Mahatma Education Society's

Pillai HOC College of Arts, Science & Commerce (Autonomous)

Affiliated to University of Mumbai

SYLLABUS

Master of Science (M. Sc.) in Information Technology Part I

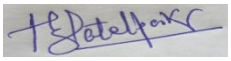
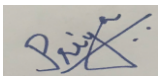
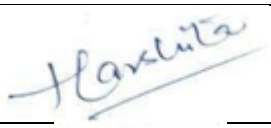
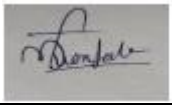
A.Y. 2026-27

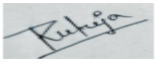
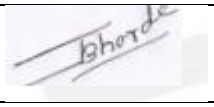
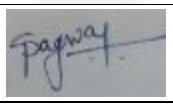
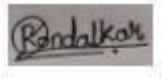
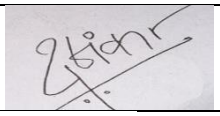
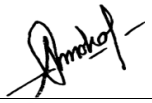
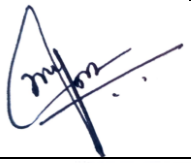
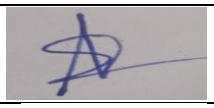
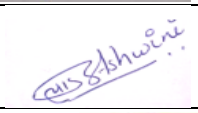
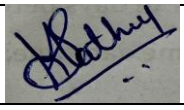
As per the National Education Policy
Choice Based Credit & Grading System

Mahatma Education Society's College Code: 870
PILLAI HOC COLLEGE OF ARTS, SCIENCE & COMMERCE
Pillai HOCL Educational Campus, HOC Colony, Rasayani, Via. Panvel, Dist. Raigad. Pin 410207
Tel: 02192 - 669000 / 01 / 02 / 03 / 04 / 05 / 06 / 07 / 08 / 09 Website : www.phcasc.ac.in Email : phcasc@mes.ac.in
(NAAC Accredited 'A+' Grade , CGPA – 3.26 in Cycle 2 & ISO 9001:2015 Certified)
Affiliated to the University of Mumbai, Approved by Government of Maharashtra
(AUTONOMOUS COLLEGE)

Ref.No: PHCASC/BOS Meeting/Attendance/2026-27 Date: 01.04.2026

Board of Studies Mathematics, Statistics and Computer Application

Sr. No	Name	Signature
1	Dr. Swapna Kadam Vice Chancellor Nominee	
2	Dr. Annie Rajan, Subject Experts	
3	Dr. Homraj Patelpaik Subject Experts	
4	Mr. Swapnil H. Patil Industry Expert	
5	Mr. Akash Ghadge Meritorious Alumnus	
6	Dr. Rinkoo Shantnu Principal	
7	Ms. Priyanka Sorte Chairperson (Programme Co-ordinator BSc. CS)	
8	Ms. Priya Prakash Member (Mathematics, Statistics)	
9	Ms. Harshita Singh Member (Mathematics, Statistics)	
10	Ms. Mrunal Wanjale Member (Mathematics, Statistics)	
11	Ms. Arpita Kante Member (Programme Co-ordinator BSc. DS)	
12	Ms. Anita Mhatre Member (Programme Co-ordinator MSc. DS)	

13	Ms. Sangeeta Menon Member (Programme Co-ordinator BSc.AIML)	
14	Ms. Aarti Wani Member	
15	Ms. Rutuja Madane Member	
16	Ms. Kranti Vartak Member	
17	Ms. Jyoti Borade Member	
18	Ms. Sonali Dagwar Member	
19	Ms. Rutuja Kondalkar Member	
20	Mr. Yash Karkhanis Member	
21	Ms. Aishwarya Mokal Member	
22	Ms. Vinaya Bhoir Member (Programme Co-ordinator BSc. Cyber Security)	
23	Ms. Namrata Kedari Member	
24	Ms. Ashwini Patil Member	
25	Ms. Ashwini Lad Member (Programme Co-ordinator MSc.IT)	
26	Ms. Priyanka Sonawane Member (Programme Co-ordinator BSc.IT)	
27	Mr. Shinoj Mathew Member	

A. INTRODUCTION TO MASTER OF SCIENCE IN INFORMATION TECHNOLOGY (M.SC.IT)

Master of Science (Information Technology) is a Programme designed to meet the needs of the market for expertise in Information Technology (IT). The Programme is intended to address the increasing demand in the work-place for IT professionals with a broad and sound knowledge of both technical and managerial skills. A master degree is granted to individuals who have undergone study demonstrating a mastery or high-order overview of a specific area.

The programme aims to equip postgraduate students with an integrated set of skills to advance their careers in Information Technology, providing both theoretical and practical knowledge necessary to understand and design complex computer applications. It prepares students to embrace future developments in the field and ensures strong professional relevance. The programme enables learners to acquire the latest skills and build future capabilities using world-class technology, developing a solid foundation in computer systems and IT, along with proficiency in advanced programming languages for creating sophisticated software across diverse applications. Additionally, students gain the expertise to work with high-end internet technologies and the managerial ability to analyze, design, develop, and maintain software solutions.

B. Programme Outcomes

Sr. No.	PO Title	POs in brief
PO1	Fundamental Knowledge Acquisition	Graduates will demonstrate a comprehensive and foundational knowledge of their chosen discipline along with an awareness of interdisciplinary connections.
PO2	Critical Thinking and Analytical Reasoning	Graduates will be able to analyse complex problems, synthesize data from multiple sources (qualitative and quantitative), and employ logical reasoning to formulate well-supported conclusions and arguments.
PO3	Effective Communication	Graduates will exhibit proficiency in both written and oral communication, articulating ideas clearly, persuasively, and ethically to diverse audiences
PO4	Problem Solving	Graduates will possess the ability to identify, formulate, and design solutions for real-world problems in their professional or social contexts, applying relevant theoretical knowledge and practical skills.
PO5	Information and Digital Literacy	Graduates will demonstrate the capability to locate, evaluate, and effectively use information from various sources, and utilize modern tools and Information and Communication Technology (ICT) for professional and academic tasks.
PO6	Research Skills and Scientific Temperament	Graduates will develop a sense of inquiry and research methodology, including the ability to design experiments (where applicable), collect and analyse data, and interpret results while maintaining scientific rigor and intellectual honesty.
PO7	Ethical Reasoning and Professional Integrity	Graduates will recognize ethical dilemmas, commit to professional and academic ethics, and demonstrate an understanding of moral and social responsibilities in their personal and professional conduct.
PO8	Employability and Professional Skills	Graduates will acquire the necessary job-ready skills, managerial competencies, and professional values to secure gainful employment or pursue advanced education in their respective fields.
PO9	Environmental and Sustainability Consciousness	Graduates will understand the importance of environmental conservation and sustainable development, displaying

		responsibility toward ecological challenges and advocating for healthy environmental practices.
PO10	Life-Long Learning	Graduates will develop the capacity for independent and self-directed learning to continuously upgrade their knowledge and skills, enabling them to adapt to rapid technological and societal changes.
PO11	Civic and Social Responsibility	Graduates will act as responsible citizens with an informed awareness of constitutional values, engaging proactively in community development and addressing social needs.
PO12	Empathy and Social Intelligence	Graduates will be able to cultivate and demonstrate affective, interpersonal, social and emotional intelligence.

C. Programme Specific Outcomes (PSO)

Sr. No	PSO Title	Programme Specific Outcomes
PSO1	Designing Ethical and Sustainable Computer Systems	Apply knowledge of mathematics, science, and computing to design, analyze, and evaluate complex computer-based systems while considering economic, environmental, social, ethical, and sustainability constraints.
PSO2	Research-Driven IT Solutions in Context	Review literature and conduct research to design experiments, analyze data, and draw valid conclusions; apply modern techniques, skills, and tools to implement effective IT solutions; and use contextual knowledge to assess professional, legal, health, social, and cultural issues in practice.
PSO3	Ethical and Societal Impacts of Computing	Analyze the local and global impact of computing on individuals, organizations, and society; apply ethical principles in professional practice; and function effectively as a team member or leader in multidisciplinary environments.
PSO4	Professional Communication and Continuous Development	Communicate effectively with diverse audiences through written, oral, and graphical modes; apply engineering and management principles to manage projects as a team member or leader; and engage in independent, lifelong learning for ongoing professional development.

D. Evaluation Pattern

Marking Code	Marking Scheme
A	50 Marks Semester End Exam, 50 Continuous Assessment (20 Marks Internal Exam, 10 Marks Research Paper, 10 Marks Assignments, 10 Marks Presentation)
B	40 Marks Semester End Exam, 60 Marks Project
C	100 Marks Practical Examination.
D	50 Marks Practical Examination.

Credit Structure of the Program (Sem I & II)

Semester - I							
Course Code	**Course Type**	**Course Title**	**Theory/ Practical**	**Marks**	**Credits**	**Lectures /Week**	**Evaluation Pattern**
HPSIT101	Major	Data Science	Theory	100	4	4	A
HPSIT102	Major	Soft Computing Techniques	Theory	100	4	4	A
HPSIT103	Major	Cloud Computing	Theory	100	2	2	A
HPSIT104	Major	Image Processing	Theory	100	4	4	A
HPSIT108	Major	Research Methodology for Information Technology	Theory	100	4	4	A
HPSIT106P	Major Practical	Practical (HPIT101)	Practical	50	2	2	D
HPSIT107P	Major Practical	Practical (HPIT102)	Practical	50	2	2	D

Semester - II							
Course Code	**Course Type**	**Course Title**	**Theory/ Practical**	**Marks**	**Credits**	**Lectures /Week**	**Evaluation Pattern**
HPSIT151	Major	Big Data Analytics	Theory	100	4	4	A
HPSIT152	Major	Modern Networking	Theory	100	4	4	A
HPSIT153	Major	Micro Services Architectures	Theory	100	2	4	A
HPSIT154P	Major Practical	Practical (HPSIT151)	Practical	50	2	2	D
HPSIT155P	Major Practical	Practical (HPSIT152)	Practical	50	2	2	D
HPSIT156P	Major Practical	Computer Vision Practical	Practical	100	4	4	C
HPSIT157	OJT/FP	On Job Training	OJT	100	4	4	

Semester I

BOS	**Mathematics, Statistics and Computer Application**				
Course	**Data Science**				
Course Code	**HPSIT101**	**Level**	**6**		
		Type	**Theory**	**Practical**	**Total**
Semester	**I**	**Credits**	04	02	06
Type	**Major**	**No of Teaching hours**	**60**	**30**	**90**
Evaluation/ Assessment	**Total Marks**	**Semester End**	**Continuous**	**Practical**	
	150	**50**	**50**	**50**	

Learning Objectives	
1	Develop in depth understanding of the key technologies in data science and business analytics: data mining, machine learning, visualization techniques, predictive modeling, and statistics
2	Practice problem analysis and decision-making.
3	Gain practical, hands-on experience with statistics programming languages and big data tools through coursework and applied research experiences.

Course Outcomes	
CO1	Apply quantitative modeling and data analysis techniques to the solution of real world business problems, communicate findings, and effectively present results using data visualization techniques & Recognize and analyze ethical issues in business related to intellectual property, data security, integrity, and privacy.
CO2	Apply ethical practices in everyday business activities and make well-reasoned ethical business and data management decisions.
CO3	Demonstrate knowledge of statistical data analysis techniques utilized in business decision making and Apply principles of Data Science to the analysis of business problems
CO4	Use data mining software to solve real-world problems & Employ cutting edge tools and technologies to analyze Big Data
CO5	Apply algorithms to build machine intelligence Demonstrate use of team work, leadership skills, decision making and organization theory.

Modules At Glance

Module No.	Content	No. of Hours	Mapping with CO
1	Data Science Introduction ,Basics and Statistics for Data Science	30	CO1 ,CO2 , CO3& CO4
2	Data Analysis with Python , Data Visualization and Machine Learning for Data Science	30	CO5,CO6,CO7,C08&C09
		60	

Syllabus

Module No.	Content	No. of Lectures
1	**Unit 1: Data Science Introduction & Basics** **Data Science Technology Stack:** Rapid Information Factory Ecosystem, Data Science Storage Tools, Data Lake, Data Vault, Data Warehouse Bus Matrix, Data Science Processing Tools ,Spark, Mesos, Akka , Cassandra, Kafka, Elastic Search, R ,Scala, Python, MQTT, The Future. **Layered Framework:** Definition of Data Science Framework, Cross-Industry Standard Process for Data Mining (CRISP-DM), Homogeneous Ontology for Recursive Uniform Schema, The Top Layers of a Layered Framework, Layered Framework for High-Level Data Science and Engineering **Business Layer:** Business Layer, Engineering a Practical Business Layer **Utility Layer:** Basic Utility Design, Engineering a Practical Utility Layer **Unit 2: Statistics for Data Science** **Three Management Layers:** Operational Management Layer, Processing-Stream Definition and Management, Audit, Balance, and Control Layer, Balance, Control, Yoke Solution, Cause-and-Effect,Analysis System, Functional Layer, Data Science Process **Retrieve Superstep:** Data Lakes, Data Swamps, Training the Trainer Model, Understanding the Business Dynamics of the Data Lake, Actionable Business Knowledge from Data Lakes, Engineering a Practical Retrieve Superstep, Connecting to Other Data Sources. **Assess Superstep:** Assess Superstep, Errors, Analysis of Data, Practical Actions, Engineering a Practical Assess Superstep	15

2	**Unit 3: Data Analysis with Python & Data Visualization** **Process Superstep :** Data Vault, Time-Person-Object-Location-Event Data Vault, Data Science Process, Data Science, **Transform Superstep :** Transform Superstep, Building a Data Warehouse, Transforming with Data Science, Hypothesis Testing, Overfitting and Underfitting, Precision-Recall, Cross-Validation Test. **Unit 4: Machine Learning for Data Science** **Transform Superstep:** Univariate Analysis, Bivariate Analysis, Multivariate Analysis, Linear Regression, Logistic Regression, Clustering Techniques, ANOVA, Principal Component Analysis (PCA), Decision Trees, Support Vector Machines, Networks, Clusters, and Grids, Data Mining, Pattern Recognition, Machine Learning, Bagging Data,Random Forests, Computer Vision (CV) , Natural Language Processing (NLP), Neural Networks, TensorFlow. **Organize and Report Supersteps :** Organize Superstep, Report Superstep, Graphics, Pictures, Showing the Difference	15
Case Study Scenario		
M1	A telecom company is experiencing a sharp increase in customer churn. The management wants to build a predictive analytics system using Data Lakes, CRISP-DM methodology, and machine learning techniques such as Logistic Regression, Decision Trees, Random Forests, and PCA. The raw customer data exists in a Data Lake containing call records, billing details, network usage, and complaint logs, but much of this data is unstructured and noisy. Using the concepts of the Retrieve, Assess, Transform, Organize, and Report Supersteps, explain how you would design a complete data science solution to identify customers at high risk of churn, including data retrieval, noise removal, feature engineering, model building, evaluation, and reporting.	
M2	A national bank wants to build a real-time fraud detection system for online transactions. The bank collects millions of transaction records daily through Kafka streams and stores them in a Data Lake and Cassandra-based distributed system. They want to apply Spark-based preprocessing, Transform Supersteps, and machine learning techniques such as SVM, Clustering, Random Forests, PCA, and Neural Networks to accurately detect fraudulent activities. Describe how you would design and implement a complete fraud detection pipeline, covering data ingestion, statistical analysis, cleaning, feature extraction, model training and testing, cross-validation, real-time prediction, and final reporting through dashboards and visualizations.	

Text and References:

A. Practical Data Science,Andreas François Vermeulen, APress , 2018.
B. Principles of Data Science, Sinan Ozdemir PACKT ,2016.
C. Data Science from Scratch Joel Grus, O'Reilly,2015.
D. Experimental Design in Data science with Least Resources, N C Das, Shroff Publishers, 2018.

Semester End Evaluation (50 Marks) **Time: 2 Hrs.**

Paper Pattern

Question No	Questions	Total Marks: 50
Q1	Attempt any 3 out of 5 (Module I)	**15 M**
Q2	Attempt any 3 out of 5 (Module II)	**15 M**
Q3	Attempt any 3 out of 5 (Module I & II)	**15 M**
Q4	Case Study (Attempt Any 1 from 2)	**05 M**

Syllabus

List of Practicals		No. Of. Lectures	CO Mapping
1	Creating and using database in Cassandra	3	CO1
2	Write the programs for the following: a. Text Delimited CSV to HORUS format b. XML to HORUS format c. JSON to HORUS format d. MySql database to HORUS format e. Picture(JPEG) to HORUS format f. Video to HORUS format g. Audio to HORUS format	3	CO2
3	a. Averaging of data b. Data Binning or Bucketing c. Fixers Utilities d. Logging e. Outlier Detection	3	CO3, CO4
4	a. Perform following data processing using R b. Program retrieve different attributes of data c. Data pattern d. Loading IP_DATA_ALL	3	CO5, CO6

5	a. Perform error management on the given data using pandas package b. Write python/R program to create the network routing diagram from the given data on routers c. Write a python/R program to build acyclic graph d. Write python/R program to pick the content for BillBoards from the given data e. Write a python/R program to generate GML file from given csv file f. Write python/R program to plan location of warehouse from the given data g. Write python/R program using data science via clustering to determine new warehouse using the given data h. Using the given data Write python/R program to plan the shipping routers from best-fit international logistics i. Write python/R program to delete the best packing option to ship in container from the given data j. Write python program to create delivery route using the given data k. Write python program to crate simple forex trading planner from the given data l. Write python program to process the balance sheet to ensure the only good data is processing m. Write python program to generate payroll from the given data	3	CO7
6	Build the time hub, links and satellites	3	CO8
7	Transforming data	3	CO8
8	Organizing data	3	CO8
9	Generating data	3	CO9
10	Data visualisation using power Bi	3	CO9

Semester End Practical Evaluation ***(50 Marks)*** ***Time: 2 Hrs***

Question No	Questions	Total Marks: 50
Q1	Program	30
Q2	Journal	10
Q3	Viva & Attendance	10

BOS	**Mathematics, Statistics and Computer Application**				
Course	**Soft Computing Techniques**				
Course Code	**HPSIT102**	**Level**	**6**		
		Type	**Theory**	**Practical**	**Total**
Semester	**I**	**Credits**	**04**	**02**	**06**
Type	**Major**	**No of Teaching hours**	**60**	**30**	**90**

Evaluation/Assessment	**Total Marks**	**Semester End**	**Continuous**	**Practical**
	150	**50**	**50**	**50**

Learning Objectives	
1	Soft computing concepts like fuzzy logic, neural networks and genetic algorithms, where Artificial Intelligence is the mother branch of all.
2	All these techniques will be more effective to solve the problem efficiently

Course Outcomes	
CO1	Gain a solid understanding of the fundamental concepts underlying soft computing, including the differences between soft computing and traditional hard computing methods.
CO2	Familiarize with a variety of soft computing techniques such as fuzzy logic, neural networks, genetic algorithms, swarm intelligence, and probabilistic reasoning.
CO3	Apply soft computing techniques to solve real-world problems from various domains such as engineering, finance, healthcare, and more.
CO4	Formulate problems in a way that lends itself to the application of soft computing techniques, taking into account the uncertainties and imprecisions present in real-world data.
CO5	Understand of how fuzzy logic works and its applications in modeling and decision- making under uncertainty.

CO6	Gain knowledge of neural network architectures, training algorithms, and their applications in pattern recognition, regression, and classification tasks.
CO7	Understand genetic algorithms, their components, and their use in optimization problems and search spaces.
CO8	Familiarize with swarm intelligence algorithms such as ant colony optimization and particle swarm optimization, and their applications in optimization and search problems.

Modules At Glance

Module No.	Content	No. of Hours	Mapping with CO
1	Introduction of soft computing,Artificial Neural Network ,Supervised Learning Network,Associative Memory Networks,Special Networks,Third Generation Neural Networks,UnSupervised Learning Networks	30	CO1 ,CO2 , CO3, CO4,CO5
2	Introduction to Fuzzy Logic, Classical Sets and Fuzzy sets ,Classical Relations and Fuzzy Relations,Membership Function,Defuzzification,Fuzzy Arithmetic and Fuzzy measures,Fuzzy Rule base and Approximate reasoning,Genetic Algorithm	30	CO6,CO7,C08
		60	

Syllabus

Module No.	Content	No. of Lectures
1	**Unit I** a) **Introduction of soft computing -** soft computing vs. hard computing, various types of soft computing techniques, Fuzzy Computing, Neural Computing, Genetic Algorithms, Associative Memory, Adaptive Resonance Theory, Classification, Clustering, Bayesian Networks, Probabilistic reasoning, applications of soft computing. **b) Artificial Neural Network -** Fundamental concept, Evolution of Neural Networks, Basic Models, McCulloh-Pitts Neuron, Linear Separability, Hebb Network**.** c) **Supervised Learning Network -** Perceptron Networks, Adaptive Linear Neuron, Multiple Adaptive Linear Neurons, Backpropagation Network, Radial Basis Function, Time Delay Network, Functional Link Networks, Tree	15

	Neural Network **Unit II** a) **Associative Memory Networks -** Training algorithm for pattern Association, Autoassociative memory network, hetroassociative memory network, bi-directional associative memory, Hopfield networks, iterative autoassociative memory networks, temporal associative memory networks. Kohonen self-organizing feature maps, learning vectors quantization, counter propogation networks, adaptive resonance theory networks. b) **Special Networks -** Simulated annealing, Boltzman machine, Gaussian Machine, Cauchy Machine, Probabilistic neural net, cascade correlation network, cognition network, neo-cognition network, cellular neural network, optical neural network c) **Third Generation Neural Networks -** Spiking Neural networks, convolutional neural networks, deep learning neural networks, extreme learning machine model. d) **UnSupervised Learning Networks -** Fixed weight competitive nets	
2	**Unit III** a) **Introduction to Fuzzy Logic, Classical Sets and Fuzzy sets -** Classical sets, Fuzzy sets. b) **Classical Relations and Fuzzy Relations -** Cartesian Product of relation, classical relation, fuzzy relations, tolerance and equivalence relations, non- iterative fuzzy sets c) **Membership Function -** features of the membership functions, fuzzification, methods of membership value assignments. d) **Defuzzification -** Lambda-cuts for fuzzy sets, Lambda-cuts for fuzzy relations, Defuzzification methods. e) **Fuzzy Arithmetic and Fuzzy measures -** fuzzy arithmetic, fuzzy measures, measures of fuzziness, fuzzy integrals. **Unit IV** a) **Fuzzy Rule base and Approximate reasoning -** Fuzzy proportion, formation of rules, decomposition of rules, aggregation of fuzzy rules, fuzzy reasoning, fuzzy inference systems, Fuzzy logic control systems, control system design, architecture and operation of FLC system, FLC system models and applications of FLC System. b) **Genetic Algorithm -** Biological Background, Traditional optimization and search techniques, genetic algorithm and search space, genetic algorithm vs. traditional algorithms, basic terminologies, simple genetic algorithm, general genetic algorithm, operators in genetic algorithm, stopping condition for genetic algorithm flow, constraints	15

	in genetic algorithm, problem solving using genetic algorithm, the schema theorem, classification of genetic algorithm, Holland classifier systems, genetic programming, advantages and limitations and applications of genetic algorithm.Differential Evolution Algorithm, Hybrid soft computing techniques – neuro – fuzzy hybrid, genetic neuro-hybrid systems, genetic fuzzy hybrid and fuzzy genetic hybrid systems.	
Case Study Scenario		
M1	A meteorological research center is developing an Artificial Neural Network (ANN) to improve short-term weather forecasting. The system uses historical data such as temperature, humidity, wind speed, and pressure patterns to predict rainfall and storms. ● Traditional statistical models fail when data is incomplete or nonlinear. ● The ANN learns hidden relationships between variables to improve accuracy. ● However, researchers must analyze the model's performance, limitations, and improvements to ensure reliable forecasts.	
M2	A hospital is developing an AI-powered diagnostic system to detect early-stage lung cancer from chest X-ray images. Traditional rule-based systems struggle with noisy images and overlapping features. To overcome this, the hospital uses an Artificial Neural Network (ANN) that learns from thousands of labeled X-rays. ● The ANN uses input neurons to process pixel data. ● Hidden layers extract features such as shape, texture, and density of lung tissues. ● The output layer classifies the result as "Normal" or "Suspicious." ● Doctors will use this system as a decision-support tool, but the hospital must ensure accuracy, reliability, and interpretability.	

Text and References:

A. Artificial Intelligence and Soft Computing,Anandita Das Battacharya,SPD,3rd,2018

B. Principles of Soft computing,S.N.Sivanandam S.N.Deepa,Wiley,3rd,2019

C. Neuro-Fuzzy and Soft Computing,J.S.R.Jang, C.T.Sun and E.Mizutani,Prentice Hall of India,2004

D. Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & ApplicationsS.Rajasekaran, G. A. Vijayalaksham

E. Fuzzy Logic with Engineering Applications,Timothy J.Ross

Semester End Evaluation (50 Marks) **Time: 2 Hrs**

Paper Pattern

Question No	Questions	Total Marks: 50
Q1	Attempt any 3 out of 5 (Module I)	**15 M**
Q2	Attempt any 3 out of 5 (Module II)	**15 M**
Q3	Attempt any 3 out of 5 (Module I & II)	**15 M**
Q4	Case Study (Attempt Any 1 from 2)	**05 M**

Practical Syllabus

List of Practicals		No. Of. Lectures	CO Mapping
1	A. Design a simple linear neural network model. B. Calculate the output of neural net using both binary and bipolar sigmoidal function	3	CO1,CO2
2	a. Generate AND/NOT function using McCulloch-Pitts neural net. b. Generate XOR function using McCulloch-Pitts neural net.	3	CO1,CO2
3	a. Write a program to implement Hebb's rule. b. Write a program to implement the delta rule.	3	CO1,CO2
4	ii. Write a program for Back Propagation Algorithm iii. Write a program for error Backpropagation algorithm.	3	CO3, CO4.CO5
5	i. Write a program for Hopfield Network. ii. Write a program for Radial Basis function	3	CO3, CO4.CO5
6	a. Kohonen Self organizing map b. Adaptive resonance theory	3	CO3, CO4.CO5
7	a. Write a program for Linear separation. b. Write a program for Hopfield network model for associative memory	3	CO6, CO7
8	a. Membership and Identity Operators | in, not in. b. Membership and Identity Operators is, is not	3	CO6, CO7
9	a. Find ratios using fuzzy logic b. Solve Tipping problem using fuzzy logic	3	CO8
10	a. Implementation of Simple genetic algorithm b. Create two classes: City and Fitness using Genetic algorithm	3	CO8

Semester End Practical Evaluation ***(50 Marks)*** ***Time: 2 Hrs***

Question No	Questions	Total Marks:50
Q1	Program	30
Q2	Journal	10
Q3	Viva & Attendance	10

BOS	**Mathematics, Statistics and Computer Application**				
Course	**Cloud Computing**				
Course Code	**HPSIT103**	**Level**	**6**		
		Type	**Theory**	**Practical**	**Total**
Semester	**I**	**Credits**	**02**	**-**	**02**
Type	**Major**	**No of Teaching hours**	**60**	**-**	**60**
Evaluation/ Assessment	**Total Marks**	**Semester End**	**Continuous**	**Practical**	
	100	**50**	**50**	**-**	

Learning Objectives	
1	To learn how to use Cloud Services
2	To implement Virtualization.
3	To implement Task Scheduling algorithms.
4	Apply Map-Reduce concept to applications.
5	To build Private Cloud
6	Broadly educate to know the impact of engineering on legal and societal issues involved.

Course Outcomes	
CO1	Analyze the Cloud computing setup with its vulnerabilities and applications using different architectures.
CO2	Design different workflows according to requirements and apply map reduce programming model.
CO3	Apply and design suitable Virtualization concept, Cloud Resource Management and design scheduling algorithms.
CO4	Create combinatorial auctions for cloud resources and design scheduling algorithms for computing cloud
CO5	Assess cloud Storage systems and Cloud security, the risks involved, its impact and develop cloud application
CO6	Broadly educate to know the impact of engineering on legal and societal issues involved in addressing the security issues of cloud computing.

Modules At Glance

Module No.	Content	No. of Hours	Mapping with CO
1	Introduction to cloud computing	15	CO1, CO3
2	Cloud Computing Architecture	15	CO4, CO6
		30	

Syllabus

Module No.	Content	No. of Lectures
1	1. **Introduction to Cloud Computing -** Introduction, Historical developments, Building Cloud Computing Environments, 2. **Principles of Parallel and Distributed Computing -** Eras of Computing, Parallel v/s distributed computing, Elements of Parallel Computing, Elements of distributed computing, Technologies for distributed computing. 3. **Virtualization -** Introduction, Characteristics of virtualized environments, Taxonomy of virtualization techniques, Virtualization and cloud computing, Pros and cons of virtualization, Technology examples. Logical Network Perimeter, Virtual Server, Cloud Storage Device, Cloud usage monitor, Resource replication, Ready-made environment.	15
2	**B. Cloud Computing Architecture:** Introduction, Fundamental concepts and models, Roles and boundaries, Cloud Characteristics, Cloud Delivery models, Cloud Deployment models, Economics of the cloud, Open challenges. **C. Fundamental Cloud Security:** Basics, Threat agents, Cloud security threats, additional considerations. **D. Industrial Platforms and New Developments:** Amazon Web Services, Google App Engine, Microsoft Azure.	15
Case Study Scenario		
M1	Netflix is experiencing rapid growth in global subscribers. Their on-premise data centers cannot handle sudden spikes in traffic, especially during new movie releases. The company faces issues such as server overload, slow content delivery, and high maintenance costs. To solve this, Netflix decides to migrate its services to Amazon Web Services (AWS).Using cloud computing concepts, explain how AWS helps Netflix improve **scalability, availability, virtualization, and distributed computing**. Mention at least three cloud components involved in this transformation.	

M2	BMW wants to process real-time data from millions of connected cars worldwide. The existing infrastructure cannot handle massive telemetry input, lacks distributed processing, and cannot support quick updates to car software. BMW chooses Microsoft Azure for a hybrid cloud architecture. Describe how Azure helps BMW implement parallel/distributed computing, virtualization, and secure cloud storage in its connected car ecosystem.

Text and References:

a. Mastering Cloud Computing Foundations and Applications Programming,Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi , 2013
b. Cloud Computing Concepts, Technology & Architecture,Thomas Erl, Zaigham Mahmood, and Ricardo Puttini BPB Publications,2013
c. Distributed and Cloud Computing, From Parallel Processing to the Internet of Things,Kai Hwang, Jack Dongarra, Geoffrey Fox,2012

Semester End Evaluation (50 Marks) ***Time: 2 Hrs***

Paper Pattern

Question No	Questions	Total Marks: 50
Q1	Attempt any 3 out of 5 (Module I)	**15 M**
Q2	Attempt any 3 out of 5 (Module II)	**15 M**
Q3	Attempt any 3 out of 5 (Module I & II)	**15 M**
Q4	Case Study (Attempt Any 1 from 2)	**05 M**

BOS	**Mathematics, Statistics and Computer Application**				
Course	**Image Processing**				
Course Code	**HPSIT104**	**Level**	**6**		
		Type	**Theory**	**Practical**	**Total**
Semester	**I**	**Credits**	**04**	**-**	**04**
Type	**Major**	**No of Teaching hours**	**60**	**-**	**60**

Evaluation/ Assessment	**Total Marks**	**Semester End**	**Continuous**	**Practical**
	100	**50**	**50**	**-**

Learning Objectives	
1	Review the fundamental concepts of a digital image processing system.
2	Analyze images in the frequency domain using various transforms.
3	Evaluate the techniques for image enhancement and image restoration.
4	Categorize various compression techniques.
5	Interpret Image compression standards.
6	Interpret image segmentation and representation techniques.

Course Outcomes	
CO1	Understand the relevant aspects of digital image representation and their practical implications.
CO2	Have the ability to design pointwise intensity transformations to meet stated specifications.
CO3	Understand 2-D convolution, the 2-D DFT, and have the ability to design systems using these concepts.
CO4	Have a command of basic image restoration techniques & wavelet decompositions and their role in image processing systems.
CO5	Understand the role of alternative color spaces, the design requirements leading to choices of color space, the ability to design systems using standard algorithms to meet design specifications.

Modules at Glance

Module No.	Content	No. of Hours	Mapping with CO
1	Introduction to Image Processing & Filtering	30	CO1 , CO2, CO3
2	Colour Image Processing & Segmentation	30	CO4, CO5, CO6
		60	

Syllabus

Module No.	Content	Total No. of Lectures
1	**Introduction:** Digital Image Processing, Origins of Digital Image Processing, Applications and Examples of Digital Image Processing, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, **Digital Image Fundamentals:** Elements of Visual Perception, Light and the Electromagnetic Spectrum, Image Sensing and Acquisition, Image Sampling and Quantization, Basic Relationships Between Pixels, Basic Mathematical Tools Used in Digital Image Processing, **Intensity Transformations and Spatial Filtering:** Basics, Basic Intensity Transformation Functions, Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing (Lowpass) Spatial Filters, Sharpening (Highpass) Spatial Filters, Highpass, Bandreject, and Bandpass Filters from Lowpass Filters, Combining Spatial Enhancement Methods, Using Fuzzy Techniques for Intensity Transformations and Spatial Filtering Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Constrained Least Squares Filtering, Geometric Mean Filter, Image Reconstruction from Projections **Wavelet and Other Image Transforms:** Preliminaries, Matrix-based Transforms, Correlation, Basis Functions in the Time-Frequency Plane, Basis Images, Fourier-Related Transforms, Walsh-Hadamard Transforms, Slant Transform, Haar Transform, Wavelet Transforms	**15**
2	**Color Image Processing:** Color Fundamentals, Color Models, Pseudocolor Image Processing, Full-Color Image Processing, Color Transformations, Color Image Smoothing and Sharpening, Using Color in Image Segmentation, Noise in Color Images, Color Image Compression. **Image Compression and Watermarking:** Fundamentals, Huffman Coding, Golomb Coding, Arithmetic Coding, LZW Coding, Run-length Coding, Symbol-based Coding, 8 Bit-plane Coding, Block Transform Coding, Predictive Coding, Wavelet Coding, Digital Image Watermarking, **Morphological Image Processing:** Preliminaries, Erosion and	**15**

	Dilation, Opening and Closing, The Hit-or-Miss Transform, Morphological Algorithms, Morphological Reconstruction, Morphological Operations on Binary Images, Grayscale Morphology **Image Segmentation I: Edge Detection, Thresholding, and Region Detection:** Fundamentals, Thresholding, Segmentation by Region Growing and by Region Splitting and Merging, Region Segmentation Using Clustering and Superpixels, Region Segmentation Using Graph Cuts, Segmentation Using Morphological Watersheds, Use of Motion in Segmentation **Image Segmentation II: Active Contours: Snakes and Level Sets:** Background, Image Segmentation Using Snakes, Segmentation Using Level Sets. **Feature Extraction:** Background, Boundary Preprocessing, Boundary Feature Descriptors, Region Feature Descriptors, Principal Components as Feature Descriptors, Whole-Image Features, Scale-Invariant Feature Transform (SIFT)	
	Case Study Scenario	
M1	How are image processing techniques applied in the medical field for automatic brain tumor detection using MRI scans? Explain how steps like noise removal, contrast enhancement, segmentation, and feature extraction help identify the tumor region and improve the accuracy, speed, and reliability of medical diagnosis.	
M2	How does an Automatic Number Plate Recognition (ANPR) system utilize image processing methods to identify vehicle registration numbers from captured images? Describe how processes such as image enhancement, edge detection, character segmentation, and Optical Character Recognition (OCR) help in applications like toll collection, traffic rule enforcement, and security monitoring.	

Text and References:

1. Digital Image Processing — Gonzalez, R. C., & Woods, R. E. (2018). 4th Edition. Pearson/Prentice Hall.
2. Fundamentals of Digital Image Processing — Jain, A. K. (Year not specified). PHI Learning.
3. The Image Processing Handbook — Russ, J. C. (2010). 5th Edition. CRC Press.
4. Digital Image Processing Using MATLAB — Gonzalez, R. C., & Woods, R. E. (2020). 3rd Edition. Gatesmark Publishing.
5. Computer Vision: Algorithms and Applications — Szeliski, R. (2010). 1st Edition. Springer (Texts in).

Semester End Evaluation (50 Marks) **Time: 2 Hrs**

Paper Pattern

Question No	Questions	Total Marks: 50
Q1	Attempt any 3 out of 5 (Module I)	**15M**
Q2	Attempt any 3 out of 5 (Module II)	**15M**
Q3	Attempt any 3 out of 5 (Module I & II)	**15M**
Q4	Case Study (Attempt Any 1 from 2)	**05M**

BOS	**Mathematics, Statistics and Computer Application**				
Course	**Research Methodology for Information Technology**				
Course Code	HPSIT108	**Level**	**6**		
		Type	**Theory**	**Practical**	**Total**
Semester	**I**	**Credits**	04	-	04
Type	**Major**	**No of Teaching hours**	**60**	**-**	**60**
Evaluation/ Assessment	**Total Marks**	**Semester End**	**Continuous**	**Practical**	
	100	**50**	**50**	**00**	

Learning Objectives	
1	To be able to conduct business research with an understanding of all the latest theories.
2	To develop the ability to explore research techniques used for solving any real world or innovate problem.

Course Outcomes	
CO1	Solve real world problems with scientific approach.
CO2	Develop analytical skills by applying scientific methods.
CO3	Recognize, understand and apply the language, theory and models of the field of business analytics.
CO4	Foster an ability to critically analyze, synthesize and solve complex unstructured business problems.
CO5	Understand and critically apply the concepts and methods of business analytics.
CO6	Identify, model and solve decision problems in different settings
CO7	interpret results/solutions and identify appropriate courses of action for a given managerial situation whether a problem or an opportunity
CO8	Create viable solutions to decision making problems

Modules At Glance

Module No.	Content	No. of Hours	Mapping with CO
1	Introduction and Beginning Stages of Research Process	30	CO1 , CO2, CO3, CO4
2	Measurement Concepts, Sampling and Field work	30	CO5, CO6, CO7, CO8
		60	

Syllabus

Module No.	Content	No. of Lectures
1	Introduction: Role of Business Research, Information Systems and Knowledge Management, Theory Building, Organization ethics and Issues Beginning Stages of Research Process: Problem definition, Qualitative research tools, Secondary data research Research Methods and Data Collection: Survey research, communicating with respondents, Observation methods, Experimental research	30
2	Measurement Concepts, Sampling and Field work: Levels of Scale measurement, attitude measurement, questionnaire design, sampling designs and procedures, determination of sample size Data Analysis and Presentation: Editing and Coding, Basic Data Analysis, Univariate Statistical Analysis and Bivariate Statistical analysis and differences between two variables. Multivariate Statistical Analysis.	30

Case Study Scenario	
M1	A regional grocery chain plans to expand into new cities but currently lacks critical data on local customer preferences and competitor pricing strategies. Management is unsure which products will be in high demand and what pricing tactics will attract new customers in these markets.
M2	A private university faced challenges in coordinating research efforts across its departments and faculties. Researchers frequently duplicated work, lacked access to prior studies, and had no shared platform for documentation. To address these issues, the university implemented a knowledge management system that allowed faculty members to upload reports, access archived research, and collaborate on projects. This initiative led to increased collaboration, higher research productivity, and better resource allocation.

Text and References:

A. Business Research Methods - William G.Zikmund, B.J Babin, J.C. Carr, Atanu Adhikari, M.Griffin.Cengage -8e 2016
B. Business Analytics — Albright Winston Cengage -5e 2015.
C. Research Methods for Business Students Fifth Edition – Mark Saunders 2011.
D. Multivariate Data Analysis - Hair Pearson -7e 20274

Semester End Evaluation (50 Marks) **Time: 2 Hrs**

Paper Pattern

Question No	Questions	Total Marks: 50
Q1	Attempt any 3 out of 5 (Module I)	**15M**
Q2	Attempt any 3 out of 5 (Module II)	**15M**
Q3	Attempt any 3 out of 5 (Module I & II)	**15M**
Q4	Case Study (Attempt Any 1 from 2)	**05M**