



**MANONMANIAM SUNDARANAR UNIVERSITY
TIRUNELVELI-627 012, TAMILNADU, INDIA**

CENTRE FOR INFORMATION TECHNOLOGY AND ENGINEERING

Board of Studies Meeting

**Ph.D. Information Technology
(CBCS-University Department)**

**Regulations, Scheme and Syllabus
For those who joined from the academic year 2016-2017 onwards**

**Submitted by
Chairman, BOS and Head,
Centre for Information Technology and Engineering,**

to

**The Registrar
Manonmaniam Sundaranar University
Tirunelveli - 12**

MANONMANIAM SUNDARANAR UNIVERSITY
TIRUNELVELI-627 012, TAMILNADU, INDIA
Centre for Information Technology and Engineering
Ph.D Course Work
(CBCS-University Department)

B. SCHEME FOR PH.D COURSE WORK

(For those who joined from the academic year 2016-2017 onwards)

| Title of the Subject | Hrs/ week | Credits |
|--|----------------------|----------------|
| RESEARCH AND TEACHING METHODOLOGY | 4 | 4 |
| DATA SCIENCES AND BIG DATA ANALYTICS | 4 | 4 |
| ADVANCED DIGITAL SIGNAL AND IMAGE PROCESSNG | 4 | 4 |
| MODERN COMMUNICATION SYSTEMS | 4 | 4 |
| PERVASIVE, GRID AND CLOUD COMPUTING | 4 | 4 |
| ENGINEERING RESEARCH METHODOLOGY | 4 | 4 |
| PATTERN RECOGNITION AND IMAGE ANALYSIS | 4 | 4 |
| CLOUD COMPUTING | 4 | 4 |
| COMPUTING FOR DATA ANALYTICS | 4 | 4 |
| BIG DATA ANALYTICS | 4 | 4 |
| FOUNDATIONS OF INFORMATION SECURITY | 4 | 4 |
| INTRODUCTION TO DIGITAL FORENSICS | 4 | 4 |
| ADVANCED INFORMATION SECURITY | 4 | 4 |
| COMPUTING TECHNIQUES FOR CANCER ANALYTICS | 4 | 4 |
| REMOTE SENSING AND IMAGE | 4 | 4 |

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|---|---|---|
| INTERPRETATION | | |
| INTRODUCTION TO MICROWAVE ANTENNA AND RADAR SIGNAL PROCESSING | 4 | 4 |
| AN INTRODUCTION TO DATA ANALYTICS | 4 | 4 |
| STATISTICAL LEARNING FOR DATA ANALYTICS | 4 | 4 |
| MACHINE LEARNING ALGORITHMS FOR DATA ANALYTICS | 4 | 4 |
| DESCRIPTIVE AND DISCOVERY ANALYTICS | 4 | 4 |
| ADVANCED INTERNET OF THINGS | 4 | 4 |
| CRYPTOGRAPHY AND NETWORK SECURITY | 4 | 4 |
| ADVANCED DEEP LEARNING FOR MALWARE ANALYSIS | 4 | 4 |
| FOUNDATIONS OF MALWARE ANALYSIS | 4 | 4 |
| STUDY OF MALWARE ANALYSIS TOOLS AND DATASET | 4 | 4 |
| MINI PROJECT | 4 | 4 |

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| RESEARCH AND TEACHING METHODOLOGY | L | T | P | C |
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Unit I: BASIC RESEARCH PROCESS:

Objectives and Motivations - Distinct Approaches and Significance of Research - Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs Experimental Researches - The significance of research - Research Methodology vs Research Methods - Research Process - Finding a Research Topic and Beginning Research - Directed Study - Research Problem Formulation - Extensive Literature Survey and Choosing an Idea - Measures of Good Research; UNDERSTANDING SCIENCE AND SCIENTIFIC RESEARCH: Goal and Process - Definitions by Contrast - Scientific Methods - Criteria to Evaluate Theories - Knowledge and Abstraction - The Origins of Knowledge - The Role of Science in Knowledge Creation - Knowledge and Objectivity - Perception and —Direct Observation - Science and Truth - Critical Thinking - Logical Arguments - Deduction and Induction. (12L)

Unit II: RESEARCH METHODOLOGY FOR SCIENCE AND ENGINEERING:

What is known as Science? - Fusion of Science, Research, Engineering & Technology - Distinctions between Science and Technology - Pseudoscience - Science And Ethics - Science vs Engineering - Distinct perspectives of goals and Importance of Knowing How Engineering Research is done - Stages in Research Execution Process; FORMULATING AND EXECUTING A RESEARCH:PROBLEM: Understanding and Formulating a Research Problem - Issues with Choosing the Research Problem - Need for Defining the Research Problem - Various steps involved in Defining the Research Problem - Designing Research Plan for Science and Engineering - Components and Key Parameters of a Good Research Plan - Types of Research Plan - Developing an Experimental Plan for Research - RESEARCH METHODS FOR SCIENCE AND ENGINEERING: - Legacy of Ideas in Computing - Computing Research - The Evolution - An Overview of Scientific Research Methods - Theoretical vs. empirical methods in Computing - Theoretical Problems and Models in Computing - An Overview Statistical Research Methods for Science and Engineering - The Classical four steps of the Scientific Method - Test of hypotheses - Applying the Scientific Method - Likely Mistakes and Errors - Science and Experimental Errors - Control of Measurement Errors in Scientific Experiments - Hypotheses, Models, Theories and Laws - Circumstances where Scientific Methods are not applicable. (12L)

Unit III: STATISTICAL RESEARCH METHODS FOR SCIENCE AND ENGINEERING:

Role of Statistics in Scientific Experiments - Link between Probability and Statistics - Branches of Statistics for Research - Descriptive and Inferential Statistics - Statistical Parameters Commonly Encountered in Research - Variables that are Not Parameters - Statistical Data Sets - Statistical Treatment Of Data - Raw Data Processing - Statistical Outliers - Statistical Analysis - Statistical Measurement Scales - Variables and Statistics - Qualitative to Quantitative Conversion - Practical Cases of Discrete Variables in Statistics - Discrete vs. Continuous Variables - Inferential Statistics - Experimental Probability - Bayesian Probability - Confidence Interval - Significance of Significance Test - Statistical Significance and Sample Size - Margin of Error - Experimental Error - Random Error - Systematic Error - Data Dredging - Data Snooping - Data Fishing - Statistical Power Analysis - Ethics in Statistics - Philosophy of Statistics - Statistical Validity and Reliability. Deductive Methods in Computing - Ordinary Mathematical Proofs - Inference systems and their applications - Inductive Methods in

Computing - Mathematical Induction - Recursive definitions and proofs by induction - Induction Vs Deduction, Hypothetico-Deductive Method - Repetitions, Patterns, Identity - Causality And Determinism - Limitations in Formal Logical Systems - Fuzzy Logic and its Applications. (12L)

Unit IV: ACQUIRING AND DISEMINATING RESEARCH IN DIGITAL ERA:

Searching for Research Papers - Identifying and Developing Research Topic - Finding Background Information - Use Encyclopedias and Dictionaries - Exploit Bibliographies - Using Catalogs to Find Books and Media - Using Indexes to Find Periodical Articles - Finding Internet Resources - Categories of Search Tools Available - Beginning Point on the Web - The Five-Step Search Strategy - Search Strategies NOT Recommended for Finding Web Documents - Search Engines Suitable for Search Needs - Three Types of Search Tools - MetaSearch Engines and Gateway Pages - Recommended Search Engines - Common Features, Notable Differences and Working Mechanism of the Search Engines - Features that make Google the best Web Search Engine 2018/2019 - Finding Subject-Focused Directories for a Specific Topic or Field - Finding the Invisible Web or the Deep Web - Method of Evaluating Web Pages - Reasons for Evaluating What is Found on the Web - Citation Styles, Style Guides, and Avoiding Plagiarism - Citing Sources - A Standard Academic Practice - Web and Internet Terminologies for Researchers - Evaluating the Information Sources; Writing and Presentation of a Research Paper for a Conference and a Journal; Writing a good thesis: Research report writing - The art of minimizing the pain of thesis writing - Thesis - To whom is it written? - How should it be written? - Master's vs. PhD Thesis - Quantum of Detail to be Provided - Thesis outline - Presenting Progress of Research Work to Doctoral Committee - Getting into the Real Business of Writing Thesis - The Ten Commandments for Thesis Writing - What One Should Learn from the Thesis Writing Exercise - Definitions and Terminology - Terms and Phrases to Avoid and Language Aspects - Focusing on Results - Key Parameters for the Thesis - References to Extant Work - Concept Vs. Instance - Terminology for Concepts and Abstractions - Knowledge Vs. Data - Cause and Effect - Drawing Only Warranted Conclusions - Canonical Organization - Suggested Order For Writing - A Suggested Ph.D. Thesis Structure - Model; Suggested M.Sc./M.E./M.Tech./M.Phil. Thesis Structure; Preparations Suggested for surviving a Thesis Defense; Converting your research thesis into a monograph. (14L)

Unit V: METHODOLOGY OF TEACHING:

Teaching - Objectives of Teaching, Phases of Teaching -Teaching Methods Lecture Method, Discussion Method, Discovery Learning, Inquiry, Problem Solving Method, Project Method, Seminar- Integrating ICT in Teaching: Individualized Instruction, Ways for Effective Presentation with Power Point- Documentation - Evaluation: Formative, Summative& Continuous and Comprehensive Evaluation - Later Adolescent Psychology: Meaning, Physical, Cognitive, Emotional, Social and Moral Development- Teaching Later Adolescents. (10L)

TOTAL (60L)

TEXT BOOK:

1. Dr.Krishnan Nallaperumal, "Research Methodology for Science and Engineering", Publication Division, Manonmaniam Sundaranar University, Tirunveli, 2018.

REFERENCES BOOKS:

1. "Thesis & Assignment Writing" By Anderson, Berny H. Dujrston, H. Pode, Wiley Eastern Ltd., New Delhi.
2. "Research Methodology" R. Panneerselvam, PHI, New Delhi 2005
3. C. R. Kothari – Research Methodology Methods and Techniques – Wishwa Prakashan Publishers – Second Edition.
4. Dr. Rajammal, P. Devadas – A Handbook on Methodology of Research – Sri Ramakrishna Mission Vidyalaya College of Rural Higher Education.
5. Scientific Social Surveys and Research - Young Pauline. V.
6. Sampath.K., Panneerselvem, A. & Santhanam,S. (1984) Introduction to educational technolog.(2nd revised ed.), New Delhi: Sterling Publisher.
7. Sharma,S.R.(2003). Effective classroom teaching modern methods, tools & techniques. Jaipur: Mangal Deep.
8. Vedanayagam, E.G. (1989). Teaching technology for college teachers New York: Sterling Publisher.

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| DATA SCIENCES AND BIG DATA ANALYTICS | L | T | P | C |
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Unit I Introduction to Data Science : Data science process – roles, stages in data science project – working with data from files – working with relational databases – exploring data – managing data – cleaning and sampling for modeling and validation – introduction to NoSQL. (12L)

Unit II – Modeling Methods and Introduction to R : Choosing and evaluating models – mapping problems to machine learning, evaluating clustering models, validating models – cluster analysis – K-means algorithm, Naïve Bayes – Memorization Methods – Linear and logistic regression – unsupervised methods - Reading and getting data into R – ordered and unordered factors – arrays and matrices – lists and data frames – reading data from files – probability distributions – statistical models in R - manipulating objects – data distribution. (14L)

Unit III – Introduction to Big Data: Introduction – distributed file system – Big Data and its importance, Four Vs, Drivers for Big data, Big data analytics, Big data applications. Algorithms using map reduce, Matrix-Vector Multiplication by Map Reduce. (12L)

Unit IV – Introduction Hadoop : Big Data – Apache Hadoop & Hadoop EcoSystem – Moving Data in and out of Hadoop – Understanding inputs and outputs of MapReduce - Data Serialization. (10L)

Unit- V Hadoop Architecture : Hadoop Architecture, Hadoop Storage: HDFS, Common Hadoop Shell commands , Anatomy of File Write and Read., NameNode, Secondary NameNode, and DataNode, Hadoop MapReduce paradigm, Map and Reduce tasks, Job, Task trackers - Cluster Setup – SSH & Hadoop Configuration – HDFS Administering –Monitoring & Maintenance. (12L)

TOTAL (60L)

REFERENCES

1. Nina Zumel, John Mount, “Practical Data Science with R”, Manning Publications, 2014.
2. Jure Leskovec, Anand Rajaraman, Jeffrey D. Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2014.
3. Mark Gardener, “Beginning R - The Statistical Programming Language”, John Wiley & Sons, Inc., 2012. 4. W. N. Venables, D. M. Smith and the R Core Team, “An Introduction to R”, 2013.
4. Tony Ojeda, Sean Patrick Murphy, Benjamin Bengfort, Abhijit Dasgupta, “Practical Data Science Cookbook”, Packt Publishing Ltd., 2014.
5. Nathan Yau, “Visualize This: The FlowingData Guide to Design, Visualization, and Statistics”, Wiley, 2011.

6. Boris lublinsky, Kevin t. Smith, Alexey Yakubovich, “Professional Hadoop Solutions”, Wiley, ISBN: 9788126551071, 2015.
7. http://www.johndcook.com/R_language_for_programmers.html
8. <http://bigdatauniversity.com/>
9. <http://home.ubalt.edu/ntsbarsh/stat-data/topics.htm#rintroduction>.
10. Boris lublinsky, Kevin t. Smith, Alexey Yakubovich, “Professional Hadoop Solutions”, Wiley, ISBN: 9788126551071, 2015.
11. Chris Eaton, Dirk deroos et al. , “Understanding Big data ”, McGraw Hill, 2012.
12. Tom White, “HADOOP: The definitive Guide”, O Reilly 2012.
13. Vignesh Prajapati, “Big Data Analytics with R and Haoop”, Packet Publishing 2013.
14. Tom Plunkett, Brian Macdonald et al, “Oracle Big Data Handbook”, Oracle Press, 2014.
15. <http://www.bigdatauniversity.com/>
16. Jy Liebowitz, “Big Data and Business analytics”,CRC press, 2013.

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| ADVANCED DIGITAL SIGNAL AND IMAGE PROCESSNG | L | T | P | C |
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UNIT I

Signals and signal Processing, characterization & classification of signals, typical Signal Processing operations, example of typical Signals, typical Signals Processing applications. Time Domain Representation of Signals & Systems- Discrete Time Signals, Operations on Sequences, Linear shift-invariant systems, Stability and Causality, Linear constant coefficient difference equations, Frequency domain representation of discrete-time systems, symmetry properties of the Fourier transform, Sampling of continuous-time systems. Z-transforms, Discrete Fourier Transform (DFT) & its properties, computation of the DFT of real sequences (13L)

UNIT II

Digital Image Fundamentals: Fundamental steps in Image Processing –Components of Image Processing System-Image Sampling and Quantization-Basic Relationships between Pixels. Image Enhancement in Spatial Domain: Basic Gray level Transformations-Histogram Processing- Enhancements using Arithmetic/logic Operations-Basics of Special Filtering-Smoothing Filters-Sharpener Filters. (12L)

UNIT III

Image Enhancements in the Frequency domain : Smoothing Filters-Sharpener Filters-Homomorphic Filters - Image Restoration: Degradation model –Noise Models-Restoration in the presence of Noise- Wiener Filter. Color Image Processing : Color Fundamentals-Color Models-Basics of full Color image Processing-Color Transformations. (12L)

UNIT IV

Wavelets and Multi-resolution Processing: Image Pyramids and Sub band Coding – Wavelet Transform in one dimension- FWT. Image Compressions: Fundamentals – Image Compression models – Elements of Information Theory – Error – Free Compression – Lossy compression – Image Compression standards. (11L)

UNIT V

Image segmentation: Detection of discontinuities – Edge linking and Boundary detection – Thresholding – Region Orientation Segmentation – use of motion in segmentation. Morphological Image Processing: Basic Binary morphological Operations. Basic grayscale morphological Operations. Representation and Description: Representation-Boundary Descriptors. (12L)

TOTAL (60L)

References:

1. Refael C. Gonzalez & Richard E. Woods - Digital Image Processing, Addison Wesley publication corporation, 2008
2. Image Processing Analysis, and Machine Vision, Milan Sonka,

3. Alan V. Oppenheim & Ronald W. Schafer, “ Digital Signal Processing” PHI, 2002
4. Sanjit K. Mitra, “ Digital Signal Processing: A computer based approach” TMH, Second Edition, 2003.

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| MODERN COMMUNICATION SYSTEMS | L | T | P | C |
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UNIT-I: Network Evolution – The ISDN – The Basic Rate ISDN customer’s Interface: The customer’s Installation layer 1, 2, 3. Primary rate ISDN access: background – signaling – evaluation of PABX signaling – International standards for inter –PABX signaling. (10L)

UNIT-II: Frame mode services: Store and Forward Switching – Data grams and Virtual Circuits - Flow and Congestion Control – New ISDN Frame mode Services – Frame Format. ISDN Customer premises Equipment and Applications: High quality speech – Music coding FACSIMILE – Photographs Video tex – Video – Audio Visual services and Embedded – Customer premises Equipment. (12L)

UNIT-III: ATM Network concepts and Architecture: ATM’s position in the OSI Reference Model – B-ISDN protocol reference model – ATM functions and layers – ATM signaling principles – The ATM layer – ATM switching principles. (12L)

UNIT-IV: Modern Communication: Fundamentals of Information Handling – Information media as viewed from the Human Interface – Various facets of modern Communication systems – Composition of Modern Communication systems. (12L)

UNIT-V: Components of modern Communication systems: Home systems – Home system image – Home systems and their service Trends – Access systems for Home systems. Business Communications: Basic structure of the Office system in a single office / Plant – Basic Structure of the Office system connected to WAN’s. The general structure of the office system – Actual Composition of CAN and WAN. Mobile Communication in the information society- Technical Background of Mobile Communication various Mobile Communications services – Positioning of VAN – Classification by service operation mode – Classification of VAN purpose – Classification of specific Industry service type VAN’s from the added value viewpoint – New Electronic Media. Construction of Global Infrastructure: Satellite Communications systems – TV Broadcasting – Approaches to meeting new goals – Possibilities of new Broadcasting forms – Information service center systems – Automatic Interpretation telephone systems – Teleconferencing systems. (14L)

TOTAL (60L)

TEXT BOOKS:

1. “ISDN Explained” John M.Griffiths 2nd Edition March 1995
John Willey & sons.
2. “Introduction to ATM Networking” Walter J. Goralski J. McGraw Hill Inc
3. “Computers and communications” Koji Kobayashi the MID Press 1986. (A version of c and C).

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| PERVASIVE, GRID AND CLOUD COMPUTING | L | T | P | C |
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UNIT-I:

Pervasive Computing Infrastructure-Applications-Device Technology- Hardware, Human-Machine Interfaces, Biometrics, And Operating Systems- Device Connectivity-Protocols, Security , And Device Management-Pervasive Web Application Architecture-Access From PCs And PDAs- Access Via WAP (12L)

UNIT-II:

Grids and Grid Technologies, Programming models - A Look at a Grid Enabled Server and Parallelization Techniques – Grid applications- Grid architecture – Grid architecture and relationship to other Distributed Technologies – computational and data Grids, semantic grids (12L)

UNIT – III:

Grid Management systems, security, Grid Grid-Enabling software and Grid enabling network services, Data Grid - Virtualization Services for Data Grids, Peer-to-Peer Grids - Peer-to-Peer Grid Databases for Web Service Discovery and application execution. (10L)

UNIT-IV:

Introduction to Cloud Computing- Definition, Characteristics, Components- Cloud provider-Administering & Monitoring cloud services-benefits and limitations- Deploy application over cloud- Introduction to Cloud Technologies: SOAP, Webservices, AJAX and mashups, Virtualization Technology, Multitenant software. (12L)

UNIT-V:

Cloud Relational databases- Cloud file systems- Cloud computing security architecture- Cloud computing security challenges- Issues in cloud computing- Cloud Middleware- Mobile Cloud Computing- Inter Cloud issues. (14L)

TOTAL (60 L)

TEXT BOOK:

1. Cloud Computing for Dummies by Judith Hurwitz, R.Bloor, M.Kanfman, F.Halper (Wiley India Edition),2010
2. Enterprise Cloud Computing by GautamShroff, Cambridge,2010.
3. Cloud Security by Ronald Krutz and Russell Dean Vines, Wiley-India,2010
4. Jochen Burkhardt, pervasive computing: Technology and Architecture of Mobile Internet Applications, Addison-Wesley Professional; 3rd edition, 2007

REFERENCES:

1. Fran Bernm, Geoffrey Fox, Anthony Hey J.G., "Grid Computing: Making the Global Infrastructure a Reality", Wiley, USA, 2003.
2. Joshy Joseph, Craig Fallenstein, "Grid Computing", Pearson Education, New Delhi, 2004.
3. Ian Foster, Carl Kesselman, "The Grid2: Blueprint for a New Computing Infrastructure". Morgan Kaufman, New Delhi, 2004.
4. Ahmar Abbas, "Grid Computing: Practical Guide to Technology andApplications", Delmar Thomson Learning, USA, 2004.

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| ENGINEERING RESEARCH METHODOLOGY | L | T | P | C |
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UNIT I:

Basic research methodology: Objectives and Motivation in Research - Types of Research - Approaches and Significance of Research - Research Methodology versus Research Methods- Research Process-Finding a Research Advisor/Guide, What to Look for in a Potential Research Advisor/Guide, How to Find an Advisor/Guide, The Advisor-Advisee Relationship; Finding a Topic and Beginning Research, Getting Research Ideas, How to be an Active Reader and Listener, Getting Exposed to Research, Directed Study; Formulating the Research Problem: Develop the Nucleus of an Idea, Extensive Literature Survey: A Trap to Avoid, Choosing an Idea, Stay Active - Measure of Good Research - Common Problems for Researchers

(10L)

UNIT II:

Overview of the Theory of Science and history of scientific research - Overview of Research Methodology for Engineering Research - Science versus Engineering - Distinct perspectives of goals Research methodology for circuit branches: Formulating the Research Problem -Research Design - Evolution of Computing Research.

(11L)

UNIT III:

Research Methods for Engineering Research - History of ideas in computing – Measurements based research methods in computer engineering - Measurements based research methods in Signal and Image Processing, Graphics, Vision and Pattern Recognition - Deductive Methods in Computing Science.

(12L)

UNIT IV:

Deductive Methods in Signal and Image Processing, Graphics, Vision and Pattern Recognition - Inductive Methods in Computing Science - Inductive Methods in Signal and Image Processing, Graphics, Vision and Pattern Recognition - Building Models – Simulation.

(13L)

UNIT V:

Searching for scientific papers - Writing and presentation of a research paper for a conference or journal - Review and opposition of engineering/scientific research papers - Writing a good thesis: Research report writing - Converting your research thesis into a monograph – Research education, the research society and research policy

(14L)

TOTAL (60L)

TEXT AND REFERENCE:

1. Lecture Notes by Prof. Dr. Krishnan Nallaperumal on “Engineering Research Methodology - A Computer Science and Engineering and Information Technology Perspective.

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| PATTERN RECOGNITION AND IMAGE ANALYSIS | L | T | P | C |
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UNIT I Introduction (12L)

Introduction: Machine perception, pattern recognition example, pattern Recognition systems, the design cycle, learning and adaptation. Bayesian Decision Theory: Introduction, continuous features – two categories classifications, minimum error-rate classification-zero-one loss function, classifiers, discriminant functions, and decision surfaces.

UNIT II 4K Normal density (12L)

Normal density: Univariate and multivariate density, discriminant functions for the normal density-different cases, Bayes decision theory – discrete features, compound Bayesian decision theory and context Maximum likelihood and Bayesian parameter estimation: Introduction, maximum likelihood estimation, Bayesian estimation, Bayesian parameter estimation–Gaussian case.

UNIT III UN- supervised (12L)

Un- supervised learning and clustering: Introduction, mixture densities and identifiability, maximum likelihood estimates, application to normal mixtures, K-means clustering. Data description and clustering – similarity measures, criteria function for clustering Pattern recognition using discrete hidden Markov models: Discrete-time Markov process, Extensions to hidden Markov models, three basic problems of HMMs, types of HMMs.

UNIT IV Continuous hidden Markov models (12L)

Continuous hidden Markov models: Continuous observation densities, multiple mixtures per state, speech recognition applications. Digital image models, sampling and quantization, basic relationships between pixels, image geometry. Image enhancement: Back ground, enhancement by point processing histogram processing, spatial filtering, introduction to image transforms, image enhancement in frequency domain.

UNIT V Image Segmentation (12L)

Image Segmentation and Edge Detection: Region Operations, Crack Edge Detection, Edge Following, Gradient operators, Compass and Laplace operators. Threshold detection methods, optimal thresholding, multispectral thresholding, thresholding in hierarchical data structures; edge based image segmentation- edge image thresholding, edge relaxation, border tracing, border detection, image morphology, image security.

Total (60 L)

TEXT BOOKS:

1. Richard O. Duda, Peter E. Hart, David G. Stroke, Pattern Classifications, Wiley, 2012
2. Lawrence Rabiner, Biing – Hwang Juang Fundamentals of Speech Recognition, Pearson, 1993.
3. Gonzalez R.C & Woods R.E., Digital Image Processing, Addison Wesley, 2009.

REFERENCES:

1. Jain A.K., Fundamentals of Digital Image Processing, Prentice Hall of India,2001.

2. Reddy M.Anji, Digital Image Processing, BS Publications.

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| CLOUD COMPUTING | L | T | P | C |
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UNIT I CLOUD COMPUTING BASICS

Cloud computing components- Infrastructure-services- storage applications-database services – Deployment models of Cloud- Services offered by Cloud- Benefits and Limitations of Cloud Computing – Issues in Cloud security- Cloud security services and design principles.

(12L)

UNIT II VIRTUALIZATION FUNDAMENTALS

Virtualization – Enabling technology for cloud computing- Types of Virtualization- Server Virtualization- Desktop Virtualization – Memory Virtualization – Application and Storage Virtualization- Tools and Products available for Virtualization.

(13L)

UNIT III SaaS and PaaS

Getting started with SaaS- Understanding the multitenant nature of SaaS solutions- Understanding OpenSaaS Solutions- Understanding Service Oriented Architecture- PaaS- Benefits and Limitations of PaaS.

(11L)

UNIT IV IaaS AND CLOUD DATA STORAGE

Understanding IaaS- Improving performance through Load balancing- Server Types within IaaS solutions- Utilizing cloud based NAS devices – Understanding Cloud based data storage- Cloud based backup devices- Cloud based database solutions- Cloud based block storage.

(12L)

UNIT V CLOUD APPLICATION DEVELOPMENT

Client Server Distributed Architecture for cloud – Traditional apps vs. Cloud apps – Client side programming model: Web clients. Mobile clients- Server Side Programming Technologies: AJAX, JSON, Web Services (RPC, REST)- MVC Design Patterns for Cloud Application Development.

(12L)

(TOTAL: 60L)

REFERENCES BOOK:

1. Anthony T .Velte, Toby J.Velte, Robert Elsenpeter, “Cloud Computing: A Practical Approach”, Tata McGraw Hill Edition, Fourth Reprint, 2010.
2. Kris Jamsa, “Cloud Computing: SaaS, PaaS, IaaS, Virtualization, Business Models, Mobile, Security and more”, Jones & Bartlett Learning Company LLC, 2013.
3. Ronald L.Krutz, Russell vines, “Cloud Security: A Comprehensive Guide to Secure Cloud Computing”, Wiley Publishing Inc., 2010.

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| COMPUTING FOR DATA ANALYTICS | L | T | P | C |
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UNIT I DATA ANALYTICS LIFE CYCLE

Introduction to Big data Business Analytics - State of the practice in analytics role of data scientists - Key roles for successful analytic project - Main phases of life cycle - Developing core deliverables for stakeholders.

(12L)

UNIT – II STATISTICS

Sampling Techniques - Data classification, Tabulation, Frequency and Graphic representation - Measures of central value - Arithmetic mean, Geometric mean, Harmonic mean, Mode, Median, Quartiles, Deciles, Percentile - Measures of variation – Range, IQR, Quartile deviation, Mean deviation, standard deviation, coefficient variance, skewness, Moments & Kurtosis.

(13L)

UNIT – III PROBABILITY AND HYPOTHESIS TESTING

Random variable, distributions, two dimensional R.V, joint probability function, marginal density function. Random vectors - Some special probability distribution - Binomial, Poison, Geometric, uniform, exponential, normal, gamma and Erlang. Multivariate normal distribution - Sampling distribution – Estimation - point, confidence - Test of significance, 1& 2 tailed test, uses of distribution, F-distribution, χ^2 distribution.

(13L)

UNIT – IV PREDICTIVE ANALYTICS

Predictive modeling and Analysis - Regression Analysis, Multicollinearity, Correlation analysis, Rank correlation coefficient, Multiple correlation, Least square, Curve fitting and good ness of fit.

(10L)

UNIT – V TIME SERIES FORECASTING AND DESIGN OF EXPERIMENTS

Forecasting Models for Time series : MA, SES, TS with trend, season - Design of Experiments, one way classification, two way classification, ANOVA, Latin square, Factorial Design.

(12L)

(TOTAL: 60L)

REFERENCES:

1. Chris Eaton, Dirk Deroos, Tom Deutsch et al., “Understanding Big Data”, McGrawHill, 2012.
2. Alberto Cordoba, “Understanding the Predictive Analytics Lifecycle”, Wiley, 2014.
3. Eric Siegel, Thomas H. Davenport, “Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die”, Wiley, 2013.
4. James R Evans, “Business Analytics – Methods, Models and Decisions”, Pearson 2013.
5. R. N. Prasad, Seema Acharya, “Fundamentals of Business Analytics”, Wiley, 2015.
6. S M Ross, “Introduction to Probability and Statistics for Engineers and Scientists”, Academic Foundation, 2011.

7. David Hand, Heiki Mannila, Padhria Smyth, “Principles of Data Mining”, PHI 2013.
8. Spyros Makridakis, Steven C Wheelwright, Rob J Hyndman, “Forecasting methods and applications”, Wiley 2013(Reprint).
9. David Hand, Heikki Mannila, Padhraic Smyth, “Principles of Data mining”, PHI 2013.
10. <http://cran.r-project.org/doc/manuals/R-intro.html>
11. W.N. Venables, D.M Smith, “An introduction to R”,
12. R in Nutshell, O Reilly, 2012

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| BIG DATA ANALYTICS | L | T | P | C |
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UNIT I

INTRODUCTION TO BIG DATA: Introduction – distributed file system – Big Data and its importance, Four Vs, Drivers for Big data, Big data analytics, Big data applications. Algorithms using map reduce, Matrix-Vector Multiplication by Map Reduce.

(12L)

UNIT II

INTRODUCTION HADOOP: Big Data – Apache Hadoop & Hadoop EcoSystem – Moving Data in and out of Hadoop – Understanding inputs and outputs of MapReduce - Data Serialization.

(11L)

UNIT- III

HADOOP ARCHITECTURE: Hadoop Architecture, Hadoop Storage: HDFS, Common Hadoop Shell commands , Anatomy of File Write and Read., Name Node, Secondary Name Node, and Data Node, Hadoop Map Reduce paradigm, Map and Reduce tasks, Job, Task trackers - Cluster Setup – SSH & Hadoop Configuration – HDFS Administering –Monitoring & Maintenance.

(13L)

UNIT-IV

HADOOP ECOSYSTEM AND YARN : Hadoop ecosystem components - Schedulers - Fair and Capacity, Hadoop 2.0 New Features Name Node High Availability, HDFS Federation, MRv2, YARN, Running MRv1 in YARN.

(12L)

UNIT-V HIVE AND HIVEQL, HBASE : Hive Architecture and Installation, Comparison with Traditional Database, HiveQL - Querying Data - Sorting And Aggregating, Map Reduce Scripts, Joins & Subqueries, HBase concepts Advanced Usage, Schema Design, Advance Indexing - PIG, Zookeeper - how it helps in monitoring a cluster, HBase uses Zookeeper and how to Build Applications with Zookeeper.

(12L)

(TOTAL: 60 L)

REFERENCES:

1. Boris lublinsky, Kevin t. Smith, Alexey Yakubovich, “Professional Hadoop Solutions”, Wiley, ISBN: 9788126551071, 2015.
2. Chris Eaton, Dirk deroos et al., “Understanding Big data”, McGraw Hill, 2012.
3. Tom White, “HADOOP: The definitive Guide”, O Reilly 2012. 6 IT2015 SRM (E&T)
4. Vignesh Prajapati, “Big Data Analytics with R and Haoop”, Packet Publishing 2013.
5. Tom Plunkett, Brian Macdonald et al, “Oracle Big Data Handbook”, Oracle Press, 2014.
6. <http://www.bigdatauniversity.com/>
7. Jy Liebowitz, “Big Data and Business analytics”,CRC press, 2013.

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| FOUNDATIONS OF INFORMATION SECURITY | L | T | P | C |
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UNIT 1: CONCEPTUAL FOUNDATION OF INFORMATION SECURITY

Information as an asset to be protected – the CIA triad – threats to information assets: loss, copying, altering, denial of service, malware injection, natural threats like fire, flood, etc. – intangibility of information as an asset – Policies and procedures to protect information assets – the AAA paradigm (11L)

UNIT – 2: RISK MANAGEMENT

Introduction to information risk management – threat horizon – vulnerabilities – CVE databases - attack path – probability of occurrence of risky events – impact of risky events – risk appetite – risk treatment plans – quantitative and qualitative risk assessment (12L)

UNIT – 3: INFORMATION CLASSIFICATION AND VALUATION

Rationale for asset classification – approaches to classification – Benefits of classification – Determining the value of information – Data retention – Disposal of information assets – owners and custodians of information – roles, responsibilities and liabilities of owners and custodians of information – De-classification of information – reclassification of information (13L)

UNIT-4: ACCESS CONTROLS

Concept of restricted and regulate access to information assets – physical vs. logical access controls – user identity and access management – provision and escalation of privileges of access – single sign on – access to networks, databases, applications and operating systems – Access monitoring and review process – event logging – providing access to data at rest and in transit (14L)

UNIT-5: PERIMETER SECURITY

Defining physical and logical perimeters of information assets - Integrating physical and logical security - Physical assets as repositories of information assets – choke points on perimeter – physical security standards as applied to data centers (10L)

TOTAL (60L)

REFERENCES:

1. CISSP All-in-One Exam Guide by Shon Harris and Fernando Maymi, 7th Edition, McGraw-Hill Education, 1 June 2016
2. The CISSP Prep Guide: Gold Edition by Ronald L. Krutz, Russel Dean Vines, Gold Edition, Wiley Publication, 31 Oct 2002
3. ISO/ IEC 27002: 2005, First Edition

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| INTRODUCTION TO DIGITAL FORENSICS | L | T | P | C |
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UNIT-1: DIGITAL FORENSIC INVESTIGATION

Evolution of investigative process of compute crimes – Terminologies and definitions used in digital forensic investigations – the investigation life cycle – digital evidence under common law systems – chain of custody – presentation in court (10L)

UNIT-2: UNDERSTANDING DIGITAL DATA

Systems of storage of data in digital format – character codes, record structure, file formats and file signatures – storage of graphic files – recognition of file formats and intern storage architecture – extraction from forensic artifacts – retrieval of deleted data (11L)

UNIT-3: FORENSIC PRINCIPLES APPLIED TO DIGITAL SPACE

Applying common principles of forensic science to digital space – various core principles of forensic sciences eg., principles propounded by Frye, Coppelino, Marx and Daubert – best practices in evidence gathering – best operational practices in forensic sciences ported to digital forensics (12L)

UNIT-4: COLLECTING DIGITAL EVIDENCE

Identifying evidence of probative value – obstacles in collection of digital evidence – volatility of digital evidence – live vs dead forensic process – collection, storage, backup and archiving of evidence – controlling contamination – copying vs. bit mapping of data – analysis of evidence on site or at remote location – challenges due to commingled data on evidence computers (14L)

UNIT-5: STANDARDS AND BEST PRACTICE GUIDELINES

Handling the Digital Crime Scene - Digital Evidence Examination Guidelines – ACPO – IOCE – SWGDE – DFRWS - ISO 27037 (13L)

TOTAL (60L)

REFERENCES:

1. Computer Forensics, Computer Crime Investigation by John.R.Vacca, 2002, Firewall Media
2. Computer Intrusion Forensics by George Mohay et al, 2003, Artech House
3. Handbook of Digital Forensics by Eoghan Casey, 2010, Elsevier
4. NIST guidelines on digital forensic processes

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| ADVANCED INFORMATION SECURITY | L | T | P | C |
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UNIT-1: CRYPTOLOGY

Cryptography and cryptanalysis – Asymmetric and Symmetric crypto systems – evolution of crypto systems – uses and limitations of symmetric and asymmetric crypto systems – confidentiality using crypto systems – DES, 3-DES, AES and Rijndael crypto systems – FIPS tests for crypto strength – work factor – RSA, ECC and Quantum crypto systems – TTP services in PKI, X.509 protocols for PKI infrastructure – Digital signature and digital envelopes – PKCS implementation – Digital signature applications - Key management life cycle

(14L)

UNIT-2: APPLICATION SECURITY

SDLC concepts – Testing for security: types, methods and issues - Program coding and security to be built into it - Software maintenance and change control processes - Configuration management - Software Capability Maturity model (CMM) - DBMS concepts & terms: types, with focus on Relational model - Data dictionary – Interfaces to databases (ODBC, ADOJDBC, XML) - Database security features - User access rights – Database auditing features and logs.

(13L)

UNIT-3: IPSEC COMMUNICATION PROTOCOLS

IPSec, - Introduction to IPSec - IPSec building blocks - Security Associations (SAs) - Security Parameter Index (SPI) - IPSec Architecture - IPSec Protocols - Authentication Header (AH) - Encapsulation Security Payload (ESP) - Tunneling and Transport Mode - Internet Key Exchange (IKE) – ISAKMP

(12L)

UNIT-4: COMMON AUTHENTICATION PROTOCOLS

Various authentication protocols - Password Authentication Protocol (PAP) - Challenge Handshake Authentication Protocol (CHAP) - Extensible Authentication Protocols - Remote Access with RADIUS and DIAMETER - TACACS and TACACS Plus - Single Sign on – Kerberos, SEASAME – Authentication in Wireless networks

(11L)

UNIT-5: DIGITAL RIGHTS MANAGEMENT

Meaning of Digital Rights Management (DRM) - Need for DRM and preventing illegal file sharing on the Internet - DRM schemes - Microsoft DRM 2.0, and Content Scrambling System - Reasons why DRM schemes have been unsuccessful so far - Requirements for a good DRM scheme - secure hardware, secure software, and an efficient legal system

(10L)

TOTAL (60L)

REFERENCES:

1. CISSP All-in-One Exam Guide by Shon Harris and Fernando Maymi, 7th Edition, McGraw-Hill Education, 1 June 2016
2. Information Security Management handbook, 6th Edition, Harold F Tipton, Micki Krause, Auerbach Publications, 5 April 2012
3. The World Beyond Digital Rights Management by Jude Umeh, 1st edition, BCS - The Chartered Institute for IT, 2009
4. Cryptography and Network Security by Dr. William Stallings, 6th Edition, Pearson Education Publication, 01 Jan 2013
5. The CISSP Prep Guide: Gold Edition by Ronald L. Krutz, Russel Dean Vines, Gold Edition, Wiley Publication, 31 Oct 2002
6. Certified Information Systems Security Professional, Study Guide by Ed Tittel, Mike Chapple, James Michael Stewart, 6th Edition, Sybex Publication, 06 July 2012

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| COMPUTING TECHNIQUES FOR CANCER ANALYTICS | L | T | P | C |
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Unit – I Introduction to Genetics

Basic genetics – Cell growth and division – Structure and composition of Genes Chromosomes – DNA – Mutations – Types of mutation. (10L)

Unit – II Introduction to Breast Cancer Biology

Breast Cancer – Oncogenes – Tumor Suppressor Genes – Apoptosis – Angiogenesis – Metastasis – Inherited Gene Mutation – BRCA1, BRCA2 genes – Risk factors and causes of Breast Cancer – Prevention and Detection –Diagnosis and staging – Treatment. (13L)

Unit – III Data Mining

Data Mining – History – Definitions – Data Mining Functionalities – Classifications of Data Mining Systems – Major Issues in Data Mining – Data warehouse and OLAP Technology – Multidimensional Data Model – Data warehouse Architecture – Data Warehouse Implementation. (12L)

Unit – IV Data Mining Techniques

Data Processing – Data Cleaning – Data Integration and Transformation – Data Reduction – Discretization and concept of Hierarchy Generation – Concept Description – characterization and comparison. Association Rule Mining – Mining Single Dimension – Multilevel Association Rules – Mining for correlation Analysis – Classification and Prediction (12L)

Unit – V Machine Learning and Analytical Techniques

Models based on Summarization: Bayes Theorem - Chi squared Statistics Regression - Decision Tree - Neural Networks - Multilayer perceptron (MLP) - Radial basis functions -Genetic Algorithms - Cluster Analysis – Outlier - Cluster Vs Classification - Clustering Issues - Impact of Outliers on clustering- Classification and regression trees (CART) Clustering problems - Clustering Approaches. (13L)

TOTAL (60L)

References:

1. QuickFACTS: Breast CANCER What You Need to Know—NOW From the Experts at the American Cancer Society
2. Hejmadi.M., Introduction to Cancer Biology, Momna Hejmadi & Ventus Publishing, 2009.
3. <http://learn.genetics.utah.edu/content/basics/>
4. <https://www.cancer.org/cancer/cancer-basics.html>
5. Pieter Adriaans, Dolf Zantinge, Data Mining, Addison Wesley 1996.
6. Daniel T. Larose (2006): Data Mining Methods and Models, John Wiley & Sons.
7. Molecular Biology of Cancer Jesse D. Martinez, Michele Taylor Parker, Kimberly E. Fultz Natalia A. Ignatenko, Eugene W. Gerner, John Wiley & Sons, Inc, 2003.

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| REMOTE SENSING AND IMAGE INTERPRETATION | L | T | P | C |
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UNIT I

Introduction – Origin – Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels - color models. (12L)

UNIT II

Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering–Smoothing and Sharpening Spatial Filtering – Frequency Domain: Introduction to Fourier Transform – Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters (12L)

Unit III

Electromagnetic energy resources, electromagnetic radiation (EMR) spectrum, EMR energy – frequency – wavelength relationship, Boltzman law, Wien Law, (11L)

Unit IV

Characteristics of aerial photographs and satellite imagery – false colour composites, photo-elemental characters, reflectance and emittance- Geosynchronous and sunsynchronous orbits, location of a satellite in space, world referencing system. (12L)

Unit V

Remote sensing plate forms - Characteristics of different remote sensing satellites and sensors, resolution, analysis and interpretations of aerial photographs and satellites imagery. Satellite remote sensing digital data products, data format and storage, preprocessing – atmospheric, geometric and radiometric correction, image rectification and registration. (13L)

TOTAL (60L)

Text Book :

1. P.K.Guha,Remote sensing for Beginner – EWP, New Delhi,2003.

Reference Book:

1. Sabino.F.F. Remote sensing principles and interpretation, Freeman, San Francisco, 1978

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| INTRODUCTION TO MICROWAVE ANTENNA AND RADAR SIGNAL PROCESSING | L | T | P | C |
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UNIT I Fundamentals Of Radiation Systems (12L)

Definition of Antenna Parameters: Gain, Directivity, Effective aperture, Radiation Resistance, Radiation Pattern, Band width, Beam width, Input impedance, Efficiency, Antenna noise temperature, Polarization.

LF Antenna: Monopole – Half wave – Folded dipole - Reciprocity theorem.

UNIT II Advanced Radiation System (11L)

Antenna Array: Broad side – End fire – Binomial – Pattern Multiplication.

Radiating Elements: Horn – Reflector – Slot – Yagi Uda – Log Periodic – Microstrip – Radiation pattern of HF antennas.

UNIT III Mic And Microwave Network Theory (13L)

Review of Low Frequency Parameters: Impedance – Admittance – Hybrid – ABCD.

Microwave Network Theory: Different types of interconnection of two port networks – High frequency parameters – formulation of S parameters – Properties of S parameters – Reciprocal – lossless networks – Mismatched load – Transmission Matrix – Introduction to MIC.

UNIT IV Microwave Devices And Measurements (10L)

Microwave Devices: Waveguide – Bend – Twist – Corners – Terminations – Attenuators – Phase shifters – Tee junction – Isolator – Circulator – Coupler – formulation with S matrix.

Measurements: VSWR, Power, Impedance, Frequency, Attenuation, Q factor.

UNIT V Radar Signal Processing (14L)

Introduction – Basic Radar – Function of Radar – Radar Frequencies – Noise – Noise figure – Noise factor – Detection of signals in noise – Signal to Noise ratio – Probabilities of Detection and False Alarm – Radar Cross section – System losses – Doppler Radar – Pulse Doppler Radar – MTI Radar – Digital MTI Processing – AMTI – Limitations to MTI Performance – ADT – Applications of Radar.

TOTAL: (60L)

TEXT BOOKS:

1. John D Kraus, “Antennas for all Applications”, 3rd Edition, TMH, 2005.
2. Constantine A Balanis, “Antenna Theory Analysis and Design”, John Wiley and Sons Ltd., 1982.
3. Annapurna Das and Sisir K Das, “Microwave Engineering”, TMH, 2005.
4. Merrill I Skolnik, “Introduction to Radar Systems”, 3rd Edition, TMH, 2003.

REFERENCES:

1. J C Toomay, “Principles of Radar”, 2nd Edition, PHI, 2004.
2. Robert E Collin, “Foundations for Microwave Engineering”, John Wiley & Sons Inc, 2005.

3. Robert E Collin, “Antennas and Radio wave Propagation”, TMH, 1985

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| AN INTRODUCTION TO DATA ANALYTICS | L | T | P | C |
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UNIT I Data Analytics and Big Data:

Data Analytics- Definition, Launch, Importance of Data Analytics, Big Data-, Definition, Sources, Characteristics, Data Analytics Applications-Biomedical, Mobile Advertising, Sentimental Analysis, Disaster Management, Recommendation Engines, Smart Cities. (12L)

UNIT II Architectural Elements for Data Analytics:

Hardware Architecture for Data Analytics, Characteristics, Requirements, Distributed File System for Big Data- Commodity Cluster for Big Data, Storage and Programming Model of Hadoop for Big Data, Data in Warehouse and Data in Hadoop- a comparison, Data Analytics on Cloud. (12L)

UNIT III Stages of Data Analytics and Data Analytics Project Life Cycle:

Stages of Data Analytics-Descriptive Analytics, Discovery Analytics, Prescriptive Analytics, Predictive Analytics. Data Analytics Project Life Cycle-Background, Phase 1: Discovery, Phase 2- Data Preparation, Phase 3: Model Planning, Phase 4: Model Building, Phase 5: Communicating Results, Phase 6: Operationalize, Roles of Data Scientist. (14L)

UNIT IV Analytics Applications :

Data Analytics in Health Care-Personalized Treatment, Business-Targeted advertising, Introducing a new Product, Fraud Prediction, Data Analytics in Sports, Disaster Management, Data Analytics for Smart Cities, Requirements for being successful with Big Data Analytics. (12L)

UNIT V Data Analytics Projects- Case Studies:

Big Data Analytics in: Commonwealth Bank of Australia for Risk Analysis, Aetna Innovation Labs Analytics for Improving Health, Walmart’s analytics to improve online shopping, Jio and Data Analytics. (10hrs)

Total (60L)

Books:

1. “A Guide to Big Data Analytics”, Datameer.com.
2. Vignesh Prajapati, “Big Data Analytics with R and Hadoop”, Packt Publications.
3. D. Dietrich, B.Heller, B.Yang, “Data Science and Big Data Analytics”, EMC Education Services.
4. “Big Data Now”, O’Reily Inc.
5. DeWitt, S. Madden, and M. Stonebraker, “A Comparison of Approaches to Large-Scale Data Analysis”, SIGMOD Conference 2009.
6. Steven Cooper, “Data Science from Scratch”, Data Science.

7. www.mercerindustries.com/wp-content/uploads/2015/02/Watson-Tutorial-Big-Data-Business-Analytics
8. www.researchgate.net/publication/273961581_Big_Data_analytics_with_applications
9. <http://cs.ulb.ac.be/conferences>
10. www.businessesgrow.com/2016/12/06/big-data-case-studies
11. Eiman Al Nuaimi, Hind Al Neyadi, Nader Mohamed , ‘Applications of big data to smart cities’, Journal of Internet Services and Applications.
12. Samiya Khan1 , Kashish Ara Shakil and Mansaf Alam, ‘Cloud-based Big Data Analytics – A Survey of Current Research and Future Directions
13. Bogdan Ionescu, Dan Ionescu, Cristian Gadea, Bogdan Solomon, and Mircea Trifan, “An Architecture and Methods for Big Data Analysis”

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| STATISTICAL LEARNING FOR DATA ANALYTICS | L | T | P | C |
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UNIT I Descriptive Statistics:

Data Sets, Describing Discrete Data, Continuous Data, Statistics for Continuous Data, Outliers and Box Plots, Comparing Data Sets, Measures of Central Tendency, Measures of Scale, Relationship between Variables- Linear Model, Residual Analysis, Measures of Relationships, (12L)

UNIT II Inferential Statistics:

Examples of Prediction Problems, Probability, Determination of Probability-Tree Diagram, Examples, Conditional Probability, Random Variables. Parameters, Discrete Probability Models- Binomial Probability Model, Poisson Probability Model, Continuous Probability Models- Uniform Probability Model, Parameters, Normal Distribution, Normal Quantiles. (10L)

UNIT III Bayesian Statistics:

Bayesian Statistics, Using Bayesian analysis to estimate a Proportion, Specifying a Prior for a Proportion, Calculating the Likelihood for a Proportion, Calculating the Posterior Distribution for a Proportion, Exercises in R. (11L)

UNIT IV Concepts of Hypothesis Testing:

Central Limit Theorem, Confidence Intervals, Testing Procedure, The Wilcoxon, Alternatives, Estimation and Confidence Interval based on Wilcoxon, Estimation and Confidence Interval based on Wilcoxon, Difference between Proportions. (13L)

UNIT V Design of Experiments and Regression: Completely Randomized Designs, Randomized Pair Designs, Regression Experimental Design, Example, Observational Studies, Linear Regression and Applications. (14L)

Total (60L)

Books:

1. A.Abebe, J.Daniels, J.W.Macean, "Statistics and Data Analytics", Statistical Computation Lab, Western Michigan University, Kalamazoo.
2. Avril Coghlan, "A little Book for R using Bayesian Statistics", Wellcome Trust Sanger Institute, U.K.
3. "Kickstarting R"- cran.r-project.org/doc/contrib/Lemon-kickstart.
4. "Introduction to R" -cran.r-project.org/doc/manuals/R-intro.html.
5. "Bayesian Statistics" (product code M249/04) by the Open University, available from the Open University Shop.
6. Jim Albert, "Bayesian Computation with R".
7. Trevor Hasti, Robert Tibshirani, Jerome Friedman, "Data Mining, Inference and Statistics", 2nd Edition, Springer Series in Statistics.

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| MACHINE LEARNING ALGORITHMS FOR DATA ANALYTICS | L | T | P | C |
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Unit: I Introduction

Basic definitions, Applications, Problems, Designing a Learning system, types of learning, hypothesis space and inductive bias, evaluation, cross-validation, (14L)

Unit II Regression and Decision Trees

Linear regression, Logistic Regression, Decision trees, overfitting, Instance based learning, Feature reduction, Collaborative filtering based recommendation, (12L)

Unit: III Probability

Probability and Bayes learning, Support Vector Machine, Kernel function and Kernel SVM (10L)

Unit: IV Neural network

Perceptron, multilayer network, backpropagation, introduction to deep neural network, Computational learning theory, PAC learning model, Sample complexity, VC Dimension, Ensemble learning (14L)

Unit: V Clustering

k-means, adaptive hierarchical clustering, Gaussian mixture model. (10L)

Total (60L)

References:

1. Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997.
2. Introduction to Machine Learning Edition 2, by Ethem Alpaydin

URLS:

1. A Course in Machine Learning - http://ciml.info/dl/v0_8/ciml-v0_8-all.pdf
2. <http://alex.smola.org/drafts/thebook.pdf>
3. <https://www.cs.ubbcluj.ro/~gabis/ml/ml-books/McGrawHill%20-%20Machine%20Learning%20-Tom%20Mitchell.pdf>
4. <https://www.analyticsvidhya.com/blog/2017/09/common-machine-learning-algorithms/>
5. <https://www.cs.huji.ac.il/~shais/UnderstandingMachineLearning/understanding-machine-learning-theory-algorithms.pdf>
6. <https://www.analyticsvidhya.com/blog/2016/04/complete-tutorial-tree-based-modeling-scratch-in-python/#one>
7. <https://doc.lagout.org/Others/Data%20Mining/Data%20Mining%20and%20Predictive%20Analytics%20%5BLarose%20%26%20Larose%202015-03-16%5D.pdf>
8. <http://auapps.american.edu/alberto/www/analytics/ISLRLectures.html>

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| DESCRIPTIVE AND DISCOVERY ANALYTICS | L | T | P | C |
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Unit 1 - Introduction to Descriptive Analytics

Introduction to Descriptive Analytics – Examples - The Role of Descriptive Analytics in Future Data Analysis – An industry Applications - Descriptive Data Collection: Survey Overview - Descriptive Data Collection: Net Promoter Score and Self-Reports - Descriptive Data Collection: Survey Design - Passive Data Collection - Media Planning- Causal Data Collection and Summary. (14L)

Unit 2 – Empowering data analysis with pandas

Packages- The data structure of pandas- Inserting and Exporting Data- Data Cleansing- Checking and Filling Missing Data- String Operations- Merging Data- Aggregation operations - Joins – Case Study. (10L)

Unit 3 – Basics of Discovery Analytics

Comparing two groups - Drawing inferences - Independent groups - Dependent groups - Independent groups - Categorical association - Chi-squared test for association - The Chi-squared test - Interpreting the Chi-squared test - Chi-squared test for goodness of fit - An alternative to the Chi-squared test- Case Study. (12L)

Unit 4 - Simple and Multiple Regressions

Simple regression - Describing quantitative association - Simple regression - Drawing inferences - Pitfalls in regression - Testing the model - Checking assumptions - Simple regression - Exponential regression - Multiple regression – Model- Tests - Overall test - Individual tests - Checking assumptions. (13L)

Unit 5 - Parametric Tests and Non-parametric Tests

Basics and One-way ANOVA - Assumptions and F-test - Post-hoc t-tests - Factorial ANOVA - Assumptions and tests - ANOVA and regression - Non-parametric tests - The basics - Comparing groups with respect to mean rank - Several samples - Kruskal-Wallis test.

References:

1. <https://www.coursera.org/learn/wharton-customer-analytics>
2. <http://www.dataversity.net/fundamentals-descriptive-analytics>
3. Samir Madhavan, “Mastering Python for Data Science”, Packt, 2015.
4. <https://www.coursera.org/learn/inferential-statistics>

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| ADVANCED INTERNET OF THINGS | L | T | P | C |
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Unit 1: The IoT Networking Core : Technologies involved in IoT Development; Internet/Web and Networking Basics OSI Model, Data transfer referred with OSI Model, IP Addressing, Point to Point Data transfer, Point to Multi Point Data transfer & Network Topologies, Sub-netting, Network Topologies referred with Web, Introduction to Web Servers, Introduction to Cloud Computing; IoT Platform overview: Overview of IoT supported Hardware platforms such as: Raspberry pi, ARM Cortex Processors, Arduino and Intel Galileo boards; Network Fundamentals: Overview and working principle of Wired Networking equipment's – Router, Switches, Overview and working principle of Wireless Networking equipment's – Access Points, Hubs etc. Linux Network configuration Concepts: Networking configurations in Linux Accessing Hardware & Device Files interactions. (16L)

Unit 2: IoT Architecture: History of IoT, M2M – Machine to Machine, Web of Things, IoT protocols; Applications: Remote Monitoring & Sensing, Remote Controlling, Performance Analysis;The Architecture: The Layering concepts, IoT Communication Pattern, IoT protocol Architecture, The 6LoWPAN; Security aspects in IoT. (10L)

Unit 3: Building IOT with Raspberry PI : Network & Communication aspects Wireless medium access issues, MAC protocol survey, Survey routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination Physical device – Raspberry Pi Interfaces – Programming – APIs / Packages – Web services. (12L)

Unit 4: Building IOT With Galileo/Arduino : Intel Galileo Gen2 with Arduino - Interfaces - Arduino IDE – Programming - APIs and Hacks- Design challenges, Development challenges, Security challenges-Other challenges. (10L)

Unit 5: Case Study & advanced IoT Applications :IoT applications in home, infrastructures, buildings, security, Industries, Home appliances, other IoT electronic equipments. Use of Big Data and Visualization in IoT, Industry 4.0 concepts. Sensors and sensor Node and interfacing using any Embedded target boards (Raspberry Pi / Intel Galileo/ARM Cortex/ Arduino). (12L)

TOTAL (60L)

Text Books:

1. 6LoWPAN: The Wireless Embedded Internet, Zach Shelby, Carsten Bormann, Wiley
2. Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, Dr. Ovidiu Vermesan, Dr. Peter Friess, River Publishers.
3. Interconnecting Smart Objects with IP: The Next Internet, Jean-Philippe Vasseur, Adam Dunkels, Morgan Kuffmann

Reference Books:

1. Arshdeep Bahga, Vijay Madiseti, “Internet of Things – A hands-on approach”, Universities Press, 2015.
2. Manoel Carlos Ramon, “Intel® Galileo and Intel® Galileo Gen 2: API Features and Arduino Projects for Linux Programmers”, Apress, 2014.
3. Marco Schwartz, “Internet of Things with the Arduino Yun”, Packt Publishing, 2014
4. Designing the Internet of Things , Adrian McEwen (Author), Hakim Cassimally
5. The Internet of Things: From RFID to the Next-Generation Pervasive Networked Lu Yan, Yan Zhang, Laurence T. Yang, Huansheng Ning.
6. Walteneus Dargie,Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice".
7. The Internet of Things: From RFID to the Next-Generation Pervasive Networked Lu Yan, Yan Zhang, Laurence T. Yang, Huansheng Ning
8. F. Adelstein and S.K.S. Gupta, “Fundamentals of Mobile and Pervasive Computing,” McGraw Hill, 2009
9. Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley-India, 2010.

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| CRYPTOGRAPHY AND NETWORK SECURITY | L | T | P | C |
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Unit 1: Security in Computing Environment: Need for Security; Security Attack – Threats, Vulnerabilities, and Controls, Types of Threats (Attacks); Security Services – Confidentiality, Integrity, Availability; Information Security; Methods of Protection. Basics of Cryptography: Terminologies used in Cryptography; Substitution Techniques – The Caesar Cipher, One-Time Pads, The Vernam Cipher, Book Cipher; Transposition Techniques – Encipherment/Decipherment Complexity, Digrams, Trigrams, and Other Patterns. **(16L)**

Unit 2: Mathematical Background: Shannon’s Theory, Computational Complexity, Finite Fields, Number Theory. **(8L)**

Unit 3: Symmetric key Ciphers: Block Cipher principles, DES, AES, Blowfish, RC5, IDEA, Block cipher operation, Stream ciphers, RC4. Asymmetric key Ciphers: Principles of public key cryptosystems, RSA algorithm, Elgamal Cryptography, Diffie-Hellman Key Exchange, Knapsack Algorithm. **(12L)**

Unit 4: Cryptographic Hash Functions: Message Authentication, Secure Hash Algorithm (SHA-512), Message authentication codes: Authentication requirements, HMAC, CMAC, Digital signatures, Elgamal Digital Signature Scheme. Key Management and Distribution: Symmetric Key Distribution Using Symmetric & Asymmetric Encryption, Distribution of Public Keys, Kerberos, X.509 Authentication Service, Public – Key Infrastructure. **(14L)**

Unit 5: Web Security: Web Security Requirements; Secure Socket Layer (SSL) – SSL Architecture, SSL Protocol; Transport Layer Security (TLS); Secure Electronic Transaction (SET) – Features, Components, Dual Signature, Purchase Request. **(10L)**

TOTAL (60)

Text Books:

1. Cryptography and Network Security – Principles and Practice: William Stallings, Pearson Education, 6th Edition
2. Cryptography and Network Security: Atul Kahate, Mc Graw Hill, 3rd Edition

Reference Books:

1. Cryptography and Network Security: C K Shyamala, N Harini, Dr T R Padmanabhan, Wiley India, 1st Edition.
2. Cryptography and Network Security : Forouzan Mukhopadhyay, Mc Graw Hill, 3rd Edition
3. Information Security, Principles, and Practice: Mark Stamp, Wiley India.
4. Principles of Computer Security: WM. Arthur Conklin, Greg White, TMH
5. Introduction to Network Security: Neal Krawetz, CENGAGE Learning

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| P1 | MINI PROJECT | L | T | P | C |
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ADVANCED DEEP LEARNING FOR MALWARE ANALYSIS

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Unit 1: *Introduction to Malware analysis:* Why Malware analysis?, Types of malware analysis, Setting up the lab environment, Lab requirements, Malware sources. Static analysis- Determining file type, Identifying the obfuscation technique used to threat analysis, Classifying and comparing the malware samples, Dynamic analysis – Dynamic analysis Tools and their features, steps involved in dynamic analysis, Monitoring the Malware activity and understanding its behaviour.

(16L)

Unit 2: *Artificial Intelligence & Machine Learning:* Artificial Intelligence - Introduction, Application of Artificial Intelligence, Why Machine Learning and security?, Classification and Clustering – Machine Learning: Problems and Approaches, Training Algorithms to Learn, Supervised classification algorithms, Practical consideration in classification, Clustering Algorithms, Adversarial Machine Learning, Transfer Learning.

(12L)

Unit 3: *History of deep learning:* Thresholding Logic, Perceptron Learning algorithm, Multilayer Perceptrons, Representation Power of MLPs, Sigmoid Neurons, Gradient Descent, Feed Forward Neural Networks, Representation power of Feed Forward Neural Networks.

(10L)

Unit 4: *Back propogation:* LeNet, AlexNet, ZFNet, VGGNet, GoogLeNet, ResNet, Visualizing Convolutional Neural Networks, Guided BackPropogation, Deep Dream, Deep Art, Convolutional Neural Networks, Long Short Term Memory Networks, Recurrent Neural Networks, Backpropogation through time (BPTT), Vanishing and Exploding Gradients.

(10L)

Unit 5: *Recent Trends in Deep learning architecture:* Truncated BPTT, GRU, Generative Adversarial Networks(GANs, Radial Basis Function Networks(RBFNs), Self Organizing Maps (SOMs), Deep Belief Networks (DBNs), Restricted Boltzmann Machines(RBMs), Encoder Decoder Models, Autoencoder, Attention Mechanism, Attention over images.

(12L)

TOTAL(60L)

Text Books:

1. “Learning Malware analysis”, Monnappa K A, Packt Publishing.
2. “Machine Learning & Security”, Clarence Cheo and David Freeman, O’Reilly Media.
3. “Deep Learning” , Ian Goodfellow and YoshuaBengio and Aaron Courville, An MIT Press book.

Reference Books:

1. “Neural Networks A Systematic Introduction”, Raul Rojas, Springer.
2. “Neural Networks and Deep Learning”, Charu. C. Agarwal, Springer.
3. “Understanding Machine Learning From Theory to Algorithms”, Shai-Shalev, Shwartz and Shai Ben-David.

FOUNDATIONS OF MALWARE ANALYSIS

| L | T | P | C |
|---|---|---|---|
| 4 | | | 4 |

Unit 1: *Fundamental Theory* - Basic concepts, Assembly languages, Becoming familiar with x86, Basics of MIPS, Working with SPARC, Moving from assembly to High level programming language.

(16L)

Unit 2: *Diving Deep into Windows Malware* - Basic static and dynamic analysis for x86, Dynamic analysis with OllyDbg/Immunity Debugger, Debugging malicious services, unpacking, Decryption and Deobfuscation.

(10L)

Unit 3: *Inspecting process injection and API Hooking* - Understanding process injection, DLL injection, Working with process injection, Dynamic analysis of code injection, Memory Forensic techniques for Process Injection, Understanding API Hooking, Working with API Hooking.

(12L)

Unit 4: *Bypassing Anti-reverse Engineering Techniques* – Exploring debugger detection, Handling debugger breakpoints evasion, Escaping the debugger, obfuscation and anti-disassemblers, detecting sandboxes and virtual machines

(10L)

Unit 5: *Understanding Kernel-Mode Rootkits* - Kernel mode versus user mode, Windows Internals, Rootkits and device drivers, Hooking Mechanism, DKOM, Process Injection in Kernel-Mode, KPP in x64 systems, Static and dynamic analysis in Kernel-Mode.

(12L)

TOTAL(60L)

Text Books:

1. “Mastering Malware analysis”, Alexey Kleymenov, AmrThabet, Packt Publishing Ltd

Reference Books:

4. “Learning Malware analysis”, Monnappa K A, Packt Publishing.
5. “Automatic Malware Analysis: An Emulator Based Approach”, Heng Yin, Dawn Song, Springer.
6. “Rootkits for Dummies”, Larry Stevenson and Nancy Altholz, Wiley.

STUDY OF MALWARE ANALYSIS TOOLS AND DATASET

| L | T | P | C |
|---|---|---|---|
| 4 | | | 4 |

Unit 1: *Basic static malware analysis:* Dynamic analysis, Identifying attack campaigns using Malware Networks- Bipartite networks, Visualizing Malware Networks, Network visualization with Graphviz.

(16L)

Unit 2: *Dataset and its Features:* Microsoft Malware Classification Challenge (BIG 2015)- Lollipop, Vundo, Ramnit, Simda, UCI Dataset Repository – Detect Malware Types Data Set, Detect Malicious Executable (Antivirus) Data set, Malware static and dynamic features VxHeaven and Virus Total Data Set, Kaggle- Microsoft Malware Prediction – MachineIdentifier, HasDetections.

(12L)

Unit 3: *Malware Functionalities and Persistence methods:* Malware functionalities- Downloader, Dropper, Keylogger, Malware Persistence methods – Run Registry Key, Scheduled Tasks, Startup folder, AppInit-DLLs, DLL search order Hijacking, Malware obfuscation, Detecting API Hooks, Kernel Mode Rootkits .

(10L)

Unit 4: *Graphical Processing unit:* What the GPU does, Types of GPUs, CPU VS GPU, Computational Functions - GPU accelerated video decoding and encoding, Video decoding processes that can be accelerate, Application of GPU, GPU forms – Terminology, Dedicated graphics cards, Integrated graphics processing unit, Hybrid graphics processing, Stream processing and general purpose GPUs , External GPU.

(10L)

Unit 5: *Google Colab:* What is Google Colab?, Your First Colab Notebook, Documenting Your code, Google Colab- Saving Your work, Sharing your Notebook, Invoking System commands, Executing External Python Files, Google Colab – Graphical Outputs, Code Editing Help, Magics, Adding Forms, Installing ML Libraries, Using Free GPUs, Conclusion.

(12L)

TOTAL(60L)

Text Books:

1. “Malware Datascience, Joshua Saxe, Hillary Sanders, No Starch Press.
2. “Learning Malware analysis”, Monnappa K A, Packt Publishing.
3. “Colab Tutorialspoint Simply Easy Learning”, Tutorialspoint.

Reference Books:

1. “Hands on GPU computing with Python”, Avimanyu Bandyopadhy, Packt Publishing.
2. “Mastering Malware analysis”, Alexey Kleymenov, AmrThabet, Packt Publishing Ltd.
3. “Multicore and GPU Programming An integrated Approach”, Gerassimos Barlas, Elsevier.