



Deccan Education Society's
Fergusson College (Autonomous)
Pune

Learning Outcomes-Based Curriculum
for 3/4 years B. Sc. / B. Sc. (Honours) Programme
as per the guidelines of
NEP-1.0

for
Fourth Year B. Sc. (Computer Science)

With effect from the Academic Year
2026-2027



Deccan Education Society's

Fergusson College (Autonomous), Pune-4

Department of Computer Science

Syllabi NEP 1.0 Implemented from Academic Year 2026-27

UG4 B.Sc. Semester : VII/VIII

Program Specific Outcomes (PSOs)

PSO	Outcomes
PSO1	Academic competence: Identify, formulate and solve real world computing system problems of various domains by understanding and applying the principles Of mathematics, computing techniques and business concepts.
PSO2	Personal and Professional Competence: Analyse, design, test, develop and maintain desktop, web, mobile and cross platform software applications using modern tools and technologies in an economical and affordable way.
PSO3	Research Competence: Identify the potentiality to design experiments for complex problems, collect data, interpret data, develop, implement computer programs and use knowledge in various domains to identify research gaps and hence to provide solutions to new ideas and innovations.
PSO4	Entrepreneurial and Social competence: Analyse and understand the evolutionary changes in computing by inculcating employability and entrepreneur skills among the lifelong learners with moral values and ethics. Develop skills required for social interaction.

Course Structure NEP UG4 B.Sc. (NEP 1.0)

Semester	Paper Code	Paper Title	Theory/Practical	Credits
VII	CSC-401	Full Stack I: Web UI and Responsive UI Framework	Theory	4
	CSC-402	Analysis of Algorithms and Computing	Theory	4
	CSC-403	Advanced Operating System	Theory	4
	OR			
	CSC-404	Business Intelligence and Analytics	Theory	4
	CSC-445	Research Methodology	Theory	4
	CSC-411	Computer Science Practical – 11	Practical	2
	CSC -412	Computer Science Practical – 12	Practical	2
	Total Semester Credits			20
VIII	CSC-451	Full Stack II MERN Stack	Theory	4
	CSC-452	Artificial Intelligence	Theory	4
	CSC-453	Software Quality and Assurance	Theory	4
	OR			
	CSC-454	Predictive analytics and data visualization	Theory	4
	CSC-495	On Job Training / Field Project	Theory	4
	CSC-461	Computer Science Practical – 13	Practical	2
	CSC-462	Computer Science Practical – 14	Practical	2
	Total Semester Credits			20
Total UG4 Credits				40

CSC-401	Full Stack I: Web UI and Responsive UI Framework Major - Theory	
	No. of Credits: 04 No. of Hours: 60	
Course Outcomes (COs) On completion of the course, the students will be able to:		Bloom's cognitive level
CO1	Describe various HTML tags for designing simple Web pages.	1
CO2	Implement different CSS styling and bootstrap for creating effective web pages.	2
CO3	Design interactive UI based web pages using JavaScript	3
CO4	Examine the responsiveness of web page using jQuery.	4
CO5	Use java script and jQuery method to Test and validate the web UI.	5
CO6	Build real time, fast and dynamic web application and web pages using AJAX.	6

**CSC-401: Full Stack I: Web UI and Responsive UI Framework
(Major- Theory)**

Unit No.	Title of Unit and Contents	No. of hours
I	Overview of HTML5 1.1 History, Vision & Future of HTML5 1.2 Structure of a Web Page:HTML5 DOCTYPE, Page Encoding 1.3 HTML5 Mark-up: New and Updated Elements, Structural Elements, New Attributes, Deprecated Elements and Attributes; 1.4 HTML5 And CSS3 1.5 Browser Support 1.6 Forms 1.7 Audio and Video 1.8 Canvas, SVG 1.9 Local Storage, Geo location	12
II	Introducing CSS3 2.1 History of CSS, Browser Support, HTML5, 2.2 Selectors and Pseudo Classes 2.3 Fonts and Text Effects 2.4 Colours, Gradients, Background Images, and Masks 2.5 Borders and Box Effects 2.6 Transitions, Transforms, and Animations, 2.7 Responsive Web Design: Viewport, Grid View, Images, Videos, Flexible Box, Media Queries.	10
III	Overview of JavaScript 3.1 Introduction to JavaScript 3.2 JavaScript Statements, JavaScript Keywords 3.3 JavaScript Functions, JavaScript Programs, 3.4 JavaScript Operators 3.5 Function Parameters, Function Return Values 3.6 JavaScript Data Types, Primitive Types, 3.7 Working with Objects: Object Overview, Object creation, Adding	12

	Properties to Objects, Adding Methods to Objects 3.8 JavaScript Conditional Statements, JavaScript Loops & Iteration 3.9 Understanding and working with DOM	
IV	Bootstrap 4.1 Introduction 4.2 Grid 4.3 Components 4.4 Plugins	8
V	JQuery and AJAX 5.1 Introduction 5.2 Attributes, Elements, Selectors, 5.3 jQuery Object, Traversing, 5.4 CSS manipulation 5.5 Data Methods 5.6 Utility Methods 5.7 Events and Effects 5.8 Key Concepts of Ajax 5.9 jQuery's Ajax-Related Methods 5.10 Ajax and Forms 5.11 Working with JSONP 5.12 Ajax Events.	12
VI	Version Control Systems 6.1 Introduction 6.2 Benefits of version control system 6.3 Types of version control systems 6.4 Git: Setting up Git, 6.5 TODO: Use Git Locally 6.6 Working with Git Repository 6.7 Centralizing Git	6

Learning Resources- References

Sr. No.	References
1.	Beginning HTML5 and CSS3 By Christopher Murphy, Divya Manian, Oliver Studholme and Richard W.Clark (APress)
2.	Beginning JavaScript By Jeremy McPeak and Paul Wilton (Wrox)
3.	Head First HTML5 Programming, Building Web Apps with JavaScript By Eric Freeman, Elisabeth Robson (O'Reilly).
4.	Beginning JQuery By Jack Franklin (APress)
5.	Bootstrap By Jake Spurlock (O'Reilly)
6.	https://media.oaipdf.com/pdf/e83a16fa-4d1a-4508-9eb73712027bd657.pdf?ref=morioh.com&utm_source=morioh.com
7.	https://git-scm.com/book/en/v2
8.	https://www.classcentral.com/course/html-css-javascript-for-web-developers-4270
9.	https://www.classcentral.com/course/freecodecamp-responsive-web-design-34059

CSC-402	Analysis of Algorithms and Computing Major -Theory	
	No. of Credits: 04 No. of Hours: 60	
Course Outcomes (COs) On completion of the course, the students will be able to:		Bloom's cognitive level
CO1	Describe the algorithmic strategies for different problems and the way to analyse them.	1
CO2	Explain the importance and analysis of strategies using different examples.	2
CO3	Implement various algorithms and analyse using different strategies.	3
CO4	Apply various algorithms to several types of problems.	4
CO5	Compare and contrast various algorithms with respect to their complexities.	5
CO6	Combine the knowledge of different strategies to write efficient algorithms for building efficient software.	6

CSC-402: Analysis of Algorithms and Computing
(Major- Theory)

Unit No.	Title of Unit and Contents	No. of hours
I	Introduction 1.1 The Role of Algorithms in Computing, Algorithm as a technology. 1.2 Fundamentals of Algorithmic Problem Solving, the Analysis Framework, Asymptotic Notations 1.3 Mathematical Analysis of Non-recursive & Recursive Algorithms Linear and Nonlinear sorting	15
II	Design Strategies 2.1 Decrease and Conquer: Types, Insertion Sort, Topological Sorting. 2.2 Divide and Conquer: Concept, Sorting algorithms, Strassen's matrix multiplication	15
III	Advanced Design and Analysis Techniques 3.1 Greedy Method: Types, Knapsack problem, Spanning Trees, An activity-selection problem, Optimal Merge Pattern, Huffman codes 3.2 Dynamic Programming: Concept, Matrix Chain Multiplication, Longest Common Subsequence, Shortest Path, Traveling Salesperson's (TSP) problem, 0/1 knapsack problem. 3.3 Backtracking: Concept, Graph coloring and Hamiltonian cycle. Branch and Bound: Concept, LCBB, TSP, 0/1 knapsack problem	20
IV	Problem classification 4.1 Nondeterministic algorithm 4.2 The class of P, NP, NP-hard and NP - Complete problems, Cook's theorem	10

Learning Resources- References

Sr. No.	References
1.	Ellis Horowitz, Sartaj Sahni & Sanguthevar Rajasekaran, Computer Algorithms, Galgotia.
2.	T. Cormen, C. Leiserson, & R. Rivest, Algorithms, MIT Press, 1990 1
3.	A. Aho, J. Hopcroft, & J. Ullman, The Design and Analysis of Computer Algorithm, Addison Wesley, 1974
4.	Donald Knuth, The Art of Computer Programming (3 vols., various editions, 1973-81), Addison Wesley

CSC-403	Advanced Operating System Elective-Theory	
	No. of Credits: 04 No. of Hours: 60	
Course Outcomes (COs) On completion of the course, the students will be able to:		Bloom's cognitive level
CO1	Describe various components - hardware, software, and concepts of the Unix Kernel	1
CO2	Interpret different data structures related to the Unix kernel	2
CO3	Develop shell scripts and programs using Unix system calls for file management, process control, and input/output operations.	3
CO4	Compare and contrast the design choices and trade-offs between different Unix- like operating systems based on reliability, security, and usage.	4
CO5	Evaluate various Inter-Process Communication mechanisms in Unix such as pipes, sockets etc.	5
CO6	Integrate advanced Unix features and techniques into application development.	6

**CSC-403: Advanced Operating System
(Elective- Theory)**

Unit No.	Title of Unit and Contents	No. of hours
I	Overview of Unix Kernel 1.1 Why Unix? 1.2 Architecture of UNIX Operating System 1.3 Concepts related to Files, Processes, Signals, and memory 1.4 Shell and Types of Shell 1.5 Shell commands 1.6 Shell Scripting	10
II	Kernel Data structures and their relationships 2.1 File data structure 2.2 Process Data structure	8
III	File, Directories and processes 3.1 Internal representation of file – Buffers and Inodes 3.2 File I/O subsystem calls – Algorithm and its implementation 3.3 File manipulation subsystem calls - Algorithm and its implementation 3.4 File status subsystem calls- Algorithm and its implementation 3.5 Process Environment, Process Control, and Process Relationships 3.6 Process State Transition 3.7 Context of a process 3.8 Creating, managing, and terminating the Process	12
IV	Inter-Process Communication 4.1 Pipes and types of pipes 4.2 Sockets	10
V	Memory and Signal Management 5.1 Memory and Signal Concepts 5.2 Memory Management policies – Demand Paging and Swapping 5.3 Memory system calls 5.4 Sending and receiving Signals 5.5 Signals system calls	12

VI	Flavors of Unix and its Industry Applications 6.1 Overview of different Unix-like operating systems 6.2 Industry Applications 6.3 Security Applications 6.4 Impact of Unix on modern technologies	8
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Learning Resources- References

Sr. No.	References
1.	Yashwant P. Kanetkar, UNIX Shell Programming, BPB
2.	Maurice J. Bach, The Design of the UNIX Operating System, PHI
3.	Richard Stevens, Advanced Programming in the UNIX Environment, Addison-Wesley
4.	Richard Stevens, UNIX Network Programming, Addison-Wesley

CSC-404	Business Intelligence and Analytics Elective-Theory	
	No. of Credits: 04 No. of Hours: 60	
Course Outcomes (COs) On completion of the course, the students will be able to:		Bloom's cognitive level
CO1	Describe the Business architecture and the concepts of policies and procedures.	1
CO2	Explain the composition of analytics and business policies with the specified strategy.	2
CO3	Implement various procedural metrics in the given data set by comparing the outcomes.	3
CO4	Differentiate between various business models and analytic applications to analyze business strategies.	4
CO5	Compare and contrast various algorithms with respect to efficiency and accuracy measures related to business policies.	5
CO6	Combine the strategies and cost evaluation techniques for analysing and predicting the business process model.	6

**CSC-404: Business Intelligence and Analytics
(Elective- Theory)**

Unit No.	Title of Unit and Contents	No. of hours
I	Introduction to Business Intelligence 1.1 Definition and History of BI 1.2 Transaction processing versus analytical processing 1.3 BI implementation 1.4 Major tools and techniques of BI	5
II	Data warehousing 2.1 Definition and concepts 2.2 Data warehouse architecture 2.3 ETL process, data warehouse development, Comparison of OLTP and OLAP 2.4 Top down vs. Bottom up 2.5 Data Mart vs. EDW, Implementation issues 2.6 Real-time data warehousing 2.7 Slicing, dicing and cross applications reporting and complex data analysis	8
III	Business performance management 3.1 Key performance indicators and operational metrics, 3.2 Balanced scorecard 3.3 Six Sigma, Dashboards and scorecards	7
IV	Introduction to Business Analytics 4.1 Understanding Business Intelligence and Analytics 4.2 Data analytic lifecycle, various phases of Data analytic lifecycle 4.3 Business analytics, Business decision 4.4 Features of Business analytics 4.5 Types of business analytics	7

V	Basic Statistics in Business Analytics 5.1 Introduction to Probability, Probability Distributions 5.2 Connection with Statistical Distributions, Statistical Properties (Mean, Mode, Median, Moments, Standard Deviation, etc.) 5.3 Common Probability Distributions (Discrete, Binomial, Normal) 5.4 Other Probability Distributions (Chi-Square, Poisson) 5.5 Joint and Conditional Probabilities	10
VI	Basics of Modeling 6.1 Differentiating descriptive, predictive, and prescriptive analytics 6.2 Data mining vs data analytics, Industrial problem-solving process 6.3 Decision needs and analytics, stakeholders and analytics 6.4 SWOT analysis	6
VII	Data Visualization Techniques 7.1 Data Preparation and Exploration 7.2 Importance of data quality 7.3 Dealing with missing or incomplete data 7.4 Data Classification	4
VIII	Modelling Techniques 8.1 Introduction to Common Modelling Techniques 8.2 Cluster Analysis (Unsupervised Learning) 8.3 Classification & Prediction (Supervised Learning) 8.4 Classification - Training & Testing 8.5 Sampling Data in Classification	8
IX	Introduction to Predictive analytics 9.1 Predictive modelling and Analysis 9.2 Regression Analysis, Multi-co-linearity, Correlation analysis 9.3 Rank correlation coefficient, Multiple correlation 9.4 Least square, Curve fitting	5

Learning Resources- References

Sr. No.	References
1.	EfraimTurban, Ramesh Sharda, Dursun Delen, and David King, Business Intelligence: A Manageri Approach, 2nd Edition, PEARSON 2012, ISBN-10: 0-13-610066-X, ISBN- 13: 978-0-13-610066-9
2.	Simon Miller and William Hutchinson, Oracle Business Intelligence Applications, McGraw Hill Education 2013, ISBN-10: 93-5134-153-4, ISBN-13: 978-93-5134-153-6
3.	Gert H.N. Laursen, JesperThorlund , Business Analytics for Managers: Taking Business Intelligence beyond Reporting Paperback , 2013
4.	Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Busines by AmbigaDhiraj, Wiely CIO Series.
5.	Data Science & Big Data Analytics” by David Dietrich, Barry Hiller, EMC education services, Wiley publications, 2012
6.	"Business analytics: the next frontier for decision sciences." By Evans, James R., and Carl H Lindner, Decision Line

CSC-445	Research Methodology Major-Theory	
	No. of Credits: 04 No. of Hours: 60	

Instructions:

- A student will choose 4 suitable modules depending on his/her faculty. The contact hours will be around 60 based on assignments and examinations. The examination for each module will be separately performed.

Mode of examination-

- The internal examination for each module will be separately conducted. The examination mode is decided by the instructor of that module.
- The external examination will be conducted at the time of 4th half yearly progress review. The student's implementation of various aspects in research methodologies will be checked.

**CSC-445: Research Methodology
(Major- Theory)**

Unit No.	Title of Unit and Contents	No. of hours
I	History of research. Indian, Egyptian, Greek ideas methodologies and research in agriculture, chemistry, metallurgy, medical. Ancient Indian research methodology applications.	6
II	Statistical analysis and its significance. , Exploratory and confirmatory research, Planned and ad-hoc methods of data collection, non-response and methods of recovering the missing response, Various software for statistical analysis. The module will consist of case studies of the research performed in various subjects using statistical methods, Error and noise analysis, curve fitting.	12
III	Creating questionnaire. Data analysis from answers, Selection of research topic (case study based). Selection of research topic (case study based)	8
IV	Literature search, selection of research topic (case study based), maintaining laboratory records (case study based). Safety in Laboratories, Ethical considerations, effective verbal and non- verbal communication, field data collection, safety in field.	12
V	Writing research paper and/or thesis, making a presentation, writing a research proposal, and patents in Science, technology.	11
VI	Databases and Research Metrics Databases (i) Indexing databases. (ii) Citation databases: Web of Science, Scopus, etc. Research Metrics (i) Impact Factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score. (ii) Metrics: h- index, g index, i10 index, altimetric	5
VII	Research Methods for Computer Science	6

	Formal Methods: Formal Specification, Algorithm, and Complexity; Building Artefacts: Proof of Performance, Proof of Concept, and Proof of Existence; Process Methodology: Methods for Software Engineering and Human-Computer Interaction, Cognitive Processes, Interactive Games, Social Networks, and Web Analytics	
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Learning Resources- References

Sr. No.	References
1.	'History of the Scientific Methods' by Martin Shuttleworth, https://explorable.com/history-of-the-scientific-method .
2.	The Statistical Analysis of Experimental Data' by, John Mandel, ISBN: 0486646661, ISBN13: 9780486646664

CSC-411	Computer Science Practical-11 Major-Practical	
	No. of Credits: 02 No. of Hours: 60	
Course Outcomes (COs) On completion of the course, the students will be able to:		Bloom's cognitive level
CO1	State use of fundamentals of UI designing and different algorithmic techniques.	1
CO2	Understand how CSS sheets can be applied to make UI more stylish and understand the use of data structures in improving the algorithm performance.	2
CO3	Design and develop professional web applications or websites with the help of HTML and CSS. Also learn variety of useful algorithms.	3
CO4	Design and implement various JavaScript methods to query a web page. implement searching and sorting algorithms.	4
CO5	Apply various jQuery function and methods to Web application. Apply the dynamic programming technique to solve real world problems.	5
CO6	Analyze the performance of various algorithms using design strategies.	6

**CSC-411: Computer Science Practical-11
(Major- Practical)**

Expt. No.	Title of the Experiment
1	Designing HTML5 Forms
2	Designing CSS3
3	JavaScript
4	jQuery fundamentals and jQuery CSS
5	jQuery Events and Effects
6	Basic Algorithms
7	Sorting methods
8	Decrease and conquer
9	Dynamic Programming
10	Greedy Algorithms
11	Back Tracking
12	Minimum Cost Spanning Tree
13	Activity 1
14	Activity 2
15	Activity 3

CSC-412	Computer Science Practical-12 Major-Practical	
	No. of Credits: 02 No. of Hours: 60	
Course Outcomes (COs) On completion of the course, the students will be able to:		Bloom's cognitive level
CO1	Describe the various programming constructs of Python language.	1
CO2	Discuss the domain of the problem and analyse the problem to find the various entities of the domain.	2
CO3	Implement various programming constructs to code the analysis done for the problem domain.	3
CO4	Differentiate the analysis and the implementation phases appropriately.	4
CO5	Compare and contrast the use of various data structures to gain suitable knowledge about their implementation.	5
CO6	Combine all the programming constructs and develop a python program to give the desired functionality	6

**CSC-412: Computer Science Practical-12
(Major- Practical)**

Expt. No.	Title of the Experiment
1	Data Types
2	Python Functions
3	Python String functions
4	Data Structures: Stacks, Queues, Tuples, Sets, Dictionaries
5	Data Structures: Stacks, Queues, Tuples, Sets, Dictionaries
6	File Handling
7	File Handling
8	Regular Expression
9	Regular Expression
10	Object Oriented Programming: Inheritance, Polymorphism, Interfaces
11	Working with Database
12	Build a small application
13	Activity 1
14	Activity 2
15	Activity 3

CSC-451	Full Stack II MERN Stack Major-Theory	
	Number of Credits: 04 No. of Hours: 60	
Course Outcomes (COs) On completion of the course, the students will be able to:		Bloom's cognitive level
CO1	Describe various database schema designs of NoSQL database	1
CO2	Implement different data modelling methods and middleware's	2
CO3	Design dynamic single page web applications using MEARN Technologies	3
CO4	Examine how to implement web applications and API's using express Framework	4
CO5	Use NodeJS method to Test and validate streams and events for non-blocking I/O	5
CO6	Build user interactive and efficient web applications using MERN Stack	6

**CSC-451: Paper Full Stack II MERN Stack
(Major- Theory)**

Unit No.	Title of Unit and Contents	No. of hours
I	MONGODB 1.1 Introduction 1.2 MongoDB Advantages 1.3 Installation (mlab – mongoose connection) 1.4 Data modelling 1.5 Creating Schemas with Mongoose 1.6 Create Database 1.7 Drop Database 1.8 CRUD Operations 1.9 Limit Records 1.10 Sort Records 1.11 Aggregation 1.12 Data Models 1.13 Change Streams 1.14 Replication & Storage	12
II	EXPRESS JS 2.1 Introduction 2.2 Installation of Node package manager (npm) 2.3 Express Generator 2.4 Static files 2.5 Routing 2.6 HTTP Methods 2.7 Writing Middleware 2.8 Using Middleware 2.9 Using template engines 2.10 Error handling 2.11 Cookies 2.12 Session 2.13 Directory Structure	12

III	REACT 3.1 What is React? 3.2 What problem does it solve? 3.3 Introduction to Component based Programming 3.4 Virtual DOM 3.5 JSX & Rendering Elements 3.6 Components and Props 3.7 State Management 3.8 Event Management 3.9 Routing & Redux	18
IV	NODEJS 4.1 Introduction 4.2 Modules 4.3 HTTP Module 4.4 File System 4.5 URL Module 4.6 Uploading Files 4.7 Event Loop 4.8 Event Emitter 4.9 Callback's Concept 4.10 Buffers 4.11 streams 4.12 Nodjs Email 4.13 Packaging	10
V	Introduction to React Native 5.1 Why Use React Native? 5.2 View, State, Props, and Style 5.3 React Native Apps VS Platform-Specific Apps	8

Learning Resources- References

Sr. No.	References
1.	Amos Q. Haviv, Mean Web Development
2.	MERN Projects for Beginners: Create Five Social Web Apps Using MongoDB, Express.js, React, and Node 1st ed. Edition by Nabendu Biswas
3.	Beginning MERN Stack: Build and Deploy a Full Stack MongoDB, Express, React, Node.js App by Greg Lim
4.	MongoDB Docs: https://www.mongodb.com/docs/manual/introduction
5.	React Docs : https://reactjs.org/tutorial/tutorial.html
6.	Github Docs : https://docs.github.com/en
7.	https://pepa.holla.cz/wp-content/uploads/2016/12/Learning-React-Native.pdf
8.	https://www.classcentral.com/course/udemy-mern-stack-front-to-back-42187

CSC-452	Artificial Intelligence Major-Theory	
	No. of Credits: 04 No. of Hours: 60	
Course Outcomes (COs) On completion of the course, the students will be able to:		Bloom's cognitive level
CO1	Describe the knowledge of AI principles and techniques.	1
CO2	Discuss the basic principles of AI toward problem solving.	2
CO3	Implement various AI techniques and machine learning algorithms by applying it to various problems.	3
CO4	Differentiate between various AI techniques and machine learning algorithms.	4
CO5	Compare and contrast various AI algorithms.	5
CO6	Combine the knowledge of AI techniques and algorithms to build an intelligent system.	6

**CSC-452: Artificial Intelligence
(Major- Theory)**

Unit No.	Title of Unit and Contents	No. of hours
I	Introduction to Artificial Intelligence 1.1 What is AI? Foundation of AI, History of AI, Applications of AI 1.2 Early work in AI, AI and related fields, AI problems and Techniques	5
II	Problems, Problem Spaces and Search 2.1 Defining AI problems as a State Space Search with examples 2.2 Production Systems, Search and Control Strategies 2.3 Problem Characteristics 2.4 Blind Search Techniques: BFS, DFS, Iterative Deepening 2.5 Heuristic Search Techniques: Generate and test, Hill Climbing 2.6 Best First search, A*, AO*, Constraint Satisfaction, Mean-2.7 End Analysis.	15
III	Knowledge Representation 3.1 Representations and Mappings 3.2 Approaches to Knowledge Representation 3.3 Knowledge representation methods. 3.4 Propositional Logic, Predicate logic 3.5 Representing Simple facts in Logic 3.6 Computable Functions and Predicates 3.7 Resolution, Forward and backward chaining 3.8 Game Playing- Minimax Search Procedures, Adding alpha- beta cutoffs.	15
IV	Introduction to AI with Python: 4.1 Introduction to Python, Why Python with AI? 4.2 Features of Python, Basics of Python. 4.3 Python statements, Methods & Functions using python. 4.4 Basic and advanced modules & Packages.	10

	4.5 Python decorators and generator. 4.6 Advanced Objects & Data structures.	
V	Machine Learning: 5.1 Why Machine learning. 5.2 Types of Machine Learning: 5.3 Supervised learning- Classification & Regression. Random Forest, KNN Algorithm. 5.4 Unsupervised learning-Clustering & Association. Reinforcement learning.	15

Learning Resources- References

Sr. No.	References
1.	Artificial Intelligence, Tata McGraw Hill, 2nd Edition, by Elaine Rich and Kevin Knight.
2.	Introduction to Artificial Intelligence and Expert System, Prentice Hall of India Pvt. Ltd., New Delhi, 1997, 2nd Printing, by Dan Patterson.
3.	Computational Intelligence by Eberhart, Elsevier Publication
4.	Artificial Intelligence: A New Synthesis Nilsson Elsevier Publication
5.	Artificial Intelligence with Python Prateek Joshi Packt Publishing Ltd
6.	Reinforcement and Systematic Machine Learning for Decision Making, Parag Kulkarni Wiley- IEEE Press Edition
7.	Introduction to Machine Learning Ethem Alpaydin PHI 2nd Edition

CSC-453	Software Quality Assurance Elective-Theory	
	No. of Credits: 04 No. of Hours: 60	
Course Outcomes (COs) On completion of the course, the students will be able to:		Bloom's cognitive level
CO1	Describe the software development life cycle from the perspective of Quality Assurance Engineer	1
CO2	Illustrate various components of the project life cycle.	2
CO3	Implement various quality improvement techniques, assessment components and apply the suitable quality factors on the project.	3
CO4	Differentiate between the Quality Assurance and Testing. Understand the importance of Quality Assurance and Control.	4
CO5	Compare and contrast the different assessment components and various quality improvement techniques.	5
CO6	Combine all the techniques of quality control and improvement to assure quality of the project.	6

**CSC-453: Software Quality Assurance
(Elective- Theory)**

Unit No.	Title of Unit and Contents	No. of hours
I	Software quality 1.1 Definition, Software errors, software faults and software failures 1.2 Software quality assurance – definition and objectives, Software quality assurance vs. software quality control 1.3 The objectives of SQA activities 1.4 Types of Quality Assurance: pre-production inspection (PPI), during production inspection (DPI), pre-shipment inspection (PSI), and container loading/loading supervision (LS)	8
II	SQA Components 2.1 Pre-project SQA Components : Contract Review, Development and Quality Plan 2.2 SQA components in Project life cycle activities assessment Verification and Validation., Various types of Reviews, Inspections, Walkthrough, Software testing, Impact of CASE Tools	12
III	SQA Infrastructure Components 3.1 Procedures and procedure manuals, Templates and Checklists 3.2 Staff training, Corrective and preventive actions, Documentation control. Writing manuals for small applications.	9
IV	Software Quality Factors and Standardization 4.1 McCall's Quality Model, Product, Process quality metrics 4.2 ISO 9000-3 and SEI-CMM	5
V	Configuration Management 5.1 Change control, Release and version control, Software configuration management audit	7

VI	Quality Improvement Techniques and Quality Costs 6.1 Pareto Diagrams, Cause-Effect Diagrams, Scatter Diagrams, Run Charts 6.2 Quality Cost Measurement, Utilizing Quality Costs for Decision-Making	9
VII	Introduction to Open-Source Quality Assurance Tools.	10

Learning Resources- References

Sr. No.	References
1.	Danial Galin, Software Quality Assurance from theory to implementation
2.	Nina Godbole, Software Quality Assurance: Principles and Practices
3.	Donna C. S., Summers -Quality, 5th ed., Prentice-Hall, 2010.
4.	Dale H., Besterfield -Total Quality Management, Prentice Hall, 2003.
5.	John Wiley. J.F.Peters, Software engineering: An Engineering approach
6.	https://csiac.org/articles/software-assurance-adoption-through-open-source-tools/
7.	https://www.testrail.com/qa-software/
8.	https://www.qatouch.com/
9.	https://www.atlassian.com/software/jira

CSC-454	Predictive Analytics and Data Visualization Elective-Theory	
	No. of Credits: 04 No. of Hours: 60	
Course Outcomes (COs) On completion of the course, the students will be able to:		Bloom's cognitive level
CO1	Apply predictive analytics tools to analyse real-life business problems.	1
CO2	Demonstrate case-based practical problems using predictive analytics techniques to interpret model outputs.	2
CO3	Examine regression, logistic regression, and forecasting using software tools.	3
CO4	To understand the various types of data, apply and evaluate the principles of data visualization.	4
CO5	To apply structured approach to create effective visualizations from the massive dataset using various visualization tools.	5
CO6	Demonstrate the analysis of large dataset using various visualization techniques and tools.	6

**CSC-454: Predictive Analytics and Data Visualization
(Elective- Theory)**

Unit No.	Title of Unit and Contents	No. of hours
I	Introduction to Predictive Analytics 1.1 Analytics in Decision Making -Game changers & Innovators - Predictive Analytics	5
II	Simple Linear Regression (SLR) Introduction to Regression 2.1 Model Development Model Validation 2.2 Multiple Linear Regression (MLR) 2.3 Multiple Linear Regression-Estimation of Regression Parameters Model Diagnostics-Logistic Regression	5
III	Decision Trees and Unstructured data analysis 3.1 Introduction to Decision Trees-CHI-Square 3.2 Automatic Interaction Detectors (CHAID)-Classification and Regression Tree (CART) 3.3 Analysis of Unstructured data-Naive Bayes Classification- Forecasting- Time Series Analysis-Forecasting Accuracy	8
IV	Introduction to Data Visualization 4.1 Overview of data visualization - Data Abstraction - Task Abstraction 4.2 Dimensions and Measures - Analysis: Four Levels for Validation 4.3 Statistical charts (Bar Chart - stacked bar chart – Line Chart - Histogram - Pie chart	8
V	Visualization Techniques 5.1 Introduction to various data visualization tools 5.2 Scalar and point techniques - vector visualization techniques - multidimensional techniques 5.3 Visualizing cluster analysis K-means and Hierarchical Cluster techniques	8

VI	Spatio-temporal Data Visualization 6.1 Time Series data visualization – Text data visualization 6.2 Spatial Data Visualization 6.3 Visual Analytics Networks and Trees - Heat Map – Tree Map - Map Color and Other Channels Manipulate View.	8
VII	Multivariate Data Visualization 7.1 Multivariate data visualization – Geometric projection techniques Icon-based techniques 7.2 Pixel-oriented techniques - Hierarchical techniques 7.3 Scatterplot matrix - Hyper box - Trellis display - Parallel coordinates	8
VIII	Data Visualization Tools 8.1 Tableau functions and logics: Marks and Channels 8.2 Arrange Tables- Arrange Spatial Data- Facets into multiple views 8.3 Visualization Dashboard Creations Data Dashboard- Taxonomies 8.4 User Interaction- Organizational Functions-Dashboard Design – Worksheets - Workbooks 8.5 Workbook Optimization - Protection and common mistakes. 8.6 Dashboard creation using visualization tool use cases: Finance-marketin insurance-healthcare.	10

Learning Resources- References

Sr. No.	References
1.	Tamara Munzer, Visualization Analysis and Design, 1st edition, CRC Press, United States, 2015.
2.	Michael Fry, Jeffrey Ohlmann, Jeffrey Camm, James Cochran, Data Visualization: Exploring and Explaining with Data, South-Western College Publishing, 2021
3.	Dr. Chun-hauh Chen, W. K. Hardle, A. Unwin, Handbook of Data Visualization, 1 st edition, Springer publication, Germany, 2008.
4.	Ben Fry, Visualizing Data, 1st edition, O'Reilly Media, United States, 2008.
5.	Avril Coghlan, A little book of R for multivariate analysis, 1st edition, Welcome Trust Sanger Institute, United Kingdom, 2013.
6.	Predictive Analytics For Dummies (For Dummies Series) by Anasse Bari (shelved 1 time as predictive-analytics)
7.	Fundamentals of Machine Learning for Predictive Data Analytics, second edition: Algorithms, Worked Examples, and Case Studies 2nd Edition by John D. Kelleher (Author) Brian Mac Namee (Author), Aoife D'Arcy (Author)

CSC-495: On-Job Training / Field Project Major-Theory		
	Number of Credits: 04 No. of Hours: 60	

**** Refer OJT guidelines from College website**

The objective of field project is to make the students understand Requirement analysis, design and implementation cycle. Any open problem statement can be taken for implementation. The system can be designed in any programming language implemented on any platform.

Sr.	Date	Details of Project work	Remark	Project guide sign

CSC-461	Computer Science Practical-13 Major-Practical	
	Number of Credits: 02 No. of Hours: 60	
Course Outcomes (COs) On completion of the course, the students will be able to:		Bloom's cognitive level
CO1	Apply MERN Technologies to develop Web Applications.	1
CO2	Understand how MongoDB can be used for data handling and validation in an web application.	2
CO3	Design and Develop web applications using various libraries and frameworks	3
CO4	Understand functional components, state components, lifecycle, and routing in React.	4
CO5	Apply various Express JS and React JS methods to create an interactive web application.	5
CO6	Analyze outputs of web-based applications and their performance	6

**CSC-461: Computer Science Practical-13
(Major- Practical)**

Expt. No.	Title of the Experiment
1	Demonstrate Accessing MongoDB from Node.js.
2	Demonstrate Manipulating MongoDB Documents from Node.js
3	Demonstrate Manipulating MongoDB Documents from Node.js
4	Implement Read and write operations on database using MongoDB APIs
5	Implement React Elements and Components
6	Develop Web application using React
7	Developing a simple CRUD application using the MERN stack
8	Develop Node JS Application
9	Implement HTTP Services in Node JS (Request and Response)
10	Demonstrate Express.js Authentication
11	Develop a Redux application.
12	Demonstrate React Component Life cycle
13	Activity 1
14	Activity 2
15	Activity 3

CSC-462	Computer Science Practical-14 Major-Practical	
	Number of Credits: 02 No. of Hours: 60	
Course Outcomes (COs) On completion of the course, the students will be able to:		Bloom's cognitive level
CO1	State fundamentals of Dot Net architecture.	1
CO2	Illustrate various Object-Oriented principles applied in real life problems.	2
CO3	Design, develop professional Web-based applications	3
CO4	Differentiate various data storage and data access strategies.	4
CO5	Test and validate the usage of MVC framework	5
CO6	Combine features and programming constructs to build to develop web applications.	6

**CSC-462: Computer Science Practical-14
(Major- Practical)**

Expt. No.	Title of the Experiment
1	Basics of MVC Web Applications
2	Basics of MVC Web Applications
3	Basics of MVC Web Applications
4	Web forms/web pages
5	Web forms/web pages
6	CRUD applications using WEBAPI
7	CRUD applications using WEBAPI
8	CRUD applications using WEBAPI
9	CRUD applications using WEBAPI
10	Use of REST API
11	Use of REST API
12	Use of REST API
13	Activity 1
14	Activity 2
15	Activity 3