1HCP-CS4.2	Web Programming Lab.	
Credits: P:3 T:1	Practical: 6Hrs/week	Max. Marks: 100 **C1: 15; C2: 15; C3: 70**

Assignments based on the paper **2HCT-CS-4.1** shall be implemented.

1HCP-CS4.3	Project Work	
Credits: P:3 T:1	Practical: 6Hrs/week	Max. Marks: 100 **C1: 15; C2: 15; C3: 70**

Students shall carry out individual project work under the supervision of guide allotted to them. Two copies of the Project work documentation shall be submitted to the Department at the end of the semester.

1SCT-CS4.4	Elective Paper	
Credits: L:4	Teaching: 4Hrs/week Total Teaching Hours : 52	Max. Marks: 100 **C1: 15; C2: 15; C3: 70**
Elective (any one) 4.4.1. Big Data Analytics 4.4.2. Cloud Computing 4.4.3. Embedded Systems		

2SCT-CS4.4.1	Big Data Analytics	
Credits: L: 4	Teaching: 4Hrs/week Total Teaching Hours : 52	Max. Marks: 100 **C1: 15; C2: 15; C3: 70**

Unit I **10 Hrs**

Introduction to big data: Data, Characteristics of data and Types of digital data: Unstructured, Semi-structured and Structured, Sources of data, Working with unstructured data, Evolution and Definition of big data, Characteristics and Need of big data, Challenges of big data, Data environment versus big data environment

Unit II **10 Hrs**

Big data analytics: Overview of business intelligence, Data science and Analytics, Meaning and Characteristics of big data analytics, Need of big data analytics, Classification of analytics, Challenges to big data analytics, Importance of big data analytics, Basic terminologies in big data environment

Unit III **12 Hrs**

Big data technologies and Databases: Introduction to NoSQL, Uses, Features and Types, Need, Advantages, Disadvantages and Application of NoSQL, Overview of NewSQL, Comparing SQL, NoSQL and NewSQL, Introduction to MongoDB and its needs, Characteristics of MongoDB, Introduction of apache cassandra and its needs, Characteristics of Cassandra

Unit IV **10 Hrs**

Hadoop foundation for analytics: History, Needs, Features, Key advantage and Versions of Hadoop, Essential of Hadoop ecosystems, RDBMS versus Hadoop, Key aspects and Components of Hadoop, Hadoop architectures

Unit V **10 Hrs**

HadoopMapReduce and YARN framework: Introduction to MapReduce, Processing data with Hadoop using MapReduce, Introduction to YARN, Components, Need and Challenges of YARN, Dissecting YARN, MapReduce application, Data serialization and Working with common serialization formats, Big data serialization formats.

References

1. Text Book Seema Acharya and Subhashini Chellappan, "Big Data and Analytics", Wiley India Pvt. Ltd., 2016
2. Boris lublinsky, Kevin t. Smith, Alexey Yakubovich, "Professional Hadoop Solutions", Wiley, ISBN: 9788126551071, 2015.
3. Chris Eaton, Dirk deroos et al. , "Understanding Big data ", McGraw Hill, 2012.
4. Tom White, "HADOOP: The definitive Guide" , O Reilly, 2012.
5. Vignesh Prajapati, "Big Data Analytics with R and Haoop", Packet Publishing 2013.
6. Tom Plunkett, Brian Macdonald et al, "Oracle Big Data Handbook", Oracle Press, 2014.
7. http://www.bigdatauniversity.com/
8. Jy Liebowitz, "Big Data and Business analytics",CRC press, 2013.
9. "Big Data" by Judith Hurwitz, Alan Nugent, Dr. Fern Halper and Marcia Kaufman, Wiley Publications, 2014.
10. ."Big Data Imperatives : Enterprise Big Data Warehouse, BI Implementations and Analytics" by Soumendra Mohanty, Madhu Jagadeesh and Harsha Srivatsa, Apress Media, Springer Science + Business Media New York, 2013

2SCT- CS4.4.2	**Cloud Computing**	
Credits: L: 4	Teaching: 4Hrs/week Total Teaching Hours : 52	Max. Marks: 100 **C1: 15; C2: 15; C3: 70**

Unit I **10 Hrs**

FOUNDATIONS : Introduction to Cloud Computing : Cloud Computing in a Nutshell – Roots of Cloud Computing – Layers and types of Clouds – Desired features of a Cloud – Cloud Infrastructure Management – Challenges and Risks – Migrating into a Cloud: - Introduction – Broad Approaches – The Seven step model – Enriching the 'Integration as a Services' Paradigm for the Cloud Era: - Introduction – The Evolution of SaaS – The Challenges of SaaS Paradigm – Approaching the SaaS Integration Enigma – New Integration Scenarios – The Integration Methodologies – SaaS Integration Services – The Enterprise Cloud Computing Paradigm: - Introduction – Background – Issues – Transition Challenges – The Cloud Supply Chain.

Unit II **10 Hrs**

INFRASTRUCTURE AS A SERVICE : Virtual Machine Provisioning and Migration Services: Introduction – Background – Manageability – Migration Services – Management of Virtual Machines for Cloud Infrastructures: - Anatomy of Cloud Infrastructures – Distributed Management of Virtual Infrastructures – Scheduling techniques for Advance Reservation of Capacity – Enhancing Cloud Computing Environments Using a Cluster as a Service: - Introduction – Related Work – RVWS

2OE-CS-4.5	**Statistical Methods Using R**
Credits: L: 4 Teaching: 4Hrs/week Total Teaching Hours : 52	Max. Marks: 100 **C1: 15; C2: 15; C3: 70**

Unit I **10 Hrs**

Getting Started and Basics: An introductory R session, R as a calculator, Vectors and matrices, Getting help and loading packages, Data entry and exporting data.

Unit II **12 Hrs**

Exploratory Data Analysis with R: Summary statistics, Probability and Distribution- Generate numbers- the built-in distribution for cumulative distribution functions, quantiles and random numbers, Graphics in R - histograms, empirical cumulative distribution, QQ-plots, box plots, bar plots, dot charts and pie charts.

Unit II **08 Hrs**

R as a programming language, Grouping, loops and conditional execution, Functions.

Unit IV **12 Hrs**

Classical tests: One-sample tests- t-test, Wilcoxon signed-rank test; Two-sample tests- t-test and Wilcoxon test, paired t-test; Tests on more than two sample, Interpret the results. Regression and correlation: Simple regression and correlation, Multiple regression, Regression diagnostics.

Unit V **10 Hrs**

Tabular data and analysis of Categorical data: Single proportion, Two independent proportions, K proportions.

REFERENCES:

1. An Introduction to R, Notes on R: A Programming Environment for Data Analysis and Graphics. W. N. Venables, D.M. Smith and the R Development Core Team. Version 3.0.1 (2013-05-16). URL: https://cran.r-project.org/doc/manuals/r-release/R-intro.pdf
2. P. Dalgaard. Introductory Statistics with R, 2nd Edition. (Springer 2008)
3. Kleinman, Horton. SAS & R: Data Management, Statistical Analysis, Graphics (CRC 2009)
4. R for Data Science: Import, Tidy, Transform, Visualize, and Model Data, 1st Edition by Hadley Wickham, and Garrett Grolemund.
5. Modern Data Science with R, 1st Edition by Benjamin S. Baumer, Daniel T. Kaplan, and Nicholas J. Horton.
6. Gardener, M (2012) Beginning R: The Statistical Programming Language, Wiley Publications.

18MCAHCT5.2	**Data Analytics**
Credits: L: 4 Teaching: 4Hrs/week Total Teaching Hours : 52	Max. Marks: 100 **C1: 15; C2: 15; C3: 70**

Unit I **10 Hrs**

Introduction and Data Exploration - Introduction, Data and Relations-Matrix representation, variable
measures, sequential relation, sampling and quantization.

Data Pre-processing: Cleaning, Transformation, Basic Visualization-PCA, multidimensional scaling, Histograms, Correlation.

Unit II **10 Hrs**

Predictive Modeling and Optimization- Linear and non-linear regression, Feature Selection.Forecasting - Recurrent Models, Classification-Rules, Trees, Naïve Bayes, SVM, Vector Quantization. Evaluation Metrics-Validation and Interpretation.

Unit III **12 Hrs**

Optimization and Clustering - Optimization Methods – With derivatives, Gradient Descent. Clustering - Cluster Partition, Sequential, Prototype-Based, Relational, Cluster Validity and Self Organizing Map.

Unit IV **10 Hrs**

Mathematical Modeling and Spatial Data- Introduction to Multi-criteria Decision Making, Using Numerical Methods in Data Science, Mathematical Modeling with Markov Chains. Modeling Spatial Data with Statistics- Getting predictive surfaces from special point data, Using trend surface analysis on spatial data.

Unit V **10 Hrs**

Visualization- Principles of Visualization - Understanding the type, Design Style, Data Graphic Type, Web-based Applications for Visualization Design, Best practices in dashboards, Making maps for Spatial Data.

REFERENCES:

1. Runkler, Thomas. A, Data Analytics:Models and Algorithms for Intelligent Data Analysis, Springer, 2012.
2. Lillean Pearson, Data Science For Dummies, John Wiley and Sons, 2015
3. Jain P and Sharma P, Behind Every Good Decision: How Anyone Can Use Business Analytics to Turn Data into Profitable Insight, Amacom, 2014.
4. John W Foreman, Data Smart: Using Data Science to Transform Information into Insight, Wiley, 2013.

MCA

20MCASCT3.6.1	Cloud Computing	
Credits: L: 4	Teaching: 4Hrs/week Total Teaching Hours : 52	Max. Marks: 100 C1: 15; C2: 15; C3: 70

UNIT-I: CLOUD COMPUTING BASICS: cloud computing Overview, Cloud components, Infrastructure, Services, Applications, Storage, Database services, Intranets and the cloud, components, Hypervisor applications -, First Movers in the Cloud.

YOUR ORGANIZATION AND CLOUD COMPUTING: When you can use Cloud computing, Benefits, Limitations, Security Concerns, Regulatory Issues. **10hrs**

UNIT-II: THE BUSINESS CASE FOR GOING TO THE CLOUD: Cloud computing services- Infrastructure as a Service, Platform as a Service, Software as a Service, Software plus services, How applications help your business, Deleting your data center.

CLOUD COMPUTING WITH THE TITANS: Google, EMC, NetApp, Microsoft, Amazon, Salesforce.com, IBM **10hrs**

UNIT- III: HARDWARE AND INFRASTRUCTURE- Clients – Mobile, thin, Thick-, Security- Data leakage, Offloading work, Logging, Forensic, Development, Auditing-, Network – Basic public Internet, The accelerated Internet, Optimized Internet overlays, Cloud providers, cloud consumers, Services.

ACCESSING THE CLOUD- Platforms – Web Application framework, Web hosting service, Proprietary methods -, Web Applications, Web APIs- What are APIs, How APIs work, API Creators -, Web Browsers. **12hrs**

UNIT-IV: CLOUD STORAGE- Overview-The Basics, storage as a service, Providers, security, Reliability, advantages, cautions, Outages, Theft-, Cloud storage providers

STANDARDS- Application – Communication, Security -, Client – HTML, Dynamic HTML, JavaScript - Infrastructure – Virtualization, OVF -, Service – Data, Web service. **10hrs**

UNIT-V:

DEVELOPING APPLICATIONS - Google, Microsoft, Intuit QuickBase, Cast Iron cloud, Bungee connect, Development, Trouble shooting, and Application Management.

LOCAL CLOUDS AND THIN CLIENTS- Virtualization in your Organization- why virtualize, How to virtualize, concerns, security-, Server solutions- Microsoft Hyper-V, VMware, VMware Infrastructure. **10hrs**

TEXT BOOKS:

1. Anthony TVelte, Toby JVelteand Robert Elsenpeter, Cloud Computing –A Practical Approach, Tata McGraw Hill Education Pvt Ltd, 2010

2. Syed A.Ahson and Mohammed Ilyas, Cloud Computing and Software Services: Theory and Techniques, CRC Press, Taylor and Francis Group, 2010.

REFERENCES BOOKS:

1. Judith Hurwitz, Robin Bloor, Marcia Kaufman and Fern Halper, Cloud Computing for Dummies. Wiley- India edition, 2010.
2. Ronald L. Krutz and Russell Dean Vines, Cloud Security: A Comprehensive Guide to Secure Cloud Computing. Wiley Publishing, Inc., 2012.

new added

20MCAHCT3.2	Digital Image Processing	
Credits: L: 4	Teaching: 4Hrs/week Total Teaching Hours : 52	Max. Marks: 100 C1: 15; C2: 15; C3: 70

UNIT-I:

INTRODUCTION: What Is Digital Image Processing?, The Origins of Digital Image Processing, Examples of Fields that Use Digital Image Processing, Fundamental Steps in Digital Image, Processing, Components of an Image Processing System. **10 hrs**

UNIT-II:

DIGITAL IMAGE FUNDAMENTALS: Elements of Visual Perception, Light and the Electromagnetic Spectrum, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships between Pixels, An Introduction to the Mathematical Tools Used in Digital Image. **10 hrs**

UNIT-III: INTENSITY TRANSFORMATIONS AND SPATIAL FILTERING: Background, Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters Combining Spatial Enhancement Methods, Using Fuzzy Techniques for Intensity, Transformations and Spatial, Filtering. **12hrs**

UNIT-IV: FILTERING IN THE FREQUENCY DOMAIN: Background, Preliminary Concepts, Sampling and the Fourier Transform of Sampled Functions, The Discrete Fourier Transform (DFT) of One Variable, Extension to Functions of Two Variables, Some Properties of the 2-D Discrete Fourier Transform, The Basics of Filtering in the Frequency Domain, Image Smoothing Using Frequency Domain Filters, Image Sharpening Using Frequency Domain Filters, Selective Filtering. **12hrs**

UNIT-V: IMAGE RESTORATION AND RECONSTRUCTION: A 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, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering Constrained Least Squares Filtering, Geometric Mean Filter, Image Reconstruction from Projections. **10hrs**

TEXT BOOK:

1. Digital Image Processing – Rafel C Gonzalez and Richard E Woods, 3rd Edition, Pearson Education, 2003.

REFERENCES BOOKS:

1. Image Processing, Analysis and Machine Vision – Milan Sonka, Vaclav Hlavac and Roger Boyle, 2nd Edition, Thomson Learning, 2001
2. Fundamentals of Digital Image Processing – Anil K Jain, Pearson Education/Prentice-Hall of India Pvt. Ltd., 1997.
3. Digital Image Processing and Analysis – B.Chanda, D Dutta Majumder, Prentice-Hall India, 2002.

20MCASCT3.6.2	Data Analytics	
Credits: L: 4	Teaching: 4Hrs/week Total Teaching Hours : 52	Max. Marks: 100 C1: 15; C2: 15; C3: 70

New added

UNIT – I:

INTRODUCTION AND DATA EXPLORATION: Introduction, Data and Relations-Matrix representation, variable measures, sequential relation, sampling and quantization.

DATA PRE-PROCESSING: Cleaning, Transformation, Basic Visualization-PCA, multidimensional scaling, Histograms, Correlation. **10 hrs**

UNIT – II:

PREDICTIVE MODELING AND OPTIMIZATION: Linear and non-linear regression, Feature Selection.

FORECASTING: Recurrent Models, Classification-Rules, Trees, Naïve Bayes, SVM, Vector Quantization. Evaluation Metrics-Validation and Interpretation. **10 hrs**

UNIT – III:

OPTIMIZATION AND CLUSTERING: Optimization Methods – With derivatives, Gradient Descent.

CLUSTERING: Cluster Partition, Sequential, Prototype-Based, Relational, Cluster Validity and Self Organizing Map. **12 hrs**

UNIT – IV:

MATHEMATICAL MODELING AND SPATIAL DATA: Introduction to Multi-criteria Decision Making, Using Numerical Methods in Data Science, Mathematical Modeling with Markov Chains. Modeling Spatial

DATA WITH STATISTICS: Getting predictive surfaces from special point data, Using trend surface analysis on spatial data. **12 hrs**

UNIT – V:

VISUALIZATION: Principles of Visualization - Understanding the type, Design Style, Data Graphic Type, Web-based Applications for Visualization Design, Best practices in dashboards, Making maps for Spatial Data. **10 hrs**

TEXT BOOKS:

1. Runkler, Thomas. A, Data Analytics: Models and Algorithms for Intelligent Data Analysis, Springer, 2012.

REFERENCES BOOKS:

1. Lillean Pearson, Data Science For Dummies, John Wiley and Sons, 2015.
2. Jain P and Sharma P, Behind Every Good Decision: How Anyone Can Use Business Analytics to Turn Data into Profitable Insight, Amacom, 2014.
3. John W Foreman, Data Smart: Using Data Science to Transform Information into Insight, Wiley, 2013.

MCA IV SEMESTER

20MCA HCT4.1	Artificial Intelligence and Machine Learning
Credits:L:4	Max.Marks:100
Teaching:4Hrs / week Total Teaching Hours:52	**C1:15; C2:15; C3:70**

UNIT – I:

INTRODUCTION TO AI AND PRODUCTION SYSTEMS: The AI-Problems, Underlying assumption, What is an AI Technique?, Level of the model, Criteria for Success. Problem Definition as a State space search, Production systems, Problem characteristics, Production system characteristics, Issues in Design a search Programs.

12 hrs

UNIT – II:

HEURISTIC SEARCH TECHNIQUES AND KNOWLEDGE REPRESENTATION ISSUES: Generate and Test, Hill Climbing, Breathfirst, Problem Reduction, Constraints satisfaction, Means-end Analysis. Representations and mapping, approaches to knowledge, Issues in Knowledge Representations. Procedural v/s Declarative knowledge, Forward v/s Backward Reasoning. **12 hrs**

UNIT – III:

INTRODUCTION, CONCEPT LEARNING AND DECISION TREES: Learning Problems, Designing Learning systems, Perspectives and Issues, Concept Learning, Version Spaces and Candidate Elimination Algorithm, Inductive bias, Decision Tree learning, Representation, Algorithm – Heuristic Space Search. **14 hrs**

UNIT – IV:

NEURAL NETWORKS AND GENETIC ALGORITHMS: Neural Network Representation, Problems, Perceptrons, Multilayer Networks andBack Propagation Algorithms, Advanced Topics, Genetic Algorithms, Hypothesis, Space Search, Genetic Programming, Models of Evolution and Learning.

E-marketing –Traditional Marketing Vs.E-Marketing – Impact of E-commerce on markets – Marketing issues in E-Marketing – Online Marketing – E-advertising – Internet Marketing Trends – E-Branding – Marketing Strategies.

E- payment methods: Electronic Payment Systems, Need of Electronic Payment System, Cash Payment System, Credit Payment System, Types of Electronic Payment Systems: Credit Card• Debit Card • Smart Card• E-Money• Electronic Fund Transfer (EFT).

Unit-IV **12 hrs**

Societal impacts: Digital Foot prints, Digital Society and Netizen, Data Protection, E-waste, Impact on Health.

Activities: Creating a Google form and send itto Tenusers, scheduling a virtual meet and invite peoples to join the Google meet and Zoom Meet, Record the virtual Meet, chatting and sharing the documents or presentation on virtual meet.

Security in E Commerce Threats in Computer Systems: Virus, Cyber Crime Network Security: Encryption, Protecting Web server with a Firewall, Firewall and the Security Policy, Network Firewalls and Application Firewalls, Proxy Server.

Text Books:

1. Fundamentals of computers-V.Rajaraman -Prentice-Hall of India.
2. Computer Fundamentals-P.K.SinhaPublisher:BPBPublications.
3. E - Commerce – An Indian Perspective, Joseph P. T: PHI learning Pvt Ltd-2012

ReferenceLinks:

1. Elias. M. Awad, " Electronic Commerce", Prentice-Hall of India Pvt Ltd.
2. RaviKalakota, Andrew B. Whinston, "Electronic Commerce-A Manager's guide", Addison-Wesley.
3. Efraim Turban, Jae Lee, David King, H.Michael Chung, "Electronic Commerce– A ManagerialPerspective", Addison-Wesley.
4. Elias M Award, "Electronic Commerce from Vision to Fulfilment", 3rd Edition, PHI, Judy Strauss, Adel El-Ansary, Raymond Frost, "E-Marketing", 3RDEdition, Pearson Education.

REFERENCES:

1. G Coulouris, J Dollimore and T Kindberg, "Distributed Systems Concepts and Design", Third Edition, Pearson Education (Unit I).
2. Kai Hwang, Faye A. Brigs, "Computer Architecture and Parallel Processing", Mc Graw Hill (Unit I).
3. Qizheng Gu "RF System Design of Transceivers for Wireless Communications "Springer 2006, (Unit II).
4. Holger Kars, "Protocols and architectures for WSN", Wiely publication (Unit II).
5. M Jochen Schiller, "Mobile communication", Person Publication (Unit II).
6. Mathew Gast, "802.11 wireless Networks the definitive guide", O'Reilly(Unit II).
7. K. T. V. GrattanB. T. Meggitt "Optical Fiber Sensor Technology Applications and Systems" Optoelectronics, Imaging and Sensing Series book series (OISS, volume 3)(Unit III).
8. Waltenegus Dargie, Christian Poellabauer "Fundamentals of Wireless Sensor Networks (Unit III).
9. Dr B.S Grewal, Higher Engineering Mathematics, Khanna Publishers (Unit IV).
10. C.Ray Wylie, L.C.Burret, Advanced Engineering Mathematics, International Students Edition,(Unit IV).
11. Wilay, Theory and Practice, Wiley series for Wireless Communication Networks, 8th Edition (Unit IV).
12. William Stallings, Cryptography and Network Security, Fourth Edition, Pearson Education 200, (Unit IV).
13. Behrouz A. Forouzan, Cryptography & Network Security, TMH 2007,(Unit IV).
14. Robert Bragg, Mark Rhodes, Network Security: The complete reference, TMH, (Unit IV)
15. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, Introduction to Algorithms, Third Edition PHI 2010 (Unit V).

PHDCS2.3	Data Mining : Advanced Topics	
Credits: L: 4	Teaching: 4Hrs/week Total Teaching Hours : 52	Max. Marks: 100 **IA: 30 Term end Exam: 70**

Objectives: Study the most important fundamentals and techniques of Data Mining - Predictive modelling; Association rules and Link analysis; Clustering; Interpretations; Some Advanced Machine Learning techniques.

Unit I **08 Hrs**

Basic data mining tasks, dimensional modelling, a statistical persepective of data mining, similarity measures.

Unit II **12 Hrs**

Classification: Statistical based algorithms- Regression, Bayesian classification; distance based algorithms, decision-tree based algorithms, neural network based algorithms, rule-based algorithms. Clustering: Similarity and distance measures, outliers, hierarchical algorithms, partitional algorithms, clustering large databases, clustering with categorical attributes.

Unit III **10 Hrs**

Association Analysis: Frequent itemset generation, rule generation, compact representation of frequent item-sets, FP-growth algorithm, evaluation of association patterns, handling categorical

and continuous attributes, Handling concept hierarchy, sequential patterns, subgraph patterns, infrequent patterns. Pattern mining in multilevel and multidimensional space.

Unit IV **12 Hrs**

Web mining: Web content mining, Web secure mining, web usage mining.
Spatial Mining: spatial data overview, spatial data mining primitives, generalization and specialization, spatial rules, spatial classification algorithm, spatial clustering algorithms.

Unit V **10 Hrs**

Temporal mining: Modeling temporal events, time series, pattern detection, sequences, and temporal association rules.
Case study: credit rating/ fraud detection/ database marketing/ customer relationship management/ and stock market investment.

References:

1. Margaret H Dunham, Data Mining: Introductory and Advanced Topics, Pearson.
2. Peng-Ning Tan, Michael Steinbach and Vipin Kumar, Introduction to Data Mining, Pearson Education.
3. Jiawei Han and Micheline Kamber, Data Mining Concepts and Techniques, 1st Edition Indian Reprint, Harcourt India Private Limited, 2001.
4. Frank, and Hall Data Mining: Practical Machine Learning Tools and Techniques.
5. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, 2007.
6. Bishop, Pattern Recognition & Machine Learning, Springer, 2007
7. S.M. Weiss and N. Indurkhya, Predictive Data Mining, Morgan Kaufmann, 1998.
8. Bing Liu, Sentiment Analysis and Opinion Mining.

PHDCS3	Literature Review
Credits: L: 4	Max. Marks: 100 **IA: 30 Term end Exam: 70**

Review Writing & Seminar on the Published Research Work in the Relevant Field of study:

A minimum of 30 Articles shall be reviewed by the M.Phil/Ph.d candidate and submit a review report, in two copies, on topic of subject or area of interest in subject, under the supervision of the research guide, and will also give a presentation/seminar of the same during term end Viva-Voce exam before the Doctoral Committee.

Unit IV: **12 Hrs**

Machine Learning- Examples of Machine Learning Applications- Learning Associations, Classification, Regression, Unsupervised Learning, Reinforcement Learning.
Review of probability theory and probability distributions, model selection, decision theory, information theory, linear models for regression, linear models for classification.
Neural Networks-Feed-forward Network Functions, Network Training, Error Back propagation, The Hessian Matrix, Regularization in Neural Networks, Mixture Density Networks, Bayesian Neural Networks.
Kernel Methods-Constructing Kernels, Radial Basis Function Networks, Gaussian Processes, Sparse Kernel Machines.

Unit V: **10 Hrs**

Graphical Models- Bayesian Networks, Markov Random Fields, Inference in Graphical Models.
Mixture Models and EM- K-means Clustering, Mixtures of Gaussians.
Sampling Methods- Basic Sampling Algorithms, Markov Chain Monte Carlo, Gibbs Sampling.
Continuous Latent Variables- Principal Component Analysis, Probabilistic PCA, Kernel PCA.

REFERENCES:

1. Rafel C Gonzalez and Richard E Woods, Digital Image Processing 3rd Edition, Pearson Education, 2003.
2. Milan Sonka, Vaclav Hlavac and Roger Boyle, Image Processing, Analysis and Machine Vision 2nd Edition, Thomson Learning, 2001.
3. C M Bishop, Pattern Recognition and Machine Learning, Springer
4. R O Duda, P.E. Hart and D.G. Stork, Pattern Classification and scene analysis, John Wiley
5. Ethem Alpaydın, Introduction to Machine Learning Second Edition, The MIT Press Cambridge

PHDCS2.2	Advances in Wireless Network Communication & Artificial Intelligence (AI)
Credits: L: 4 Teaching: 4Hrs/week Total Teaching Hours : 52	Max. Marks: 100 IA: 30 Term end Exam: 70

new added.

Unit-I: Wireless and Mobile Systems: **8 Hrs**

Probability, Statistics and Traffic Theories, Mobile Radio Propagation, Channel Coding, The Cellular Concept, Multiple Radio Access, Multiple Division Techniques, Channel Allocation, Mobile Communication Systems, Existing Wireless Systems, Satellite Systems, Network Protocols, Ad Hoc Sensor Networks, Wireless LANs and Pans, Recent Advances of wireless and mobile networks.

Unit-II: Introduction to Wireless Sensor Networks: **12 Hrs**

Introduction: Constraints and Challenges, Opportunities and Challenges in Wireless Sensor Networks, Advantages of Sensor Networks (Energy Advantage and Detection Advantage), Sensor Network Applications, Smart Transportation, Collaborative Processing, Key Definitions.
Sensor Network Architecture and Applications: Introduction, Functional Architecture for Sensor Networks, Sample Implementation Architectures, Classification of WSNs, Characteristics, Technical Challenges, and Design Directions, Technical Approaches, Coverage in Wireless Sensor Networks, Location in Wireless Sensor Networks, Data Gathering and Processing.

Unit-III: Optical and Sensor Networks: **10 Hrs**

Computer Networks, Communication Systems, Optical Networks, Optical Fiber Principles and Operation, Wavelength Division Multiplexing (WDM) Network Architecture, Routing and Wavelength Assignment (RWA) Problems, Classification and Different Existing Heuristics, Multi-fiber WDM Networks and Different Existing Algorithms, Provisioning, Traffic Grooming, Protection and Reliability of Optical Networks. Sensor Network and its Challenges, Different Data Gathering Techniques, Security of Sensor.

PHDCS4	RESEARCH AND PUBLICATION ETHICS (RPE)	
Credits: L: 4	Teaching: 4Hrs/week Total Teaching Hours : 30	Max. Marks: 100 **IA: 15 Term end Exam: 35**

Valuable course

Course Title:

Research and Publication Ethics (RPE): Course for awareness about the publication ethics and publication misconducts.

Overview:

This course has total 6 units focusing on basis of philosophy of science and ethics, research integrity, publication ethics. Hands-on-sessions are designed to identify research misconduct and predatory publications. Indexing and citation database, open access publications, research metrics (Citations, H-Index, Impact Factor etc) and plagiarism tools will be introduced in this course.

Pedagogy:

Class room teaching, guest lectures, group discussions and practical sessions.

Evaluation:

Continuous assessment will be done through tutorials, assignments, quizzers and group discussions. Weightage will be given for active participation. Final written examination will be conducted at the end of the course.

Course Structure:

The course comprises of six modules listed in table below. Each module has 4-5 units.

Module	Unit title	Teaching hours
Theory		
RPE 01	Philosophy and Ethics	04
RPE 02	Scientific Conduct	04
RPE 03	Publication Ethics	07
Practice		
RPE 04	Open Access Publishing	04
RPE 05	Publication Misconduct	04
RPE06	Database and Research Metrics	01
	Total	**30**

Syllabus in detail:

THEORY:

- **RPE 01: PHILOSOPHY AND ETHICS** **(03 hrs.)**
  1. **Introduction to philosophy:** definition, nature and scope, concept, brances.
  2. **Ethics:** definition, moral philosophy, nature of moral judgments and reactions.
- **RPE 02: SCIENTIFIC CONDUCT** **(05 hrs.)**
  1. Ethics with respect to science and research.
  2. Intellectual honesty and research integrity.
  3. **Scientific misconducts:** Falsification, Fabrication and Plagiarism (FFP)
  4. **Redundant publications:** duplicate and overlapping publications, salami slicing.

5. Selective reporting and misrepresentation of data.

- **RPE 03: PUBLICATION ETHICS** **(07 hrs.)**

1. **Publication ethics:** definition, introduction and importance.
2. **Best practices/standards setting initiatives and guidelines:** COPE, WAME, etc.
3. Conflicts of interest.
4. **Publication misconduct:** definition, concepts, problems that lead to unethical behavior and vice versa, types.
5. Violation of publication ethics, authorship and contributorship
6. Identification of publication misconduct, complaints and appeals.
7. Predatory publishers and journal.

PRACTICE:

- **RPE04: OPEN ACCESS PUBLISHING** **(04 hrs.)**

1. Open access publications and initiatives.
2. SHERPA/RoMEO online recourse to check publisher copyright and self-archiving policies.
3. Software tool to identify predatory publications developed by SPPU.
4. Journal finder/journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc.

- **RPE05: PUBLICATION MISCONDUCT** **(04 hrs.)**

A. Group Discussion (02 hrs.)

1. Subject specific ethical issues, FFP, authorship.
2. Conflicts of interest.
3. Complaints and appeals: examples and fraud from India and abroad.

B. Software tools (02 hrs.)

Use of plagiarism software like Turnitin, Urkund and other open source software tools.

- **RPE 06: DATABASE AND RESEARCH METRICS (07 hrs.)**

A. Database (04 hrs.)

1. Indexing databases.
2. Citation database: Web of Science, Scopus, etc.

B. Research Metrics (03 hrs.)

1. Impact Factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score.
2. Metrics: H-Index, G-Index, i10 Index, Almetrics.

REFERENCES:

1. C. R. Kothari , Research Methodology, New Age International, New Delhi
2. Donald H. McBurney, Research Methods, Thomson Asia Pvt. Ltd. Singapore, 2002.
3. Kishor S. Trivedi, Probability and Statistic with Reliability, Queuing and computer Science Applications, Prentice-Hall of India
4. Goon Gupta and Das Gupta: Fundamentals of Statistics, Vol. 1, The World Press Pvt. Ltd., Kolkata.
5. Snedecor and Cochran: Statistical Methods, Oxford and IBH Publishers.
6. Gupta and Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi.
7. Neil Weiss, Introductory Statistics, Pearson Publishers.
8. Donald H. McBurney, Research Methods, Thomson Asia Pvt. Ltd. Singapore, 2002.

Assignments :

1. Paper Critique/Review & Summary.
2. Writing formal research proposal in IEEE / ACM style.
3. Evaluating a Software Process / Product.
4. Presenting a paper in a conference setup arranged for the class

PHDCS2.1	**Digital Image Processing And Pattern Recognition**	
Credits: L: 4	Teaching: 4Hrs/week Total Teaching Hours : 52	Max. Marks: 100 **IA: 30 Term end Exam: 70**

Objectives: This course provides a general understanding of the fundamentals of digital image processing. Familiarize the use of basic theories and computer algorithms to perform digital image processing. Familiarize with the fundamental algorithms of pattern recognition and machine learning. Select appropriate techniques for image processing problems.

Unit I **10 Hrs**

Introduction: Elements of Digital Image Processing Systems, Some basic relationships on pixels, Linear and Non Linear Operations.

Image Enhancement in the Spatial Domain: Gray Level Transformations, Histogram Processing, Enhancement, Smoothening and Sharpening Spatial Filters.

Image Enhancement in the Frequency Domain: Introduction to Fourier Transform and the frequency Domain Computing and Visualizing the 2D DFT, Smoothing Frequency Domain Filters, Sharpening Frequency Domain Filters, Homomorphic Filtering.

Unit II **10 Hrs**

Image Restoration: 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, Geometric Mean Filter, Geometric Transformations.

Morphology Image Processing: Erosion and dilation, opening and closing, hit-or-miss operations, basic morphological algorithms, gray-scale morphology.

PHDCS1	RESEARCH METHODOLOGY	
Credits: L: 4	Teaching: 4Hrs/week Total Teaching Hours : 52	Max. Marks: 100 **IA: 30 Term end Exam: 70**

Objectives: Study major categories, techniques, and processes of doing research with application to Computer Science. Preparing presentation and report on research. To acquaint students with elementary statistical methods of analysis of data Understanding of elementary probability theory and its applications, Understanding common univariate probability distributions, Multivariate distributions, curve fitting, etc.

Unit I **10 Hrs**

Fundamentals of Research: Introduction to Research Issues in Computer Science, Objectives and Dimension of Research. Exploring research in Computer Science, browsing the periodicals sections of the Library.

Tools of Research: General Tools of Research, Library and its Resource as a Tool of Research, The Computer and its Software as a Tool of Research, Measurement as Tool of Research, Different Measurements, Statistics as a Tool of Research, The Human Mind as a Tool of Research, Language as Tool of Research.

Unit II **10 Hrs**

Focusing Your Research Efforts: Identifying and Describing the Research Problem/Project, Stating the Research Problem, Identifying Sub Problems and its Characteristics. Stating the Hypotheses, Preparing a Research Proposal, aSample Research Proposal.

Reviewing the Related Literature: Role of the Review, Locating related literature, Using library catalog, indexes, abstracts and other general references, Using the library's on line Databases, Organizing information collected, Evaluating, organizing and synthesizing the literature, writing a sample research proposal.

Unit III **10 Hrs**

Research Planning: Planning a Research Proposal, Basic format of a research proposal, Research Planning versus Research Methodology, Genera Criteria for a Research Project, Role of Data in Research, Linking Data and Research Methodology, Comparing Quantitative and Qualitative Approaches.

Research Proposal: Organizing a Research Proposal, Practical applications, preparing a research report. Technical writing using LaTeX.

Unit IV **12 Hrs**

Statistical Techniques

Attributes, Primary data, Secondary data. Cross-sectional data, time series data, Notion of a statistical population, Notion of sample, random sample and non-random sample.

Measures of Central Tendency, Measures of Dispersion, Moments, Skewness and Kurtosis, Correlation, Regression.

Sampling distributions (Chi-Square, t, F, z). Test of Hypothesis- Testing for Attributes - Mean of Normal Population - One-tailed and two-tailed tests, F-test and Chi-Square test - - Analysis of variance ANOVA - One way and two way classifications.

Unit V **10 Hrs**

Probability Theory:

Probability as a measure of uncertainty, probabilities for events, axioms, probability rules, Fail time data analysis, Hazard models, conditional probability, Bayes' rule, random variables, probability distributions, discrete and continuous distributions, univariate and multivariate distributions, joint, marginal, conditional distributions. Curve Fitting and Principles of Least Squares- Regression and correlation.