Course Structure and Syllabus

Integrated M.Tech.-Ph.D.

(A Dual Degree Course)

in

Computer Science & Engineering

महात्मा ज्योतिबा फुले
रूहेलखण्ड विश्वविद्यालय, बरेली

Submitted by

Department of Computer Science & Information Technology(CSIT)
Faculty of Engineering and Technology (FET)
MJP Rohilkhand University, Bareilly (UP) 243 006

Semester I

S.No	Subject code	Subjects	Teaching schedule			Credits
			L	T	P	
1.	CSMT-101	Advanced Data Structures	3	1	0	3
2.	CSMT-103	Machine Learning	3	1	0	3
3.	CSMT-105	Wireless Network & Mobile Computing	3	1	0	3
4.	CSMT-107	Cloud Computing	3	1	0	3
5.	CSMT-109	Research Methodology	2	1	0	2
6.	CSMT-111	Advanced Data Structure Lab	0	0	6	3
7.	CSMT-113	Machine Learning Lab	0	0	6	2
		Total Credits				**20**

Semester II

S.No	Subject code	Subjects	Teaching schedule			Credits
			L	T	P	
1	CSMT-102	Network Security & Cryptography	3	1	0	3
2.	CSMT-104	Data Analytics	3	1	0	3
3.	CSMT-106	Digital Image Processing	3	1	0	3
4.	CSMT-***	Elective-I*	3	1	0	3
5.	HUM-108	Human Values and Professional Ethics	2	1	0	2
6.	CSMT-110	Data Analysis Lab	0	0	6	3
7.	CSMT-112	Digital Image Processing Lab	0	0	6	3
		Total Credits				**20**

*** Students my opt Elective Course/Subject from the List of Courses/subjects offered by Department.**

Semester-III

S.No	Subject code	Subjects	Teaching schedule			Credits
			L	T	P	
1.	CSMT-201	Seminar	0	6	0	2
2.	CSMT-203	Dissertation (Preparatory work)	0	0	24	18
		Total Credits				**20**

Semester-IV

S.No	Subject code	Subjects	Teaching schedule			Credits
			L	T	P	
1	CSMT-202	Dissertation/Project work*	0	0	30	20
		Total Credits				**20**

Tota. : 80 Credits

* It is desirable that candidate should publish at least 01 research papers in UGC CARE/SCOPUS/SCI approved journal

List of Elective Subjects:

CSMT- 214	Mathematical Foundations of Computer Science
CSMT-215	Mobile Application Development
CSMT-217	Information Security
CSMT-219	Web and Database Security
CSMT-221	Advanced Algorithms
CSMT-223	Cyber Security
CSMT-225	Advanced Windows Programming
CSMT-227	Elements of Robotics
CSMT-229	Software Engineering & Project Management
CSMT-231	Remote Sensing Systems
CSMT-233	Theoretical Foundations of Computer Science
CSMT-235	Distributed Computer Systems
CSMT-237	Cellular Automata & Its Applications
CSMT-239	AI & Neural Network
CSMT-241	Sensor Networks
CSMT-243	Object Oriented Information System Design
CSMT-245	Enterprise Computing Methodologies
CSMT-247	Biomedical Signal Processing
CSMT-249	Bio-informatics
CSMT-251	Soft Computing
CSMT-253	Medical Imaging Techniques
CSMT-255	Artificial Neural network and Fuzzy Systems
CSMT-257	Pattern Recognition
CSMT-259	Parallel Computing
CSMT-260	Compiler Construction

Note: The above list is subject to be modified depending on the availability of faculty members and the subject syllabi shall be decided by the faculty concerned.

SYLLABUS

CSMT-101 **ADVANCED DATA STRUCTURES** **Credit:3(3-1-0)**

Unit 1: Introduction: Basic concepts of Linear and Non-linear data Structures, Computational Models, Linear Search, Binary Search, Heap Sorting, Merg sort. **Binary Search trees:** Introduction, Height of Binary search tree, Basic Operations in Binary Search Tree: Search, Successor, predecessor, insert, deletion, minimum, maximum.

Unit 2: Balanced Search Trees: Introduction, rotations, AVL Trees- insertion, deletion, Red Black Trees. insertion, deletion, Splay Trees- properties, splaying modes, splay tree operations, insertion, deletion, searching.

Multiway Search Trees: m-way search tree, B-tree-insertion, deletion, B' tree- Searching, insertion, deletion, analysis, Finger Search Tree and level Linking, finger searching, finger search tree, search in finger tree, Randomized Finger Search Trees- Finger searching in Treaps, Finger searching in Skip Lists, trees- height, insertion, deletion, application in range query, x-fast tree, y-fast tree.

Unit 3: String Data Structures- Introduction, Digital Search trees- searching, insertion, deletion, Binary tries, Suffix Trees, Suffix Array, Correspondence between suffix array and suffix tree.

Unit 4: Data Structure for Disjoint Sets- Introduction, Disjoint set operations, Determining connected components of an undirected graph, Disjoint set representation- Linked representation, Disjoint set forests, Kruskal's Minimum spanning tree

Unit 5: Hashing Techniques- Introduction, Static Hashing, Hash functions, Cuckoo hashing, Bloom filters- design and applications.

BOOKS:

1. Advanced Data Structures by Peter Brass, **Publisher:** Cambridge University Press
2. Handbook of Data Structures and Applications, By Sartaj Sahani, Dinesh P. Mehta

CSMT-103 **MACHINE LEARNING** Credit:3(3-1-0)

Unit -1 Machine Learning - Introduction , Model of Learning , Types of Learning , Types of problem Regression and Classification, Supervised and Unsupervised learning, Reinforcement Learning ,Linear Regression Model representation for single variable, Single variable Cost Function, Gradient Decent for Linear Regression Multivariable model representation , Logistic Regression : Classification, Hypothesis Representation, Decision Boundary, Cost function, Advanced Optimization, Multi-classification (One vs All), Problem of Overfitting Regularization, Bias and Variance.

Unit -2 Data Prepossessing : Label Encoder, Standard Scalar , Supervised Machine Learning : k-Neares Neighbors, Support Vector Machine, Decision Tree, Random Forest, Hyper Parameter Tuning, Over Fitting and Under-fitting , Unsupervised Learning-K-MEAN Clustering , Random Initialization, Choosing number of clusters.

Unit -3 : Artificial Neural Networks :The Neuron, The Activation, Function How do Neural Networks work? How do Neural Networks learn? Gradient Descent, Stochastic Gradient Descent, Back propagation, Convolutiona Neural Networks : Convolution Operation, ReLU Layer, Pooling, Flattening , Full Connection, Softmax & Cross-Entropy , Recurrent Neural Networks : The idea behind Recurrent Neural Networks , The Vanishing Gradien Problem, LSTMs, LSTM Variations.

Unit -4 : Python Library for Machine Learning - Numpy : Basic & Advanced Array Operations, Slicing Indexing, Pandas : Creating a DataFrame, Dealing with Rows and Columns, Indexing and Selecting Data, Working with Missing Data, Seaborn: Stripplot, Swarmplot , KDE Plot, Box plot, Pair plot, Count Plot, Joint Plot Scikitl.earn: Data Split, Model Training, Confusion Matrix, Performance Metrics ,Tensor Flow : Tensor, Graph Session, Placeholder , Keras : metrics , optimizers , activations function , Building an ANN, Evaluating, Improving and Tuning the ANN, Building CNN, Evaluating, Improving, Tuning the CNN.

Unit 5 : Natural Language Processing : Tokenization , stemming , Lemmatization ,POS , Name Entity Recognition , Chunking , spacy , nltk ; Image processing in Python : Using the Image class , Reading and writing images , Cutting, pasting, and merging images , Geometrical transforms , Color transforms ,Image enhancement using PIL, matplotlib, open cv .

Books :

1. E. Alpaydin, **Introduction to Machine Learning**, Prentice Hall of India, 2006.
2. T. M. Mitchell, **Machine Learning**, McGraw-Hill, 1997.
3. C. M. Bishop, **Pattern Recognition and Machine Learning**, Springer, 2006.
4. R. O. Duda, P. E. Hart, and D.G. Stork, **Pattern Classification**, John Wiley and Sons, 2001.

CSMT-105 WIRELESS NETWORK & MOBILE COMPUTING Credit:3(3-1-0)

UNIT-1 Overview of wireless communication: History, Different Generations, General characteristics of mobile devices, Electromagnetic spectrum, Radio propagation mechanisms, characteristics of wireless medium, wireless topology, cellular system (cell concepts, cell hierarchy, cell fundamentals) Issues in mobile computing: Introduction, functions, 3-Tier architecture, applications and services. GSM: Mobile services, System architecture, Radio interface, Protocols, Localization and calling Handover, Security.

UNIT-2 WLAN: Technical issue (uses, design goal, types, components and services offered by a typical IEEE 802.11 network), IEEE 802.11 standard (physical layer, MAC layer mechanism & functionalities, CSMA/CA mechanism). HIPERLAN: HIPERLAN standard, HyperLAN/1 (physical layer, DLC & RLC layer, MAC sub-layer), HyperLAN/2 (Physical layer, MAC sub-layer, power conservation issues) BLUETOOTH: Specifications, transport protocol group, middleware protocol group, profile.

UNIT 3: Medium access control (wireless): Motivation for a specialized MAC (hidden and exposed terminals, near and far terminals), SDMA, FDMA, TDMA and CDMA.

UNIT 4: Mobile Network layer: Mobile IP: Goals, assumptions, entities and terminology, IP packet delivery, agent advertisement and discovery, registration, tunneling and encapsulation, optimizations, and dynamic host configuration protocols (DHCP). Mobile Transport layer: Traditional TCP, Indirect TCP, Snooping TCP,, Mobile TCP, Fast retransmission/ fast recovery, transmission/time-out freezing, selective retransmission, transaction oriented TCP. Wireless Application Protocol WAP: Introduction, protocol architecture and treatment of protocols of all layers.

UNIT-5 Introduction & issues in Ad Hoc wireless networks: introduction (cellular vs ad hoc wireless networks and applications), Medium Access Scheme, Routing, Multicasting, transport layer protocols, Pricing Scheme, QoS provisioning, Self organization, security, addressing and service discovery, energy management, Scalability, deployment considerations, Issues in designing a routing protocol for ad hoc wireless Networks (Mobility, Bandwidth constraint, Error prone shared broadcast radio channel, Hidden & exposed Terminal Problems, Resource Constraints, characteristics of idle routing protocol), Classification of routing protocols: Table-driven routing protocols (DSDV,WRP), On-demand routing protocols (DSR, AODV, LAR).

Text Books:

1. Murthy and Manoj, Ad Hoc Wireless Networks, Pearson Education publication.
2. Jochen Schiller,—Mobile Communications‖,Addison-Wesley.
3. Stojmenovic and Cacute, -Handbook of Wireless Networks and Mobile Computing‖, Wiley, 2002, ISBN 0471419028.

REFERENCES :

1. Adelstein, Frank, Gupta, Sandeep KS, Richard III, Golden , Schwiebert, Loren, -Fundamentals of Mobile and Pervasive Computing‖, ISBN: 0071412379, McGraw-Hill Professional,.
3. Hansmann, Merk, Nicklous, Stober, -Principles of Mobile Computing‖, Springer,
4. Martyn Mallick, -Mobile and Wireless Design Essentials‖, Wiley DreamTech,
5. Mobile computing, A. K. talukder and R R Yavagal

CSMT-107 # CLOUD COMPUTING Credit:3(3-1-0)

UNIT-I

Cloud Computing Overview Origins of Cloud computing – Cloud components - Essential characteristics – On-demand selfservice, Broad network access, Location independent resource pooling ,Rapid elasticity , Measured service. Comparing cloud providers with traditional IT service providers, Roots of cloud computing.

UNIT-II

Cloud Insights Architectural influences – High-performance computing, Utility and Enterprise grid computing, Cloud scenarios – Benefits: scalability ,simplicity ,vendors ,security, Limitations – Sensitive information - Application development- security level of third party - security benefits. Regularity issues: Government policies.

UNIT-III

Cloud Architecture- Layers and Models Layers in cloud architecture, Software as a Service (SaaS), features of SaaS and benefits, Platform as a Service (PaaS), features of PaaS and benefits, Infrastructure as a Service (IaaS), features of IaaS and benefits, Service providers, challenges and risks in cloud adoption. Cloud deployment model: Public clouds – Private clouds – Community clouds - Hybrid clouds - Advantages of Cloud computing.

UNIT-IV

Cloud Simulators- CloudSim and GreenCloud Introduction to Simulator, understanding CloudSim simulator, CloudSim ArchitectureUser code, CloudSim, GridSim, Simlava) Understanding Working platform for CloudSim, Introduction to GreenCloud

UNIT-V

Introduction to VMWare Simulator Basics of VMWare, advantages of VMware virtualization, using Vmware workstation, creating virtual machines-understanding virtual machines, create a new virtual machine on local host, cloning virtual machines, virtualize a physical machine, starting and stopping a virtual machine.

BOOKS:

1. Cloud computing a practical approach - Anthony T.Velte , Toby J. Velte Robert Elsenpeter, TATA McGraw- Hill
2. Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate
3. Cloud computing for dummies- Judith Hurwitz , Robin Bloor , Marcia Kaufman ,Fern Halper, Wiley Publishing, InC
4. Cloud Computing (Principles and Paradigms). Edited by Rajkumar Buyya, James Broberg, Andrzej Goscinski, John Wiley & Sons, Inc. 2011

CSMT-109 RESEARCH METHODOLOGY Credits: 2(2-1-0)

Unit-1

Objectives and types of research: Motivation and objectives – Research methods *vs* Methodology. Types of research – Descriptive *vs.* Analytical, Applied *vs.* Fundamental, Quantitative *vs.* Qualitative, **Conceptual *vs.* Empirical.**

Research Formulation – Defining and formulating the research problem - Selecting the problem - Necessity of defining the problem - Importance of literature review in defining a problem – Literature review – Primary and secondary sources – reviews, treatise, monographs-patents – web as a source – searching the web - Critical literature review – Identifying gap areas from literature review - Development of working hypothesis.

Unit-2

Research design and methods – Research design – Basic Principles- Need of research design — Features of good design – Important concepts relating to research design – Observation and Facts, Laws and Theories, Prediction and explanation, Induction, Deduction, Development of Models, Developing a research plan - Exploration, Description, Diagnosis, Experimentation, Determining experimental and sample designs.

Unit-3

Data Collection and analysis: Execution of the research - Observation and Collection of data - Methods of data collection – Sampling Methods- Data Processing and Analysis strategies - Data Analysis with Statistical Packages - Hypothesis-testing - Generalization and Interpretation.

Unit-4

Reporting and thesis writing – Structure and components of scientific reports - Types of report – Technical reports and thesis – Significance – Different steps in the preparation – Layout, structure and Language of typical reports – Illustrations and tables

- Bibliography, referencing and footnotes - Oral presentation – Planning – Preparation – Practice – Making presentation – Use of visual aids - Importance of effective communication –.

Unit-5 Application of results and ethics - Environmental impacts - Ethical issues - ethical committees - Commercialisation – Copy right – royalty - Intellectual property rights and patent law – Trade Related aspects of Intellectual Property Rights – Reproduction of published material – Plagiarism - Citation and acknowledgement - Reproducibility and accountability.

REFERENCE BOOKS:

1 Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. *An introduction to Research Methodology*, RBSA Publishers.

2 Sinha, S.C. and Dhiman, A.K., 2002. *Research Methodology*, Ess Ess Publications. 2 volumes.

CSMT-102 NETWORK SECURITY AND CRYPTOGRAPHY Credit:3(3-1-0)

Unit 1 **Introduction:** Terminology, Substitution ciphers and Transposition ciphers, Simple XOR, One-Time Pads, Computer Algorithms, Cryptographic Protocols

Unit 2 **Protocol Building Blocks:** Introduction, Communication using Symmetric Cryptography, One-Way Hash Functions, One-Way Hash Functions, Communication using Public-Key Cryptography, Digital Signatures, Digital Signatures with Encryption

Unit 3 **Protocols:** Authentication and Key exchange, Key Exchange, Authentication, Multiple key public key cryptography, Secret splitting, Secret Sharing, Cryptographic protection, Zero- Knowledge Proofs, Zero-Knowledge Proofs of Indentity, Blind Signatures, Obilivious Transfer, oblivious signature, Simultaneous contract singing Cryptographic Techniques

Unit 4 **Key Management :** Generating Keys, Nonlinear Keyspaces, Transferring Keys, Verifying Keys, Using Keys.

Unit 5 **Using Algorithms:** Choosing an Algorithm, Public-Key cryptography versus Symmetric cryptography, Encrypting Communication Channels, Encrypting data for Storage.
Cryptographic Algorithms: RSA, DES

Books:

1 Applied Cryptography by Bruce Schneier, John Viley & Sons.

2 Network Security and Cryptography by William Stalling

3 Network Security and Cryptography by Forouzon

[illegible] **DATA ANALYTICS** Credit [illegible]

UNIT-1

Course Overview & Descriptive Statistics: Descriptive statistics - graphical approaches, Descriptive statistics - measures of central tendency, Descriptive statistics - measures of dispersion.

Probability Distributions & Inferential Statistics: Random variables & probability distributions, Probability distributions, Inferential statistics - motivation, Inferential statistics - single sample tests.

Inferential Statistics: Two sample tests, Type I & type II errors, Confidence intervals, ANOVA and test of independence, Short introduction to regression.

UNIT-2

Supervised Learning (Regression & Classification Techniques) I : Logistic regression, Training a logistic regression classifier, Classification & regression trees, Bias variance dichotomy, Model assessment and selection, Support vector machines, SVMs & kernel transformations.

UNIT-3

Supervised Learning (Regression & Classification Techniques) II: Ensemble methods & random forests, Artificial neural networks - 1, Artificial neural networks - 2, Deep learning.

UNIT-4

Association Rule Mining & Big Data: Association rule mining - 1, Association rule mining - 2, Big data - a small introduction - 1, Big data - a small introduction - 2

UNIT-5

Clustering Analysis & Predictive Analytics: Clustering analysis - 1, Clustering analysis - 2, Introduction to experimentation & active learning - 1, Introduction to experimentation & active learning - 2, Introduction to online learning - reinforcement learning - 1, Introduction to online learning - reinforcement learning - 2

Books:

1. Introduction to Data Analytics by Prof. Nandan Sudarsanam
2. Data Analytics by Dr. Anil Maheshwari

CSMT-106 DIGITAL IMAGE PROCESSING Credit:3(3-1-0)

Unit 1: **Introduction and Fundamentals** Motivation and Perspective, Applications, Components of Image Processing System, Element of Visual Perception, A Simple Image Model, Sampling and Quantization.
Image Enhancement in Spatial Domain Introduction; Basic Gray Level Functions – Piecewise- Linear Transformation Functions: Contrast Stretching; Histogram Specification; Histogram Equalization; Local Enhancement; Enhancement using Arithmetic/Logic Operations – Image Subtraction, Image Averaging; Basics of Spatial Filtering; Smoothing - Mean filter, Ordered Statistic Filter; Sharpening – The Laplacian.

Unit 2: **Image Enhancement in Frequency Domain** Fourier Transform and the Frequency Domain, Basis of Filtering in Frequency Domain, Filters – Low-pass, High-pass; Correspondence Between Filtering in Spatial and Frequency Domain; Smoothing Frequency Domain Filters – Gaussian Lowpass Filters; Sharpening Frequency Domain Filters – Gaussian Highpass Filters; Homomorphic Filtering.
Image Restoration A Model of Restoration Process, Noise Models, Restoration in the presence of Noise only-Spatial Filtering – Mean Filters; Arithmetic Mean filter, Geometric Mean Filter, Order Statistic Filters – Median Filter, Max and Min filters; Periodic Noise Reduction by Frequency Domain Filtering – Bandpass Filters; Minimum Mean-square Error Restoration.

Unit 3: **Color Image Processing** Color Fundamentals, Color Models, Converting Colors to different models, Color Transformation, Smoothing and Sharpening, Color Segmentation.
Morphological Image Processing Introduction, Logic Operations involving Binary Images, Dilation and Erosion, Opening and Closing, Morphological Algorithms – Boundary Extraction, Region Filling, Extraction of Connected Components, Convex Hull, Thinning, Thickening.

Unit 4: **Registration** Introduction, Geometric Transformation – Plane to Plane transformation, Mapping, Stereo Imaging Algorithms to Establish Correspondence, Algorithms to Recover Depth **Segmentation** Introduction, Region Extraction, Pixel-Based Approach, Multi-level Thresholding, Local Thresholding, Region-based Approach, Edge and Line Detection: Edge Detection, Edge Operators, Pattern Fitting Approach, Edge Linking and Edge Following, Edge Elements Extraction by Thresholding, Edge Detector Performance, Line Detection, Corner Detection.

Unit 5: **Feature Extraction** Representation, Topological Attributes, Geometric Attributes **Description** Boundary-based Description, Region-based Description, Relationship.
Object Recognition Deterministic Methods, Clustering, Statistical Classification, Syntactic Recognition, Tree Search, Graph Matching.

Referenced Text Books

S.no	Title of Book	Author Name	Publisher of Book
1	Digital Image Processing	Rafael C. Gonzalvez and Richard E. Woods	Pearson Education
2	Digital Image Processing and Computer Vision	R.J. Schalkoff	John Wiley and Sons
3	Fundamentals of Digital Image Processing	A.K. Jain	Prentice Hall, Upper Saddle River, NJ

HUM-108 **HUMAN VALUES AND PROFESSIONAL ETHICS Credits: 2(2-1-0)**

UNIT 1

Course Introduction - Need, Basic Guidelines, Content and Process for Value Education , Understanding the need, basic guidelines, content and process for Value Education ,Self Exploration what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self exploration , Continuous Happiness and Prosperity- A look at basic Human Aspirations , Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority

UNIT 2

Understanding Harmony in the Human Being - Harmony in Myself! ,Understanding human being as a co-existence of the sentient 'I' and the material 'Body' , Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha , Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer) ,Understanding the characteristics and activities of 'I' and harmony in 'I' ,Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs.

UNIT 3

Understanding Harmony in the Family and Society- Harmony in HumanHuman Relationship. Understanding Harmony in the family – the basic unit of human interaction , Understanding values in human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti; Trust (Vishwas) and Respect (Samman) as the foundational values of relationship .

UNIT 4

Understanding Harmony in the Nature and Existence - Whole existence as Co-existence ,Understanding the harmony in the Nature ,Interconnectedness and mutual fulfillment among the four orders of naturerecyclability and self-regulation in nature ,Understanding Existence as Co-existence (Sah-astitva) of mutually interacting units in all-pervasive space ,Holistic perception of harmony at all levels of existence - Practice Exercises and Case Studies will be taken up in Practice Sessions.

UNIT 5

Implications of the above Holistic Understanding of Harmony on Professional Ethics ,Natural acceptance of human values ,Definitiveness of Ethical Human Conduct ,Basis for Humanistic Education.

References:

1. Value Education websites, http://uhv.ac.in, http://www.uptu.ac.in
2. Story of Stuff, http://www.storyofstuff.com
3. Al Gore, An Inconvenient Truth, Paramount Classics, USA
4. Charlie Chaplin, Modern Times, United Artists, USA
5. IIT Delhi, Modern Technology – the Untold Story 6. Gandhi A., Right Here Right Now, Cyclewala Productions