VARDHAMAN
COLLEGE OF ENGINEERING

CURRICULUM
For
Bachelor of Technology

Information Technology (Honors)

Under
Choice Based Credit System (CBCS)

B. Tech. - Honors Program

(For batches admitted from the Academic Year 2025 - 2026)

August 2025

VARDHAMAN COLLEGE OF ENGINEERING
(Autonomous)
Affiliated to **JNTUH,** Approved by **AICTE,** Accredited by **NAAC** with **A++** Grade
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III B.Tech. I Semester													
#	Course Code	Title of the Course	Category	Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
				CI		LI	TW + SL	H	C	CIE	SEE	Total
				L	T	P	SL					
Theory Courses												
1	H2601	Operations Research	PC	45	-	-	45	90	3	40	60	100
	H2602	Advanced Computer Architecture										
2	H2603	Business Intelligence	PC	45	-	-	45	90	3	40	60	100
	H2604	Advanced Data Structures										
Total				90	0	0	90	180	6	80	120	200

III B.Tech. II Semester													
#	Course Code	Title of the Course	Category	Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
				CI		LI	TW + SL	H	C	CIE	SEE	Total
				L	T	P	SL					
Theory Courses												
1	H2605	Business Analytics in Practice	PC	45	-	-	45	90	3	40	60	100
	H2606	Parallel Computing										
2	H2607	Ethics and Privacy in Analytics	PC	45	-	-	45	90	3	40	60	100
	H2608	Reinforcement Learning										
Total				90	0	0	90	180	6	80	120	200

IV B.Tech. I Semester													
#	Course Code	Title of the Course	Category	Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
				CI		LI	TW + SL	H	C	CIE	SEE	Total
				L	T	P	SL					
Theory Courses												
1	H2609	Retail and Customer Analysis	PC	45	-	-	45	90	3	40	60	100
	H2610	Software Testing Methodologies										
2	H2611	Time Series Analysis	PC	45	-	-	45	90	3	40	60	100
	H2612	Agile Project Management										
Total				90	0	0	90	180	6	80	120	200

IV B.Tech. II Semester													
#	Course Code	Title of the Course	Category	Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
				CI		LI	TW + SL	H	C	CIE	SEE	Total
				L	T	P	SL					
Experiential Learning Course													
1	H2041	Technical Report Writing	PW	-	-	-	90	90	2	40	60	100
Total				0	0	0	90	90	2	40	60	100

III B.Tech. I Semester

H2601– Operations Research

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

Course Description

Course Overview

This course builds foundation of basic concepts of operations research and at the same time provides an indication of the relevance and importance of the theory in solving practical problems in different fields. The mathematical modeling skills sustained from this course acquaint the students with the knowledge of various tools and techniques which helps in optimal utilization of the scarce resources of an organization

Course Pre/Co-requisites

A9001-Matrices and Calculus

Course Outcomes

After the completion of the course, the student will be able to:

H2601.1. Illustrate operations research features, models, methods, applications, advantages and limitations.

H2601.2. Build mathematical models to obtain optimum solution for various real world problems.

H2601.3. Develop operational policies for efficient management of personnel, materials, machines, production, distribution, and service systems, optimizing service rate and server count to minimize queuing and service.

H2601.4. Evaluate various alternatives available to aid in decision making situations.

H2601.5. Choose the best strategies to maximize the profit thereby minimizing loses in the presence of a competitor.

Course Syllabus

Unit-I:

Introduction to Operation Research:

Basic definition, scope, objectives, phases, models and limitations of Operations Research. Linear Programming Problem, Formulation and Graphical solution of Linear Programming Problem, Simplex Method, Artificial variables Techniques, Big-M method..

Unit-II:

Transportation Problem:

Formulation, Solution, Unbalanced Transportation problem. Finding basic feasible solutions, North-West corner rule, Least cost method and Vogel's approximation method, Optimality test MODI method. ASSIGNMENT MODEL: Formulation, Hungarian method for optimal solution, solving unbalanced problem.

Unit-III:

Sequencing Models: l

Solution of Sequencing Problem, Processing n Jobs through two ma- chines, Processing n Jobs through three machines, Processing two Jobs through m machines, Processing n Jobs through m Machines. Queuing Theory: Introduction, Single Channel, Poisson arrivals, exponential service times with infinite population and finite population models

Unit-IV:

Replacement and Inventory Models:

Replacement Models: Replacement of Items that Deteriorate whose maintenance costs in- crease with time without change in the money value, Replacement of items that fail suddenly, individual replacement policy, group replacement policy. Inventory Models: Inventory costs, Models with deterministic demand model: (a) Demand rate uniform and production rate infinite, (b) Demand rate non-uniform and production rate infinite.

Unit-V:

Game Theory:

Competitive game, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle, Rectangular games without saddle point, mixed strategy for 2 X 2 games.

Books and Materials

Text Books:

1. J K. Sharma , Operations Research Theory and Applications, 6th Edition, Trinity Press Ltd New Delhi, India.
2. Frederick S Hillier; Gerald J Lieberman, Introduction to Operations Research,10th Edition, McGraw- Hill , New York

Reference Books:

1. Hamdy Abdelaziz Taha , Operations Research: an Introduction, 9th Edition, Pearson, Boston.
2. Prem Kumar Gupta and D S Hira, Operations Research, Revised edition, S. Chand Publishing, New Delhi, India.
3. P ShankaraIyer, Operations Research, 1st Edition, Tata McGraw Hill, Publishing Com-pany, NewDelhi, India.

H2602– Advanced Computer Architecture

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

Course Description

Course Overview

This course presents an overview of the memory organizations and mapping techniques. Students will be able to know about the Parallelism concepts in Programming and the objective is to give the students an elaborate idea about the different memory systems and buses. To introduce the advanced processor architectures to the students and to make the students know about the importance of multiprocessor and multi- computers, to study about data flow computer architectures. This course examines the techniques and underlying principles that are used to design high-performance computers and processors. Particular emphasis is placed on understanding the trade-offs involved when making design decisions at the architectural level. The course also enables to demonstrate VLSI based architectures

Course Pre/Co-requisites

A9505-Computer Organization

Course Outcomes

After the completion of the course, the student will be able to:

H2602.1. Identify the various concepts of parallelism in Hardware and Software.

H2602.2 . Analyze different memory systems and buses for multi processor systems.

H2602.3. Demonstrate the complex architectures to provide parallel processing.

H2602.4. Examine the design requirements of multi processor architectures.

H2602.5. Compare VLSI based architectures for efficient processing.

Course Syllabus

Unit-I:

Parallel Computer Models:

Evolution of Computer architecture, system attributes to performance, Multi processors and multi computers, Multi-vector and SIMD computers, PRAM and VLSI models-Parallelism in Programming, conditions for Parallelism-Program Partitioning and Scheduling-program flow Mechanisms-Speed up performance laws-Amdahl‘s law, Gustafson‘s law-Memory bounded speedup Model

Unit-II:

Memory Systems and Buses:

Memory hierarchy, cache and shared memory concepts, Cache memory organization, cache addressing models, Aliasing problem in cache, cache memory mapping techniques, Shared memory organization, Interleaved memory organization, Lower order interleaving, Higher order interleaving. Back plane bus systems-Bus addressing, arbitration and transaction.

Unit-III:

Advanced Processors:

Instruction set architectures-CISC and RISC scalar processors- Super scalar processors-VLSI architecture- Mul-

tivector and SIMD computers-Vector processing principles-Cray Y-MP 816 system-Inter processor communication.

Unit-IV:

Multi Processors and Multi Computers

Multiprocessor system interconnects, Cross bar switch, Multiport memory, Hot spot problem, Message passing mechanisms, Pipelined processors, Linear pipeline, non linear pipeline, Instruction pipeline design, Arithmetic pipeline design

Unit-V:

Data Flow Computers and VLSI Computations:

Data flow computer architectures- Static, Dynamic-VLSI Computing Structures-Systolic array architecture, mapping algorithms into systolic arrays, Reconfigurable processor array-VLSI matrix arithmetic processors-VLSI arithmetic models, partitioned matrix algorithms, matrix arithmetic pipelines.

Books and Materials

Text Books:

1. Kai Hwang., Advanced Computer Architecture: Parallelism, Scalability, Programmability, Mc Graw Hill,N.Y, 2003.
2. Kai Hwang & Briggs., Computer Architecture and Parallel Processing,Mc Graw Hill, N.Y, 1999.

Reference Books:

1. David A. Patterson and John L. Hennessey., Computer organization and design, 5th Edition, Elsevier, , 2014.
2. Quinn., Parallel Computing: Theory and Practice, TMH, India, 2010.

H2603-Business Intelligence

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

Course Description

Course Overview

Business Intelligence (BI) is a set of architectures, theories, methodologies, and technologies that transform structured, semi-structured, and unstructured data into meaningful and useful information. Students will analyze enterprise data requirements to develop queries, and reports and build OLAP cubes that use business analytics to answer complex business questions.

Course Pre/Co-requisites

A9509-Database Management Systems

Course Outcomes

After the completion of the course, the student will be able to:

H2603.1. Discuss the impact of Business Intelligence (BI) theories, architectures, and methodologies on the organizational decision-making process.

H2603.2 . Analyze the differences between the structured, semi-structured, and un- structured data types to leverage the best technologies.

H2603.3. Explain how different data can be integrated for querying and reporting to improve the performance of marketing and sales strategies.

H2603.4. Illustrate the ACID and BASE theories for data storage and consistency.

H2603.5. Create a BI solution by conducting the enterprise-wide data requirements analysis.

Course Syllabus

Unit-I:

Business Intelligence:

Business intelligence systems: Definition, Goals, and Organization. Understanding Attributes, Hierarchies, and Dimensions in Data Analysis for Multi-dimensional Analysis. Understanding the Fact Table, Dimension Tables, Surrogate Keys, and alternate Table Structure of the Dimensional Data Warehouse. What is OLAP in multi-dimensions?

Unit-II:

Understanding OLAP:

Spreadsheet formulas, meta-data-based inquiries, and mast response. Understanding the speed and meta-data of Analysis Services. Business intelligence Platform from Microsoft. Tools for analysis services. Extraction, transformation, and loading of data. Tools and Meaning for the Same.

Unit-III:

Making your rst project for business intelligence:

Making a data source and a data view. the Data view being changed. Time, creating new dimensions, and changing existing dimensions. Child-Parent Dimension. Cube creation: Cube creation wizard. Cube sneak peek. measure and measure groups being added to a cube. gured members. A Cube's Deployment and Exploration

Unit-IV:

Aggregate Functions:

Advanced Measures and Calculations. To retrieve values from a cube, use MDX. Scripting for calculations. establishing KPIs. Creating reference, fact, and many-to-many dimensions is referred to as advanced dimensional design. Financial Analysis Cubes are used. manipulating a cube. creating drill-down and standard actions.

Unit-V:

Creating Perspectives, MDX Queries, and Excel with Analysis Services

Retriev- ing Data from Analysis Services ,Data mining: Its significance and goal. data collection for data mining. building a data mining model. selecting an algorithm for data mining. recognising data mining software. mapping the columns of source data to the mining structure. via means of Cube Sources. defining the parameters of an algorithm. The creation of prediction queries for data mining reports. recognising DMX terminology.

Books and Materials

Text Books:

1. Carlo Vercellis (2011). Business Intelligence: Data Mining and Optimization for De- cision Making . John Wiley & Sons.
2. David Loshin (2012). Business Intelligence: The Savvy Manager's Guide . Newnes.
3. Elizabeth Vitt, Michael Luckevich, Stacia Misner (2010). Business Intelligence . O'Reilly Media, Inc
4. Sharda, R., Delen, D., & Turban, E. (2015).Business Intelligence and Analytics: Systems for Decision Support (10th ed.). Upper Saddle River, NJ: Pearson.

Reference Books:

1. Rajiv Sabhrwal, Irma Becerra-Fernandez (2010). Business Intelligence . John Wiley & Sons.
2. Swain Scheps (2013). Business Intelligence for Dummies . Wiley.

H2604-Advanced Data Structures

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

Course Description

Course Overview

Advanced Data Structures is a course to improve the programming skills and implement various data structures which are important in real time applications and software design. C programming language is used to implement these data structures. The course covers applications of linked lists, queues and advanced search trees and graphs are implemented using C. The course also enables to explore the concepts of hashing and dictionaries in handling large amount of data.

Course Pre/Co-requisites

A9501-Programming for Problem Solving
A9503-Data Structures

Course Outcomes

After the completion of the course, the student will be able to:

H2604.1. Implement Linked lists and Queues to process the given data.

H2604.2. Design various non-linear data structures suitable for a given application.

H2604.3. Examine the various search trees to organize data.

H2604.4. Make use of Dictionaries and Hash Tables for efficient search operation.

H2604.5. Develop algorithm for text processing applications.

Course Syllabus

Unit-I:

Linear Lists:

Applications of Linked Lists - Polynomial Representation, Polynomial addition, Polynomial multiplication, circular Linked Lists, circular queue using linked list, deque using linked list, Priority Queue and its applications

Unit-II:

Trees and Graphs:

Binary trees and its types, Binary Search trees-definition, insertion, deletion, searching and traversal. Graph Traversal techniques: Breadth First Search (BFS) and Depth First Search (DFS), Minimum Spanning Trees, Prims Algorithm, Kruskal's algorithm, heap sort, min heap, max heap.

Unit-III:

Search Trees:

Balanced search trees, AVL Trees- Definition, Height of an AVL Tree,Operations – Insertion, Deletion and Searching, Red Black Trees, Definition, Operations – Insertion, Deletion and Searching , Splay Trees, B-Trees-definition, insertion and searching operations.

Unit-IV:

Dictionaries and Hash Tables:

Dictionaries, linear list representation, operations - insertion, deletion and searching, hashtable representation,

hash functions, collision resolution-separate chaining, open addressing-linear probing, quadratic probing, double hashing, rehashing, extendible hashing.

Unit-V:

Text Processing:

String Operations, Brute-Force Pattern Matching, The Boyer-Moore Algorithm, The Knuth-Morris-Pratt Algorithm, Standard Tries, Compressed Tries, Suffix Tries.

Books and Materials

Text Books:

1. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran (2008), Fundamentals of Com- puter Algorithms,2nd edition, University Press(India) Private Limited, India.
2. G.A.V.Pai(2009),Data Structures and Algorithms,Tata Mcgraw hill,NewDelhi.

Reference Books:

1. D.Samanta(2003),Classic Data Structures,Prentice Hall of India Private Limited.
2. Aho,Hopcraft,Ullman(1998),Design and Analysis of Computer Algorithms,Pearson Edu- cation India.
3. Goodman,Hedetniemi(2002),Introduction to the Design and Analysis of Algorithms, Tata Mcgraw Hill,New Delhi, India.
4. Adam Drozdek (2005),Data Structures and Algorithms in C++,3rd Edition, Thomson Course Technology.

III B.Tech. II Semester

H2605 -Business Analytics in Practice

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

Course Description

Course Overview

This course provides a comprehensive introduction to Business Analytics and its three key pillars Descriptive, Predictive, and Prescriptive Analytics for data-driven decision-making. Students will learn statistical foundations, data visualization, regression analysis, clustering techniques, and optimization models. The course blends theoretical concepts with practical tools, enabling learners to apply analytical methods to solve real-world business problems and support strategic decision-making.

Course Pre/Co-requisites

A9005-Probability Distributions and Applied Statistics

Course Outcomes

After the completion of the course, the student will be able to:

H2605.1. Explain the principles of descriptive, predictive, and prescriptive analytics in the context of business decision-making.

H2605.2 Apply statistical measures and visualization techniques to summarize and interpret business data.

H2605.3 Analyze business datasets using regression and clustering methods to identify patterns and trends.

H2605.4. Evaluate the performance of predictive models and recommend suitable improvements.

H2605.5 Develop and solve linear programming models to optimize business decisions.

Course Syllabus

Unit-I:

Introduction to Business Analytics:

Analytics Landscape, Why Analytics, Business Analytics: The Science of Data-Driven Decision Making, Descriptive Analytics, Predictive Analytics, Prescriptive Analytics, Descriptive, Predictive, and Prescriptive Analytics Techniques, Big Data Analytics, Foundations of Data Science: Descriptive Analytics

Unit-II:

Introduction to Descriptive Analytics:

Data Types and Scales of Variable Measurement, Types of Variable Measurement Scales, Population and Sample, Measures of Central Tendency, Percentile, Decile and Quartile, Measures of Variation, Measures of Shape - Skewness and Kurtosis, Data Visualization, Feature Engineering Using Visualization.

Unit-III:

Simple Linear Regression

Introduction to Simple Linear Regression, SLR Model Building, Estimation of Parameters Using OLS, Interpretation of SLR Coefficients, Validation of the SLR Model, Outlier Analysis, Confidence Interval for Regression Coefficients β_0 and β_1,Confidence Interval for the Expected Value of Y for a Given X, Prediction Interval for the Value of Y for a Given.

Unit-IV:

Clustering:

Introduction to Clustering, Distance and Similarity Measures Used in Clustering, Quality and Optimal Number of Clusters, Clustering Algorithms, K-Means Clustering, Hierarchical Clustering

Unit-V:

Prescriptive Analytics:

Introduction to Prescriptive Analytics, Linear Programming, Linear Programming (LP) Model Building, Linear Programming Problem (LPP) Terminologies, Assumptions of Linear Programming, Sensitivity Analysis in LPP, Solving a Linear Programming Problem Using Graphical Method, Range of Optimality, Range of Shadow Price, Dual Linear Programming, Primal-Dual Relationships, Multi-Period (Stage) Models, Linear Integer Programming (ILP),Multi-Criteria Decision-Making (MCDM) Problems

Books and Materials

Text Books:

1. U. D. Kumar, Business Analytics in Practice, 1st ed. Pearson, 2021.

Reference Books:

1. J. R. Evans, Business Analytics, 3rd ed. Pearson, 2019.
2. Christian Albright and W. L. Winston, Business Analytics: Data Analysis & Decision Making, 7th ed., Cengage, 2022.

H2606– Parallel Computing

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

Course Description

Course Overview

This course is an introduction to the basic issues of and techniques for writing parallel programming. Students will be provided with an advanced foundation in various programming models and varieties of parallelism in current hardware. The course is structured so that the students understand challenges in efficient execution of large-scale parallel applications and the students will be able to understand various searching and sorting methods on parallel programming environment.

Course Pre/Co-requisites

H2602-Advanced Computer Architecture A9507-Operating Systems

Course Outcomes

After the completion of the course, the student will be able to:

H2606.1. Develop an understanding of various basic concepts associated with parallel computing environments.

H2606.2. Make use of CUDA Programming Model for parallel computing..

H2606.3. Identify various sources of overhead in parallel Programs.

H2606.4. Examine the algorithms to resolve the Issues in Sorting on Parallel Computers.

H2606.5. Choose appropriate Search Algorithm to solve Discrete Optimization Problems.

Course Syllabus

Unit-I:

Introduction to Parallel Computing:

Scope, issues, applications and challenges of Parallel and Distributed Computing Parallel Programming Platforms: Implicit Parallelism: Trends in Microprocessor Architectures, Dichotomy of Parallel Computing Platforms, Physical Organization, Communication Costs in Parallel Machines, Routing Mechanisms for Interconnection Networks, GPU, co- processing. Principles of Parallel Algorithm Design: De- composition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing.

Unit-II:

CUDA Programming Model:

Overview of CUDA, Isolating data to be used by parallelized code, API function to allocate memory on parallel computing device, to transfer data, Concepts of Threads, Blocks, Grids, Developing a kernel function to be executed by individual threads, Execution of kernel function by parallel threads, transferring data back to host processor with API function.

Unit-III:

Analytical Modeling of Parallel Programs:

Sources of Overhead in Parallel Programs, Performance Metrics for Parallel Systems, The Effect of Granularity on Performance, Scalability of Parallel Systems, Minimum Execution Time and Minimum Cost-Optimal Execution Time Compression.

Unit-IV:

Dense Matrix Algorithms:

Matrix-Vector Multiplication, Matrix-Matrix Multiplication, Issues in Sorting on Parallel Computers, Bubble Sort and Variants, Quick Sort, Other Sorting Algorithms Graph Algorithms: Minimum Spanning Tree: Prim's Algorithm, Single- Source Shortest Paths: Dijkstra's Algorithm, All-Pairs Shortest Paths, Transitive Closure, Connected Components, Algorithms for Sparse Graph.

Unit-V:

Search Algorithms for Discrete Optimization Problems:

Sequential Search Algorithms, Parallel Depth-First Search, Parallel Best-First Search, Speed-up Anomalies in Parallel Search Algorithms.

Books and Materials

Text Books:

1. A Grama, A Gupra, G Karypis, V Kumar, Introduction to Parallel Computing , 2nd Edition, Addison Wesley, 2020.
2. C Lin, L Snyder., Principles of Parallel Programming, USA: Addison-Wesley Publishing Company, 2018.

Reference Books:

1. J Jeffers, J Reinders. Intel Xeon Phi Coprocessor High-Performance Programming. Morgan Kaufmann Publishing and Elsevier, 2013.
2. T Mattson, B Sanders, B Massingill. Patterns for Parallel Programming. Addison-Wesley Professional, 2004.

H2607-Ethics and Privacy in Analytics

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

Course Description

Course Overview

"Ethics and Privacy in Analytics" isa thought-provoking course that explores the ethical implications and privacy considerations surrounding data analytics and technology. In a world increasingly driven by data, this course delves into the complex ethical challenges that arise when collecting, analyzing, and using data to make decisions. Students will ex- amine real-world case studies and ethical frameworks to critically evaluate issues like data privacy, bias, transparency, and accountability. By the end of the course, participants will be equipped with the knowledge and tools to navigate the ethical and privacy dilemmas in the analytics eld, ensuring responsible and sustainable data-driven practices in various industries.

Course Pre/Co-requisites

No Pre requisites

Course Outcomes

After the completion of the course, the student will be able to:

H2607.1 Develop the capacity to have constructive conversations about ethical dilemmas of data analytics.

H2607.2 Identify types of data protection laws and legal obligations. .

H2607.3 Examine a particular ethical issue in data collection and apply multiple theories to understand possible solutions

H2607.4. Explain the challenges in ML in the language of business and business ethics.

H2607.5 Develop Ethical Guidelines and Codes of Conduct. .

Course Syllabus

Unit-I:

Introduction:

Introduction to Data Analytics and Ethical Concerns Understanding the role of data analytics in decision-making. Introduction to ethical considerations in data collection, analysis, and application. Ethics Codes: History, Context, and Challenges. Data & Society

Unit-II:

Legal Framework and Privacy Regulations:

Overview of data protection laws (e.g., GDPR, CCPA, HIPAA). Understanding the legal obligations and responsibilities in data handling. Impact of privacy regulations on data analytics practices.

Unit-III:

Data Collection and Informed Consent:

Ethical issues in data collection, including in- formed consent. Ensuring transparency and fairness in data collection processes, Case studies on data collection ethics. Concepts of data privacy and de ident cation., Techniques for data anonymization and pseudonymization, Evaluating the effectiveness of anonymization methods.

Unit-IV:

Data Ethics in Machine Learning:

Ethical challenges in machine learning model de- velopment. Bias and fairness in machine learning algorithms. Ethical considerations in deploying machine learning models.

Unit-V:

Ethical Guidelines and Codes of Conduct:

Overview of ethical guidelines and codes of conduct in data analytics (e.g., ACM, IEEE)How to apply ethical principles in data analytics projects, Ethical responsibility of data professionals Case Study

Books and Materials

Text Books:

1. Data and Goliath: The Hidden Battles to Collect Your Data and Control Your World" by Bruce Schneier, publisher: W. W. Norton & Company, First Edition(2015).

Reference Books:

1. Ethics of Big Data: Balancing Risk and Innovation" by Kord Davis and Doug Patterson, Publisher: O'Reilly Media, Latest Edition, First Edition (2012).

H2608-Reinforcement Learning

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

Course Description

Course Overview

This course provides an in-depth study of Reinforcement Learning (RL), integrating foundational probability concepts, Markov Decision Processes (MDPs), planning and prediction algorithms, and temporal-difference learning methods. It introduces classical and deep RL frameworks, covering dynamic programming, Monte Carlo methods, policy gradient techniques, and actor–critic architectures. Students will develop a solid theoretical understanding of RL principles, proofs of convergence, and function approximation, while exploring practical applications in robotics, games, and recommendation systems. Emphasis is placed on connecting RL to machine learning, control theory, and neuroscience.

Course Pre/Co-requisites

No Pre requisites

Course Outcomes

After the completion of the course, the student will be able to:

H2608: Describe RL origins, history, and links to other fields.

H2608: Apply probability and MDP concepts to decision problems.

H2608: Compare DP, MC, and TD methods with convergence analysis

H2608: Analyze effects of function approximation and deep RL.

H2608 : Evaluate RL algorithms for real-world applications

Course Syllabus

Unit-I:

Probability Foundations

Introduction, origin, and history of RL, Connections to machine learning, control theory, and neuroscience, Probability review: Axioms of probability, random variables, PMF, PDF, CDF, expectation, Joint and conditional distributions, marginalization, Correlation and independence

Unit-II:

Markov Decision Processes (MDPs):

Markov property, Markov chains, Markov reward processes (MRP),Bellman equations: expectation and optimality forms, Proofs of existence and uniqueness of Bellman solutions, State and action value functions, optimal policies.

Unit-III:

Planning & Prediction Methods:

Dynamic Programming (DP) for MDPs: Policy evaluation, policy iteration, value iteration, Contraction mapping proof, convergence guarantees, Monté Carlo methods: First-visit & every-visit MC,MC control, On-policy & off-policy learning, importance sampling.

Unit-IV:

Temporal Difference Learning & Function Approximation's methods:

TD(0), TD(λ), k-step returns SARSA, Q-Learning, variants, Function approximation: Gradient MC, semi-gradient TD, eligibility traces, Control with function approximation, Experience replay, Deep Q-Network basics

Unit-V:

Policy Gradient & Advanced Topics:

Policy gradient theorem, REINFORCE algorithm, Variance reduction techniques: baselines, advantage functions, Actor–Critic methods, Applications in robotics, games, recommendation systems

Books and Materials

Text Books:

1. R. S. Sutton and A. G. Barto, Reinforcement Learning: An Introduction, 2nd ed. Cambridge, MA, USA: MIT Press, 2018.
2. D. P. Bertsekas, Dynamic Programming and Optimal Control, Vol. 1, 4th ed. Belmont, MA, USA: Athena Scientific, 2017.
3. A. Papoulis and S. U. Pillai, Probability, Random Variables, and Stochastic Processes, 4th ed. New York, NY, USA: McGraw-Hill, 2002.

Reference Books:

1. M. L. Puterman, Markov Decision Processes: Discrete Stochastic Dynamic Programming. New York, NY, USA: Wiley, 1994.
2. V. François-Lavet et al., An Introduction to Deep Reinforcement Learning. Cham, Switzerland: Springer, 2018.

IV B.Tech. I Semester

H2609 - Retail and Customer Analysis

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

Course Description

Course Overview

"Retail and Customer Analytics" is a comprehensive course that delves into the dynamic intersection of data analysis and the retail industry. This course explores the strategic use of data to enhance customer experiences, optimize inventory management, and drive profitability. Students will learn how to collect and analyze customer data, identify purchasing patterns, and make data-driven decisions for merchandising, pricing, and marketing strategies. Through case studies and real-world applications, participants will gain insights into the latest tools and techniques used in retail analytics. Upon completion, you will be well-prepared to harness the power of data to revolutionize retail operations and customer engagement, contributing to the success of retail businesses in a data-centric age.

Course Pre/Co-requisites

No Pre requisites

Course Outcomes

After the completion of the course, the student will be able to:

H2609.1. Demonstrate the applicability of the context of organizational behavior to understand the behavior.

H2609.2 . Develop an understanding of the complexities associated with the management of individual human behavior.

H2609.3. Analyze the complexities associated with the management of the group behavior in the organization.

H2609.4. Illustrate the ways the organization's behavior can integrate the understanding of motivation.

H2609.5. Interpret how different types of leadership skills can be used by successful leaders and managers.

Course Syllabus

Unit-I:

Introduction to Retailing

Introduction to retailing: Definition and Scope, Evolution of retailing, Benefits of retailing, retailing environment-Growing importance of retailing ,Types of retail- Retail Channel and Formats - Trends in retailing industry.

Unit-II:

Functions and Activities of Retailing

Strategic retail management process Stores Location Steps in choosing a retail location Merchandise category its uses and Functionality in a retail environment-Retail Assortment basics-Retail promotions and Pricing.

Unit-III:

Services & Quality in Retailing:

Factors constituting retailing the service classification of service and quality Implementation of service management Elements & Components of Retail Operation Managing Inventory & Display.

Unit-IV:

Analytics in Retailing:

Definition, importance, functions, types of analytics, Role, and applications of analytics in retailing In-store Analytics Inventory and product assortment analytics-Customer analytics.

Unit-V:

Descriptive Analytics:

Descriptive analytics in understanding retail consumer behavior Predictive analytics in understanding retail consumer purchase decision making Diagnostic and Prescriptive analytics in service quality and service recovery.

Books and Materials

Text Books:

1. Gibson G. Vedamani, (2012), Retail Management: Functional Principles and Practices, 4th Edition, Jaico Publishing, Bengaluru.
2. Michael Levy and Barton AWeitz, (2019), Retailing Management, 10th Revised edition, McGraw-Hill Inc., US, (ISE Editions).

Reference Books:

1. R. Sudharshan, S. Ravi Prakash and M. SubrahamanyaSarma, (2007), Retail Manage- ment: Principles & Practices, 1st Edition, New Century Publications, New Delhi.

H2610- Software Testing Methodologies

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

Course Description

Course Overview

Testing is a critical component in the successful implementation of software project and its quality assurance for any application. Effective Test Management will ensure the delivery of high-quality applications, satisfied clients. This course presents a comprehensive study of software testing principles, methodologies, management strategies and techniques. Also the emphasis is on understanding software testing processes and testing tools.

Course Pre/Co-requisites

No Pre requisites

Course Outcomes

After the completion of the course, the student will be able to:

H2610.1. Identify terminology, basic concepts, test processes for continuous quality improvement.

H2610.2 . Select an appropriate testing methodology for a given problem.

H2610.3. Make use of transaction flow testing and data flow testing techniques on an application.

H2610.4. Use software testing methods and modern software testing tools for automation of testing process.

Course Syllabus

Unit-I:

Introduction:

Terminology, evolving nature of area, Errors, Faults and Failures, Correct- ness and reliability, Roles and responsibilities, Purpose of testing, Software Testing Life Cycle, some dichotomies, a model for testing, Taxonomy for Bugs: some bug statistics, Con- sequences of bugs, Requirements, Features, and functionality bugs, Structural bugs, Data bugs, Coding bugs, Interface, Integration and system bugs, Test and Test design bugs, De- fect or Bug Life Cycle.

Unit-II:

Software Testing Methodologies:

White/Glass Box Testing, Black Box Testing, Grey Box Testing, Black Box testing Techniques: Boundary Value analysis, Equivalence Class Partition, state Based Testing, Cause effect Graph, Decision table, Exploratory Testing.

Unit-III:

MFlow Graphs and Path Testing:

Path testing basics, predicates, path predicates and achievable paths, path sensitizing, path instrumentation, paths, Path Products and Regu- lar Expressions: Path products and path expressions, a reduction procedure, applications, regular expressions and flow anomaly detection

Unit-IV:

Transaction flow testing and data flow testing:

Transaction flows, transaction flow testing techniques, dataflow testing basics, data flow testing strategies, application, tools and effectiveness

Unit-V:

Testing Tools:

Selenium IDE Basics: Capture Playback – Recording a script. Install And Run Selenium RC: Overview of the contents of the selenium archive, command line, Start and stop Selenium server, Run IDE Tests in different browsers. Creating a Junit Test using Selenium IDE: Export an IDE script as a JUnit test, Run the JUnit test, Run the test in debug mode. My First Selenium Tests.java Annotated

Books and Materials

Text Books:

1. Boris Beizer., Software Testing Techniques, 2nd Edition, Dreamtech Press, New Delhi 2004.

Reference Books:

1. Richardson, Alan John. Selenium Simplified: A Tutorial Guide to Selenium RC with Java and JUnit. Compendium Developments, 2012.
2. Krishna Rungta, Learn Selenium in 1 Day: Definitive Guide to Learn Selenium for Beginners.
3. Software Testing – Principles, Techniques and Tools, M.G.Limaye, Tata McGraw- Hill,2009.

H2611 - Time Series Analysis

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

Course Description

Course Overview

This is exploring fundamental principles and advanced techniques for analyzing time-dependent data. This course equips students with the knowledge and skills to effectively model, interpret, and forecast temporal patterns in various domains, including nance, economics, climate science, and more. It includes time series decomposition, auto-regressive and moving average models, spectral analysis, and state-space models. Students will gain proficiency in data preprocessing, model selection, and diagnostic checks. Practical applications using software like R or Python will be key, allowing students to apply their learning to real-world datasets. By the end of the course, students will have a deep understanding of time series analysis and its practical implications in decision-making and prediction.

Course Pre/Co-requisites

A9005-Probability Distributions and Applied
A9511-Python Programming Laboratory Statistics

Course Outcomes

After the completion of the course, the student will be able to:

H2611.1 . Analyze and forecast Time series models and state-space models.
H2611.2 . Evaluate the accuracy of time series forecasts using appropriate metrics.
H2611.3. Identify and analyze trends, seasonality, and cyclical patterns in data through techniques.
H2611.4. Analyze time series popular tools and programming languages.
H2611.5. To use time series analysis to make informed business decisions with its limitations and assumptions.

Course Syllabus

Unit-I:

Introduction to Time Series:

Introduction, Examples of time series, Stationary models and autocorrelation function, Estimation and elimination of trend and seasonal component, simple descriptive techniques, trend, seasonality, the correlogram, Probability models for time series: stationary. Moving average (MA), Autoregressive (AR), ARMA and ARIMA models.

Unit-II:

ARMA Models:

Stationary Process and ARMA Models,Basic properties and linear pro- cesses, introduction to ARMA models, properties of sample mean and auto-correlation function, forecasting stationary time series, ARMA(p,q) processes.

Unit-III:

Spectral Analysis:

ACF and PACF, Forecasting of ARMA processes, Spectral Analysis, Spectral densities, Time-invariant linear filters, the spectral density of an ARMA process.

Unit-IV:

Modeling and Forecasting:

Modeling and forecasting with ARMA Processes, preliminary estimation maximum likelihood estimation, diagnostics, forecasting, order selection.

Unit-V:

Forecasting Techniques:

Forecasting techniques, the ARAR algorithm, the Holt-Winter algorithm, the Holt-Winter seasonal algorithm estimation of time series models.

Books and Materials

Text Books:

1. Brockwell, Peter J. and Davis, Richard A. (2002). Introduction to Time Series and Forecasting, 2nd edition. Springer-Verlag, New York.

Reference Books:

1. Box, G.E.P., Jenkins, G.M. and Reinsel, G.C. (1994). Time Series Analysis: Forecasting and Control, 3rd Edition, Prentice Hall, New Jersey.

H2612-Agile Project Management

Teaching and Learning Scheme				Hours	Credits	Assessment Marks		
CI		LI	TW+SL	H	C	CIE	SEE	Total
L	T	P	SL					
45	0	0	45	90	3	40	60	100

Course Description

Course Overview

Agile project management has become an increasingly dominant and popular manner to develop new or improved products, services, or results in a variety fields such as software development, engineering, product development, and process improvement. In environments with uncertainty (for example, changing customer needs or unknown root cause), agile project management has been found to product higher customer satisfaction in less time compared to more traditional, plan-driven project management methodologies.

Course Pre/Co-requisites

No Pre-requsites

Course Outcomes

After the completion of the course, the student will be able to:

H2612.1. Use the Agile project management approach including values and principles for a project.

H2612.2. Identify the essential roles in a Scrum team for effective development of project working models.

H2612.3. Make use of Self Organizing Teams to solve issues during the project.

H2612.4. Build a Product Backlog and perform Backlog Refinement in a given scenario.

H2612.5. Examine large projects by using scrum methods.

Course Syllabus

Unit-I:

Agile Software Development:

Basics and Fundamentals of Agile Process Methods, Values of Agile, Principles of Agile, stakeholders, Challenges. Lean Approach: Waste Management, Kaizen and Kanban, add process and products add value. Roles related to the lifecycle, differences between Agile and traditional plans, differences between Agile plans at different lifecycle phases

Unit-II:

Agile and Scrum Principles:

Agile Manifesto, Twelve Practices of XP, Scrum Practices, Applying Scrum. Need of scrum, working of scrum, advanced Scrum Applications, Scrum and the Organization, scrum values.

Unit-III:

Agile Product Management:

Communication, Planning, Estimation Managing the Agile approach Monitoring progress, Targeting and motivating the team, managing business involvement, Escalating issue.

Unit-IV:

Agile Requirements:

User Stories, Backlog Management. Agile Architecture: Feature Driven Development. Agile Risk Management: Risk and Quality Assurance, Agile Tools. Agile Testing: Agile Testing Techniques, Test-Driven Development, User Acceptance Test.

Unit-V:

Scaling Agile for large projects:

Scrum of Scrums, Team collaborations, Scrum; Estimate a Scrum Project, Track Scrum Projects, Communication in Scrum Projects, and Best Practices to Manage Scrum.

Books and Materials

Text Books:

1. Robert C. Martin., Agile Software Development, Principles, Patterns, and Practices, Alan Apt Series, 2011.
2. Mike Cohn., Succeeding with Agile: Software Development Using Scrum, Pearson Publications, 2010.

Reference Books:

1. David J. Anderson and Eli Schragenheim., Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results, 4th Edition, Prentice Hall, 2003.
2. Hazza and Dubinsky, Agile Software Engineering Series: Undergraduate Topics in Computer Science, Springer, 2009.

Vision

To be a pioneer institute and leader in engineering education to address societal needs through education and practice.

Mission

To adopt innovative student centric learning methods.
To enhance professional and entrepreneurial skills through industry institute interaction.
To train the students to meet dynamic needs of the society.
To promote research and continuing education.

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We at Vardhaman College of Engineering, endeavor to uphold excellence in all spheres by adopting the best practices in effort and effect.

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