Fergusson College (Autonomous), Pune

NEP 2020 - Based Curriculum

For

M. Sc. I – Computer Science

With effect from July 2023

Department of Computer Science, Fergusson College (Autonomous), Pune

Program Outcomes (POs) of M.Sc. Computer Science
PO1	**Disciplinary Knowledge:** Demonstrate comprehensive knowledge of the discipline that forms a part of a postgraduate programme. Execute strong theoretical and practical understanding generated from the specific programme in the area of work.
PO2	**Critical Thinking and Problem solving:** Exhibit the skill of critical thinking and understand scientific texts and place scientific statements and themes in contexts and also evaluate them in terms of generic conventions. Identify the problem by observing the situation closely, take actions and apply lateral thinking and analytical skills to design the solutions.
PO3	**Social competence:** Exhibit thoughts and ideas effectively in writing and orally; communicate with others using appropriate media, build effective interactive and presenting skills to meet global competencies. Elicit views of others, present complex information in a clear and concise and help reach conclusion in group settings.
PO4	**Research-related skills and Scientific temper:** Infer scientific literature, build sense of enquiry and able to formulate, test, analyse, interpret and establish hypothesis and research questions; and to identify and consult relevant sources to find answers. Plan and write a research paper/project while emphasizing on academics and research ethics, scientific conduct and creating awareness about intellectual property rights and issues of plagiarism.
PO5	**Trans-disciplinary knowledge**: Create new conceptual, theoretical and methodological understanding that integrates and transcends beyond discipline-specific approaches to address a common problem.
PO6	**Personal and professional competence**: Perform independently and also collaboratively as a part of a team to meet defined objectives and carry out work across interdisciplinary fields. Execute interpersonal relationships, self-motivation and adaptability skills and commit to professional ethics.
PO7	**Effective Citizenship and Ethics**: Demonstrate empathetic social concern and equity centered national development, and ability to act with an informed awareness of moral and ethical issues and commit to professional ethics and responsibility.
PO8	**Environment and Sustainability**: Understand the impact of the scientific solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.
PO9	**Self-directed and Life-long learning:** Acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes.

Program Specific Outcomes (PSOs) for M.Sc. Computer Science Program	
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 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.

Fergusson College (Autonomous), Pune
Proposed First Year Curriculum as per NEP 2020
Department of Computer Science

M.Sc. Computer Science

Semester	Paper Code	Paper Title	Credits
I	CSC-501	Full Stack I: Web UI and Responsive UI Framework	**4**
	CSC-502	Analysis of Algorithms and Computing	**4**
	CSC-503 **OR**	Advanced Operating System	**4**
	CSC-504	Business Intelligence and Analytics	
	CSC-510	Research Methodology	**4**
	CSC-520	Practical I (Based on FS I and AAC)	**2**
	CSC-521	Practical II (Python Programming)	**2**
		Total Semester Credits	**20**
II	CSC-551	Full Stack II MERN Stack	**4**
	CSC-552	Artificial Intelligence	**4**
	CSC-553 **OR**	Software Quality and Assurance	**4**
	CSC-554	Predictive analytics and data visualization	
	CSC-560	Project	**4**
	CSC-570	Practical III (FS II)	**2**
	CSC-571	Practical IV (Based on Dot NET)	**2**
		Total Semester Credits	**20**
		Total PG-I Credits	**40**

Department of Computer Science, Fergusson College (Autonomous), Pune

F.Y. M.Sc. Computer Science Semester I

Title of the Course and Course Code	Subject Title (Core): CSC501 Full Stack – I: Web UI and Responsive UI Framework	Number of Credits: 04
	Course Outcome (COs) **On completion of the course, the students will be able to:**	
CO1	Describe various HTML tags for designing simple Web pages.	
CO2	Implement different CSS styling and bootstrap for creating effective web pages.	
CO3	Design interactive UI based web pages using JavaScript	
CO4	Examine the responsiveness of web page using jQuery.	
CO5	Use java script and jQuery method to Test and validate the web UI.	
CO6	Build real time, fast and dynamic web application and web pages using AJAX.	

Unit No.	Title of Unit and Contents
1	**Overview of HTML5** ● History, Vision & Future of HTML5 ● Structure of a Web Page:HTML5 DOCTYPE, Page Encoding ● HTML5 Mark-up: New and Updated Elements, Structural Elements, New Attributes, Deprecated Elements and Attributes; ● HTML5 And CSS3 ● Browser Support ● Forms ● Audio and Video ● Canvas, SVG ● Local Storage, Geo location.
2	**Introducing CSS3** ● History of CSS, Browser Support, HTML5, ● Selectors and Pseudo Classes ● Fonts and Text Effects ● Colours, Gradients, Background Images, and Masks ● Borders and Box Effects ● Transitions, Transforms, and Animations, ● Responsive Web Design: Viewport, Grid View, Images, Videos, Flexible Box,

		Media Queries.
3		**Overview of JavaScript** ● Introduction to JavaScript ● JavaScript Statements, JavaScript Keywords ● JavaScript Functions, JavaScript Programs, ● JavaScript Operators ● Function Parameters, Function Return Values ● JavaScript Data Types, Primitive Types, ● Working with Objects: Object Overview, Object creation, Adding Properties to Objects, Adding Methods to Objects ● JavaScript Conditional Statements, JavaScript Loops & Iteration ● Understanding and working with DOM ● Enumerating properties ● Callbacks ● JSON
4		**Bootstrap** ● Introduction ● Grid ● Components ● Plugins.
5		**jQuery and AJAX** ● Introduction ● Attributes, Elements, Selectors, ● jQuery Object, Traversing, ● CSS manipulation ● Data Methods ● Utility Methods ● Events and Effects ● Key Concepts of Ajax ● jQuery's Ajax-Related Methods ● Ajax and Forms ● Working with JSONP ● Ajax Events.
6		**Version Control Systems** ● Introduction ● Benefits of version control system ● Types of version control systems ● Git: Setting up Git, ● TODO: Use Git Locally ● Working with Git Repository ● Centralizing Git

Learning Resources:

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)

E- BOOKS

1. https://media.oiipdf.com/pdf/e83a16fa-4d1a-4508-9eb7-3712027bd657.pdf?ref=morioh.com&utm_source=morioh.com
2. https://git-scm.com/book/en/v2

MOOC

1. https://www.classcentral.com/course/html-css-javascript-for-web-developers-4270
2. https://www.classcentral.com/course/freecodecamp-responsive-web-design-34059

F.Y. M.Sc. Computer Science Semester I		
Title of the Course and Course code	**Subject Title (Core): CSC502 Analysis of Algorithm and Computing**	**Number of Credits: 04**
Course Outcome (COs) **On completion of the course, the students will be able to:**		
CO1	Describe the algorithmic strategies for different problems and the way to analyze them.	
CO2	Explain the importance and analysis of strategies using different examples.	
CO3	Implement various algorithms and analyze using different strategies.	
CO4	Apply various algorithms to several types of problems.	
CO5	Compare and contrast various algorithms with respect to their complexities.	
CO6	Combine the knowledge of different strategies to write efficient algorithms for building efficient software.	

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

Learning Resources:

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 Algorithms, Addison Wesley, 1974
4. Donald Knuth, The Art of Computer Programming (3 vols., various editions, 1973-81), Addison Wesley

<table>
<tr><td colspan="3" align="center">F.Y. M.Sc. Computer Science Semester I</td></tr>
<tr>
<td>Title of the Course and Course Code</td>
<td align="center">Subject Title (Elective): CSC503 Advanced Operating System</td>
<td>Number of Credits: 04</td>
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<tr>
<td colspan="3" align="center">Course Outcome (COs)
On completion of the course, the students will be able to:</td>
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<tr>
<td align="center">CO1</td>
<td colspan="2">Describe various components - hardware, software, and concepts of the Unix kernel</td>
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<tr>
<td align="center">CO2</td>
<td colspan="2">Interpret different data structures related to the Unix kernel</td>
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<tr>
<td align="center">CO3</td>
<td colspan="2">Develop shell scripts and programs using Unix system calls for file management, process control, and input/output operations.</td>
</tr>
<tr>
<td align="center">CO4</td>
<td colspan="2">Compare and contrast the design choices and trade-offs between different Unix-like operating systems based on reliability, security, and usage.</td>
</tr>
<tr>
<td align="center">CO5</td>
<td colspan="2">Evaluate various Inter-Process Communication mechanisms in Unix such as pipes, sockets etc</td>
</tr>
<tr>
<td align="center">CO6</td>
<td colspan="2">Integrate advanced Unix features and techniques into application development.</td>
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Unit No.	Title of Unit and Contents
1	**Overview of Unix Kernel** ● Why Unix? ● Architecture of UNIX Operating System ● Concepts related to Files, Processes, Signals, and memory ● Shell and Types of Shell ● Shell commands ● Shell Scripting
2	**Kernel Data structures and their relationships** ● File data structure ● Process Data structure
3	**File, Directories and processes** ● Internal representation of file – Buffers and Inodes ● File I/O subsystem calls – Algorithm and its implementation ● File manipulation subsystem calls - Algorithm and its implementation ● File status subsystem calls- Algorithm and its implementation ● Process Environment, Process Control, and Process Relationships ● Process State Transition ● Context of a process ● Creating, managing, and terminating the Process

4	**Inter-Process Communication** ● Pipes and types of pipes ● Sockets
5	**Memory and Signal Management** ● Memory and Signal Concepts ● Memory Management policies – Demand Paging and Swapping ● Memory system calls ● Sending and receiving Signals ● Signals system calls
6	**Flavors of Unix and its Industry Applications** ● Overview of different Unix-like operating systems ● Industry Applications ● Security Applications ● Impact of Unix on modern technologies

Learning Resources:
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

F.Y. M.Sc. Computer Science Semester I		
Title of the Course and Course Code	**Subject Title (Elective): CSC504 Business Intelligence and Analytics**	**Number of Credits: 04**
Course Outcome (COs)		
On completion of the course, the students will be able to:		
CO1	Describe the Business architecture and the concepts of policies and procedures.	
CO2	Explain the composition of analytics and business policies with the specified strategy.	
CO3	Implement various procedural metrics in the given data set by comparing the outcomes.	
CO4	Differentiate between various business models and analytic applications to analyze business strategies.	
CO5	Compare and contrast various algorithms with respect to efficiency and accuracy measures related to business policies.	

CO6	Combine the strategies and cost evaluation techniques for analysing and predicting the business process model.

Unit No	Title of Unit and Contents
1	**Introduction to Business Intelligence** ● Definition and History of BI ● Transaction processing versus analytical processing ● BI implementation ● Major tools and techniques of BI
2	**Data warehousing** ● Definition and concepts ● Data warehouse architecture ● ETL process, data warehouse development, Comparison of OLTP and OLAP ● Top down vs. Bottom up ● Data Mart vs. EDW, Implementation issues ● Real-time data warehousing ● Slicing, dicing and cross applications reporting and complex data analysis
3	**Business performance management** ● Key performance indicators and operational metrics, ● Balanced scorecard ● Six Sigma ● Dashboards and scorecards
4	**Introduction to Business Analytics** ● Understanding Business Intelligence and Analytics ● Data analytic lifecycle, various phases of Data analytic lifecycle ● Business analytics, Business decision ● Features of Business analytics ● Types of business analytics
5	**Basic Statistics in Business Analytics** ● Introduction to Probability, Probability Distributions ● Connection with Statistical Distributions, Statistical Properties (Mean, Mode, Median, Moments, Standard Deviation, etc.) ● Common Probability Distributions (Discrete, Binomial, Normal) ● Other Probability Distributions (Chi-Square, Poisson) ● Joint and Conditional Probabilities
6	**Basics of Modeling** ● Differentiating descriptive, predictive, and prescriptive analytics ● Data mining vs data analytics, Industrial problem-solving process ● Decision needs and analytics, stakeholders and analytics

	● SWOT analysis
7	**Data Visualization Techniques** ● Data Preparation and Exploration ● Importance of data quality ● Dealing with missing or incomplete data ● Data Classification
8	**Modeling Techniques** ● Introduction to Common Modeling Techniques ● Cluster Analysis (Unsupervised Learning) ● Classification & Prediction (Supervised Learning) ● Classification - Training & Testing ● Sampling Data in Classification
9	**Introduction to Predictive analytics** ● Predictive modeling and Analysis ● Regression Analysis, Multi-co-linearity, Correlation analysis ● Rank correlation coefficient, Multiple correlation ● Least square, Curve fitting

Learning Resource:

1. EfraimTurban, Ramesh Sharda, Dursun Delen, and David King, Business Intelligence: A Managerial 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 Business 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
7. Eric Siegel, Thomas H. Davenport, "Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die", Wiley, 2013

F.Y. M.Sc. Semester I		
Title of the Course and Course Code	**Subject Title (Core): CSA510 Research Methodology**	**Number of Credits: 04**

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.

Unit No.	Title of Unit and Contents
1	History of research. Indian, Egyptian, Greek ideas methodologies and research in agriculture, chemistry, metallurgy, medical. Ancient Indian research methodology applications.
2	(Recommended for science, technology, engineering, economics, management, archaeology, behavioral science) 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 softwares 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.
3	(Recommended for arts, performing arts, languages, commerce) Creating questionnaire. Data analysis from answers, Selection of research topic (case study based). Selection of research topic (case study based)
4	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.

Department of Computer Science, Fergusson College (Autonomous), Pune

5	Writing research paper and/or thesis, making a presentation, writing a research proposal, and patents in Science, technology.
6	Writing research paper and/or thesis, making a presentation, writing a research proposal in arts, management, commerce faculty.

Learning Resources:

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

F.Y. M.Sc. Computer Science Semester I		
Title of the Course and Course Code	**Subject Title (Core): CSC520 Practical I (Based on FS I and AAC)**	**Number of Credits: 02**

Course Outcome (COs) **On completion of the course, the students will be able to:**	
CO1	State use of fundamentals of UI designing and different algorithmic techniques.
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.
CO3	Design and develop professional web applications or websites with the help of HTML and CSS. Also learn variety of useful algorithms.
CO4	Design and implement various JavaScript methods to query a web page. implement searching and sorting algorithms.
CO5	Apply various jQuery function and methods to Web application. Apply the dynamic programming technique to solve real world problems.
CO6	Analyze the performance of various algorithms using design strategies.

Sr. No.	Title of Experiment/ Practical
1	Designing HTML5 Forms
2	Designing CSS3
3	JavaScripts

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

F.Y. M.Sc. Computer Science Semester I		
Title of the Course and Course Code	**Subject Title (Core): CSC521 Practical II (Python Programming)**	**Number of Credits: 02**
Course Outcome (COs) **On completion of the course, the students will be able to:**		
CO1	Describe the various programming constructs of Python language.	
CO2	Discuss the domain of the problem and analyze the problem to find the various entities of the domain.	
CO3	Implement various programming constructs to code the analysis done for the problem domain.	
CO4	Differentiate the analysis and the implementation phases appropriately.	
CO5	Compare and contrast the use of various data structures to gain suitable knowledge about their implementation.	
CO6	Combine all the programming constructs and develop a python program to give the desired functionality	

Sr. No.	Title of Unit and Contents
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

F.Y. M.Sc. Computer Science Semester II

Title of the Course and Course code	Subject Title (Core): CSC551 Full Stack – II: MERN Stack	Number of Credits: 04

Course Outcome (COs) **On completion of the course, the students will be able to:**	
CO1	Describe various database schema designs of NoSQL database
CO2	Implement different data modelling methods and middleware's
CO3	Design dynamic single page web applications using MEARN Technologies
CO4	Examine how to implement web applications and API's using express framework
CO5	Use NodeJS method to Test and validate streams and events for non-blocking I/O
CO6	Build user interactive and efficient web applications using MERN Stack

Unit No.	Title of Unit and Contents
1	**MONGODB** ● Introduction ● MongoDB Advantages ● Installation (mlab – mongoose connection) ● Data modelling ● Creating Schemas with Mongoose ● Create Database ● Drop Database ● CRUD Operations ● Limit Records ● Sort Records ● Aggregation ● Data Models ● Change Streams ● Replication Storage

2	● **EXPRESS JS** ● Introduction ● Installation of Node package manager (npm) ● Express Generator ● Static files ● Routing ● HTTP Methods ● Writing Middleware ● Using Middleware ● Using template engines ● Error handling ● Cookies ● Session ● Directory Structure
3	**REACT** ● What is React? ● What problem does it solve? ● Introduction to Component based Programming ● Virtual DOM ● JSX Rendering Elements ● Components and Props ● State Management ● Event Management ● Routing & Redux
4	**NODEJS** ● Introduction ● Modules ● HTTP Module ● File System ● URL Module ● Uploading Files ● Event Loop ● Event Emitter ● Callback's Concept ● Buffers ● Streams ● Nodejs Email Packaging
5	**Introduction to React Native** ● Why Use React Native? ● View, State, Props, and Style React Native Apps VS Platform-Specific Apps

Learning Resources

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

Web References

1. MongoDB Docs: https://www.mongodb.com/docs/manual/introduction
   mongoose Docs: https://mongoosejs.com/docs/
2. React Docs : https://reactjs.org/tutorial/tutorial.html
3. Github Docs : https://docs.github.com/en
4. https://pepa.holla.cz/wp-content/uploads/2016/12/Learning-React-Native.pdf

MOOC

1. https://www.classcentral.com/course/udemy-mern-stack-front-to-back-42187

F.Y. M.Sc. Computer Science Semester II		
Title of the Course and Course Code	**Subject Title (Core): CSC552 Artificial Intelligence**	**Number of Credits: 04**
Course Outcome (COs) **On completion of the course, the students will be able to:**		
CO1	Describe the knowledge of AI principles and techniques.	
CO2	Discuss the basic principles of AI toward problem solving.	
CO3	Implement various AI techniques and machine learning algorithms by applying it to various problems.	
CO4	Differentiate between various AI techniques and machine learning algorithms.	
CO5	Compare and contrast various AI algorithms.	
CO6	Combine the knowledge of AI techniques and algorithms to build an intelligent system.	

Unit No	Title of Unit and Contents
1	**Introduction to Artificial Intelligence**

	● What is AI? Foundation of AI, History of AI, Applications of AI ● Early work in AI, AI and related fields, AI problems and Techniques
2	**Problems, Problem Spaces and Search** ● Defining AI problems as a State Space Search with examples ● Production Systems, Search and Control Strategies ● Problem Characteristics ● Blind Search Techniques: BFS, DFS, Iterative Deepening ● Heuristic Search Techniques: Generate and test, Hill Climbing ● Best First search, A*, AO*, Constraint Satisfaction, Mean-End Analysis.
3	**Knowledge Representation** ● Representations and Mappings ● Approaches to Knowledge Representation ● Knowledge representation methods. ● Propositional Logic, Predicate logic ● Representing Simple facts in Logic ● Computable Functions and Predicates ● Resolution, Forward and backward chaining ● Game Playing- Minimax Search Procedures, Adding alpha-beta cutoffs.
4	**Introduction to AI with Python:** ● Introduction to Python, Why Python with AI? ● Features of Python, Basics of Python. ● Python statements, Methods & Functions using python. ● Basic and advanced modules & Packages. ● Python decorators and generator. ● Advanced Objects & Data structures.
5	**Machine Learning:** ● Why Machine learning. ● Types of Machine Learning: ● Supervised learning- Classification & Regression. Random Forest, KNN Algorithm. ● Unsupervised learning-Clustering & Association. Reinforcement learning.

Learning Resources:

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

F.Y. M.Sc. Computer Science Semester II

Title of the Course and Course code	Subject Title (Elective): CSC553 Software Quality Assurance	Number of Credits: 04
	Course Outcome (COs) **On completion of the course, the students will be able to:**	
CO1	Describe the software development life cycle from the perspective of Quality Assurance Engineer	
CO2	Illustrate various components of the project life cycle.	
CO3	Implement various quality improvement techniques, assessment components and apply the suitable quality factors on the project.	
CO4	Differentiate between the Quality Assurance and Testing. Understand the importance of Quality Assurance and Control.	
CO5	Compare and contrast the different assessment components and various quality improvement techniques.	
CO6	Combine all the techniques of quality control and improvement to assure quality of the project.	

Unit No.	Title of Unit and Contents
1	**Software quality** ● Definition, Software errors, software faults and software failures ● Software quality assurance – definition and objectives, Software quality assurance vs. software quality control ● The objectives of SQA activities ● Types of Quality Assurance: pre-production inspection (PPI), during production inspection (DPI), pre-shipment inspection (PSI), and container loading/loading supervision (LS)
2	**SQA Components** ● **Pre-project SQA Components:** Contract Review, Development and Quality Plan ● **SQA components in Project life cycle activities assessment** Verification and Validation., Various types of Reviews Inspections, Walkthrough, Software testing, Impact of CASE Tools

3	**SQA Infrastructure Components**
	● Procedures and procedure manuals, Templates and Checklists
	1. Staff training, Corrective and preventive actions, Documentation control. Writing manuals for small applications.
4	**Software Quality Factors and Standardization**
	● Mccall's Quality Model, Product, Process quality metrics
	1. ISO 9000-3 and SEI-CMM
5	**Configuration Management**
	1. Change control, Release and version control, Software configuration management audit
6	**Quality Improvement Techniques and Quality Costs**
	● Pareto Diagrams, Cause-Effect Diagrams, Scatter Diagrams, Run Charts
	1. Quality Cost Measurement , Utilizing Quality Costs for Decision-Making
7	**Introduction to Open Source Quality Assurance Tools.**

Learning Resources:

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

Web References:
1. https://csiac.org/articles/software-assurance-adoption-through-open-source-tools/
2. https://www.testrail.com/qa-software/
3. https://www.qatouch.com/
4. https://www.atlassian.com/software/jira

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<tr><th colspan="3" style="text-align:center">F.Y. M.Sc. Computer Science Semester II</th></tr>
<tr><td>Title of the Course and Course Code</td><td>Subject Title (Elective): CSC554 Predictive Analytics and Data Visualization</td><td>Number of Credits: 04</td></tr>
<tr><td colspan="3" style="text-align:center">Course Outcome (COs)
On completion of the course, the students will be able to:</td></tr>
<tr><td>CO1</td><td colspan="2">Apply predictive analytics tools to analyse real-life business problems.</td></tr>
<tr><td>CO2</td><td colspan="2">Demonstrate case-based practical problems using predictive analytics techniques to interpret model outputs.</td></tr>
<tr><td>CO3</td><td colspan="2">Examine regression, logistic regression, and forecasting using software tools.</td></tr>
<tr><td>CO4</td><td colspan="2">To understand the various types of data, apply and evaluate the principles of data visualization.</td></tr>
<tr><td>CO5</td><td colspan="2">To apply structured approach to create effective visualizations from the massive dataset using various visualization tools.</td></tr>
<tr><td>CO6</td><td colspan="2">Demonstrate the analysis of large dataset using various visualization techniques and tools.</td></tr>
</table>

Unit No.	Title of Unit and Contents
1	**Introduction to Predictive Analytics** ● Analytics in Decision Making -Game changers & Innovators - Predictive Analytics
2	**Simple Linear Regression (SLR) Introduction to Regression** ● Model Development Model Validation ● Multiple Linear Regression (MLR) ● Multiple Linear Regression-Estimation of Regression Parameters-Model Diagnostics-Logistic Regression
3	**Decision Trees and Unstructured data analysis** ● Introduction to Decision Trees-CHI-Square ● Automatic Interaction Detectors (CHAID)-Classification and Regression Tree (CART) ● Analysis of Unstructured data-Naive Bayes Classification-Forecasting-Time Series Analysis-Forecasting Accuracy
4	**Introduction to Data Visualization** ● Overview of data visualization - Data Abstraction - Task Abstraction

	● Dimensions and Measures - Analysis: Four Levels for Validation ● Statistical charts (Bar Chart - stacked bar chart – Line Chart - Histogram - Pie chart
5	**Visualization Techniques** ● Introduction to various data visualization tools ● Scalar and point techniques - vector visualization techniques - multidimensional techniques ● Visualizing cluster analysis K-means and Hierarchical Cluster techniques
6	**Spatio-temporal Data Visualization** ● Time Series data visualization – Text data visualization ● Spatial Data Visualization ● Visual Analytics Networks and Trees - Heat Map – Tree Map - Map Colour and Other Channels Manipulate View.
7	**Multivariate Data Visualization** ● Multivariate data visualization – Geometric projection techniques - Icon-based techniques ● Pixel-oriented techniques - Hierarchical techniques ● Scatterplot matrix - Hyper box - Trellis display - Parallel coordinates
8	**Data Visualization Tools** ● Tableau functions and logics: Marks and Channels ● Arrange Tables- Arrange Spatial Data- Facets into multiple views ● Visualization Dashboard Creations Data Dashboard- Taxonomies ● User Interaction- Organizational Functions-Dashboard Design – Worksheets - Workbooks ● Workbook Optimization - Protection and common mistakes. ● Dashboard creation using visualization tool use cases: Finance-marketing-insurance-healthcare.

Learning Resources:
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, 1st 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)

F.Y. M.Sc. Computer Science Semester II		
Title of the Course and Course Code	**CSC560 Project**	**Number of Credits: 04**
Course Outcome (COs) **On completion of the course, the students will be able to:**		
CO1	Describe a through and systematic understanding of project contents.	
CO2	Illustrate knowledge of computing and mathematics appropriate to the discipline.	
CO3	Implement project management knowledge, processes, tools and techniques in order to achieve project success.	
CO4	Design, implement, and evaluate a computational system to meet desired needs within realistic constraints.	
CO5	Integrate the identified modules using techniques and tools.	
CO6	Evaluate the generated modules using evaluation techniques and tools.	

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

F.Y. M.Sc. Computer Science Semester II		
Title of the Course and Course Code	**Subject Title (Core): CSC570 Practical III (Lab Assignments Based on FS II)**	**Number of Credits: 02**
Course Outcomes (COs) **On completion of the course, the students will be able to:**		
CO1	Apply MERN Technologies to develop Web Applications.	
CO2	Understand how MongoDB can be used for data handling and validation in an web application.	
CO3	Design and Develop web applications using various libraries and frameworks	
CO4	Understand functional components, state components, lifecycle, and routing in React.	
CO5	Apply various Express JS and React JS methods to create an interactive web application.	
CO6	Analyze outputs of web-based applications and their performance	

Sr. No.	Title of the Experiment or Practical
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

Department of Computer Science, Fergusson College (Autonomous), Pune

F.Y. M.Sc. Computer Science Semester II		
Title of the Course and Course Code	**Subject Title (Core): CSC571 Practical IV (Lab Based on Dot NET)**	**Number of Credits : 02**
Course Outcome (COs) **On completion of the course, the students will be able to:**		
CO1	State fundamentals of Dot Net architecture.	
CO2	Illustrate various Object-Oriented principles applied in real life problems.	
CO3	Design, develop professional Web-based applications	
CO4	Differentiate various data storage and data access strategies.	
CO5	Test and validate the usage of MVC framework	
CO6	Combine features and programming constructs to build to develop web applications.	

Sr. No.	Title of Experiment/ Practical
1	Write C# programs for understanding C# basics involving a. Variables and Data Types b. Object-Based Manipulation c. Conditional Logic d. Loops e. Methods
2	Write C# programs for Object oriented concepts of C# such as: a. Program using classes b. Constructor and Function Overloading c. Inheritance d. Namespaces
3	Design ASP.NET Pages with a. Server controls. b. Web controls and demonstrate the use of AutoPostBack c. Rich Controls (Calendar / Ad Rotator)
4	Design ASP.NET Pages for State Management using a. Cookies b. Session State c. Application State
5	Perform the following activities a. Design ASP.NET page and perform validation using various Validation Controls b. Design an APS.NET master web page and use it other (at least 2-3) content pages. c. Design ASP.NET Pages with various Navigation Controls

6	Performing ADO.NET data access in ASP.NET for a. Simple Data Binding b. Repeated Value Data Binding
7	Design ASP.NET application for Interacting (Reading / Writing) with XML documents
8	Design ASP.NET Pages for Performance improvement using Caching
9	Design ASP.NET application to query a Database using LINQ
10	Design and use AJAX based ASP.NET pages.
11	Mini-Project based on .NET
12	Mini-Project based on .NET