Head
Department of Computer Science,
IUST Kashmir.

Subject: **Approved Ph.D. Course Work Syllabus**

Sir

In accordance with the recommendations of 7th Board of Studies (BoS) of Department of Computer Science, SoE&T held on 09-12-2020, kindly find the revised Course Work syllabus for Ph.D. programme effective from Batch 2019 onwards.

Members:

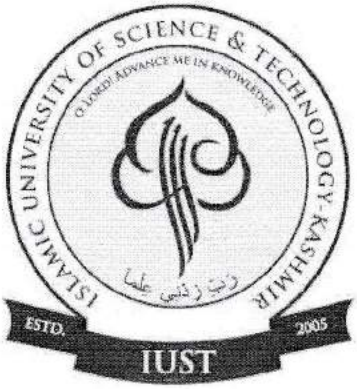
1. Dr. Kaisar Javeed Giri

2. Dr. Zahid Hussain Wani

Islamic University of Science & Technology, Kashmir, J&K - 192122
Department of Computer Science SoET

Dated:

Department of Computer Science
Islamic University of Science & Technology



Ph.D. Course Work

(2019 Onwards)

Outline of Ph.D. Course Work

Paper Category	Course Code	Course Name	Hours/Week			Credits	Marks	
			L	T	P		Continuous Assessment	End Term Examination
Core	In-line with Research Methodology Course from School of Engineering & Technology							
Core	DCS-1T1-C	Design and Analysis of Algorithms	3	1	0	04	50	50
Discipline Centric Elective (Only one to be selected)	DCS-1E1-DCE	Natural Language Processing	3	1	0	04	50	50
	DCS-1E2-DCE	Digital Image Processing	3	1	0	04	50	50
	DCS-1E3-DCE	Soft Computing Techniques	3	1	0	04	50	50
	DCS-1E4-DCE	Big Data Analytics	3	1	0	04	50	50
	DCS-1E5-DCE	Machine Learning	3	1	0	04	50	50

*** Continuous Assessment shall comprise following components**

1.	Written test	:	60% of the total marks allotted for continuous assessment
2.	Assignment	:	20% of the total marks allotted for continuous assessment
3.	Seminar	:	20% of the total marks allotted for continuous assessment

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Note: All courses are divided into two parts namely **Core** and **Discipline Centric Electives (DCE)**. Core courses are mandatory part to be selected by the students; however, students are subjected to choose any of the Discipline Centric Elective courses.

Paper Category: Core

L T P C
3 1 0 4

Course Title: Algorithm Analysis & Design
Course Code: DCS-1T1-C

Maximum Marks: 100
Maximum Time: 3 Hrs.

A) Instructions for Paper-setters

The question paper will consist of four sections A, B, C, D. All the sections will have two questions from each unit of the syllabus and will carry 40% marks each.

B) Instructions for candidates

Candidates are required to attempt one question from each section of the question paper.

UNIT I:

Basics of Algorithms and Mathematics: What is an algorithm?, Mathematics for Algorithmic Sets, Functions and Relations, Vectors and Matrices, Linear Inequalities and Linear Equations.

Analysis of Algorithm: The efficient algorithm, Average, Best and worst case analysis, Amortized analysis, Asymptotic Notations, Analyzing control statement, Loop invariant and the correctness of the algorithm,

Sorting Algorithms and analysis: Bubble sort, Selection sort, Insertion sort, Heap sort.

UNIT II:

Divide and Conquer Algorithm : Introduction, Recurrence and different methods to solve recurrence, Multiplying large Integers Problem, Problem Solving using divide and conquer algorithm - Binary Search, Max-Min problem, Sorting (Merge Sort, Quick Sort), Matrix Multiplication.

Dynamic Programming: Introduction, The Principle of Optimality, Problem Solving using Dynamic Programming – Calculating the Binomial Coefficient, Making Change Problem, Assembly Line-Scheduling, Knapsack problem, All Points Shortest path, Matrix chain multiplication, Longest Common Subsequence.

UNIT III:

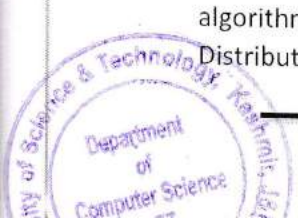
Greedy Algorithm : General Characteristics of greedy algorithms, Problem solving using Greedy Algorithm - Activity selection problem, Elements of Greedy Strategy, Minimum Spanning trees (Kruskal's algorithm, Prim's algorithm), Graphs: Shortest paths, The Knapsack Problem, Job Scheduling Problem, Huffman code.

Backtracking and Branch and Bound: Introduction, The Eight queens problem, Knapsack problem, Travelling Salesman problem, Minimax principle

UNIT IV:

String Matching: Introduction, The naive string matching algorithm, The Rabin-Karp algorithm, Knuth-Morris-Pratt algorithm, BM algorithm.

Introduction to NP-Completeness: The class P and NP, Polynomial reduction, NP- Completeness Problem, NP-Hard Problems. Travelling Salesman problem, Hamiltonian problem, Approximation algorithms. Non-deterministic polynomial problems, Strategy for parallel computing, Parallel and Distributed algorithms, Advanced Graph algorithms,



Text Book:

1. Fundamentals of Computer Algorithms, Ellis Horowitz, Sartaj Sahni, 2nd Edition, 2008.

Reference Books:

1. Introduction to Algorithms, Thomas H. Corman, 3rd Edition, 2009.
2. Algorithms, Robert Sedgewick & Kevin Wayne, 4th Edition, 2011.
3. The Algorithm Design Manual, Steve S. Skiena, 2007.
4. Algorithm Design, Kleinberg & Tardos, 2013.

Paper Category: Discipline Centric Elective (DCE)

L T P C
3 1 0 4

Course Title: Natural language Processing
Course Code: DCS-1E1-DCE

Maximum Marks: 100
Maximum Time: 3 Hrs.

A) Instructions for Paper-setters

The question paper will consist of four sections A, B, C, D. All the sections will have two questions from each unit of the syllabus and will carry 40% marks each.

B) Instructions for candidates

Candidates are required to attempt one question from each section of the question paper.

UNIT I:

Introduction to NLP: Definition, History, Applications, Goals. Regular expressions and Automata, Morphology and Finite State Transducers, Computational Phonology and Text-to-Speech, Probabilistic Models of Pronunciation and Spelling.

UNIT II:

N-grams, HMMs and Speech Recognition, Syntax: Word Classes and Part-of Speech Tagging,
Semantic Analysis: An Introduction, Lexical Analysis: Relations among Lexemes and Their Senses.
WordNet: A Database of Lexical Relations.

UNIT III:

Word Sense Disambiguation: Selection Restriction Based Disambiguation, Robust WSD: Machine Learning, Supervised Learning Approaches, Bootstrapping Approaches, Unsupervised Methods, Dictionary Based Approaches.

UNIT IV:

Information Retrieval: The Vector Space Model, Term Weighing, Term Selection and Creation, Homonymy, Polysemy, and Synonymy.
Discourse: Reference Resolution, Text Coherence, Machine Translation: Introduction, Language Similarities and Differences, Approaches, Steps involved in machine translation system design.

Text Book:

1. Jurafsky, D. and J. Martin, Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition, Pearson Education.

Reference Books:

1. Grosz, B.J., Sparck Jones, K. & Webber, B.L. (eds) Readings in natural language processing. Los Altos, CA, 1986: Morgan Kaufmann.
2. Allen, J., Natural language understanding. 2nd edition. Redwood City, CA: 1994. Benjamin/Cummings.
3. Bharti, Akshar, Chaitanya Vineet, Sangal Rajeev, Natural Language Processing, Prentice Hall.

Paper Category: Discipline Centric Elective (DCE)

L T P C
3 1 0 4

Course Title: Digital Image Processing
Course Code: DCS-1E2-DCE

Maximum Marks: 100
Maximum Time: 3 Hrs.

A) **Instructions for Paper-setters**
The question paper will consist of four sections A, B, C, D. All the sections will have two questions from each unit of the syllabus and will carry 40% marks each.

B) **Instructions for candidates**
Candidates are required to attempt one question from each section of the question paper.

UNIT I:

Digital Image Processing: Definition, Examples of Fields that use Digital Image Processing, Fundamental Steps in Digital Image Processing, Image Sampling and Quantization, Basic Relationship between Pixels, Distance Measures, Linear and Non-linear Operations.

Intensity Transformations and Spatial Filtering: Basic Gray Level Transformations, Histogram Processing, Enhancements using Arithmetic/Logic Operations, Basics of Spatial Filtering, Smoothing, Spatial Filters, Sharpening Spatial Filters, Using Laplacian and First Order Derivatives for Image Sharpening.

UNIT II:

Filtering in the Frequency Domain: Fourier Series, Fourier transform of Functions of One Continuous Variable, Discrete Fourier Transform (DFT) of one variable and Its Inverse, 2-D Discrete Fourier Transform and Its inverse, Properties of 2-D DFT, Image Smoothing using Frequency Domain Filters, Image Sharpening Using Frequency Domain Filters, Laplacian in Frequency Domain, Homomorphic Filtering, Bandreject and Bandpass Filters, Notch Filters, The Fast Fourier Transform in 1-D

Image Restoration: Noise Models, Restoration in the Presence of Noise Only-Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Linear, Position-Invariant Degradations, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Constrained Least Squares Filtering, Geometric Mean Filter, Geometric Transformations.

UNIT III:

Colour Image Processing: Colour Models, Pseudocolour Image Processing, Basics of Full Colour Image Processing. Colour Transformations, Smoothing and Sharpening. Colour Segmentation.

Wavelets and Multi Resolution Processing: The Haar Transform, series expansion, scaling functions, wavelet functions, wavelet transform in 1-D, Inverse Discrete wavelet Transform in 1-D, Fast wavelet Transform in 1-D, Discrete wavelet Transform in 2-D.

UNIT IV:

Image Segmentation: Point Detection, Line Detection and Edge Detection, Edge Linking and Boundary Detection, Hough Transform, Basic Global Thresholding, Otsu's Method, Multiple Thresholds, Variable Thresholding, Multivariable Thresholding, Region Growing, Region Splitting and Merging, Use of Motion in Segmentation, Spatial Techniques, Frequency Domain Techniques.

Representation and Description: Boundary Following, Chain Codes, Polygonal Approximation Using Minimum-Perimeter Polynomial, Fourier Descriptors, Geometric Moments, Moment Invariants.

Text Book:

1. R. C. Gonzalez, R. E. Woods, Digital Image Processing, Third Edition, PHI, 2008
2. Mark Nixon, Feature Extraction and Image Processing for Computer Vision, Third Edition.

Reference Book:

1. A. K. Jain, Fundamentals of Digital Image Processing, PHI, 2002.
2. Maria Petrou, Costas Petrou, Image Processing: The Fundamentals, Second Edition.

Paper Category: Discipline Centric Elective (DCE)

L T P C
3 1 0 4

Course Title: Soft Computing Techniques
Course Code: DCS-1E3-DCE

Maximum Marks: 100
Maximum Time: 3 Hrs.

A) Instructions for Paper-setters

The question paper will consist of four sections A, B, C, D. All the sections will have two questions from each unit of the syllabus and will carry 40% marks each.

B) Instructions for candidates

Candidates are required to attempt one question from each section of the question paper.

UNIT I:

Introduction to Artificial Intelligence systems: Neural Networks, Fuzzy Logic and Genetic Algorithm.
Fundamentals of neural networks: History, Basic concepts, Taxonomy, Neural network architecture, characteristics, learning methods.
Back propagation Neural Networks: Architecture, Learning and Applications.

UNIT II:

Associative memory: Autocorrelations, Hetero-correlations, Wang's multiple training encoding strategy, exponential BAM, Associative memory for real coded pattern pairs, applications.

UNIT III:

Fuzzy set theory: Fuzzy versus crisp, crisp sets, fuzzy sets, crisp relations, fuzzy relations.
Fuzzy systems: crisp logic, predicate logic, fuzzy logic. Fuzzy rule based systems, de-fuzzification methods, Fuzzy Applications.

UNIT IV:

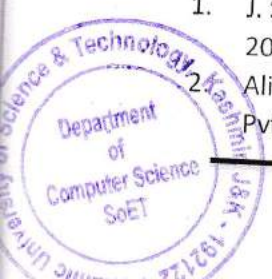
Genetic algorithms: History, Basic concepts, creating of offspring, working principle, encoding, fitness function, reproduction.
Genetic Modeling: Inheritance operators, crossover, inversion and deletion, mutation operator, bitwise operator, bitwise operator using genetic algorithms, generational cycle, convergence of genetic algorithms, applications.

Text Book:

1. S. Rajasekaran and G. A. V. Pai, Neural Networks, Fuzzy Logic and Genetic Algorithms, Prentice-Hall of India, 2003.

Reference Books:

1. J. S. R. Jang, C. T. Sun and E. Mizutani, Neuro-Fuzzy and Soft Computing, Prentice-Hall of India, 2007.
2. Aliev, R. A and Aliev, R. R, Soft Computing and its Application, World Scientific Publishing Co. Pvt. Ltd., 2001.



Paper Category: Discipline Centric Elective (DCE)

L T P C
3 1 0 4

Course Title: Big Data Analytics
Course Code: DCS-1E4-DCE

Maximum Marks: 100
Maximum Time: 3 Hrs.

A) Instructions for Paper-setters

The question paper will consist of four sections A, B, C, D. All the sections will have two questions from each unit of the syllabus and will carry 40% marks each.

B) Instructions for candidates

Candidates are required to attempt one question from each section of the question paper.

UNIT I:

Introduction to Big Data And Hadoop: Types of Digital Data, Introduction to Big Data, Big Data and its importance, Drivers for Big data, Big data applications, Big Data Analytics, History of Hadoop, Apache Hadoop, Analysing Data with Unix tools, Analysing Data with Hadoop, Hadoop Streaming, Hadoop Echo System, IBM Big Data Strategy, Introduction to Infosphere BigInsights and Big Sheets.

UNIT II:

HDFS (Hadoop Distributed File System): The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow, Data Ingest with Flume and Scoop and Hadoop archives.
Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures.
Map Reduce: Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features.

Unit III:

Hadoop Eco System: PIG- Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators.
Hive: Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions.
Hbase: HBasics, Concepts, Clients, Example, Hbase Versus RDBMS, Big SQL: Introduction

Unit IV:

Big Data Privacy, Ethics and Security: Privacy – Reidentification of Anonymous People – Why Big Data Privacy is self regulating? – Ethics – Ownership – Ethical Guidelines – Big Data Security -Organizational Security.

Security, Compliance, Auditing, and Protection: Steps to secure big data – Classifying Data – Protecting – Big Data Compliance – Intellectual Property Challenge – Research Questions in Cloud Security – Open Problems.

Text Books

1. Tom White, Hadoop: The Definitive Guide, Third Edit on, O'reily Media, 2012.
2. Seema Acharya, Subhasini Chellappan, Big Data Analytics, Wiley 2015.

References

1. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, 2007.
2. Jay Liebowitz, Big Data and Business Analytics, Auerbach Publications, CRC press (2013)
3. Bill Franks, Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics, John Wiley & sons, 2012.
4. Glen J. Myat, Making Sense of Data, John Wiley & Sons, 2007
5. Michael Mineli, Michele Chambers, Ambiga Dhiraj, Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses, Wiley Publications, 2013.
6. Paul Zikopoulos ,Dirk DeRoos , Krishnan Parasuraman , Thomas Deutsch , James Giles , David Corigan , Harness the Power of Big Data The IBM Big Data Platform , Tata McGraw Hill Publications, 2012.
7. Ben Spivey, Joey Echeverria, Hadoop Security Protecting Your Big Data Problem, O'Reilly Media, 2015.

Paper Category: Discipline Centric Elective (DCE)

L T P C
3 1 0 4

Course Title: Machine Learning
Course Code: DCS-1E5-DCE

Maximum Marks: 100
Maximum Time: 3 Hrs.

A) Instructions for Paper-setters

The question paper will consist of four sections A, B, C, D. All the sections will have two questions from each unit of the syllabus and will carry 40% marks each.

B) Instructions for candidates

Candidates are required to attempt one question from each section of the question paper.

UNIT I:

MATLAB/PYTHON Programming, writing MATLAB/ PYTHON program for machine learning algorithms like support vector machines, clustering algorithm, evolutionary algorithm etc.

UNIT II:

Clustering Algorithms, Clustering using Euclidean distance and Mahalanobis distance algorithms, Clustering using basic sequential scheme algorithms, K-means algorithm, Fuzzy C-means clustering algorithm, Clustering using Gaussian Probability Density Function.

UNIT III:

Support Vector Machines, Discriminant function for linearly separable cases, Discriminant function for non-linear cases, Dimensionality reduction, Principle Component Analysis and Multiple Discriminant Analysis.

UNIT IV:

Evolutionary Algorithms, Genetic Algorithms, Defining Cost function for Genetic Algorithms, Simulated Annealing and Application, Tabu search, Intensification and Diversification strategies.

Text Book:

1. Pattern Classification by Duda, Hart and Stock.
2. Machine Learning by Tom M. Mitchell.

Reference Book:

1. Pattern Recognition and Machine Learning by Christopher M. Bishop.