

# **Syllabus of Ph.D. Course Work**

**[2016-2017]**



**Department of Information and Communication Technology,**

**Fakir Mohan University,**

**Vyasa Vihar, Balasore-756019,**

**Odisha.**

## Structure of Ph.D. Course Work (2016-17)

Code	Course Name	Credit Points	Examination Scheme (Marks)		Total Marks
			Continuous Evaluation	End Term Examination	
DPICT-101	Research Methodology	8	20	80	100
DPICT-102	Elective Paper [Specialization]	8	20	80	100
DPICT-103	Review Work	8	Continuous Evaluation		100

### Explanations:

1. The Course work is of one semester duration.
2. Theory classes of DPICT-101, DPICT-102 will be conducted in the Department.
3. For DPICT-103, the candidate is continually evaluated by the supervisor and has to submit a survey paper before the last evaluation of the continuous evaluation process.
4. A student will be eligible for appearing the end term examination provided he/she has secured minimum 75% class attendance in each paper.

## **DPICT-101: Research Methodology**

**Unit I: Research Concepts & Design:** Objectives of Research, Research Approaches, Types of Research, Research Process, Research Proposal, Need, Concepts and different Research Designs.

**Sampling Techniques:** Population and Sample, Sample survey and Census Survey, Different methods sampling.

**Unit II: Data Collection and Scaling Techniques:** Primary and secondary data, Methods of collecting primary data, Sources of secondary data. Scaling: Levels of Measurement scales, Attitude measurement, Different types of scaling.

**Analysis and Presentation of Data:** Data preparation and description, exploratory data analysis, Cross tabulation, Univariate analysis, Test of significance. Large sample tests(z-test), Small sample test (t-test), Bivariate analysis, F-test,  $\chi^2$  –test, Analysis of variance, (ANOVA), One way ANOVA, Two way ANOVA, Multivariate analysis.

**Unit III: Analysis of Data using software packages:** Data Screening and Transformation, Correlation, t-Test, Analysis of Variance, Factor Analysis, Cluster Analysis, Multidimensional Scaling, Multiple Regression, Non-Parametric Tests of Significance, Analysis of examples from different disciplines.

**Report Writing:** Framework of a report, Types of reports, Essentials of a good report, Presentation of a report.

**Unit IV: Research and Publication Ethics:** Ethics: Definition, Moral Philosophy, Nature of moral judgements and reactions. Ethics with respect to science and research, Intellectual honesty and research integrity, scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP), Redundant Publication: duplicate and overlapping publications, salami slicing, Publication Ethics: Definition, Introduction and Importance. Conflicts of interest, Use of plagiarism software like Turnitin, Urkund and other open source software tools. Indexing databases, Citation databases: Web of Science, Scopus, etc., Impact Factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Metrics: h-index, g index, i10 index, altmetrics

### **Text Books:**

1. C. R. Kothari, Research Methodology: Methods and Techniques, 3<sup>rd</sup> Ed., New Age International Pvt. Ltd.
2. C.G. Gaum & H.F. Graves, Report Writing, 3<sup>rd</sup> Ed., PHI.
3. S. C. Gupta, Fundamentals of Statistics, Himalaya Publishing
4. Paul D. Leedy, Practical Research: Planning & Design, Prentice Hall

5. Indian National Science Academy (INSA), Ethics in Science Education, Research and Governance (2019), ISBN:978-81-939482-1-7. [http://insaindia.res.in/pdf/Ethics\\_Book.pdf](http://insaindia.res.in/pdf/Ethics_Book.pdf)

**Reference Books:**

1. G. Marczyk, D. Dematteo and D. Festinger, Essentials of Research Design and Methodology, John Wiley & Sons Inc 2005.
2. D. B. Resnik, What is ethics in research & why is it important. National Institute of Environmental Health Sciences, 1-10, 2011. Retrieved from <https://www.niehs.nih.gov/research/resources/bioethics/whatis/index.cfm>
3. P. Chaddah, Ethics in Competitive Research: Do not get scooped: do not get plagiarized, 2018 ISBN:978-9387480865

## **DPICT-102: Name of the Elective**

### **1: Knowledge Discovery in Databases and Soft Computing**

**Unit I: Introduction to Knowledge discovery and Preprocessing:** KDD Process, Data Mining on what kind of data, Kind of pattern mined, Patterns Interestingness.

**Data Preprocessing:** Data Cleaning, Data Integration and Transformation, Data Reduction, Data Reduction, Discretization and Concept Hierarchy Generation.

**Tasks of Data Mining:** Mining Association Rules in Large Databases, Classification and Prediction, Cluster Analysis. Applications and Trends in KDD.

**Unit II: Fuzzy Theory:** Fuzzy Set Theory –Fuzzy Vs Crisp –Crisp & Fuzzy Sets, Crisp & Fuzzy Relations, Fuzzy Systems –Crisp Logic, Predicate Logic, Fuzzy Logic, Fuzzy Rule Based System, Defuzzification Methods.

**Unit III: Supervised and Unsupervised Neural Networks:** Basic concepts of Artificial Neural Networks, Learning Schemes, Multi-layer feed-forward neural networks, Back Propagation Algorithm, Effect of tuning parameters of the back propagation neural network. Selection of various parameters in BPN, Variations of standard back propagation algorithm. Recurrent Neural Networks, Functional Link Neural Nets, Radial Basis Function Neural Networks, Kohonen Neural Network: Self-Organizing Feature Man, Learning Vector Quantization.

**Unit IV: Genetic Algorithms:** Basic Concepts, Creation of offspring, Working Principle, Encoding, Fitness Function, Reproduction, Genetic Modeling, Inheritance Operators, Cross Over, Inversion & Deletion, Mutation Operator, Bit-wise Operators, Bit-wise operators in GA, Generational Cycle, Convergence of GA, Application.

#### **Text Books:**

1. J.Han, M.Kamber, J.Pei, Data Mining Concepts and Techniques, Morgan Kauffman, 3<sup>rd</sup> Edition, 2011
2. J.-S.R. Jang, C.-T. Sun, E.Mizutani, Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence, PHI, 2004
3. S.C.Gupta, Fundamentals of Statistics, Himalaya Publishing

#### **Reference Books:**

1. Simon Haykin, Neural Networks: A Comprehensive Foundation, Prentice Hall, 1998.
2. H.J. Zimmermann, Fuzzy Set Theory and its Applications, Allied Publishers Ltd., Kluwer Academic Publishers, 1985.

## **2: Computational Intelligence(CI)**

**Unit I: Introduction to Computational Intelligence:** Basic concepts of CI, different techniques of CI, Related fields of CI, Applications of CI.

**Unit II: Evolutionary Computation:** Single Objective Evolutionary Algorithms-Genetic Algorithms, Genetic Programming, Evolutionary Strategies, Evolutionary Programming, Ant Colony Optimization, Particle Swarm Optimization, Artificial Bee Colony.

**Multi-objective Evolutionary Algorithms:** MOGAs, MOPSO, MOABC.

**Unit III: Supervised Neural Networks:** Basic of Learning, Activation functions, Topologies, Feed-forward neural networks, back-propagation learning, Functional link artificial neural networks, Radial Basis Function Networks, Recurrent Neural Networks.

**Unsupervised Neural Networks:** Adaptive Resonance Theory(ART), Kohonen Self Organizing Feature Map, Learning Vector Quantization.

**Unit IV: Fuzzy and Rough Sets:** Basic concepts of fuzzy set theory and rough set theory.

### **Text Books:**

1. Andries P. Engelbrecht, Computational Intelligence: An Introduction, Wiley, 2<sup>nd</sup> Edition, 2007
2. D. K. Pratihar, Soft Computing, Narosa Publishing House, 2008.

### **Reference Books:**

1. D.P.Achariya, S.Dehuri, S.Sanyal, Computational Intelligence for Big Data Analysis, Springer, 2015.
2. B. B. Mishra, S. Dehuri, B. K. Panigrahi, A. K. Nayak, B.S.P. Mishra, H.Das(Eds.), Computational Intelligence in Sensor Networks, Springer, 2019.

### **3: Cloud Computing and Virtualization**

**Unit I: Cloud Computing Fundamentals:** Cloud Computing definition, Types of cloud, Cloud services: Benefits and challenges of cloud computing, Evolution of Cloud Computing, Applications cloud computing, Business models around Cloud – Major Players in Cloud Computing, Issues in Cloud

**Unit II: Different Computing Paradigm and Cloud Models:** Cluster Computing, Grid Computing, Grid Computing Versus Cloud Computing, Key Characteristics of Cloud Computing. Cloud Models: Benefits of Cloud Models, Public Cloud, Private Cloud, Hybrid Cloud, Community Cloud, Shared Private Cloud, Dedicated Private Cloud, and Dynamic Private Cloud.

**Unit III: Cloud Services and File System:** Types of Cloud services: Software as a Service, Platform as a Service, Infrastructure as a Service, Database as a Service. Service providers- Google, App Engine, Amazon EC2, Microsoft Azure.

**Unit IV: Virtualization:** Basics of Virtualization - Types of Virtualization, Implementation Levels of Virtualization, Virtualization Structures, Tools and Mechanisms.

**Security in the Cloud:** Security Overview, Cloud Security Challenges and Risks, Security Architecture Design, Data Security, Application Security.

#### **Reference Books:**

1. Cloud Computing” A Practical Approach” Anthony T. Velte, Toby J. Velte, Robert Elsenpeter. McGraw-Hill.
2. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, “Distributed and Cloud Computing, From Parallel Processing to the Internet of Things”, Morgan Kaufmann Publishers, 2018.
3. John W. Rittinghouse and James F.Ransome, “Cloud Computing: Implementation, Management, and Security”, CRC Press, 2017.
4. Toby Velte, Anthony Velte, Robert Elsenpeter, “Cloud Computing, A Practical Approach”, TMH, 2015.
5. Kumar Saurabh, “Cloud Computing – insights into New -Era Infrastructure”, Wiley India,2011.
6. Ronald L. Krutz, Russell Dean Vines, “Cloud Security – A comprehensive Guide to Secure Cloud Computing”, Wiley – India, 2010.

## **4: Digital Image Processing and Computer Vision**

**Unit I:** Introduction, Motivation & Perspective, Applications, Components of Image Processing System, Fundamentals Steps in Image Processing, Image Sampling and Quantization, Some basic relationships like Neighbors, Connectivity, Distance Measures between pixels, Image Enhancement in the Spatial and Frequency Domain: Image enhancement by point processing, Image enhancement by neighborhood processing, Basic Gray Level Transformations, Histogram Processing, Enhancement Using Arithmetic and Logic operations, Zooming, Basics of Spatial Filters, Smoothing and Sharpening

**Unit II:** Model of The Image Degradation Restoration Process, Noise Models, Restoration in the presence of Noise Only Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Linear Position-Invariant Degradations, Estimation of Degradation Function, Inverse filtering, Wiener filtering, Constrained Least Square Filtering, Geometric Mean Filter, Geometric Transformations.

**Unit III:** Data Redundancies, Image Compression models, Elements of Information Theory, Lossless and Lossy compression, Huffman Coding, Shannon-Fano Coding, Arithmetic Coding, Golomb Coding, LZW Coding, Run Length Coding, Loss less predictive Coding, Bit Plane Coding, Image compression standards.

**Unit IV:** Image Segmentation and Morphological Image Processing: Discontinuity based segmentation, similarity based segmentation, Edge linking and boundary detection, Threshold, Region based Segmentation Introduction to Morphology, Dilation, Erosion, Some basic Morphological Algorithms Object Representation and description and Computer Vision Techniques: Introduction to Morphology, Some basic Morphological Algorithms, Representation, Boundary Descriptors, Regional Descriptors, Chain Code, and Structural Methods. Review of Computer Vision applications; Fuzzy-Neural algorithms for computer vision applications.

### **Text Books:**

1. Gonzalez Rafael C. and Woods Richard E., Digital Image Processing, New Delhi: Prentice–Hall of India.

### **Reference Books:**

1. A.K.Jain “Fundamental of digital image processing”, Prentice-Hall
2. R.C.Gonzalez,R.E.Wood “Digital image processing using MATLAB”, Pearson Education
3. M. Sonka, V. Hlavac, R. Boyle,” Image processing analysis and machine vision” Chapman & Hall



## 5: Bioinformatics

**Unit I: Introduction:** Introduction to Artificial Intelligence, Applications of Artificial Intelligence, Intelligent Agents, Structure of Intelligent Agents. Computer vision, Natural Language Processing.

**Machine Learning:** Supervised and unsupervised learning, Decision trees, Statistical learning models, learning with complete data - Naive Bayes models, Learning with hidden data - EM algorithm, Reinforcement learning.

**Pattern Recognition:** Introduction, Design principles of pattern recognition system, Statistical Pattern recognition, Parameter estimation methods - Principle Component Analysis (PCA) and Linear Discriminant Analysis (LDA), Classification Techniques – Nearest Neighbor (NN) Rule, Bayes Classifier, Support Vector Machine (SVM), K – means clustering.

**Unit II: Medical imaging technology:** Medical imaging techniques, such as X-Ray, Medical imaging technology, image segmentation, r, statistical modeling, visualization, and applications of computational tools for medicine.

**AI for Medical Diagnosis:** Disease detection with computer vision - Building and Training a Model for Medical Diagnosis, Training, prediction, and loss, Model Testing, Ground Truth and Consensus Voting- Practice classifying diseases on chest x-rays using a neural network. Evaluating models- Sensitivity, specificity and evaluation metrics, PPV, NPV, Confusion matrix, ROC curve and Threshold-Practice implementing standard evaluation metrics to see how well a model performs in diagnosing diseases.

**Unit III: Storage and Processing:** Electronic health record (EHR) and its derivatives, and the functions for which it is used, including clinical decision support and re-use of clinical data. Personal health record (PHR) and decision aids, and the functions for which they are used to inform personal health decision-making. Dissemination of health-related knowledge and demonstrate the ability to retrieve and appraise it.

**Medical Image Storage:** Archiving and Communication Systems and Formats Picture archiving and communication system (PACS); Formats: DICOM Radiology Information Systems (RIS) and Hospital Information Systems (HIS). Medical Image Processing, Enhancement, Filtering Basic image processing algorithms

**Unit IV: Segmentation and Visualization:** Medical Image Segmentation - Histogram-based methods; Multi-scale segmentation; semi-automated methods; clustering-based methods; classification-based methods; multi-model segmentation. Medical Image; cost functions; optimization techniques. Image classification.

**Medical Image Visualization:** Fundamentals of visualization; surface and volume rendering/ visualization; animation; interaction.

**Text books:**

1. Stuart Russell, Peter Norvig, "Artificial Intelligence – A Modern Approach", Pearson Education.
2. Elaine Rich and Kevin Knight, "Artificial Intelligence", McGraw-Hill.
3. Tom M. Mitchell, "Machine Learning", McGraw-Hill, 2010
4. Bishop, Christopher. Neural Networks for Pattern Recognition. New York, NY: Oxford University Press, 1995  
Paul Suetens, "Fundamentals of Medical Imaging", Second Edition, Cambridge University Press, 2009.
5. Hoyt, RE and Yoshihashi, A, Eds. (2014). Health Informatics: Practical Guide for Healthcare and Information Technology Professionals, Sixth Edition. Pensacola, FL, Lulu.com.

**References**

1. E Charniak and D McDermott, "Introduction to Artificial Intelligence", Pearson Education.
2. 4. Dan W. Patterson, "Artificial Intelligence and Expert Systems", Prentice Hall of India.
3. Jerry L. Prince and Jonathan Links, "Medical Imaging Signals and Systems", First Edition, Prentice Hall, 2005.
4. John L. Semmlow, "Biosignal and Medical Image Processing", Second Edition, CRC Press, 2008.
5. Kayvan Najarian and Robert Splinter, "Biomedical Signal and Image Processing", Second Edition, CRC Press, 2005
6. Geoff Dougherty, "Digital Image Processing for Medical Applications", First Edition, Cambridge University Press, 2009.
7. Ethem Alpaydin, "Introduction to Machine Learning (Adaptive Computation and Machine Learning)", The MIT Press, 2004.
8. T. Hastie, R. Tibshirani, J. H. Friedman, "The Elements of Statistical Learning", Springer (2nd ed.), 2009

## 6: Cryptography and Network Security

**Unit I: Introduction to Cryptography and network security:** Security Threats, Vulnerability, attacks, Security services and mechanism, Conventional Encryption Model, CIA model, Traditional Block Cipher Structure, the Feistel Cipher, Steganography.

**Basic Concepts in Number theory and Finite fields:** Divisibility and the Division Algorithm, The Euclidean and Extended Euclidean Algorithms, Modular Arithmetic, Abstract Algebra: Groups, rings, fields, construction of finite fields,  $GF(p)$ , Polynomial arithmetic,  $GF(2^n)$ .

**Unit II: Number theory:** Prime Numbers, Fermat's and Euler's Theorems, Primality test, The Chinese Remainder Theorem, Discrete Logarithms.

**PSEUDORANDOM NUMBER GENERATION and Stream Ciphers: Principles** of Pseudorandom Number Generation, Pseudorandom Number Generators: Use of random numbers, TRNGs, PRNGs and PRFs, PRNG requirements, Algorithm Design, Stream Ciphers, RC4.

**Unit III: Symmetric Key Ciphers: Data** Encryption Standard, Block Cipher Designing Principles, Advanced Encryption standard, Block Cipher Operation: Multiple operation and Triple DES, ECB, Block Cipher modes of operation: ECB, CBC, CFB, OFB, CTR.

**Public-Key Cryptosystems:** Diffie-hellman Key exchange algorithm, Principles of public-key Cryptosystem, The RSA algorithm, ElGamal Cryptosystem, Elliptic Curve Cryptography.

**Unit IV:** Cryptographic Hash Functions and MD Hash Family. Message Authentication, Digital signatures.

**Network and System Security:** Security at the application Layer: e-mail Security, PGP, Web Security: requirements, secure sockets layer (SSL) and Transport layer security(TLS), Secure Electronic Transactions. IP security: Overview, Architecture, Authentication, Encapsulating Security Payload. System Security: Intruders, Viruses and related threats, Denial of Service Attacks, firewall design principles, trusted systems.

### Text Books:

1. William Stallings, Cryptography and Network security Principles and Practices, Pearson/PHI, 6<sup>th</sup> ed.
2. B.A. Forouzan & D. Mukhopadhyay, Cryptography and Network Security, McGraw Hill, 4<sup>th</sup> ed.
3. Bruce Schneier, Applied Cryptography Protocols, Algorithms and Source Code in C, Willey India Ed, 2<sup>nd</sup> ed.

### Reference Books:

1. Oded Goldreich, Fundamentals of Cryptography, Cambridge University Press
2. Eric Maiwald, Fundamentals of Network Security, Dreamtech press.

3. Charlie Kaufman, Radia Perlman and Mike Speciner, Network Security - Private Communication in a Public World, Pearson/PHI.
4. Robert Bragg, Mark Rhodes, Network Security: The complete reference, TMH

## **DPICT-103: Review Work**

This paper is consisting of two parts.

**In part 1**, students are required to undergo for an extensive literature survey in one of the areas of Computer Science (CS), Information Technology (IT), Information and Communication Technology (ICT). The outcome of this work shall be disseminated in shape of a review paper/survey paper published in at least Peer Reviewed/Scopus Indexed Journals.

**In part 2**, students are required to acquire skill to develop a meaningful synopsis for Ph.D. registration.

### **References:**

[http://www.cs.ucf.edu/~lboloni/Teaching/EEL6788\\_2008/slides/SurveyTutorial.pdf](http://www.cs.ucf.edu/~lboloni/Teaching/EEL6788_2008/slides/SurveyTutorial.pdf)

[https://cs.pomona.edu/classes/cs190/survey\\_workshop\\_slides.pdf](https://cs.pomona.edu/classes/cs190/survey_workshop_slides.pdf)

<http://cs.swan.ac.uk/~csbob/research/star/how/mcnabb19how.pdf>