Deccan Education Society's
FERGUSSON COLLEGE (AUTONOMOUS), PUNE

Syllabus
for

M. Sc. (Computer Science) - II

[Pattern 2019]
(M.Sc. Semester-III and Semester-IV)

From Academic Year
2020-21

Deccan Education Society's
Fergusson College (Autonomous), Pune

M.Sc. Computer Science- II (Pattern 2019)

From academic year 2020-21

Particulars	Name of Paper	Paper Code	Title of Paper	No. of Credits
M.Sc. - II Semester III	Theory Core Paper - 1	CSC5301	Soft Computing	4
	Theory Core Paper - 2	CSC5302	Full Stack-II : MEAN stack	4
	Theory Core Paper – 3	CSC5303	Software Project Management	4
	Theory Elective Paper- III	CSC5304	Cloud Computing	4
		CSC5305	Machine Learning	4
		CSC5306	MOOC-III	4
		CSC5307	General Elective – III – Modelling and Simulation	4
	Theory Elective Paper- IV	CSC5308	Cryptography and Cyber Forensics	4
		CSC5309	Digital Image Processing	4
		CSC5310	Data Science Using R	4
		CSC5311	MOOC-IV	4
		CSC5312	General Elective – IV – Natural Language Processing	
	Practical Core Paper - 1	CSC5313	Project –III	4
M.Sc. – II Semester IV	Practical Core Paper	CSC5401	Industrial Training	8

S. Y. M.Sc. Semester III		
Title of the Course and Course Code	**Soft Computing (CSC5301)**	**Number of Credits : 04**
Course Outcome (CO) **On completion of the course, the students will be able to:**		
CO1	Describe the importance of different soft computing techniques.	
CO2	Discuss the mathematical base of soft computing techniques and its application in real life problems.	
CO3	Implement soft computing techniques like fuzzy logic and neural network to solve the problems.	
CO4	Differentiate between hard and soft computing techniques and illustrate different soft computing techniques.	
CO5	Compare and contrast various algorithms under fuzzy logic and neural networks.	
CO6	Combine the knowledge of all soft computing techniques to solve real life problems.	

Unit	Details	Lectures
I	**Introduction to Soft Computing:** 1.1 Neural Networks: Definition, Advantages, Applications, Scope. 1.2 Fuzzy logic: Definition, Applications. 1.3 Genetic Algorithms: Definition, Applications.	[5]
II	**Fuzzy Sets and Relations:** 2.1 Brief Review of Conventional Set Theory, Introduction to Fuzzy Sets, Properties of Fuzzy Sets 2.2 Operations on Fuzzy Sets, Crisp Relation, Fuzzy Relation, Cartesian Product and Composition 2.3 Tolerance and equivalence relation, Fuzzy Tolerance and equivalence relation, 2.4 Value assignments, Other Forms of the Composition.	[8]
III	**Membership Functions, Russification and Defuzzification:** 3.1 Features of the Membership Function, Various Forms 3.2 Fuzzification, Defuzzification to Crisp Sets, λ-Cuts for Fuzzy Relations, 3.3 Defuzzification to Scalars, Membership value Assignment-Intuition, Inference.	[6]
IV	**Fuzzy Classification, Logic and Fuzzy Systems:** 4.1 Classical Logic, Fuzzy Logic 4.2 Approximate Reasoning, Natural Language	[3]

	4.3 Linguistic Hedges, Fuzzy (Rule-Based) Systems 4.4 Fuzzy Classification	
V	**Fuzzy Arithmetic and the Extension Principle** 5.1 Extension Principle, Crisp Functions, Mapping, and Relations 5.2 Functions of Fuzzy Sets – Extension Principle 5.3 Fuzzy Transform (Mapping) 5.4 **Fuzzy Arithmetic** 5.5 Interval Analysis in Arithmetic 5.6 Approximate Methods of Extension	[8]
VI	**Neural Network** 6.1 **Fundamental Concept**: Artificial Neural Network, Biological Neural Network, 6.2 Comparison Between Biological Neuron and Artificial Neuron (Brain vs. Computer), 6.3 Advantages of Neural Networks, 6.4 Application Scope of Neural Networks. 6.5 **Artificial Neurons, Neural Networks and Architectures**: Neuron Abstraction, Neuron Signal Functions, 6.6 Mathematical Preliminaries, Architectures: Feed forward and Feedback, Salient Properties of Neural Networks 6.7 **Geometry of Binary Threshold Neurons and Their Networks**: Pattern Recognition and Data Classification, Convex Sets, 6.8 Convex Hulls and Linear Separability, Space of Boolean Functions, Binary Neurons are Pattern Dichotomizers, Non-linearly Separable Problems 6.9 Capacity of a Simple Threshold Logic Neuron, Multilayer Networks. 6.10 **Learning and Memory:** An Introduction, Long Term Memory, The Behavioural Approach to Learning, The Molecular Problem of Memory, Learning Algorithms, Error Correction and Gradient Descent Rules, Learning Objective for TLNs, Pattern Space and Weight Space. 6.11 Linear Separability, Hebb Network, Perceptron Network, α-Least Mean Square learning	[15]

VII	**Genetic Algorithms** 7.1 A Gentle Introduction to Genetic Algorithms: What are Genetic Algorithm? 7.2 Robustness of traditional Optimization and Search Methods, 7.3 The Goals of Optimization, how are Genetic Algorithms Different from Traditional Methods 7.4 A simple Genetic Algorithm.	**[3]**

Books:

1. Deepa & Shivanandan, "Introduction to Soft Computing", Wiley Publication, 2011
2. Timothy Ross, "Fuzzy Logic with Engineering Applications", 3rd Edition, Wiley Publication, 2010
3. Satish Kumar, "Neural Networks", Tata McGraw Hill, 2004
4. David Goldberg, "Genetic Algorithms in Search Optimization and Machine Learning", Pearson Education, 1989

Web References:

1. https://www.tutorialspoint.com/artificial intelligence
2. https://onlinelibrary.wiley.com
3. http://neuralnetworksanddeeplearning.com
4. http://www.myreaders.info/html/soft_computing.html

Title of the Course and Course Code	**Full Stack II: MEAN Stack (CSC5302)**	**Number of Credits : 04**
Course Outcome (CO) **On completion of the course, the students will be able to:**		
CO1	Describe various database schema designs of NoSQL database.	
CO2	Illustrate different data modelling methods and different middleware's.	
CO3	Implement dynamic single page web applications using Angular JS.	
CO4	Analyse the implementation of web applications and API's using express framework.	
CO5	Test, validate streams and events for non-blocking I/O using Nodejs.	
CO6	Build user interactive and efficient web applications using MEAN Stack.	

Unit	Details	Lectures
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, Drop Database, CRUD Operations 1.7 Limit Records 1.8 Sort Records 1.9 Aggregation, Data Models, Change Streams, Replication, Storage	**[12]**
II	**EXPRESS JS** 2.1 Introduction 2.2 Installation of Node package manager (npm) 2.3 Express Generator, Static files 2.4 Routing, HTTP Methods 2.5 Writing Middleware, Using Middleware, Using template engines 2.6 Error handling 2.7 Cookies, Session, Directory Structure	**[12]**
III	**ANGULAR JS** 3.1 What is AngularJS? 3.2 What is Single Page Application? 3.3 Features, Advantages of AngularJS 3.4 MVC and MVVM structure 3.5 Services, Controllers, Directives 3.6 Built-in Directives 3.7 Template 3.8 Routing (with server configurations) 3.9 Digest Cycle (Watcher in AngularJS	**[10]**
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, Buffers, Streams, Nodejs	**[14]**

	Email, Packaging	

Books:

1. Simon Holmes, "Getting MEAN with Mongo, Express, Angular, and Node", Second Edition, ISBN 9781617294754, 2019
2. Colin J Ihrig, Adam Bretz, "Full Stack JavaScript Development with MEAN: MongoDB, Express, AngularJS, and Node.JS", ISBN 0992461251, 2015
3. Amos Q. Haviv, "MEAN Web Development", ISBN 978-1-78398-328-5, 2014

Web References:

1. https://www.tutorialspoint.com/meanjs/index.htm
2. https://www.w3schools.com/nodejs/
3. https://angular.io/start
4. https://www.javatpoint.com/mongodb-tutorial

Title of the Course and Course Code	**Software Project Management (CSC5303)**	**Number of Credits : 04**
Course Outcome (CO) **On completion of the course, the students will be able to:**		
CO1	Describe the concepts and various knowledge areas of project management.	
CO2	Explain the knowledge of managing projects in the industry.	
CO3	Implement various tools and techniques to manage the project deadlines and budget for cost and time management.	
CO4	Differentiate between the process management and project management.	
CO5	Compare and contrast various organizational structures, frames of the organization.	
CO6	Combine the knowledge areas to identify, mitigate the risks and establish a proper communication channel within the team members.	

Unit	Details	Lectures
I	**Introduction to Project Management** 1.1 What is Project? 1.2 What is Project management? 1.3 Project phases and project life cycle 1.4 Organizational structure 1.5 Qualities of Project Manager.	**[5]**
II	**Project Management Components** 2.1 Project Integration Management-Project plan development and execution 2.2 Change controls 2.3 Configuration management.	**[6]**

III	**Scope Management** 3.1 Strategic planning 3.2 Scope planning, 3.3 Scope Definition 3.4 Scope Verification 3.5 Scope Control.	**[4]**
IV	**Time management** 4.1 Activity planning 4.2 Schedule development 4.3 Schedule control 4.4 Case study.	**[4]**
V	**Cost Management** 5.1 Cost estimation 5.2 Cost Control 5.3 Case study.	**[4]**
VI	**Quality Management** 6.1 Quality planning 6.2 Quality assurance.	**[2]**
VII	**Human Resource Management** 7.1 Organizational planning 7.2 Staff acquisition	**[2]**
VIII	**Communication Management** 8.1 Information distribution 8.2 Reporting.	**[2]**
IX	**Risk Management** 9.1 Risk identification 9.2 Risk Quantification 9.3 Risk Control	**[3]**
X	**Procurement Management** 10.1 Solicitation 10.2 Contract administration	**[2]**
XI	**Software Metrics** 11.1 The scope of software metrics 11.2 Software metrics data collection 11.3 Analyzing software data 11.4 Measuring size 11.5 Structure 11.6 External attributes.	**[6]**
XII	**Planning a measurement program** 12.1 What is metrics plan: Developing goals, questions, and metrics	**[5]**

	12.2 Where and When: Mapping measures to activities. 12.3 How: Measurement tools. 12.4 Who: Measurers, analyst, tools revision plans.	
XIII	**Quality Standards** 13.1 CMM 13.2 PSP/TSP	**[3]**

Books:

1. Kathy Schwalbe, Information Technology Project Management, 2008
2. Norman Fenton, Shari Lawrence Pfleeger, Software Metrics A rigorous and practical approach, 1998
3. Roger Pressman, Software Engineering (6th Edition), 2009

Title of the Course and Course Code	**Cloud Computing (CSC5304)**	**Number of Credits : 04**
Course Outcome (CO) **On completion of the course, the students will be able to:**		
CO1	Describe various Cloud computing platforms and models.	
CO2	Explain different cloud architectures and Operating systems related functions.	
CO3	Implement various virtualization concepts and apply them to understand types of hypervisors used in cloud computing.	
CO4	Classify different levels and challenges of security under cloud security architecture.	
CO5	Compare and contrast different types of service models under cloud platform.	
CO6	Integrate various challenges and issues in cloud computing with respect to security and quality of services.	

Unit	**Details**	**Lectures**
I	**Introduction to Cloud Computing** 1.1 Cloud Computing definition, 1.2 Cloud service Models and Types 1.3 Benefits and limitations of Cloud 1.4 Cloud computing vs. Cluster computing vs. Grid computing 1.5 Cloud Computing and SOA	**[8]**
II	**Virtualization** 2.1 Virtualization Basics	**[6]**

	2.2 Benefits of Virtualization 2.3 Understanding Hypervisors	
III	**Infrastructure as a Service (IaaS)** 3.1 Introduction to IaaS 3.2 Introduction to virtualization 3.3 Different approaches to virtualization 3.4 Data storage in cloud computing 3.5 Examples of clouds	**[8]**
IV	**Platform as a Service (PaaS)** 4.1 Evolution of computing paradigms and related components 4.2 Introduction to PaaS-What is PaaS, 4.3 Service Oriented Architecture (SOA)	**[7]**
V	**Software as a Service(SaaS)** 5.1 Introduction to SaaS 5.2 Web services 5.3 Case Study on SaaS	**[7]**
VI	**Cloud Security** 6.1 Cloud Security Fundamentals 6.2 Privacy and Security in Cloud 6.3 Cloud Security Architecture 6.4 Identity Management and Access control 6.5 Cloud Computing security challenges	**[8]**
VII	**Issues in Cloud Computing** 7.1Issues in Inter cloud computing 7.2Quality of services in cloud Computing 7.3Data Migration in Cloud 7.4Streaming in Cloud	**[4]**

Books:

1. Dr. Kumar Saurabh, **"**Cloud Computing", Wiley Publication, 2012
2. Gautam Shroff, Enterprise Cloud Computing, Cambridge publication, 2010
3. Ronald Krutz and Russell Dean Vines, Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Wiley-India, 2010
4. Judith Hurwitz, R.Bloor, M.Kanfman, F.Halper, Cloud Computing for Dummies, Wiley India Edition, 2010

Web References:

1. https://aws.amazon.com/what-is-cloud-computing/
2. https://www.tutorialspoint.com/cloud_computing/index.htm

Title of the Course and Course Code	Machine Learning (CSC5305)	Number of Credits : 04
Course Outcome (CO) **On completion of the course, the students will be able to:**		
CO1	Describe the concept of intelligent systems with machine learning algorithms.	
CO2	Explain the importance and efficiency of Machine learning algorithms with respect to complexity of the system.	
CO3	Implement various functional methodologies of machine learning system and represent its predictive approach.	
CO4	Differentiate between various algorithms and analyze its efficiency by applying the Machine learning techniques.	
CO5	Compare and contrast various algorithms with respect to efficiency and accuracy measures related to Machine learning outcomes in the given data set.	
CO6	Combine the strategies and techniques for analysing and predicting the intelligent system.	

Unit	Details	Lectures
I	**Introduction to Machine Learning** 1.1 Why Machine learning, Examples of Machine Learning Problems 1.2 Structure of Learning, learning versus Designing, Training versus Testing 1.3 Characteristics of Machine learning tasks, Predictive and descriptive tasks 1.4 **Machine learning Models:** Geometric Models, Logical Models, Probabilistic Models. 1.5 Features: Feature types, Feature Construction and Transformation, Feature Selection.	**[10]**
II	**Classification and Regression** 2.1 **Classification:** Binary Classification- Assessing Classification performance 2.2 Class probability Estimation, Assessing class probability Estimates, Multiclass Classification. 2.3 **Regression:** Assessing performance of Regression- Error measures, Overfitting- Catalysts for Overfitting, Case study of Polynomial Regression. 2.4 Theory of Generalization: Effective number of hypothesis,	**[12]**

	2.5 Bounding the Growth function 2.6 VC Dimensions, Regularization theory.	
III	**Linear Models** 3.1 Least Squares method, Multivariate Linear Regression, Regularized Regression 3.2 Using Least Square regression for Classification. Perceptron 3.3 Support Vector Machines, Soft Margin SVM 3.4 Obtaining probabilities from Linear classifiers 3.5 Kernel methods for non-Linearity.	**[8]**
IV	**Logic Based and Algebraic Models** 4.1 **Distance Based Models**: Neighbours and Examples, Nearest Neighbours Classification 4.2 Distance based Clustering-K means Algorithm, Hierarchical clustering 4.3 **Rule Based Models:** Rule learning for subgroup discovery, Association rule mining. 4.4 **Tree Based Models:** Decision Trees, Ranking and Probability Estimation Trees, Regression trees, Clustering Trees.	**[10]**
V	**Probabilistic Models** 5.1 Normal Distribution and Its Geometric Interpretations, Naïve Bayes Classifier 5.2 Discriminative learning with Maximum likelihood 5.3 Probabilistic Models with Hidden variables: Estimation-Maximization Methods 5.4 Gaussian Mixtures, and Compression based Models.	**[5]**
VI	**Trends in Machine Learning** 6.1 Model and Symbols- Bagging and Boosting 6.2 Multitask learning 6.3 Online learning and Sequence Prediction 6.4 Data Streams and Active Learning 6.5 Deep Learning, Reinforcement Learning.	**[3]**

Books:

1. C. M. Bishop, "Pattern Recognition and Machine Learning", Springer 1st Edition-2013.
2. Ethem Alpaydin, "Introduction to Machine Learning", PHI 2nd Edition-2013.

3. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", Cambridge University Press, Edition 2012.
4. Hastie, Tibshirani, Friedman, "Introduction to Statistical Machine Learning with Applications in R", Springer, 2nd Edition-2012.
5. Parag Kulkarni, "Reinforcement and Systematic Machine Learning for Decision Making", WileyIEEE Press, Edition July 2012.

Web References:

1. http://alex.smola.org/drafts/thebook.pdf
2. http://robotics.stanford.edu/~nilsson/MLBOOK.pdf
3. http://research.microsoft.com/en-us/um/people/cmbishop/prml/
4. http://mitpress.mit.edu/books/introduction-machine-learning

Title of the Course and Course Code	**Modelling and Simulation (CSC5307)**	**Number of Credits : 04**
Course Outcome (CO) **On completion of the course, the students will be able to:**		
CO1	Describe different types of simulation techniques.	
CO2	Illustrate the concepts of system modelling based on events and time.	
CO3	Implement the concepts related to simulators and modelling formalisms.	
CO4	Analyse the different probability techniques and models used for modelling and simulation.	
CO5	Compare and contrast different analysis techniques used for models.	
CO6	Integrate various techniques of verification and validation with respect to models.	

Unit	**Details**	**Lectures**
I	**Systems modelling** Concepts of continuous and discrete formalisms. Stepped and Event-based Time in Simulations. Sources and Propagation of Error.	**[4]**
II	**Types of Simulations** Graph or Network Transitions Based Simulations, Actor Based Simulations, Mesh Based Simulations, Hybrid Simulations, Framework for Simulation and Modelling,	**[8]**

III	**Modelling and simulators** Modelling formalisms and their simulators, Discrete time, continuous time, discrete event, Process based simulators. Hybrid systems and their simulators	**[8]**
IV	**Probability** Basic probability, Probability distributions, estimation, Testing of hypotheses	**[8]**
V	**Probability in modelling** Selecting input probability distributions, Models of arrival processes, Queues and Random Noise, Random number generators, their evaluation, Generating random variates from various distributions	**[10]**
VI	**Analysing models** Output analysis, transient behavior, Steady state behavior of stochastic systems, Computing alternative systems, Variance reduction techniques. Sensitivity Analysis, Verification and Validation	**[10]**

Books:

1. J., et.el., Discrete-Event System Simulation, Fourth Edition, Banks (2005), Publisher Pearson, ISBN-13: 9780131293427
2. A.M. and W.D. Kelton, Simulation Modeling and Analysis, Third Edition, by Law (2000), Publisher McGraw-Hill, ISBN-13: 978-0071165372
3. Kofman and Cellier Continuous System Simulation, Publisher Springer, ISBN-13: 9780387261027
4. B. Zeigler, H. Praehofer, T. Kim , Theory of modeling and Simulation, 2nd., Publisher Academic Press, 2000, ISBN-13: 978-0127784557
5. Ben Klemens, Modeling with Data: Tools and Techniques for Scientific Computing, Publisher: Princeton University Press 2008, ISBN-13: 9780691133140

Title of the Course and Course Code	Cryptography and Cyber Forensics (CSC5308)	Number of Credits : 04
Course Outcome (CO) **On completion of the course, the students will be able to:**		
CO1	Describe different types of security in computing.	
CO2	Explain the concepts of Info-Sys-Security, Cryptography and Cyber forensics.	
CO3	Illustrate the concepts related to applied cryptography and its algorithms.	
CO4	Analyze the requirements of computer security and choose the appropriate programming interface (API).	
CO5	Compare different user authentication mechanisms.	
CO6	Compile all the security techniques to build a secure digital environment.	

Unit	Details	Lectures
I	**Security in Computing** 1.1 Overview of Program Security 1.2 Operating system security 1.3 Database security 1.4 Device Security (IOT, mobile security	**[4]**
II	**Symmetric Key Cryptography** 2.1 Review of cryptography algorithm 2.2 Algorithm types and modes 2.3 Diffie Hellman key exchange algorithm 2.4 DES (Data Encryption Standard) 2.5 IDEA (International Data Encryption Algorithm) 2.6 RC5, Blowfish, AES (Advanced Encryption Standard)	**[6]**
III	**Asymmetric Key Cryptography** 3.1 RSA Algorithm 3.2 Digital Envelope 3.3 Digital Signature	**[4]**
IV	**Message Integrity Technique and Digital signature** 4.1 Message Digest 4.2 MD5 , SHA 4.3 Digital Signature Technique	**[4]**
V	**Digital Certificate and public key infrastructure** 5.1 Digital certificates	**[5]**

	5.2 Private key management 5.3 Public key cryptography standard	
VI	**Internet Security Protocol** 6.1 Secure Socket Layer 6.2 TLS 6.3 SHTTP 6.4 Time stamping protocol 6.5 Secure Electronic standard 6.6 3-D secure protocol 6.7 Electronic money 6.8 Email security Protocol	**[10]**
VII	**User Authentication** 7.1 Password based authentication 7.2 Certificate based authentication 7.3 Biometric authentication 7.4 Kerberos	**[4]**
VIII	**Practical Cryptography** 8.1 Cryptography solution (using different programming language cryptographic Toolkits)	**[5]**
IX	**Computer Forensic** 9.1 Fundamentals of computer forensics 9.2 Computer forensic services 9.3 Types of computer forensics techniques 9.4 Specialized forensic techniques 9.5 Types of computer forensic systems	**[6]**

Learning Resources:

1. Charles P. Pfleeger, Shari Lawrence Pfleeger, Security in Computing 5th edition, Prentice Hall,2015
2. John R. Vacca, Computer Forensics Computer Crime Scene Investigation, Second Edition, 2015
3. Atul Kahate, Cryptography and Network Security Second Edition, McGraw Hill Education (India) Pvt Ltd,2008
4. Andrew Tanenbaum, Computer Networks Fourth Edition, Prentice Hall, 2002

Web References:

1. https://studentnotes88322212.wordpress.com/2018/05/08/security-in-computing-lecture-notes-study-materials-and-important-questions-answers
2. http://www.brainkart.com/subject/Security-in-Computing_156/
3. https://www.sciencedirect.com/topics/computer-science/diffie-hellman
4. https://www.forensiccontrol.com

Title of the Course and Course Code	Digital Image Processing (CSC5309)	Number of Credits : 04
Course Outcome (CO) **On completion of the course, the students will be able to:**		
CO1	Describe the fundamental concepts of a digital image processing system.	
CO2	Explain different types of image transformations, need and their properties.	
CO3	Evaluate the techniques for image enhancement and image restoration.	
CO4	Analyse images in the frequency domain using various transforms.	
CO5	Interpret image segmentation and representation techniques.	
CO6	Integrate image segmentation and representation techniques.	

Unit	Details	Lectures
I	**Introduction** 1.1 What is Digital Image Processing? 1.2 The origins of Digital Image Processing 1.3 Examples of Fields that use Digital Image Processing 1.4 Fundamental steps in Digital Image Processing 1.5 Components of an Image Processing System	**[3]**
II	**Digital Image Fundamentals** 2.1 Elements of Visual Perception 2.2 Image sensing and Acquisition 2.3 Image Sampling and Quantization 2.4 An Introduction to the Mathematical Tools Used in Digital 2.5 Image Processing	**[6]**
III	**Intensity Transformation** 3.1 Basic Intensity Transformation Functions 3.2 Histogram Processing 3.3 Histogram Equalization 3.4 Histogram Matching 3.5 Local Histogram Processing 3.6 Fourier Transformation 3.7 Sampled Functions 3.8 Discrete Fourier Transform (DFT) 3.9 Properties of 2-D Discrete Fourier Transform	**[8]**
IV	**Filtering in Spatial and Frequency Domain** 4.1 Fundamentals of Spatial Filtering	**[5]**

	4.2 Image Smoothing Using Spatial Filters 4.3 Image Sharpening Using Spatial Filter 4.4 Basics of filtering in Frequency Domain 4.5 Image Smoothing Using Frequency Domain Filters 4.6 Image Sharpening Using Frequency domain Filter	
V	**Image Restoration and Reconstruction** 5.1 A Model of the Image Degradation / Restoration Process 5.2 Noise Models 5.3 Restoration in the Presence of Noise Only- Spatial Filtering 5.4 Periodic Noise Reduction by Frequency Domain Filtering 5.5 Estimating the Degradation Function 5.6 Minimum Mean Square Error(Wiener) Filtering	**[6]**
VI	**Morphological Image Processing** 6.1 Preliminaries 6.2 Erosion and Dilation 6.3 Opening and Closing 6.4 The Hit-or-Miss Transformation 6.5 Some Basic Morphological Algorithms 6.6 Extraction of Connected Components	**[8]**
VII	**Image Segmentation** 7.1 Fundamentals 7.2 Point, Line, and Edge Detection 7.3 Background 7.4 Detection of Isolated Points 7.5 Line Detection 7.6 Edge Models 7.7 Thresholding 7.8 Basic Global Thresholding	**[7]**
VIII	**Representation and Description** 8.1 Representation 8.2 Boundary (Border) Following 8.3 Chain Codes 8.4 Shape Numbers 8.5 Polygonal Approximations Using Minimum-Perimeter Polygons 8.6 Other Polygonal Approximation Approaches	**[5]**

Books:

1. Gonzalez, R. C., Woods, R. E., and Eddins, S. L., "Digital Image Processing Using MATLAB", 2nd ed., Gatesmark Publishing, Knoxville, TN, 2009
2. Gonzalez, R. C. and Woods, R. E., "Digital Image Processing", 3rd ed., Prentice Hall, 2002/2008
3. Burger, Willhelm and Burge, Mark J., "Digital Image Processing: An Algorithmic Introduction Using Java", Springer, 2008,
4. A.K. Jain, "Fundamentals of digital image processing", PHI, 1995

Web References:

1. cs.auckland.ac.nz/courses/compsci773s1c/lectures/ImageProcessing-html/topic4.htm
2. https://www.tutorialspoint.com/dip/index.htm
3. https://www.javatpoint.com/applications-of-digital-image-processing

Title of the Course and Course Code	**Data Science using R (CSC5310)**	**Number of Credits : 04**
Course Outcome (CO) **On completion of the course, the students will be able to:**		
CO1	Describe concepts of Data Science and its specialised branches. State the use of R and R-Studio's interactive environment.	
CO2	Illustrate fundamental concepts of R programming.	
CO3	Apply the data manipulation and transformation techniques to prepare data for modelling.	
CO4	Analyze the nature of data with help of statistical methods, different tools and visualization techniques. Infer the applicability of the algorithms for given data.	
CO5	Evaluate the model performance by applying various algorithms and communicate the observations.	
CO6	Write R scripts to build predictive models and to solve real world problems.	

Unit	**Details**	**Lectures**
I	**Introduction to data science** 1.1 What is data science? 1.2 Composition of data science 1.3 Analytics and its types 1.4 Role of AI and ML in data science 1.5 Nature of data 1.6 Technologies for data science	**[6]**
II	**Introduction to R programming** 2.1 Introduction to R-studio	**[6]**

	2.2 mathematical and logical operators in R 2.3 Data types 2.4 simple operations and programs	
III	**Data structures and function in R** 3.1 Vectors, Matrix, List 3.2 Data Frame, Factor 3.3 Control flow: If...else, if else () Function, Programming for loop While Loop, Break & next, Repeat Loop 3.4 Functions in R 3.5 Strings: String construction rules, String Manipulation functions	**[10]**
IV	**More about R** 4.1 R packages: Study of different packages in R 4.2 R Data Reshaping: Joining Columns and Rows in a Data Frame 4.3 Merging Data Frames, Melting and Casting 4.4 Working with files: Read and writing into different types of files	**[10]**
V	**Data visualization in R and Data Management** 5.1 Working with different charts 5.2 Histogram 5.3 Boxplot 5.4 Missing Value Treatment 5.5 Outlier Treatment 5.6 Sorting Datasets 5.7 Merging Datasets 5.8 Binning variables	**[8]**
VI	**Statistical modelling in R** 6.1 Mean, mode, median 6.2 co-variance 6.3 correlation 6.4 Linear regression 6.5 Decision tree 6.6 K-means Clustering	**[8]**

Books:

1. Hadley Wickham, Garrett Grolemund, "R for data scienc", O'Reilly
2. Norman Matloff, The Art of R Programming-a tour of statistical software design.
3. Nina Zumel , John Mount , Jim Porzak, Practical Data Science.

Web References:

1. www.datacamp.com/r-tutorial
2. https://www.codecademy.com
3. https://www.edx.org › course ›Introduction to R for Data Science

Title of the Course and Course Code	Natural Language Processing (CSC5312)	Number of Credits : 04
Course Outcome (CO) On completion of the course, the students will be able to:		
CO1	Describe the basic concepts and algorithmic description of the main language levels: morphology, syntax, semantics, and pragmatics.	
CO2	Understand the core concepts of Natural language processing and levels of language analysis.	
CO3	Implement various natural language processing techniques by applying it to various problems.	
CO4	Analyse different natural language processing techniques with the help of real problems.	
CO5	Compare and contrast various natural language processing techniques and their complexities.	
CO6	Combine the knowledge of natural language processing to design and implement applications based on natural language processing	

Unit	Details	Lectures
I	**Words and Word Forms** Morphology fundamentals; Morphological Diversity of Indian Languages; Morphology Paradigms; Finite State Machine Based Morphology; Automatic Morphology Learning; Shallow Parsing; Named Entities; Maximum Entropy Models; Random Fields.	**[12]**
II	**Structures** Theories of Parsing, Parsing Algorithms; Robust and Scalable Parsing on Noisy Text as in Web documents; Hybrid of Rule Based and Probabilistic Parsing; Scope Ambiguity and	**[12]**
III	**Meaning** Lexical Knowledge Networks, Wordnet Theory; Indian Language Wordnets and Multilingual Dictionaries; Semantic Roles; Word Sense Disambiguation; WSD and Multilinguality;	**[12]**

	Metaphors; Coreferences.	
IV	**Applications of NLP** Sentiment Analysis; Text Entailment; Robust and Scalable Machine Translation; Question Answering in Multilingual Setting; Cross Lingual Information Retrieval (CLIR).	**[12]**

Learning Resources:

1. Allen, James, Natural Language Understanding, Second Edition, Benjamin/Cumming, 1995.
2. Charniack, Eugene, Statistical Language Learning, MIT Press, 1993.
3. Jurafsky, Dan and Martin, James, Speech and Language Processing, Second Edition, Prentice Hall, 2008.
1. Manning, Christopher and Heinrich, Schutze, Foundations of Statistical Natural Language Processing, MIT Press, 1999.
4. Natural Language Processing and Text Mining, Kao, Springer, ISBN-9781846281754

Title of the Course and Course Code	**Project III (CSC5313)**	**Number of Credits : 04**
Course Outcome (CO) **On completion of the course, the students will be able to:**		
CO1	Describe a thorough 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.	

Objective:
The objective of 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 in any platform.

The Project can be platform, Language and technology independent. Project will be evaluated by project guide. Assessment will be done weekly in the respective batch. Evaluation will be

on the basis of weekly progress of project work, progress report, oral, results and documentation and demonstration.
Student should fill their status of the project work on the progress report and get the signature of project guide regularly. Progress report should sharply focus how much time you have spent on specific task. (The format of progress report is given as follow.) Project will not be accepted if progress report is not submitted and all responsibility remains with student.

Project Progress Report

Roll No and Name of the Student	
Title of the project	
Project guide name	

Sr.	From Date	To Date	Details of Project work	Guide sign

Project Guide

S.Y. M.Sc. Semester IV		
Title of the Course and Course Code	**Industrial Training (CSC5401)**	**Number of Credits : 04**
Course Outcome (CO) **On completion of the course, the students will be able to:**		
CO1	Describe the various skills, attitude and knowledge to understand the professionalism in IT industry.	
CO2	Discuss the working culture of the Industry in view to maintain quality standards.	
CO3	Implement the confidence, presentation skills and logical thinking in developing the system.	
CO4	Differentiate between the academics and professional work culture in timely delivery of projects.	
CO5	Compare and contrast the professional development of the programs and project.	
CO6	Combine the techniques to enhance oneself as a thorough software professional.	

The necessary details for Industrial Training course are as follows:
A student can complete Industrial Training Project (ITP) in any I.T. industry / academic institute / with a research project of a teacher / an expert funded by any funding agency for a minimum period of three months.

1. There will be a teacher coordinator for a group of 10 students. A teacher coordinator is responsible to:

- Maintain a weekly status / progress report of the student.
- Keep in touch with the reporting authorities from industry for each student.
- Help the students to solve their difficulties.
- Arrange the meeting and presentations as per requirement.
- Guide each student for preparing final project report.
- Keep complete documentation record for each student separately.
- Internal assessment of each student for 100 marks

The workload for this teacher coordinator is proposed as four hours per week. The workload for a teacher coordinator who is guiding 3 students doing their ITP in Fergusson College (Autonomous) Pune (no mentor from industry) is proposed as four hours per week.

2. Guidelines for submitting the final project report:
The student must include the project completion certificate issued by the respective industry/research institute/educational institute in the report. A student will submit two hard bound copies and one CD: Student Copy, Department copy, Controller of Examination copy of the work carried out during ITP (CD to be given by students).

3. Scheme of Assessment:

- **Continuous Internal Assessment**

  Evaluation for internal 100 Marks will be done by the Internal Teacher Coordinator.

Description	Marks
Weekly Reports (Minimum 12)	40
Project Report writing	20
Internal Presentation Demo	30
Weekly Attendance	10

- **End Semester Assessment**

  Evaluation for external 100 Marks will be done by a panel of three consisting of One Industrial Expert, One Academic Expert (External from other college) and One Internal Examiner.

  Each examiner is expected to assess each student for 100 marks independently and average of the three scores is to be considered as the final ESE score (out of 100)

Description	Marks
Knowledge and Execution of the System	20
Final Project Report	20
Presentation	30
Viva	30

The internal examiner(s) will be responsible for submitting the total marks out of 200 to examination section.

The final grade (to be printed on the mark list) is to be calculated on the basis of UGC 10 point scale.

Marks	Grade	Grade Point
180 – 200	O: Outstanding	10
160-179	A+ : Excellent	9
141- 159	A: Very Good	8
131 – 140	B+ : Good	7
121 – 130	B: Above Average	6
111 – 120	C+ : Average	5
101 –110	C: Below Average	4
91 – 100	D : Satisfactory	3
80-90	E:Pass	2
0 -79	F : Fail	0
	Absent	0

Note: - A student who has obtained Grade F will have to carry out this project once again for a complete semester (minimum three months).