



CURRICULUM FOR

**“Ph.D.
Coursework”**
(Paper-III & IV)
w.e.f. April 2025

॥ तमसो मा ज्योतिर्गमय ॥

VISION

To provide equal opportunities for value based global education for creating an Enlightened Society

MISSION

To establish and facilitate educational institutions in the region for providing affordable value based global education to all who aspire to study and to create opportunities to educators, social workers and philanthropists to serve society



SARVAJANIK
UNIVERSITY

INCLUSIVE | INTEGRATED | INNOVATIVE

creating an enlightened society...

UNIVERSITY OFFICE

Dr. R. K. Desai Marg, Athwalines,
Surat-395001, Gujarat, India.
Website: www.sarvajanikuniversity.ac.in
Email: admin@sarvajanikuniversity.ac.in
Email: info@sarvajanikuniversity.ac.in
Mo.: +919979102021 / +9197129 30321
Contact No. +912612660266



Constituent Institute:

**Shree Ramkrishna Institute of
Computer Education and Applied
Sciences (SRKI)**

SARVAJANIK UNIVERSITY
Faculty of Science



SARVAJANIK
UNIVERSITY

INCLUSIVE | INTEGRATED | INNOVATIVE

Faculty of Science

Syllabus for Ph.D. Coursework in Computer Science Paper-III and IV

SARVAJANIK UNIVERSITY
Faculty of Science

Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences

Faculty	Science		Program	Ph.D. (Computer Science)
Year	1		Version	3.0
Semester	1/2		Effective From	April, 2025
Course Code	PSCS31101	Course Name	Paper III: Ph.D. Computer Science Coursework Paper III	

Teaching Scheme				Examination Scheme		
Credits	Lecture (L)	Tutorial (T)	Practical (P)	Continuous Assessments (CA)	Term end examinations (TEE)	Total
4	4	0	0	50	50	100



SARVAJANIK UNIVERSITY
Faculty of Science

Syllabus for Ph.D Course Work in Computer Science
(Paper III : Recent Advances in Computer Science)

PART - A	Elective - I	30 Hrs
PART - B	Elective - II	30 Hrs
		4 Credits (60 Hrs.)
* Any two distinct electives from following list of coursework electives to be opted by research scholar for the subject under the guidance of supervisor.		
Coursework Electives	1. Data Science and Data Analytics 2. Machine Learning 3. Digital Image Processing 4. Network Security and Cryptography 5. Natural Language Processing 6. Neural Network and Deep Learning	
Evaluation methodology	Evaluation-1- MCQ test and Practical hands-on / Project presentation on relevant tools and technologies. Evaluation-2 Literature review / Survey / Field Study / Comparative study and it's presentation.	



Elective: Data Science and Data Analytics

Unit 1 Basics of Data Science

- Data Acquisition : Data sources - Web APIs, Open Data Sources, Data APIs, Web Scrapping
- Data Pre-processing and Preparation
- Data Quality and Transformation: Data imputation, Data Transformation (minmax, log transform, z-score transform etc.), Outlier/Noise& Anomalies
- Handling Text Data : Bag-of-words, Regular Expressions, Sentence Splitting and Tokenization , Punctuations and Stop words, Incorrect spellings, Properties of words and Word cloud, Lemmatization and Term-Document TxD computation, Sentiment Analysis (Case Study)

Unit 2 : Statistical Decision Making

- Data Visualization: Science of Visualization, Visualization Periodic Table, Concepts of measurement - scales of measurement, Design of data collection formats, Principles of data visualization - different methods of presenting data in business analytics, Visualization types, Visualization charts
- Sampling and Estimation: Sample versus population, Sample techniques (simple, stratified, clustered, random), Sampling Distributions, Parameter Estimation, Unbalanced data treatment
- Inferential Statistics: Develop an intuition how to understand the data, attributes, distributions, Procedure for statistical testing, etc., Test of Hypothesis (Concept of Hypothesis, testing, Null Hypothesis and Alternative, Hypothesis)

Unit 3 : Predictive Analytics

- Linear Regression, Regression basics: Relationship between attributes using Covariance and Correlation, Relationship between multiple variables: Regression (Linear, Multivariate) in prediction, Residual Analysis, Identifying significant features, Hypothesis testing of Regression Model

Unit 4 : Big Data Analytics

- Challenges of processing Big Data
- Big Data Frameworks – Hadoop, Spark and NoSQL Systems
- Essential Algorithms (Word count, Page Rank, IT-IDF), Spark: RDDs, Streaming and Spark ML



SARVAJANIK UNIVERSITY
Faculty of Science

Elective: Machine Learning

UNIT 1 : Introduction Machine Learning

Introduction: Defining learning systems, Goals and applications of machine learning. Aspects of developing a learning system: training data, concept representation, function approximation, supervised learning, unsupervised learning, learning algorithms. Scalable Machine Learning - Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models

UNIT 2 : Decision Tree based Learning

Decision Tree Learning: Representing concepts as decision trees. Recursive induction of decision trees. Picking the best splitting attribute: entropy and information gain. Searching for simple trees and computational complexity, Overfitting, noisy data, and pruning.,

UNIT 3: Supervised and Unsupervised Learning Methods

Support Vector Machines: Maximum margin linear separators. Kernels for learning non-linear functions. Bayesian Learning: theory and Bayes rule. Naive Bayes learning algorithm. Parameter smoothing. Generative vs. discriminative training. Logistic regression. Bayes nets and Markov nets for representing dependencies. Instance-Based Learning: Constructing explicit generalizations versus comparing to past specific examples. k-Nearest-neighbour algorithm, Case-based learning.

UNIT 4: Ensemble Learning

Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory. Ensemble Learning: Bagging, boosting, and Ada-Boost. Experimental Evaluation of Learning Algorithms, Measuring the accuracy of learned hypotheses. Comparing learning algorithms: cross-validation, learning curves, and statistical hypothesis testing.

Study and review of latest tools, technologies and research trends of Machine Learning, Study of Research projects, Research design and Research Evaluation in Machine Learning.

REFERENCES:-

1. Machine Learning – Tom M. Mitchell, - MGH
2. Machine Learning: An Algorithmic Perspective, Stephen Marsland, Taylor & Francis (CRC)
3. Machine Learning Methods in the Environmental Sciences, Neural Networks, William WHsieh, Cambridge University Press.
4. Richard o. Duda, Peter E. Hart and David G. Stork, pattern classification, John Wiley & Sons Inc., 2001
5. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.
6. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012, Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009



Elective: Digital Image Processing

Unit 1 Digital Image Fundamentals

Definition of digital image, pixels, representation of digital image in spatial domain as well as in matrix form, Block diagram of fundamentals steps in digital image processing, Applications of digital image processing system, Light, brightness adaption and discrimination, Image as a 2D data, Image representation Gray scale and Colour images

Unit 2 Image Enhancement, Filter in Spatial Domain and Image restoration

Intensity transformation functions, Contrast stretching, Thresholding, Image negative, Log transformation, Power-law transformation, Image histogram, Histogram equalization process, Fundamentals of spatial filtering, Correlation and convolution, Spatial filtering mask for low pass filtering (smoothing) and high pass filtering (sharpening), Homomorphic filtering, 2D-DFT, 2DFFT, 2D- DCT, Fundamentals of 2D-wavelet transform, Reasons for image degradation, Image restoration using spatial filtering (Mean filters, Order statistic filters, adaptive filters)

Unit 3 Image Compression & Image Segmentation

Fundamentals of redundancies, Basic Compression Methods: Huffman coding, JPEG Compression standard, Wavelet based image compression, Edge based segmentation, Region based segmentation, Optimal thresholding.

Unit 4: Morphological Image Processing and Image Analytics

Basic morphological operations, Erosion, dilation, Structuring elements, Hit-or-Miss transform, Basic Morphological Algorithms: hole filling, connected components, thinning, skeletons, Reconstruction by erosion and dilation, Feature extraction, Feature selection

Study and review of latest tools, technologies and research trends of Digital Image Processing, Study of Research projects, Research design and Research Evaluation in Digital Image Processing.

Reference books:

1. Digital Image Processing, Rafael C. Gonzalez and Richard E. Woods, Third Edition, Pearson Education
2. Digital Image Processing, S Jayaraman, S Esakkirajan, T Veerakumar, Tata McGraw Hill Publication
3. Digital Image Processing, S Sridhar, Oxford University Press



SARVAJANIK UNIVERSITY
Faculty of Science

Elective: Network Security and Cryptography

(30 Hours)

Unit 1: Security basics and attacks

Phishing, various attacks and their prevention, privacy preservation, data reconnaissance, active attack, passive attack, spoofing, spamming, cyber defamation, salami attack, data diddling. Introduction to threats, vulnerabilities, integrity, confidentiality, anonymity, authentication, authorization, non-repudiation, plain text, cipher text, encryption and decryption.

Unit 2: Cryptography

Introduction to cryptography, cryptosystems, cryptanalysis, basic concepts of public key and private key cryptography, symmetric-asymmetric encryption, classical encryption algorithms. Secret Key Cryptography: DES, Triple DES, AES, Key Distribution. Public Key Cryptography: RSA, ECC, Key Exchange. Public Key Infrastructure: Digital Certificates, Certification Authorities.

Unit 3: Message Authentication process and protocols

Hash Functions, MAC, Digital Signature, Protocols used in security: Authentication Protocols, Needham Schroeder Protocol, Kerberos, Network Security with IP Security, Web Security using SSL, SET, System Security using Firewalls and VPN

Unit 4: Other Security Aspects

Security audit and logs, Smart Cards security, Zero knowledge protocols, Enterprise Application Security, Biometric Authentication, Database Access Control, Security and Privacy Issues in RFIDs.

Study and review of latest tools, technologies and research trends of Network Security and Cryptography, Study of Research projects, Research design and Research Evaluation in Network Security and Cryptography.

Reference books:

1. Cryptography and Network Security by William Stallings
2. Security in Computing by Pfleeger and Pfleeger, 3rd Edition, PHI,
3. Computer Security: Art and Science by Bishop, Pearson Edition
4. Computer Security by Gollmall, Willey Publication
5. Network Security by Kaufman, Pearson Edition



Elective: Natural Language Processing and Text Mining

Unit 1: Basic Linguistics

Parts of speech, Noun vs. verb and other “senses” of a word and their effect on analytics, ‘Nyms’ – homonyms, synonyms, troponyms, meronyms, and other variants, Stopwords, dictionaries, and taxonomies, Stemming, Lemmas, and other concepts, Dealing with contractions and other specialized forms

Unit 2: Language analysis & Tokenization

Extracting meaning from text, Humans parse language, Understanding complexity, Preparing to analyze texts, The process of text analysis, Space-based vs. NLP style tokenization, Various tokenizer models

Unit 3: Part-of-Speech (POS) tagging and Named Entity Recognition (NER), Sentiment Analysis, Topic Modeling

Introduction to POS tagging, Stop words and dictionaries, Introduction to NER, Lesk Algorithm and Word Sense Disambiguation (WSD), Sentiment Analysis, Tools and techniques, Limitations, Extracting topics from a document corpus, Strategies, methods, and outcomes

Unit 4: Ontologies, Taxonomies, and Dictionaries, Semantic technology

Taxonomy basics, Applications to machine learning, Ontologies, Dictionaries, Overview of Semantic Technologies

Study and review of latest tools, technologies and research trends of Natural Language Processing, Study of Research projects, Research design and Research Evaluation in Natural Language Processing.

Reference Books:

1. Srinivasa-Desikan, Bhargav, Natural Language Processing and Computational Linguistics, Pakt 2018
2. Natural Language Processing and Information Retrieval-By bSiddiqui and Tiwari, Oxford University Press
3. Speech and Language Processing - By Jurafsky and Martin, Pearson Education
4. Natural Language Processing with Python. – Analyzing Text with the
5. Natural Language Toolkit. Steven Bird, Ewan Klein, and Edward Loper, O’relly publication
6. The Oxford Handbook of Computational Linguistics 2nd edition Edited by Ruslan Mitkov, Oxford Press



SARVAJANIK UNIVERSITY

Faculty of Science

Elective : Neural Network and Deep Learning

Unit 1: Foundation of Neural Network

Biological Inspiration, Artificial Neural Network, Structure of a neural net (topology), Models of Neuron, Neural Network Architectures, Artificial Neuron, Multilayer Perceptron, weights, bias, Activation Function, Loss function, Epochs, Threshold function. Mathematical Concepts for Neural Network: Scalars, Vectors, Matrices, Tensors, Hyperplanes, Products, Feature, Solving Systems of Equations, Hyperparameters and Convergence, Gradient Descent, Evaluation Metrics

Unit 2 : Architectures of Neural Network

Types of ANN, Feed Forward Neural Network, Backpropagation Neural Network, Error calculation in ANN, Input Layer, Output Layer, Hidden Layers of Deep Neural Network, Case Study of Classifying movie reviews using ANN

Unit 3: Deep Learning with Neural Network

Concept of Deep Learning, Applications of areas Deep Learning, Convolutional Neural Networks, Recurrent Neural Networks and Implementation, LSTM and GRU

Unit 4 Advanced Topics in Deep Learning

Attention Mechanisms, Generative Adversarial Networks (GANs), Training a Generative Adversarial Network , Transformers e.g. BERT, pre-trained Models in Deep Learning.

Study and review of latest tools, technologies and research trends of ANN and Deep Learning, Study of Research projects, Research design and Research Evaluation in ANN and Deep Learning.

Reference Books:

1. Deep Learning with Python, Manning Franci Cohlet
2. Fundamentals of Deep Learning, Orelly, Nikhil Buduma
3. Deep Learning: A Practitioner's Approach, Josh Patterson , Adam Gibson O'relly Publications
4. Neural Networks and Deep Learning, A Textbook - Springer, Chru C Agrawal
5. Fundamentals of Deep Learning - Nikhil Buduma, O'relly Publications



SARVAJANIK UNIVERSITY
Faculty of Science

Name of College: Shree Ramkrishna Institute of Computer Education and Applied Sciences

Faculty	Science		Program	Ph.D. (Computer Science)		
Year	1		Version	3.0		
Semester	1/2		Effective From	April, 2025		
Course Code	PSCS31102	Course Name	Paper IV: Ph.D. Computer Science Coursework Paper IV			
Teaching Scheme				Examination Scheme		
Credits	Lecture (L)	Tutorial (T)	Practical (P)	Continuous Assessments (CA)	Term end examinations (TEE)	Total
2	0	2	0	50	50	100

