, "Data Visualisation with R", Springer, Second Edition, 2019.
2. Ashutosh Nandeshwar, "Tableau Data Visualization Cookbook", Packt Publishing Ltd., 2013.
3. Atmajitsinh Gohil, "R Data Visualization Cookbook", Packt Publishing Ltd., 2015.

Web References

1. https://sites.harding.edu/fmccown/r/
2. https://www.datamentor.io/r-programming/
3. https://interworks.com/blog/ccapitula/2014/08/04/tableau-essentials-chart-types-introduction/
4. https://www.tableau.com/learn/articles/data-visualization
5. https://kb.tableau.com/articles/howto/stacked-bar-chart-multiple-measures
6. https://www.tableau.com/about/blog/2017/8/10-ways-add-value-your-dashboards-maps-75709

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1	3	2	3	3	-	-	-	-	-	-	-	-	3	2	2
2	3	2	3	3	-	-	-	-	-	-	-	-	3	2	2
3	2	2	2	2	-	-	-	-	-	-	-	-	2	2	2
4	3	2	3	3	-	-	-	-	-	-	-	-	3	2	2
5	3	2	3	3	-	-	-	-	-	-	-	-	3	2	2

U20ADP406	ADVANCED MACHINE LEARNING TECHNIQUES LABORATORY	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To learn the insight of machine learning algorithms.
- To study about the Decision and Rule based learning concepts.
- To understand the Equivalence Class Transformation Algorithm
- To develop and boost the Machine learning models using ensemble methods.
- To understand the concept of neural network

Course Outcomes

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

CO1 – Understand the basics of machine learning algorithms. **(K2)**
CO2 – Implement decision and rule based learning models. **(K2)**
CO3 – Experiment the Equivalence class transformation algorithm. **(K3)**
CO4 – Implement ensemble models. **(K2)**
CO5 – Implement the neural network. **(K3)**

List of Experiments

Implementation the following algorithms with suitable applications using Python.

1. ID.3 algorithm
2. C4.5 algorithm
3. CART Decision Tree Algorithm
4. Apriori
5. Equivalence Class Transformation Algorithm
6. Naïve Bayes ensemble
7. Random forests
8. Adaboost
9. XGBoost
10. Simple Neural Network

Reference Books

1. Andreas C. Mueller and Sarah Guido, "Introduction to Machine Learning with Python", O'Reilly Media, Inc. First edition, 2016.
2. Charu C. Aggarwal "Data Classification Algorithms and Applications" Chapman & Hall/CRC Data Mining and Knowledge Discovery Series.
3. John Hearty "Advanced Machine Learning with Python", Packt Publishing Ltd., 2016.

Web References

1. https://www.deeplearning.ai/
2. https://www.youtube.com/c/MachineLearningwithPhil/playlists
3. https://www.youtube.com/user/howardjeremyp/playlists
4. https://www.youtube.com/user/dataschool/videos
5. https://www.youtube.com/channel/UC5zx8Owijmv-bbhAK6Z9apg/playlists

COs/POs/PSOs Mapping

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2	3	2	3	3	-	-	-	-	-	-	-	-	3	2	2
3	2	2	2	2	-	-	-	-	-	-	-	-	2	2	2
4	3	2	3	3	-	-	-	-	-	-	-	-	3	2	2
5	3	2	3	3	-	-	-	-	-	-	-	-	3	2	2

U20ADP407	EXPERT SYSTEM AND DECISION MAKING LABORATORY	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To learn the basics of expert system.
- To understand the concept of decision making.
- To analyze the specific expert system problems.
- To understand the applications of expert system.
- To equip the student to produce the decision making systems.

Course Outcomes

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

CO1 – Understand the basics of expert system. **(K2)**
CO2 – Learn the concept of decision making. **(K2)**
CO3 – Implement the specific expert system problems. **(K2)**
CO4 – Experiment the applications of expert system. **(K2)**
CO5 – Implement the decision making systems. **(K2)**

List of Experiments

1. Develop an Expert system for Diagnosing Eye Diseases.
2. Develop a Medical Expert System.
3. Develop an Expert system for Categorize disease.
4. Build an expert system for Diagnosing mental disorders.
5. Develop an expert system for Disease Diagnosis to Expert systems style.
6. Build an expert system that attempts to guess the user's animal in 20 questions or less.
7. Develop an Expert System that asks you a couple of questions about a certain flower, and answers with its name as a result.
8. Develop an Expert system for space rockets launch decision-making on the basis of weather conditions.
9. Develop an Expert system for Propositional calculus with backward-chaining inference engine.
10. Build an Expert system that advises the university best suited to the user based on his choices.

Reference Books

1. Durkin, J., "Expert systems Design and Development", Macmillan, 1994.
2. Elias M. Awad, "Building Expert Systems", West Publishing Company, 1996.
3. Peter Jackson, "Introduction to Expert Systems", Addison Wesley Longman, 1999.

Web References

1. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-034-artificial-intelligence-fall-2010/lecture-videos/lecture-3-reasoning-goal-trees-and-rule-based-expert-systems/
2. http://www.umsl.edu/~joshik/msis480/chapt11.htm
3. https://www.coursera.org/courses?query=decision%20making
4. https://www.slideshare.net/akhilrocker143/572-11293384
5. https://www.sciencedirect.com/science/article/abs/pii/0378720693900696

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	3	3	-	-	-	-	-	-	-	-	3	2	2
2	3	2	3	3	-	-	-	-	-	-	-	-	3	2	2
3	2	2	2	2	-	-	-	-	-	-	-	-	2	2	2
4	3	2	3	3	-	-	-	-	-	-	-	-	3	2	2
5	3	2	3	3	-	-	-	-	-	-	-	-	3	2	2

U20ADS403	SKILL DEVELOPMENT COURSE 3 (Choose anyone of the below three courses)	L	T	P	C	Hrs
		0	0	2	0	30

1. API DESIGN – II

Course Content:

1. Building a Typical Web API
2. Specifying the API
3. Implementing routes
4. Testing the API
5. Content negotiation
6. Cross-origin resource sharing
7. API versioning
8. Using NoSQL Databases
9. Key/value store – LevelDB
10. Document store – MongoDB
11. Database modeling with Mongoose
12. Testing a NoSQL database solution
13. Content delivery network
14. Implementing a Full-fledged RESTful Service
15. Extensibility and versioning
16. Working with arbitrary data
17. Linking
18. Implementing paging and filtering
19. Caching
20. Discovering and exploring RESTful services

2. DYNAMIC PROGRAMMING

Course Content:

1. Longest Common Subsequence
2. Longest Increasing Subsequence
3. Edit Distance
4. Minimum Partition
5. Ways to Cover a Distance
6. Longest Path In Matrix
7. Subset Sum Problem
8. Optimal Strategy for a Game
9. 0/1Knapsack Problem
10. Boolean Parenthesization Problem
11. Shortest Common Supersequence
12. Matrix Chain Multiplication
13. Partition problem
14. Rod Cutting
15. Coin change problem
16. Word Break Problem
17. Maximal Product when Cutting Rope
18. Dice Throw Problem
19. Box Stacking
20. Egg Dropping Puzzle

3. APTITUDE – III

Course Content:

1. Quicker Mathematical Methods
2. Permutation & Combination
3. Probability
4. Simple & Compound Interest
5. Data Sufficiency
6. Clocks & Calendars
7. Geometry
8. Data Interpretation
9. Logical Reasoning
10. Syllogism
11. Direction Sense
12. Blood Relation
13. Number Series
14. Coding & Decoding
15. Logical Analogy
16. Analytical Reasoning
17. Passage Oriented Analysis
18. Seating Arrangements
19. Cubes & Dices
20. Lateral Thinking
21. Mind Bending Puzzles

U20ADE401 AUTOMATA AND COMPILER DESIGN

L	T	P	C	Hrs
2	2	0	3	60

Course Objectives

- To introduce the Finite Automata, NFA and DFA.
- To gain insight into the Context Free Language and Pushdown Automata.
- To understand in depth about Parsing and Turing machine.
- To study about the Lexical Analysis and Syntax Analysis.
- To acquaint the Intermediate Code Generation, Code Optimization and Code Generation.

Course Outcomes

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

CO1 - Understand the concept of Finite Automata, NFA and DFA **(K2)**

CO2 - Understand about Context Free Language and Pushdown Automata. **(K2)**

CO3 - Construct a Turing Machine. **(K3)**

CO4 - Explain the concept of Lexical Analysis and Syntax Analysis. **(K3)**

CO5 - Describe the Intermediate code generation, Code Optimization and Code Generation. **(K4)**

UNIT I FINITE AUTOMATA AND REGULAR EXPRESSIONS (12 Hrs)

Introduction: Finite Automata – Deterministic Finite Automata – Non-Deterministic Finite Automata – Conversion from NFA to DFA – NFA with ε moves. Regular Expression: Conversion from Regular Expression to DFA (Direct / Indirect method) – Two way finite automata – Moore and Mealy Machine – Applications of Finite Automata.

UNIT II CONTEXT-FREE GRAMMAR AND LANGUAGES, PUSHDOWN AUTOMATA (12 Hrs)

Context – Free Grammar and Languages: Definitions and More Examples – Regular Languages and Regular Grammars – Derivation Trees and Ambiguity – Simplified Forms and Normal Forms – Chomsky Normal Form – Greibach Normal Form. Pushdown Automata: Definitions and Examples – A PDA from a Given CFG – A CFG from a Given PDA. Pumping Lemma.

UNIT III TURING MACHINES (12 Hrs)

Turing Machines: Turing Machines as Language Acceptors – Turing Machines for Accepting Regular Languages – Turing Machine for Addition and Subtraction.

UNIT IV LEXICAL ANALYSIS AND SYNTAX ANALYSIS (12 Hrs)

Compilers: The Phases of compiler – Lexical analysis – The role of the lexical analyser – Input buffering – Specification of tokens – Recognition of tokens – A language for specifying lexical analyzers – Design of a lexical analyzer. Parser: Top Down Parser – Predictive Parser, Bottom up Parser – SLR Parser.

UNIT V INTERMEDIATE CODE GENERATION, CODE OPTIMIZATION AND CODE GENERATION (12 Hrs)

Intermediate Code Generation: Declarations – Assignment statements – Boolean expressions – Procedure calls. Code Optimization: Principle sources of optimization – Loop Optimization. Code Generation: Issues in the design of code generator – Simple code generator – Basic blocks and flow graphs – The DAG representation of Basic Block – Generating code form DAGs – Peephole optimization.

Text Books

1. Hopcroft, 'Introduction to Automata Theory, Languages, and Computation", Pearson, 3rd Edition, 2008.

2. Alfred Aho, V. Ravi Sethi, and D. Jeffery Ullman, "Compilers Principles, Techniques and Tools", Addison-Wesley, 2nd Edition, 2007.
3. John C. Martin, "Introduction to Languages and the Theory of Computations", McGraw Hill, 3rd Edition, 2007.

Reference Books

1. Kamala Krithivasan, Rama R, "Introduction to Formal languages Automata Theory and Computation", Pearson, 2019.
2. Peter Linz, "An Introduction to Formal Languages and Automata", Jones & Bartlett, 6th Edition, 2016.
3. Anil Malviya, Malabika Datta, "Theory of Computation & Applications - Automata Theory Formal Languages", BPB publications, 2015.
4. Charles N. Fischer and Richard J. Leblanc, "Crafting a Compiler with C", Benjamin Cummings, 2009.
5. Mishra K.L.P, "Theory of Computer Science: Automata, Languages and Computation", Prentice Hall India Learning, 1st Edition, 2006.

Web References

1. https://www.cse.iitb.ac.in/~akg/courses/2019-cs310/index.html
2. https://www.cse.iitm.ac.in/~krishna/cs3300/
3. https://www.geeksforgeeks.org/theory-of-computation-automata-tutorials/
4. https://www.javatpoint.com/automata-tutorial
5. https://www.tutorialspoint.com/automata_theory/index.htm

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2	3	3	3	2	3	1	2	-	2	1	-	2	3	2	2
3	2	3	2	3	2	2	-	-	3	-	-	-	3	2	2
4	3	3	2	3	3	1	-	-	2	-	-	-	3	2	2
5	2	3	3	2	2	2	1	-	2	-	-	-	3	2	2

U20ADE402	PRINCIPLES OF DATA ANALYTICS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To provide strong foundation for data analytics.
- Understand the underlying core concepts in Big Data and cloud technologies.
- Exploring data visualizing tools.
- Apply Machine learning models using data analytics.
- To explore the recent technologies.

Course Outcomes

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

CO1 – Explore the fundamental concepts of data analytics.**(K2)**
CO2 – Understand data analysis techniques for applications handling large data.**(K2)**
CO3 – Understand basic concepts of R Programming. **(K2)**
CO4 – Analyze various Visualization and Exploration techniques. **(K2)**
CO5 – Explore the Geographic data using ggmap library. **(K3)**

UNIT I INTRODUCTION **(9 Hrs)**

Data Analytics - Types – Phases - Quality and Quantity of data – Measurement - Exploratory data analysis - Business Intelligence.

UNIT II BIG DATA **(9 Hrs)**

Big Data and Cloud technologies - Introduction to HADOOP: Big Data, Apache Hadoop, MapReduce - Data Serialization - Data Extraction - Stacking Data - Dealing with data.

UNIT III BASICS TO R PROGRAMMING **(9 Hrs)**

Installing packages and getting help in R – Data types in R - Special values in R – Matrices in R – Editing a matrix in R – Data frames in R – Editing a data frame in R – Importing data in R – Exporting data in R – Writing a function in R – Writing if else statements in R – Basic loops in R – Nested loops in R – The apply, lapply, sapply, and tapply functions – Using par to beautify a plot in R – Saving plots.

UNIT IV DATA EXPLORATION AND VISUALIZATION TECHNIQUES IN R **(9 Hrs)**

Measuring Categorical Variation with a Bar Chart – Continuous Variation with a Histogram – Covariation with Box Plots – Covariation with Symbol Size – 2D bin and Hex Charts – Creating a Scatterplot – Adding a regression line to the – Scatterplot – Plotting categories – Labeling the Graph – Legend Layouts – Creating a facet – Theming – Bar Charts – Violin Plots – Density Plots.

UNIT V VISUALIZING GEOGRAPHIC DATA WITH GGMAP **(9 Hrs)**

Displaying Information with Maps – Activity: Creating a Variable-Encoded Regional Map – Trends, Correlations and Statistical Summaries – Creating a Time Series Plot with the Mean, Median, and Quantiles – Trends, Correlations, and Scatter plots – Creating a Scatter Plot and Fitting a Linear Regression Model – Creating a Correlation Plot.

Text Books

1. Davy Cielen, Arno D. B. Meysman, Mohamed Ali, "Introducing Data Science", Manning Publications Co., 1st Edition, 2016.
2. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, "An Introduction to Statistical Learning: with Applications in R", Springer, 1st Edition, 2013.
3. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", Wiley.
4. Eric Pimpler, "Data Visualization and Exploration with R", Geospatial Training Services, 2017.

Reference Books

1. Dr Anil Maheshwari, "Data Analytics Made Accessible", Publisher: Amazon.com Services LLC.
2. Joel Grus, "Data Science from Scratch: First Principles with Python", O'Reilly, 1st Edition, 2015.

3. Cathy O'Neil, Rachel Schutt, "Doing Data Science, Straight Talk from the Frontline", O' Reilly, 1st Edition, 2013.
4. Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2nd Edition, 2014.
5. Dr. Tania Moulik, "Applied Data Visualization with R and ggplot2", Packt Publishing Ltd., 2018.
6. Atmajitsinh Gohil, "R Data Visualization Cookbook", Packt Publishing Ltd., 2015.

Web Resources

1. https://glanalytics.ca/data-analysis-principles/
2. https://www.datadecisionsgroup.com/blog/the-basic-principles-of-predictive-analytics
3. https://www.coursera.org/learn/r-programming
4. https://www.tutorialspoint.com/r/index.htm
5. https://www.r-project.org/about.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	3	3	-	-	-	-	-	-	-	-	3	2	2
2	3	2	3	3	-	-	-	-	-	-	-	-	3	2	2
3	2	2	2	2	-	-	-	-	-	-	-	-	2	2	2
4	3	2	3	3	-	-	-	-	-	-	-	-	3	2	2
5	3	2	3	3	-	-	-	-	-	-	-	-	3	2	2

U20ADE403	SOFT COMPUTING	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- Soft Computing techniques and their difference from conventional techniques.
- To introduce the concepts and techniques of building blocks of Artificial Intelligence.
- To generate an ability to design, analyze and perform experiments on real life problems using various Neural Network algorithms.
- To provide the understanding of Genetic Algorithms and its applications in developing solutions to real-world problems.
- To conceptualize Fuzzy Logic and its implementation for various real-world applications.

Course Outcomes

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

CO1 – Analyze and evaluate whether a problem can be solved using AI techniques and analyze the same using basic concepts of AI. **(K3)**

CO2 – Understand AI concepts used to develop solutions that mimic human like thought process on deterministic machines for real-world problems. **(K2)**

CO3 – Understand the fundamental concepts of Neural Networks, different neural network architectures, algorithms, applications and their limitations. **(K2)**

CO4 – Apply Genetic Algorithms in problems with self-learning situations that seek global optimum.**(K4)**

CO5 – Apply Fuzzy Logic, the concept of fuzziness and fuzzy set theory in various systems. **(K4)**

UNIT I INTRODUCTION TO SOFT COMPUTING **(9 Hrs)**

Importance of soft computing - Soft computing versus hard computing - Supervised and unsupervised learning - Introduction to main components of soft computing: Fuzzy logic - Neural networks - Genetic algorithms.

UNIT II FOUNDATIONS OF ARTIFICIAL INTELLIGENCE **(9 Hrs)**

Introduction to artificial intelligence - Application areas of artificial intelligence - State space search: Depth first search - Breadth first search - Heuristic search: Best first search - Hill Climbing - Beam Search - Tabu Search - Introduction to randomized search: Simulated annealing - Genetic algorithms - Ant colony optimization - Introduction to expert systems - Introduction to AI-related fields like game playing - speech recognition - language detection machine - computer vision - robotics.

UNIT III NEURAL NETWORKS **(9 Hrs)**

Basic concepts of neural network - Overview of learning rules and parameters - Activation functions - Single layer perceptron and multilayer perceptron - Multilayer feed forward network - Backpropagation networks: Architecture – Algorithm - Variation of standard backpropagation neural network - Radial basis function network - Recurrent neural network - Introduction to Associative Memory - Recent applications.

UNIT IV GENETIC ALGORITHMS **(9 Hrs)**

Difference between traditional algorithms and Genetic Algorithm (GA) - Basic concepts of GA - Working principle - Encoding methods - Fitness function - GA Operators: Reproduction – Crossover – Mutation - Convergence of GA - Detailed algorithmic steps - Adjustment of parameters - Multi-criteria optimization - Solution of typical problems using genetic algorithm - Recent applications.

UNIT V FUZZY LOGIC **(9 Hrs)**

Concepts of uncertainty and imprecision - Concepts, properties and operations on classical sets and fuzzy sets - Classical and fuzzy relations - Membership functions and its types – Fuzzification - Fuzzy rule-based systems – Defuzzification - Fuzzy propositions - Fuzzy extension principle - Fuzzy inference system - Recent applications.

Text Books

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach", Pearson Education, 3rd Edition, 2015.
2. S. Rajasekaran and G. A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications, PHI.

3. S. N. Sivanandam and S. N. Deepa, Principles of Soft Computing, 2nd Edition, Wiley India.

Reference Books

1. Elaine Rich and Kelvin Knight, "Artificial Intelligence", Tata McGraw Hill, 3rd Edition, 2017.
2. Zurada, Introduction to Artificial Neural Systems, Jaico Publishing House.
3. D. Goldberg, Genetic Algorithms in Search, Optimization and Machine Learning, Addison- Wesley
4. G. Klir, B. Yuan, Fuzzy Sets and Fuzzy Logic: Theory and A: Theory and Applications, Pearson.
5. DAN.W. Patterson, "Introduction to A.I. and Expert Systems", PHI, 2007

Web Resources

1. https://www.bcg.com/en-in/publications/2017/technology-digital-strategy-building-blocks-artificial-intelligence.aspx
2. https://www.analyticsinsight.net/the-building-blocks-of-ai-data-analytics-machine-learning-and-deep-learning/
3. https://connect.altran.com/2018/10/the-building-blocks-artificial-intelligence/
4. https://www.datadriveninvestor.com/2018/05/30/the-building-block-of-artificial-intelligence/

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	3	3	-	-	-	-	-	-	-	-	3	2	2
2	3	2	3	3	-	-	-	-	-	-	-	-	3	2	2
3	2	2	2	2	-	-	-	-	-	-	-	-	2	2	2
4	3	2	3	3	-	-	-	-	-	-	-	-	3	2	2
5	3	2	3	3	-	-	-	-	-	-	-	-	3	2	2

U20ADE404	GPU COMPUTING	L	T	P	C	Hrs
		3	0	0	3	45

Course objectives

- The course aims to give an overview of an important trend in high performance computing – GPU programming.
- To experience the expertise of GPUs (graphics processing units) are special purpose hardware originally designed for graphics and games
- To understand the basic concepts of GPU programming,
- To get the introduction about CUDA (Compute Unified Device Architecture) parallel computing platform and hands-on experience on implementing some standard CUDA programs
- Finally the course will give a brief overview of the current applications and future trends of GPU computing in scientific research.

Course Outcome

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

CO1 – Define terminology commonly used in parallel computing, such as efficiency and speedup. **(K2)**
CO2 – Describe common GPU architectures and programming models. **(K2)**
CO3 – Implement efficient algorithms for common application kernels, such as matrix multiplication. **(K3)**
CO4 – Given a problem, develop an efficient parallel algorithm to solve it. **(K4)**
CO5 – Given a problem, implement an efficient and correct code to solve it, analyze its performance, and give convincing written and oral presentations explaining your achievements. **(K2)**

UNIT I INTRODUCTION **(9 Hrs)**

History, Graphics Processors, Graphics Processing Units, GPGPUs. Clock speeds, CPU / GPU comparisons, Heterogeneity, Accelerators, Parallel programming, CUDA OpenCL / Open ACC, Hello World Computation Kernels, Launch parameters, Thread hierarchy, Warps / Wave fronts, Thread blocks / Workgroups, Streaming multiprocessors, 1D / 2D / 3D thread mapping, Device properties, Simple Programs, OpenMP.

UNIT II MEMORY **(9 Hrs)**

Memory hierarchy, DRAM / global, local / shared, private / local, textures, Constant Memory, Pointers, Parameter Passing, Arrays and dynamic Memory, Multi-dimensional Arrays, Memory Allocation, Memory copying across devices, Programs with matrices, Performance evaluation with different memories.

UNIT III SYNCHRONIZATION **(9 Hrs)**

Memory Consistency, Barriers (local versus global), Atomics, Memory fence. Prefix sum, Reduction. Programs for concurrent Data Structures such as Worklists, Linked-lists. Synchronization across CPU and GPU Functions: Device functions, Host functions, Kernels functions, Using libraries (such as Thrust), and developing libraries.

NIT IV SUPPORT, STREAM, SYNCHRONIZATION **(9 Hrs)**

Support: Debugging GPU Programs. Profiling, Profile tools, Performance aspects Streams: Asynchronous processing, tasks, Task-dependence, Overlapped data transfers, Default Stream, Synchronization with streams. Events, Event-based-Synchronization - Overlapping data transfer and kernel execution, pitfalls.

UNIT V CASE STUDIES **(9 Hrs)**

Image Processing, Graph algorithms, Simulations, Deep Learning Advanced Concepts: Dynamic Parallelism, Unified Virtual Memory, Multi-GPU Processing, Peer access, Heterogeneous processing, cuDNN.

Text Books

1. David Kirk, Wen-meiHwu; Morgan Kaufman "Programming Massively Parallel Processors: A Hands-on Approach", 2010 (ISBN: 978-0123814722)
2. Shane Cook; Morgan Kaufman "CUDA Programming: A Developer's Guide to Parallel Computing with GPUs", 2012 (ISBN: 978-0124159334).
3. Yiyu Cai, Simon See "GPU Computing and Applications", Springer Singapore, 2014.

Reference Books

1. Wen-mei Hwu "GPU Computing Gems Emerald Edition", Elsevier Science, 2011.
2. Benedict Gaster,Lee Howes, David R. Kaeli "Heterogeneous Computing with OpenCL", Morgan Kaufmann , 2011.
3. Nicholas Wilt, CUDA Handbook: A Comprehensive Guide to GPU Programming, Addison-Wesley, 2013.
4. Jason Sanders, Edward Kandrot, "CUDA by Example: An Introduction to General Purpose GPU Programming", Addison – Wesley, 2010.

Web Resources

1. https://www.sciencedirect.com/book/9780123859631/gpu-computing-gems-jade-edition
2. https://www.boston.co.uk/info/nvidia-kepler/what-is-gpu-computing.aspx
3. https://en.wikipedia.org/wiki/General-purpose_computing_on_graphics_processing_units
4. https://www.infoworld.com/article/3299703/what-is-cuda-parallel-programming-for-gpus.html
5. https://www.kdnuggets.com/2016/04/basics-gpu-computing-data-scientists.html

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3	2	2	2	2	-	-	-	-	-	-	-	-	2	2	2
4	3	2	3	3	-	-	-	-	-	-	-	-	3	2	2
5	3	2	3	3	-	-	-	-	-	-	-	-	3	2	2

U20ADE405	MICROPROCESSORS AND MICROCONTROLLERS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand and learn the architecture and assembly language program of 8085.
- To understand and learn the architecture and assembly language program of 8086.
- To explore the interfacing the peripherals and other chips to 8086
- To learn and understand the Intel 8051 microcontroller architecture.
- To acquire the knowledge of Raspberry Pi and Arduino Processors.

Course Outcomes

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

CO1 - Explain the basic architecture of 8085 microprocessors **(K2)**
CO2 - Articulate the knowledge of the architecture and instruction sets of 8086 **(K2)**
CO3 - Summarize the interfacing of various peripherals to various 8086. **(K2)**
CO4 - Illustrate the architecture of the 8051 microcontrollers **(K2)**
CO5 - Exemplify the use of Raspberry and Arduino processors. **(K2)**

UNIT I INTEL 8085 MICROPROCESSORS **(9 Hrs)**

Introduction – Need for Microprocessor – Evolution – 8085 Architecture – Pin diagram - Timing Diagram – Addressing Modes – Instruction Formats – Instruction Set.

UNIT II INTEL 8086 MICROPROCESSORS **(9 Hrs)**

Introduction to 8086 Microprocessor – 8086 Architecture – Pin diagram – I/O and Memory Interfacing – Addressing Modes – Instruction Format – Instruction Set – Interrupts – Assembler Directives – Assembly Language Programming.

UNIT III PERIPHERALS AND INTERFACING TO 8086 **(9 Hrs)**

Parallel Communication Interface (8255) – Serial Communication interface (8251) – D/A and A/D Interface – Programmable Timer Controller (8254) – Keyboard/display controller (8279) – Programmable Interrupt Controller (8259) – DMA controller (8237).

UNIT IV INTEL 8051 MICROCONTROLLER AND INTERFACING **(9 Hrs)**

Introduction – Architecture – Memory Organization – Special Function Registers – Pins and Signals – Timing and control – Port Operation – Memory and I/O Interfacing – Interrupts – Instruction Set and Programming. Interfacing – LCD and Keyboard Interfacing – RTC and EEPROM interface using I2C protocol – Stepper Motor, Traffic Light Controller.

UNIT V INTRODUCTION TO RASPBERRY PI and ARDUINO **(9 Hrs)**

Raspberry Pi Hardware – Raspberry Pi Software – Programming on Raspberry Pi – Interfacing to Raspberry Pi Inputs/ Outputs – Interfacing to Raspberry Pi Buses – Interacting to Physical Environment. – Arduino Board – Sketches – Mathematical Operators – Serial Communications – Interfacing with sensors.

Text Books

1. Yu-Cheng Liu, Glenn A.Gibson, "Microcomputer Systems: The 8086 / 8088 Family Architecture, Programming and Design", Prentice Hall of India, Second Edition, 2015.
2. Ramesh S. Gaonkar, "Microprocessor - Architecture, Programming and Applications with 8085", Penram International Publications, Sixth Edition, 2013.
3. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", Pearson education, Second Edition, 2011.

Reference Books

1. Jeremy Blum, "Exploring Arduino: Tools and Techniques for Engineering Wizardry", Wiley, Second Edition, 2019.

2. Rithard blum,Christile Bresnahan, "Programming with Raspberry Pi: Getting Started with Python", Second Edition, Packet Publisher, 2016.
3. Derek Molloy, "Exploring Raspberry Pi: Interfacing to the Real World with Embedded Linux", Wiley, 1st Edition, 2016.
4. Krishna Kant, "Microprocessors and Microcontrollers – Architectures, Programming and system Design 8085, 8086, 8051, 8096", PHI, 2014.
5. Doughlas V.Hall, "Microprocessors and Interfacing, Programming and Hardware", TMH, 2012.

Web References

1. https://swayam.gov.in/nd1_noc20_ee42/microprocessors-and-microcontrollers/
2. https://www.classcentral.com/course/swayam
3. https://freevideolectures.com/course/3018/microprocessors
4. https://www.arduino.cc/

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2	2	1	-	-	-	-	-	-	-	-	-	-	3	2	2
3	2	1	-	-	3	-	-	-	-	-	-	-	3	2	2
4	2	1	-	-	3	-	-	-	-	-	-	-	3	2	2
5	2	1	-	-	3	-	-	-	-	-	-	-	3	2	2