Kolhapur Institute of Technology's

College of Engineering (Autonomous), Kolhapur

KOLHAPUR INSTITUTE
OF TECHNOLOGY'S
**COLLEGE OF
ENGINEERING
(AUTONOMOUS)
KOLHAPUR**

Curriculum Structure and Contents for

M.Tech. Computer Science & Engineering (Data Science)

w.e.f. Academic Year 2020-2021

Dr. M. S. Kalas

BOS Chairman & Head

Head
Department of Comp. Sci. & Engg.
Kolhapur Institute of Technology's
College of Engineering (Autonomous),
Kolhapur

Dr. M. S. Chavan

Dean Academics

Dean Academic
Kolhapur Institute of Technology's
College of Engineering (Autonomous,
Kolhapur

Dr. V. V. Karjinni

Director

Director
Kolhapur Institute of Technology's
College of Engineering (Autonomous)
Kolhapur

Department of Computer Science and Engineering (PG)

COLLEGE OF ENGINEERING KOLHAPUR

Structure for M.Tech. Computer Science & Engineering (Data Scienece) w.e.f July 2020)

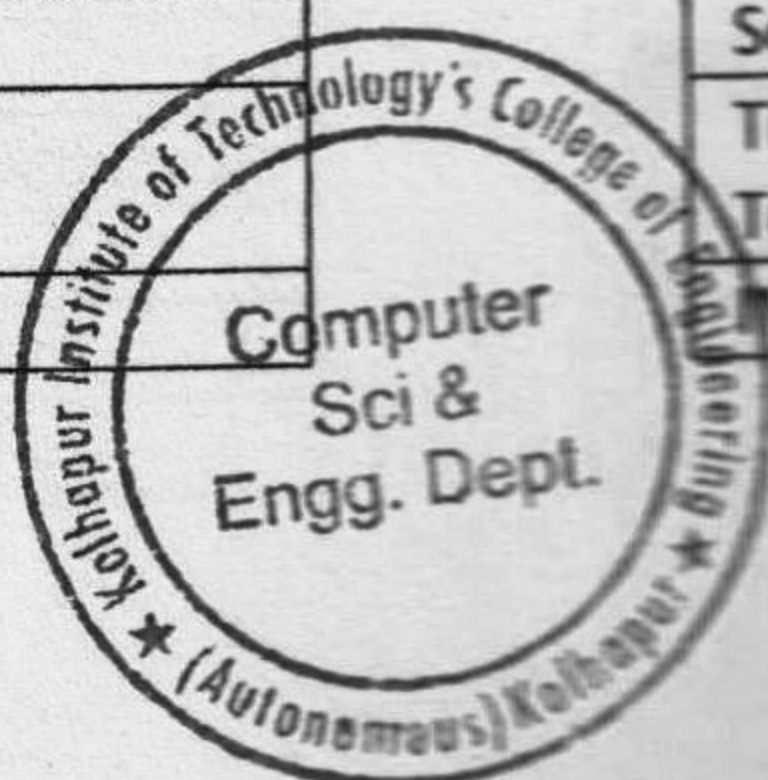**Teaching And Evaluation Scheme For First Year M.Tech. Programme**

Semester - I

Course Code	Course	Teaching Scheme				Evaluation Scheme (TH)			
		L	P	T	Credits	Components	Max	Min for Pass	
PCDS0161	Research Methodology	2	-	0	0	ESE	100		40
PCDS0101	Mathematical Foundations for Data Science	3	-	1	4	ISE-I	10		40
						ISE-II	10		
						MSE	30		
						ESE	50	20	
PCDS0102	Data Mining & Warehousing	3	-	1	4	ISE-I	10		40
						ISE-II	10		
						MSE	30		
						ESE	50	20	
PCDS0103	Machine Learning & Deep Learning	3	-	1	4	ISE-I	10		40
						ISE-II	10		
						MSE	30		
						ESE	50	20	
PCDS01**	Professional Elective-I	3	-	-	3	ISE-I	10		40
						ISE-II	10		
						MSE	30		
						ESE	50	20	
PCDS01**	Professional Elective-II	3	-	-	3	ISE-I	10		40
						ISE-II	10		
						MSE	30		
						ESE	50	20	
PCDS0131	Programming Lab-I		2	-	1	ISE	50	20	
						ESE(OE)	50	20	
PCDS0132	Professional Elective Lab-I		4	-	2	ISE	50	20	
						ESE(OE)	50	20	
PCDS0141	Seminar-I		4	-	2	ISE-I	50	40	
						ISE-II	50		
		17	10	3	23		900		
		Total Credits: 23				Total Contact hours: 30			

Head
Department of Comp. Sci. & Engg.
Kolhapur Institute of Technology's
College of Engineering (Autonomous)
Kolhapur

L	Lecture	ISE	In Semester Evaluation
P	Practical	MSE	Mid Semester Exam
T	Tutorial	ESE	End Semester Exam

PDS01 PROFESSIONAL ELECTIVE-I**

Course Name	Course Code
Pattern Recognition &NLP	PCDS0121
Web Analytics	PCDS0122
Introduction to NO-SQL	PCDS0123

PDS01 PROFESSIONAL ELECTIVE-II**

Course Name	Course Code
Soft computing in Data Analytics	PCDS0124
Time Series Analysis and Forecasting Techniques	PCDS0125
MHO Bioinformatics	PCDS0126

Structure for M.Tech. Computer Science & Engineering (Data Scienece) w.e.f July 2020)

Teaching And Evaluation Scheme For First Year M.Tech. Programme

Semester - II

Course Code	Course	Teaching Scheme				Evaluation Scheme (TH)			
		L	P	T	Credits	Components	Max	Min for Pass	
PCDS0261	Data Analytics Tools	2	-	-	0	ESE	100		40
PCDS0201	Statistical Foundations for Data science	3	-	1	4	ISE-I	10		40
						ISE-II	10		
						MSE	30		
						ESE	50	20	
PCDS0202	Artificial Intelligence	3	-	1	4	ISE-I	10		40
						ISE-II	10		
						MSE	30		
						ESE	50	20	
PCDS0203	Image processing &Video Analytics	3	-	1	4	ISE-I	10		40
						ISE-II	10		
						MSE	30		
						ESE	50	20	
PCDS02**	Professional Elective-III	3	-	1	4	ISE-I	10		40
						ISE-II	10		
						MSE	30		
						ESE	50	20	
PCDS02**	Professional Elective-IV	3	-	1	4	ISE-I	10		40
						ISE-II	10		
						MSE	30		
						ESE	50	20	
PCDS0231	Programming Lab-II		2	-	1	ISE	50	20	
						ESE(OE)	50	20	
PCDS0232	Professional Elective Lab-II		4	-	2	ISE	50	20	
						ESE(OE)	50	20	
PCDS0241	Seminar-II		2	-	1	ISE-I	50	40	
						ISE-II	50		
PCDS0251	Mini Project		2		1	ISE	50	20	
		17	10	5	25	ISE	950		
		Total Credits: 25				Total Contact hours: 32			

L	Lecture	ISE	In Semester Evaluation
P	Practical	MSE	Mid Semester Exam
T	Tutorial	ESE	End Semester Exam

PDS02** PROFESSIONAL ELECTIVE-III	
Course Name	**Course Code**
Business Intelligence System	PCDS0221
cloud computing	PCDS0222
Optimization Techniques	PCDS0223

PDS02** PROFESSIONAL ELECTIVE-IV	
Course Name	**Course Code**
IoT and Cognitive Computing	PCDS0224
Big Data Storage and Hadoop	PCDS0225
Financial Risk Analytics and Management	PCDS0226

Structure for M.Tech. Computer Science & Engineering (Data Scienece) w.e.f July 2020)

Teaching And Evaluation Scheme For First Year M.Tech. Programme

Semester - III

Course Code	Course	Teaching Scheme				Evaluation Scheme (TH)			
		L	P	T	Credits	Components	Marks		
							Max	Min for Pass	
PCDS0351	Dissertation Phase-I	-	4	-	2	ISE-I	50	60	
			8		4	ISE-II	100		
PCDS0352	Dissertation Phase-II	-	-	-	4	ESE	100	40	
PCDS0341	Industrial Training	-	-	-	2	ISE-I	50	20	
		0	12	0	12	-	300	-	
		Total Credits: 12				Total Contact hours: 12			

L	Lecture	ISE	In Semester Evaluation
P	Practical	MSE	Mid Semester Exam
T	Tutorial	ESE	End Semester Exam

Note: Industrial Training to be completed after Semester -II & before Semester-III

Structure for M.Tech. Computer Science & Engineering (Data Scienece) w.e.f July 2020)

Teaching And Evaluation Scheme For First Year M.Tech. Programme

Semester - IV

Course Code	Course	Teaching Scheme				Evaluation Scheme (TH)			
		L	P	T	Credits	Components	Marks		
							Max	Min for Pass	
PCDS0451	Dissertation Phase-III	-	8	-	4	ISE-I	100	80	
			8		4	ISE-II	100		
PCDS0452	Dissertation Phase-IV	-	-	-	8	ESE	200	80	
		0	16	0	16	-	400	-	
		Total Credits: 16				Total Contact hours: 16			

L	Lecture	ISE	In Semester Evaluation
P	Practical	MSE	Mid Semester Exam
T	Tutorial	ESE	End Semester Exam

Title of the Course: Research Methodology	L	T	P	Credit
Course Code: PDS0161	2	-	-	

Course: There are no Pre-Requisite for this course

Course Description: This course will provide an opportunity for participants to establish or advance their understanding of research through critical exploration of research language, ethics, and approaches.

Course Objectives:
1. Defending the use of Research Methodology
2. Judging the reliability and validity of experiments
3. Perform exploratory data analysis
4. Draw conclusions from categorical data
5. Using computer-intensive methods for data analysis
6. compare statistical models

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Defend the use of Research Methodology	Affective domain	Defend
CO2	Judge the reliability and validity of experiments	Psychomotor	Judge
CO3	perform exploratory data analysis	Psychomotor	analysis
CO4	draw conclusions from categorical data	Psychomotor	conclude
CO5	Use computer-intensive methods for data analysis	Psychomotor	data analysis
CO6	Drawing conclusions from statistical test results & compare statistical models	Psychomotor	compare

CO-PO Mapping:

CO	PO1	PO2	PO3
CO1	3	1	1
CO2	3	1	1
CO3	1	1	2
CO4	1	2	2
CO4	1	3	1
CO5	3	1	1
CO6	3	1	1

Assessments :
Teacher Assessment:
Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one EndSemester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	-
MSE	-
ISE 2	-

ESE	100

ESE: Assessment is based on 100% course content

Course Contents:

Unit I: Introduction to Research An Introduction, Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology Research and Scientific Method, Importance of Knowing How Research is Done, Research Process Criteria of Good Research, Problems Encountered by Researchers	**5 Hrs.**
Unit II Research Design Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs	**4 Hrs.**
Unit III Sampling Design Need for sampling, Population, Sample, Normal distribution, Steps in sampling, Systematic bias and Sampling error, Characteristics of good sample design, Probability sampling and Random sampling, Determination of sample size	**4 Hrs.**
Unit IV:--- **Results and Analysis** Importance and scientific methodology in recording results, importance of negative results, Different ways of recording, industrial requirement, artifacts versus true results, types ofanalysis (analytical, objective, subjective) and cross verification, correlation with published results, discussion, outcome as new idea, hypothesis, concept, theory, model etc	**4Hrs.**
Unit V : Measurement and Scaling Techniques Introduction, Concept of measurement - Measurement of scale, Developing measurement scale, Criteria of good measurement tools, Error measurement. Concept of Scaling, Classification, Approaches of scale construction, Types of scales - Rating scale, Ranking scale, Arbitrary scale, Differential scale, Summated scale, Cumulative scale, Factor scale.	**3 Hrs.**

Unit VI: Data Collection and Analysis of Data	4 Hrs.
Collection of Primary Data, Observation Method, Interview Method, Collection of Data through Questionnaires, Collection of Data through Schedules, Difference between Questionnaires and Schedules, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Data Processing Operations, Problems in Processing, Elements/Types of Analysis	

Textbooks:

1. Books: C. R. Kothari, "Research Methodology", New Age international, 2004.

2. Deepak Chopra and Neena Sondhi, "Research Methodology : Concepts and cases", Vikas Publishing House, New Delhi, 2008.

3. Ranjit Kumar, "Research Methodology: A Step by Step Guide for Beginners", 2nd Edition, Sage Publisher, 2011.

1. Kothari C.K., Research Methodology- Methods and Techniques (New Age International, New Delhi), 2004..

Unit wise Measurable students Learning Outcomes:
1. Recall research terminology
2. Be aware of the ethical principles of research, ethical challenges and approval processes
3. Describe quantitative, qualitative and mixed methods approaches to research
4. Identify the components of a literature review process
5. Critically analyze published research
6. Discuss Research Methodology

Title of the Course: Mathematical Foundations for Data Science	L	T	P	Credit
Course Code:PCDS0101	3	1		4

Course Pre-Requisite: Basic Mathematics

Course Description:
 This course introduces fundamental mathematical concepts relevant to data science and provides a basis for further study in machine learning, data analytics, and artificial intelligence

Course Objectives:
1.The course will introduce students to the fundamental mathematical concepts required for data science.
2. Introducing the basic notions of vector spaces, Linear Algebra and the use of Linear Algebra in applications to Data Science.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Demonstrate understanding of basic mathematical concepts in data sciencerelating to linear algebra.	2	Demonstrate
CO2	Understand the properties of Vector spaces, Matrices etc.	2	Understand
CO3	Demonstrate proficiency on the topics Eigenvalues, Eigenvectors and Inner Product Spaces	2	Demonstrate
CO4	Apply mathematics for problem-solving in Data Science.	4	Apply

CO-PO Mapping:

CO	PO1	PO2	PO3
CO1	2		2
CO2	3		2
CO3	3		2
CO4	3		3

Assessments :
Teacher Assessment:
Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1:---Vectors and Linear Equations Vectors, Matrices, Idea of Elimination, Matrix Operations, Factorization, Transposes and Permutations	8 **Hrs.**

Unit 2:---Vector Spaces and Subspaces Spaces of vectors, Null space , Independence , Basis and Dimension, Dimension of four subspaces	6 **Hrs.**
Unit 3:---Eigen Values and Eigen Vectors Eigen values, Diagonalizing a Matrix, Differential Equations, Singular Value Decomposition	8 **Hrs.**
Unit 4:--- Linear Transformations Linear Transformations, Matrix of Linear Transformations, Complex Vectors and Matrices	8 **Hrs.**
Unit 5:---Numerical Linear Algebra Gaussian Elimination in Practice, Norms and Condition Numbers, Iterative Methods and Pre-conditioners	6 **Hrs.**
Unit 6:--- Linear Algebra in Probability and Statistics Mean, Variance and Probability, Covariance Matrices and Joint Probabilities, Multivariate Gaussian and Weighted Least Squares	8 **Hrs.**

Textbooks:
1. G. Strang (2016). Introduction to Linear Algebra, Wellesley-Cambridge Press, Fifth edition, USA.
2.S. Axler, Linear algebra done right, Springer,2017.

References:
1] David C. Lay, Steven R. Lay, Judi J. McDonald, Linear Algebra and Its Applications, 5th edition, Pearson.

2]Avrim Blum, John Hopcroft, and RavindranKannan, Foundations of Data Science, Cambridge University Press.

Unit wise Measurable students Learning Outcomes:
1
2
3
4
5
6

Title of Course: Data Mining and Warehousing	L	T	P	Credits
Course Code: PCDS0102	3	1		4

Course Pre-Requisite: Data model, Database management system

Course Description: This course gives an introduction to methods and theory for development of data warehouses and data analysis using data mining. Data quality and methods and techniques for pre-processing of data. Modeling and design of data warehouses. Algorithms for classification, clustering and association rule analysis.

Course Learning Objectives:

To expose students to:

1. To understand the necessity of data-pre-processing and learn the applicability of the techniques in pre-processing.
2. To understand the usage of data warehouse.
3. To Identify the scope and necessity of Data Mining
4. To learn what are data mining algorithms and when and how to apply them to solve real world problems.
5. To explore how algorithm parameters and data properties affect the effectiveness of data mining methods used.

Course Outcome:

CO	After the completion of the course the student should be able to
CO1	Recall the data types and data pre-processing techniques.
CO2	Explain Data Warehouse fundamentals and Data Mining Principles.
CO3	Identify appropriate data mining algorithms to solve real world problems.
CO4	Compare and evaluate different data mining techniques like classification, prediction, clustering and association rule mining

CO-PO Mapping:

CO	PO1	PO2	PO3
CO1			3
CO2			3
CO3	1		3
CO4	1		3

Assessments:

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE1	10
MSE	30
ISE2	10
ESE	50

ISE 1 and 2 are based on assignment/declared test/quiz/seminar/group discussion etc.

MSE assessment is based on 50% of course content (Normally first three modules)

ESE assessment is based on 100% course content with 60-70% weight age for course content (Normally last three modules) covered after MSE.

Course Contents:

Unit 1: Introduction to Data Mining and Data Pre-processing : 1.1 Introduction 1.2 Data Mining Process 1.3 Basic Data Types 1.4 Data Objects and Attribute Types 1.5 Basic Statistical Descriptions of Data 1.6 Data Pre-processing: An Overview 1.7 Data Cleaning 1.8 Data Integration, 1.9 Data Reduction	**7 Hrs**
Unit 2: **Data Warehousing and Online Analytical Processing:** 2.1 Data Warehouse: Basic Concepts 2.2 Data Warehouse Modeling: Data Cube and OLAP 2.3 Data Warehouse Design and Usage 2.4 Data Warehouse Implementation 2.5 Data Cube Computation: Preliminary Concepts 2.6 Data Cube Computation Methods	**7Hrs**
Unit 3: Mining Frequent Patterns, Associations, and Correlations: 3.1 Basic Concepts 3.2 Frequent Itemset Mining Methods 3.3 Pattern EvaluationMethods	**5 Hrs**

Unit 4: Classification: 4.1 Basic Concepts 4.2 Decision Tree Induction-Decision Tree Induction, Attribute Selection Measures, Tree Pruning 4.3 Bayes Classification Methods 4.4 Rule-Based Classification 4.5 Model Evaluation and Selection- Metrics for Evaluating Classifier Performance, Holdout Method and Random Subsampling, Cross-Validation, Bootstrap 4.6Advanced Methods - Classification Using Frequent Patterns, *k*-Nearest-Neighbor Classifiers	**8Hrs**
Unit 5: Cluster Analysis: 5.1 Cluster Analysis 5.2 Partitioning Methods 5.3 Hierarchical Methods 5.4 Density-Based Methods 5.5 Grid-Based Methods 5.6 Advanced Cluster Analysis- Clustering Graph and Network Data	**7 Hrs**
Unit 6: Outlier Detection 6.1 Outliers and Outlier Analysis 6.2 Outlier Detection Methods 6.3 Statistical Approaches 6.4 Proximity-Based Approaches 6.5 Clustering-Based Approaches 6.6 Classification-Based Approaches	**6 Hrs**

Textbooks:

1. Jiawei Han, MichelineKamber, Jian Pei: Data Mining -Concepts and Techniques, 3rd Edition, Morgan Kaufmann Publisher, 2012.

2. Charu C. Aggarwal Data Mining The Textbook - Springer International Publishing Switzerland 2015

References:

1. Margaret H. Dunham: DATA MINING Introductory and Advanced Topics, Pearson Education, Prentice Hall, 2002.
2. Pang-Ning Tan, Michael Steinbach, Vipin Kumar: Introduction to Data Mining, Pearson, First impression, 2014
3. Sam Anahory, Dennis Murray: Data Warehousing in the Real World, Pearson, Tenth Impression, 2012.

Title of the Course: Machine Learning and Deep Learning	L	T	P	Credit
Course Code:PCDS0103	3	1		4

Course Pre-Requisite: Linear Algebra, Statistics and Probability

Course Description: This course introduces students to Machine Learning and Deep Learning. It enables students to understand the mathematical foundation on which the algorithms rely. And it enables students to identify research areas and applications in the field of deep machine learning.

Course Objectives:

1.   To introduce students to basic machine learning algorithms
2.   To give an insight of mathematical base required for different machine learning algorithms to students
3.   To introduce students to deep learning algorithms.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Identify real life problems where learning algorithms are applicable	3	Apply
CO2	Select suitable learning algorithm to solve a given problem	3	Apply
CO3	Analyse a learning problem mathematically	4	Analyse
CO4	Design a model based on machine learning for an application	5	Design

CO-PO Mapping:

CO	PO1	PO2	PO3
CO1	1		
CO2	1		
CO3	2		2
CO4	3	1	2

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one EndSemester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10

MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1 (Introduction and Regression):--- Introduction, Types of Learning, Simple Linear Regression: Hypothesis, Cost Function, Learning Rate, Gradient Descent for Linear Regression, Multivariate Linear regression, Polynomial Linear Regression.	**06 Hrs.**
Unit 2(Classification and Clustering):--- Naïve Bayes Classification, Decision tree Classification, Clustering: K-means Clustering, Association Rules	**07 Hrs.**
Unit 3(Neural Networks):--- Logistic Regrssion, Hypothesis, Cost Function, Gradient Descent Learning, Multiclass Classification, Back propagation of Error	**05 Hrs.**
Unit 4(Convolutional Neural Networks):--- The operation, Pooling, Convolution and Pooling as an infinitely strong prior, Variants of the basic functions, Efficient algorithms, Random or Unsupervised Features, Nueroscintific Basis for Convolutional Networks	**08 Hrs.**
Unit 5(Recurrent Neural Networks):--- RNN, Bidirectional RNN, Encoder-Decoder Sequence to sequence architecture, Deep Recurrent Networks, Recursive Neural Networks, The Long Short Term Memory and other Gated RNNs, Optimization for Long Term Dependencies.	**08 Hrs.**
Unit 6 (Applications):--- Large-Scale Deep Learning, Computer Vision, Speech Recognition, Natural Language Processing, Other Applications	**06 Hrs.**

Textbooks:

1. Deep Learning - Goodfellow, Bengio and Courville

2. Fundamentals of Deep Learning – Nikhil Budama

References:

1. Neural Networks and Deep Learning – CharuAggarwal

2. Hands-on Deep Learning Algorithms with Python – SudharsanRavichandran

Title of the Course: Professional Elective-I (Pattern Recognition and Natural Language Processing)	L	T	P	Credit
	3	-	-	3
Course Code: PCDS0121				

Course Prerequisites: Formal Languages Theory, Probability, Natural Language Features

Course Description: This course introduces different algorithms for natural language processing. It also gives an overview of different applications of natural language processing.

Course Learning Objectives:
1. To introduce classifiers in pattern recognition to the students
2. To introduce the algorithms of feature selection in pattern recognition to the students
3. To introduce the algorithms of syntax analysis of natural languages to the students
4. To introduce the algorithms of semantics analysis of natural languages to the students

Course Outcomes:

CO	After the completion of the course the student should be able to
CO1	explain classifiers in pattern recognition
CO2	apply algorithms for feature generation in pattern recognition
CO3	apply algorithms for syntax analysis of natural languages
CO4	apply algorithms for semantic analysis of natural languages

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1													
CO2	2	2												
CO3	2	2												
CO4				1										1

Assessments :
Teacher Assessment:
Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one EndSemester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:	
UNIT-I : Introduction **I**mportance of pattern recognition, Bayesian classifier for normal distribution, Bayesian networks, logistic discrimination, Non linear Classifier: decision tree, geometric average rule, arithmetic average rule.	**06 Hrs.**
UNIT-II: Feature Selection: Preprocessing, feature selection based on statistical hypothesis, feature subset selection, optimal feature generation, neural network and feature generation.	**06 Hrs.**
UNIT-III: Feature Generation: Regional features, feature for size and shape characterization, typical features for speech and audio classification.	**07 Hrs.**
UNIT-IV: Syntax Analysis: Dynamic Programming Parsing Methods, Partial Parsing, Probabilistic Context Free Grammars, Probabilistic CKY parsing of PCFG's, Learning PCFG Rule Probabilities, Problems and solutions of PCFG's	**07 Hrs.**
UNIT-V: Representing Semantics: Formal Meaning Representation, First-Order Logic, Representing Events and States, Syntax-Driven Semantic Analysis, Semantic Augmentations to Context-Free Grammar Rules, Quantifier Scope Ambiguity and Underspecification, Unification-Based Approaches to Semantic Analysis	**08 Hrs.**
UNIT-VI: Computational Lexical Semantics: Relations between Senses, WordNet: A Database of Lexical Relations, Word Sense Disambiguation, Supervised Word Sense Disambiguation, WSD: Dictionary and Thesaurus Methods	**07 Hrs.**

Textbooks:

1. Pattern Recognition –SergiosTheodoridis, KonstantinosKoutroumbas, Fourth Edition
2. Speech and Language Processing- Daniel Jurafsky, James H. Martin

References:

1. Natural Language Understanding- James Allen
2. Introduction to Natural Language Processing - Jacob Einstein
3. Natural Language Processing with Python - Bird, Klein, Loper
4. Pattern Recognition Concepts, Methods and Applications- J.P. Marques de Sa Springer

Title of the Course: Professional Elective-I (Web Analytics)		L	T	P	Credit
Course Code:PCDS0122		3			3

Course Pre-Requisite: Basic knowledge of web programming**.**

Course Description: In this course students will be exposed to web analytics tools and techniques. Students will learn to analyze the web content and improve it for better performance.

Course Objectives: In this course students will be exposed to:-

1. The importance of Web Analysis.
2. Different metrics used for Web Analysis.
3. Analytics tools available and their applications.

Course Learning Outcomes: Student will be able to:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		level	Descriptor
CO1	List the metrics used for Web Analytics.	I	List
CO2	Classify the tools for behavioural analysis.	II	Classify
CO3	Apply measuring techniques for user conversation.	III	Apply
CO4	Analyze the results obtained by applying the web analytics techniques	IV	Analyze

CO-PO Mapping:

CO	PO1	PO2	PO3
CO1		1	2
CO2		2	2
CO3	1	2	2
CO4	2	2	3

Assessments :
Teacher Assessment:
Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one EndSemester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1:--- **Introduction:** to Web Analytics. Importance of Web Analytics. How it can help to improve/increase business, traffic to channel/web page.	4 **Hrs.**

Unit 2:--- **Metrics:-**Standard Metrics:- visitors, time on page, site, Bounce Rate, Exit Rate. Conversion Rate. Engagement.	5 **Hrs.**

Unit 3:--- **Behavior Analysis**: Click Density Analysis, Segmenting, Source of Traffic. PPC-Pay Per Click Policy, Direct Traffic Analysis, Email Campaign Analysis, Rich Experience analysis- Video, Flash, Widgets. Visitors Tracking using Cookies, data Sampling.	6 **Hrs.**
Unit 4:--- : **Measuring Conversions:**KPI-key performance indicator, Completion Rate, Share of Search, Visitors Recency and Retaining, Subscriptions. Macro and Micro Conversions, Length of Visit, Depth of Visit.	4**Hrs.**
Unit 5:--- **Testing and Analysis:** A/B Testing, Multivariant Testing, Actions on test results. Data Sources, Types. Web traffic analysis, Search and keyword analysis.	5 **Hrs.**
Unit 6:--- **Popular Tools:** Case study and application of any one from the list: Google Analytics, MOZ, Crazy Egg, Piwik, Open Web Analysis, Woopra, Clikcy	6 **Hrs.**
References: **Book:-**Web Analytics 2.0, Author:- AvinashKaushik, Wiley Publication. https://analytics.google.com/ https://www.crazyegg.com http://www.openwebanalytics.com/ . .	

Title of Course: Professional Elective-I (Introduction to NOSQL) Course Code: PCDS0123	L	T	P	Credits
	3	-	-	3

Course Pre-Requisite: Data model, Database management system, Data structure concepts.

Course Description: Unlike traditional database management systems, NoSql databases are capable of storing unstructured data. They therefore not only meet the performance, scalability and flexibility needs that data – intensive applications require but are essential to big data processing.

Course Learning Objectives:

To expose students to:
1. NoSql database system
2. Comparison of relational databases to new NoSQL stores
3. Replication and sharding
4. NoSQL Key/Value databases using MongoDB
5. Column- oriented NoSQL databases using Apache HBASE
6. NoSQL Key/Value databases using Riak
7. Graph NoSQL databases using Neo4

Course Outcome:

CO	After the completion of the course the student should be able to
CO1	Categorize different types of NoSql Databases.
CO2	Interpret replication and sharing with respect to NoSql Databases.
CO3	Make use of databases such as MongoDB, Cassandra, HBASE, Neo4j etc for implementation Of NoSql Databases concept.

CO-PO Mapping:

CO	PO1	PO2	PO3
CO1	2		3
CO2			3
CO3	3		3

Assessments:

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE1	10
MSE	30
ISE2	10

	ESE	50	

ISE 1 and 2 are based on assignment/declared test/quiz/seminar/group discussion etc.

MSE assessment is based on 50% of course content (Normally first three modules)

ESE assessment is based on 100% course content with 60-70% weight age for course content (Normally last three modules) covered after MSE.

Course Contents:	
Unit 1: Introduction: Overview, History of NoSQL Databases Definition of the Four Types of NoSQL Database, The Value of Relational Databases, Getting at Persistent Data, Concurrency, Integration, Impedance Mismatch, Application and Integration Databases, Attack of the Clusters, The Emergence of NoSQL, Key Points, Comparison of relational databases to new NoSQL stores, Mongo DB, Cassandra, HBASE, Neo4j use and deployment, Application, RDBMS approach, Challenges NoSQL approach, Key-Value and Document Data Models, Column- Family Stores, Aggregate-Oriented Databases.	**8Hrs**
Unit 2: Replication and Sharding: MapReduce on databases. Distribution Models, Single Server, Sharding, Master-Slave Replication, Peer-to-Peer Replication, Combining Sharding and Replication.	**5 Hrs**
Unit 3: NoSql key/Value Databases using MongoDB: Document Databases, Document Database, Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Event Logging, Content Management Systems, Blogging Platforms, Web Analytics or Real-Time Analytics, E-Commerce Applications,Complex Transactions Spanning Different Operations, Queries against Varying Aggregate Structure.	**7 Hrs**
Unit 4: Column Oriented NoSql Databases using Apache HBASE: Column-oriented NoSQL databases using Apache Cassandra, Architecture of HBASE, What Is a Column-Family Data Store? Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Event Logging, Content Management Systems, Blogging Platforms, Counters, Expiring Usage.	**7 Hrs**
Unit 5: NoSql key/Value Databases using Riak: Key-Value Databases, What Is a KeyValue Store, KeyValue Store Features, Consistency, Transactions, Query Features, Structure of Data, Scaling, Suitable Use Cases, Storing Session Information, User Profiles, Preferences, Shopping Cart Data, When Not to Use, Relationships among Data, Multioperation Transactions, Query by Data, Operations by Sets.	**7 Hrs**
Unit 6: Graph NoSQL databases using Neo4: NoSQL database development tools and programming languages, Graph Databases, Graph Database, Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Connected Data, Routing, Dispatch, and Location-Based Services, Recommendation Engines,	**6 Hrs**

Textbooks: NoSql Distilled: A Brief Guide to the Emerging World of Poluglot Persistence, Author: Sadalage, P. & Fowler, Publication: Pearson Education

References: Name: Redmond, E. &Wilson , Author: Seven Databases in Seven Weeks: A Guide to Modern Databases and the NoSQL Movement Edition: 1st Edition, NoSQL – A brief guide to the emerging world of Polyglot Persistence – Distilled, Pramod J. Sadalage – Martin Fowler, Getting started with NoSql – GauravVaish

Title of Course: Professional Elective-II(Soft computing in Data Analytics)	L	T	P	Credits
Course Code: PCDS0124	3			3

Course time: 3 hours

Course Pre-Requisite: Basic Engineering Mathematics: linear algebra, multivariate calculus, and probability theory

Course Description: This course provides an introduction to the basic concepts of Soft Computing methodology and covers three main components – Neural Networks, Fuzzy Logic and Genetic Algorithms. The course combines theoretical foundations with practical applications using different tools and techniques.

Course Learning Objectives:

To expose students to:

1. Introduce basic concepts and techniques of soft computing
2. foster their abilities in designing appropriate technique for a given scenario
3. Impart the knowledge of technologies and fundamentals of artificial neural networks, fuzzy sets, fuzzy logic and genetic algorithms.
4. Apply soft computing-based techniques to solve real-world problems.

Course Outcome:

CO	After the completion of the course the student should be able to
CO1	Classify soft computing techniques and their roles in building intelligentmachines
CO2	Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems.
CO3	Apply genetic algorithms to combinatorial optimization problems.
CO4	Evaluate solutions by various soft computing approaches for a given problem.

CO-PO Mapping:

CO	PO1	PO2	PO3
CO1	2		3
CO2	3		3
CO3	3		3
CO4	3		3

Assessments:

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE1	10
MSE	30
ISE2	10
ESE	50

ISE 1 and 2 are based on assignment/declared test/quiz/seminar/group discussion etc.

MSE assessment is based on 50% of course content (Normally first three modules)

ESE assessment is based on 100% course content with 60-70% weight age for course content (Normally last three modules) covered after MSE.

Course Contents:	
Unit 1 **Introduction to soft computing and Neural networks:** Evolution ofComputing: Soft Computing Constituents, From Conventional AI to Computational Intelligence: Machine Learning Basics	**6Hrs**
Unit 2 **Fuzzy logic:** Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions, Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making.	**8 Hrs**
Unit 3 **Learning Neural Networks I:** Machine Learning Using Neural Network, Adaptive Networks, Feed forward Networks, Supervised Learning Neural Networks, Radial Basis Function Networks	**6Hrs**
Unit 4 **Learning Neural NetworksII :** Reinforcement Learning Unsupervised Learning NeuralNetworks, Reinforcement Learning, Unsupervised Learning NeuralNetworks, Adaptive Resonance architectures, Advances in Neural networks	**6 Hrs**
Unit 5 **Genetic Algorithms:** Introduction to Genetic Algorithms (GA), Applications	**6 Hrs**

Unit 6 **Hybrid and other Soft computing Systems:** Neuro-fuzzy hybrid systems – genetic neuro hybrid systems – genetic fuzzy hybrid and fuzzy genetic hybrid systems – simplified fuzzy ARTMAP – Other Soft computing Techniques – Simulated Annealing, Ant colony optimization and Particle swarm optimization.	**8 Hrs**

Textbooks:

1. Jyh: Shing Roger Jang, Chuen: Tsai Sun, EijiMizutani, Neuro: Fuzzy and Soft Computing, Prentice:Hall of India, 2003.

2. George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic:Theory and Applications, Prentice Hall,1995.

3. Genetic Algorithms: Search and Optimization, E. Goldberg

4. Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis &Applications,S.Rajasekaran, G. A. Vijayalakshami, PHI.

References:

1. Neuro-Fuzzy Systems, Chin Teng Lin, C. S. George Lee, PHI.
2. Build_Neural_Network_With_MS_Excel_sample by Joe choong.

Title of the Course: Professional Elective-II (Time Series Analysis) Course Code:PCDS0125	L	T	P	Credit
	3			3

Course Pre-Requisite: Mathematical statistics (estimation, hypothesis testing), Linear models.

Course Description: This course will cover models for analyzing time series data from both time and frequency domain perspectives.
The emphases will be a balance of theory and applications.
The course is intended to prepare the student for methodological research in this area and to train the students on cutting-edge data analytic methods for time series.
The primary topics include ARMA/ARIMA models; spectral and coherence estimation; transfer function modeling; and classification and discrimination of time series.
The course will conclude with advanced topics on non-stationary time series, time-frequency analysis and state- space models.

Course Objectives: The students will be able to :
1. to master the basic concepts of time domain and spectral domain aspects of time series analysis.
2. The students are expected to master the basic theoretical results on estimation and inference on the spectrum, coherence and parametric models.
3. Students should become skillful in analysis and modeling of stochastic processes of ARMA

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Understand time series analysis related basic concepts	1	
CO2	Able to demonstrate knowledge with the help of state of the art methods and techniques related to spectral domain aspects of time series analysis.	2	
CO3	Able to practice high quality time series data analysis methods and models using real economic data	4	

CO-PO Mapping:

CO	PO1	PO2	PO3
CO1	2		3
CO2	2		3
CO3	2		3

Assessments :
Teacher Assessment:
Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one EndSemester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10

MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:	
Unit 1: **INTRODUCTION** : Examples of Time Series, A Model-Building Strategy , Time Series Plots in History **Time Series Data :** Purpose ,Time series, R language , Plots, trends, and seasonal variation, , Decomposition of series	5 **Hrs.**
Unit 2: **FUNDAMENTAL CONCEPTS** :Time Series and Stochastic Processes, Means, Variances and Covariance , Stationarity , Expectation, Variance, Covariance, and Correlation **TRENDS** Deterministic Versus Stochastic Trends, Estimation of a Constant Mean ,Regression Methods, Reliability and Efficiency of Regression Estimates, Interpreting Regression Output , Residual Analysis	7 **Hrs.**
Unit 3: **MODELS FOR STATIONARY TIME SERIES:** General Linear Processes , Moving Average Processes ,Autoregressive Processes , The Mixed Autoregressive Moving Average Model,Invertibility. **MODELS FOR NONSTATIONARY TIME SERIES :** Stationarity Through Differencing, ARIMA Models, constant Terms in ARIMA Models Other Transformations	6 **Hrs.**
Unit 4: **MODEL SPECIFICATION:** Properties of the Sample Autocorrelation Function ,The Partial and Extended Autocorrelation Functions ,Specification of Some Simulated Time Series, Nonstationarity : Specification of Some Actual Time Series	4 **Hrs.**
Unit 5: **PARAMETER ESTIMATION** : The Method of Moments , Least Squares Estimation . Maximum Likelihood and Unconditional Least Squares , Properties of the Estimates, Illustrations of Parameter Estimation ,Bootstrapping ARIMA Models **MODEL DIAGNOSTICS** :Residual Analysis, Overfitting and Parameter Redundancy	6 **Hrs.**
Unit 6: **FORECASTING:** Minimum Mean Square Error Forecasting , Deterministic Trends, ARIMA Forecasting , Prediction Limits ,Forecasting Illustrations , Updating ARIMA Forecasts, Forecast Weights and Exponentially Weighted Moving Averages , Forecasting Transformed Series **TIME SERIES REGRESSION MODELS:** Intervention Analysis , Outliers, Spurious Correlation.	6 **Hrs.**

Textbooks:

1." TimeSeriesAnalysis with applications in R", Springer series ,Jonathan D.Cryer,Kung-sikchan, 2009

2. Introductory Time Series with R, Paul S.P. Cowpertwait · Andrew V. Metcalfe

3. Shumway R and Stoffer D. (2017). Time Series Analysis and Its Applications with R Examples, 4th ed. Springer.

References:

1] Introduction to Time Series Analysis and Forecasting (Wiley Series in Probability and Statistics)

Title of the Course: Professional Elective-II (IMHO BioInformatics) Course Code: PCDS0126	L	T	P	Credit
	3			3

Course Pre-Requisite:
Regardless of major, to begin graduate studies in **bioinformatics**, students need to complete **prerequisites** in subjects that typically include molecular biology, genetics, statistics, linear algebra and computer programming. Linear Algebra

Course Description: The aim of the course is to enable students to get familiar with a significant number of bioinformatics tools and databases, understand the computational methods behind them, be able to exploit in-depth the capabilities of the tools, implement and competently interpret and present the results of a wide range of bioinformatics analyses.

Course Objectives:
1. To understand Bio informatics from computing perspective.

2. To comprehend bio informatics databases, file formats and its applications.

3. To understand the applications of Bio informatics

Course Learning Outcomes:

CO	After the completion of the course the student should beable to
CO1	Explore bioinformatics from computing perspective.
CO2	Apply data mining techniques to provide better health care services
CO3	Explore and extract hidden information from bio informatics databases.

CO-PO Mapping:

CO	PO1	PO2	PO3
CO1	2		
CO2	2		2
CO3	1		3

Assessments :
Teacher Assessment:
Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one EndSemester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:	
Unit 1:-Introduction History of Bioinformatics-role of Bioinformatics in biological sciences- scope of bioinformatics -introduction to internet-WWW- network basics- LAN & WAN standards-network topologies and protocols- FTP- HTTP - division of Bioinformatics- Bioinformatics and internet-challenges in Bioinformatics.	**7 Hrs**
Unit 2:-Databases – Format and Annotation: Conventions for database indexing and specification of search terms, Common sequence file formats. Annotated sequence databases - primary sequence databases, protein sequence and structure databases; Organism specific databases.	**6 Hrs**
Unit 3:-Data – Access, Retrieval and Submission: Standard search engines; Data retrieval tools – Entrez, DBGET and SRS; Submission of (new and revised) data; Sequence Similarity searches: Local versus global. Distance metrics. Similarity and homology. Scoring matrices. Dynamic programming algorithms, Needleman-wunsch and Smith-waterman. Heuristic Methods of sequence alignment, FASTA, BLAST and PSI BLAST.	**7 Hrs.**
Unit 4:-Sequence submission: Sequence submission tools-BANKIT-SEQUIN-WEBIN-SAKURAliterature databases-PubMed and medline. Data mining and its techniques- data warehousing- Sequence annotation- principles of genome annotation- annotation tools & resources.	**6 Hrs.**
Unit 5 :-Applications of bioinformatics: Applications of Bioinformatics-phylogenetic analysissteps in phylogenetic analysis-microarrays-DNA and protein microarrays, Bioinformatics in pharmaceutical industry- informatics & drug- discovery – pharma informatics resources drug discovery and designing-SNP	**7 Hrs.**
Unit 6:-File formats: File formats-raw/plain format-NCBI-Genbank flat file format-ASN.1-GCGFASTA- EMBL- NBRF- PIR-swissprot sequence formats- PDB format-Introduction to structure prediction methods.	**7 Hrs.**

Textbooks:

1. Attwood T.K, Parry-Smith, "Introduction to Bioinformatics", Addison Wesley Longman, 1999.
2. Bioinformatics: Databases and Systems, by Stanley I. Letovsky
3. Bioinformatics Databases: Design, Implementation, and Usage (Chapman & Hall/ CRC Mathematical Biology & Medicine), by SorinDraghici

References:
1. Des Higgins and Willie Taylor, "Bioinformatics Sequence, Structures and Databanks", Oxford University Press, 2000.
2. Jason T.L.Wang, Mohammed J. Zaki, Hannu T.T. Toivonene and Dennis Shasha, "Data Mining in   Bioinformatics", Springer International Edition, 2005.
 3. K. Erciyes, "Distributed and Sequential Algorithms for Bioinformatics", Springer, 2015.

Title of the Course: Programming Lab I	L	T	P	Credit
Course Code: PCDS0131	0	0	2	1

Course Prerequisite: nil

Course Description:

This course aims at providing students with basic knowledge of Python Programming and exploring python modules required for Data Science.

Course Objectives:

1. To understand the Python programming environment.
2. To write, run, document programs in Python language.
3. To make use of Python libraries used in Data Science.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to
CO 1	Recall the basic concepts of Python programming.
CO 2	Write python programs related to simple-moderate mathematical/statistical/logical problems.
CO 3	Make use of the Python libraries used in data science projects.

Assessments :

Teacher Assessment:

One component of In Semester Evaluation (ISE) and one End Semester Examination (ESE) having 50%, and 50% weights respectively.

Assessment	Marks
ISE	50
ESE	50

ISE is based on laboratory assignments performed / Quiz / Mini-Project assigned / Presentation / Group Discussion / Internal oral etc.

ESE: Assessment is based on Oral Examination.

Course Contents:

Unit 1: Introduction	3 **Hrs.**
Features of Python, identifiers, variables, comments, operators, Input/Output, Setting up Python Programming Environment - iPython, Anaconda, Jupyter Notebooks	

Unit 2: Control Flow, Functions, Data Structures	4 **Hrs.**
Control Flow: Decision Making, Control Statements, Loops, Nested loops **Function:** Function definition, calling function, function argument, variable scope, recursive functions **Data Structures:** Boolean, Numbers, Strings, List, Tuple, Dictionary, Set	
Unit 3: Modules, Packages, What are Modules? Built in modules, creating modules, import statement, Namespace and scope, Packages.	3 **Hrs.**
Unit 4: Exception Handling, File Handling **Exceptions:** Built-in Exception, Detecting and Handling exception-try...except, try statement with multiple except, except statement with multiple exception, catching all exception, exception arguments, else clause, finally clause, try-finally statement **File Object:** File handling functions, reading from files, writing to files.	3 **Hrs.**
Unit 5: Python for data science Introduction to numpy, operations on numpy array, introduction to pandas, getting and cleaning data	4 **Hrs.**
Unit 6:Visualization in Python Introduction to Data Visualization Basics of Visualization: Plots, Subplots and their Functionalities Plotting Data Distributions Plotting Categorical and Time-Series Data	4 **Hrs.**
Reference Books: 1. "Core Python Programming" By Wesley J Chun 2. "Python Data Science Handbook" By Jake VanderPlas	

Experiments: It should consist of 8-12 experiments based on the above topics.

Title of the Course: Professional Elective Lab-I	L	T	P	Credit
Course Code: PCDS0132	-	-	4	2

Course Pre-Requisite: RelationalDatabases, Programming Language

Course Description: This course is designed for use of Soft Computing in Data Analytics, data mining & warehousing, pattern recognition& web Analytics. It provides practical knowledge of NoSQL databases, Web Analytics, Pattern recognition & NLP.

Course Learning Objectives:
1. To UnderstandNoSQL Key/Value databases using MongoDB
2. To understand Analytics tools available and their applications
3. To comprehend bio informatics databases, file formats and its applications.
4. To introduce the algorithms of feature selection in pattern recognition
5. Apply soft computing-based techniques to solve real-world problems.

Course Outcomes:

CO	After the completion of the course the student should be able to
CO1	Categorize different types of NoSql Databases.
CO2	Classify the tools for behavioral analysis.
CO3	Apply data mining techniques to provide better health care services
CO4	Apply algorithms for feature generation in patternrecognition
CO5	Evaluate solutions by various soft computing approaches for a given problem.

CO-PO Mapping:

CO	PO1	PO2	PO3
CO1	2		3
CO2		2	2
CO3	2		2
CO4	2	2	
CO5	3		3

Assessments :
Teacher Assessment:
Two components of In Semester Evaluation (ISE) and one End Semester Examination (ESE) having 50%, and 50% weights respectively.

Assessment	Marks
ISE	50
ESE(OE)	50

ISE are based on practical performed/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc.
ESE: Assessment is based on practical-oral examination.

Course Contents:

Experiment No.1 : Getting started with graph databases	**02 Hrs.**
Experiment No.2 : The Neo4J web user interface	**02 Hrs.**
Experiment No.3 :Creating nodes and relationships	**02 Hrs.**

Experiment No.4: Using Neo4J in conjunction with SQL Server
 	
    a.   Creating the nodes
    b.   Creating the relationships
	02 Hrs.

Experiment No.5: Implementation of MongoDB concepts.	**02 Hrs.**
Experiment No.6: Implementation of Fuzzy Operations.	**02 Hrs.**
Experiment No.7: Implementation of Fuzzy Relations.	**02 Hrs.**
Experiment No.8: Implementation of Fuzzy Controller	**02 Hrs.**
Experiment No.9: Implementation of Simple Neural Network.	**02 Hrs.**
Experiment No.10: Implementation of Simple Genetic Application	**02 Hrs.**
Experiment No.11: Introduction to UNIX basic commands and UNIX Filters	**02 Hrs.**

Experiment No.12: Perl programming and applications to Bioinformatics.
 	
   •   Basic scripting.
   •   Regular expressions.
	02 Hrs.

Experiment No.13: Perl programming and applications to Bioinformatics
 	
   •   File i/o& control statement.
   •   Subroutines & functions.
   •   Writing scripts for automation
	02 Hrs.

Experiment No.14: Types of Biological Databases and Using it.
 	
   •   Databases for the Storage and "Mining" of Genome Sequences
   •   Using Databases to Compare and Identify Related Protein Sequences
	02 Hrs.

Experiment No.15: Implement object(like car,fruits) identification from image using classification	**02 Hrs.**
Experiment No.16: Implement face identification.	**02 Hrs.**
Experiment No.17: Implement object categorization from image.	**02 Hrs.**

Experiment No.18: Implement word analysis	**02 Hrs.**
Experiment No.19: Implement part of speech using Hidden Markova Model	**02 Hrs.**
Experiment No.20: Explain with examples how AutoRegression Method (in Time Series Forecasting) works ?	**02 Hrs.**
Experiment No.21: Predicting changes in the thickness of Ozone layer based on its time-series data from 1926 - 2016	**02 Hrs.**
Experiment No.22: Carrying out some exploratory time series analysis using the e-mails sent per week to employees, Visualize by plotting data and Elaborate with justification	**02 Hrs.**
Experiment No.23: Identify trend of monthly unemployment data in India .Elaborate with justification. Visualize by plotting the data	**02 Hrs.**
Experiment No.24: Download given the data file . This is a data set of x observations of y-dimensional vectors. Examine this data set and answer the following questions. Clearly justify your answers with arguments and plots. a.Is this a time series? Justify your answer. b. What kind of probabilitic model would you use to model this data? Why? Some choices are probabilistic PCA, factor analysis, mixtures of Gaussians, hidden Markov models, linear dynamical systems, nonlinear dynamical systems. Support your answer with plots and arguments.	**02 Hrs.**
Experiment No.25: Develop a tool to count the number of visitors to a web page.	**02 Hrs.**
Experiment No.26: Extend the tool to record information of visitor. Information shall include details such as:- Visitors IP address, Source, Time of access, Source URL (shall not be restricted to this) etc.	**02 Hrs.**
Experiment No.27: Try A/B Testing for the same page (Extend the code of Exp. 2). Analyse the user behaviour by collecting data.	**02 Hrs.**
Experiment No.28: Try to use popular analytics tools in your web page :- google analytics, open web analysis etc.	**02 Hrs.**
Experiment No.29: Create a detailed report of the analysis done, the report shall suggest the required improvement/changes/scope to the web page.	**02 Hrs.**
Textbooks: 1. NoSql Distilled: A Brief Guide to the Emerging World of Poluglot Persistence, Author: Sadalage, P. & Fowler, Publication: Pearson Education	

2. Jyh: Shing Roger Jang, Chuen: Tsai Sun, EijiMizutani, Neuro: Fuzzy and Soft Computing,

Prentice: Hall of India, 2003

3. Attwood T.K, Parry-Smith, "Introduction to Bioinformatics", Addison Wesley Longman, 1999.

References:
1. Web Analytics 2.0, Author:-AvinashKaushik, Wiley Publication.

https://analytics.google.com/

https://www.crazyegg.com

http://www.openwebanalytics.com/
   2. Neuro-Fuzzy Systems, Chin Teng Lin, C. S. George Lee, PHI.
   3. Des Higgins and Willie Taylor, "Bioinformatics Sequence, Structures and Databanks", Oxford University Press, 2000.

Title of the Course: Seminar-I	L	T	P	Credit
Course Code:PCDS0141	0	0	4	2

Course Pre-Requisite:

Course Description: Students are trained for research and presentation skills in this course.

Course Objectives:
1. To promote and develop presentation skills
2. Learn how to evaluate research papers
3. Identify and use variety of academic resources available
4. Learn fundamental principles, concepts or theories

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Demonstrate ability to use technical resources available	2	Demonstrate
CO2	Write technical documents and give oral presentations related to the work completed	5	Write
CO3	Explain some specific skills, competences and points of view needed by computing professionals	6	Explain

CO-PO Mapping:

CO	PO1	PO2	PO3
CO1	3	2	3
CO2	2	3	2
CO3	1	3	2

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE)

Assessment	Marks
ISE-I	50
ISE-II	50

ISE are based on Presentation/ Internal oral etc.

Course Contents/Guidelines:

● Attendance at each seminar is mandatory for all students enrolled
● Abstract should be concise(<250 words), well written and free of grammatical and typographical errors
● Each student will give 30- minute presentation
● Your seminar should cover several(5 or more) related papers
● The topic should be in an area closely related to your research.
● You should strive to organize your seminar into a cohesive presentation, and be selective about what you present
● Final grade will be determined by several factors: the quality and content of your seminars, presentation and the ability to meet scheduled deadlines.

Semester-II

Title of the Course: Data Analytics Tools	L	T	P	Credit
Course Code:PCDS0261	2			-
Course Pre-Requisite:				
Course Description: In this course students will acquire the skills of Cloud Computing Platform. The course will help students understand cutting edge Cloud Computing Platforms and experiment with it.				
Course Objectives: To expose students to 1. Visualizations, organize data, and design dashboards to empower more meaningful business decisions using different tools like Tableu. 2. TensorFlow library for solving supervised and unsupervised Learning Problems 3. Keras library for solvingsupervised and unsupervised learning Problems				

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Illustrate how to build visualizations, organize data, and design dashboards to empower more meaningful business decisions using different tools like Tableu.	II	Illustrate
CO2	Utilize TensorFlow for solving supervised and unsupervised Learning Problems	III	Utilize
CO3	Build supervised and unsupervised learning models using the Keras library	III	Build

CO-PO Mapping:

CO	PO1	PO2	PO3
CO1	2		3
CO2	2		3
CO3	2		3

Assessments :

Teacher Assessment:

One EndSemester Examination (ESE)

Assessment	Marks
ESE	50

ESE: Assessment is based on 100% course content

Course Contents:

Unit 1: Introduction to Tableu:Tableau Prep, Connecting to Data.	4 **Hrs.**
Unit 2:---Visual Analytics: Sorting, Grouping Working with sets, Tableu Filters, Basic tools.	4 **Hrs.**
Unit 3:---Mapping and calculating: Maps in tableu, Spatial Files, Mapbox Integration, Table calculations, LOD Expressions	4 **Hrs.**
Unit 4:--- TesorFlow:TensorFlow Basic Syntax, TensorFlow Graphs, Variables and Placeholders	4 **Hrs.**
Unit 5:---TF Regression and Classification: TF Regression Exercise, TF Classification Exercise	4 **Hrs.**
Unit 6:--- Keras:- Deep Learning Libraries, Regression Models with Keras,	4 **Hrs.**

Classification Models with Keras

Reference:

- https://www.tableau.com/learn/training/20194

- https://www.tensorflow.org/tutorials

- https://www.udemy.com/course/complete-guide-to-tensorflow-for-deep-learning-with-python/

- https://www.datacamp.com/community/tutorials/tensorflow-tutorial/

Title of the Course: Statistical Foundations for Data Science	L	T	P	Credit
Course Code:PCDS0201	3	1		4

Course Pre-Requisite: Basic Mathematics

Course Description:
This course introduces fundamental mathematical concepts relevant to data science and provides a basis for further study in machine learning, data analytics, and artificial intelligence.

Course Objectives:
1. Introduce students to the fundamental mathematical concepts required for data science.
2. Introducing the basic notions of Probability distribution and Statistical analysis.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Enable the students to understand the fundamentals of statistics to apply descriptive measures and probability for data analysis.		
CO2	Demonstrate the random variables as well as various discrete and continuous distributions and their usage.		
CO3	Infer the concept of nonparametric tests for single sample and two samples.		

CO-PO Mapping:

CO	PO1	PO2	PO3
CO1	2		3
CO2	3		2
CO3	3		2

Assessments :
Teacher Assessment:
Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one EndSemester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1:--- Probability	8 **Hrs.**
Sample Spaces and Events, Interpretations of Probability, Conditional Probability, Bayes Theorem	

Unit 2:--- Probability Distribution	8 **Hrs.**
Discrete Random Variables and Continuous Random Variables Probability Distribution	

Unit 3:--- **Random Sampling and Data Description** Data Summary and Display, Random Sampling, Stem-and-Leaf Diagrams, Frequency Distribution and Histograms, Box Plots, Time sequence Plots, Probability Plots	6 **Hrs.**
Unit 4:--- **Point Estimation of Parameters** Concept of Point Estimation, Methods of Point Estimation, Sampling Distribution	6 **Hrs.**
Unit 5:--- **Statistical Intervals for Single Sample** Confidence Interval on the Mean of a Normal Distribution, Confidence Interval on the Variance and Standard Deviation of a Normal Distribution, A Large-Sample Confidence Interval for a Population Proportion , A Prediction Interval for a Future Observation , Tolerance Intervals for a Normal Distribution	8 **Hrs.**
Unit 6:--- **Statistical Intervals for Two Samples** Inference For a Difference in Means of Two Normal Distributions, Paired t-Test, Inference on the Variances of Two Normal Distributions, Inference on Two PopulationProportions	8 **Hrs.**

Textbooks:

1. Montgomery, D. C. and G. C. Runger (2011). Applied Statistics and Probability for Engineers. 5th Edition. John Wiley & Sons, Inc., NY, USA.
.

References:

1] Sheldon Ross, A First Course in Probability, 9th edition, Pearson New International Edition
2] Jeff M. Philips, Mathematical Foundations For Data Analytics

Unit wise Measurable students Learning Outcomes:
1
2
3
4
5
6

Title of the Course: Artificial Intelligence	L	T	P	Credit
Course Code: PCDS0202	3	1	-	4

Course Pre-Requisite:

Design and Analysis of Algorithms.

Course Description: The course will enable to realize the intelligent human behaviors on a computer. The ultimate goal of AI is to make a computer that can learn, plan, and solve problems autonomously. This course introduce the most fundamental knowledge for understanding AI,some basic search algorithms for problem solving; knowledge representation and reasoning.

Course Objectives:

1. To learn techniques and theory developed in major areas of Artificial Intelligence.
2. To emphasis transforming conventional procedural computing into intelligent computing.
3. To Gain the skill to make machine intelligent by learning

After the completion of the course the student should be able to

CO1: Identify the AI problem which can be solved by searching & knowledge base.

CO2: Evaluate the recent trends in Artificial Intelligence

CO3 : Create basic Artificial Intelligent systems

CO-PO Mapping:

CO	PO1	PO2	PO3
CO1	2		2
CO2	2		3
CO3	2		3

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one EndSemester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1:- **Introduction to AI:**Brief history, Agents and rationality, task environments, agent architecture types, Introduction, , Characteristics of AI, Applications, AI in future.	**6 Hrs**
Unit 2:**Logic and Computation**:Classical concepts, Computational logic,FOL,SymbolTableu,Resolution,Unification,Predicate calculus in problem solving,Model logic,Temporal logic.	**7 Hrs**
Unit 3:-Search and Knowledge representation: Search spaces.Uninformed and informed search.Hill climbing, simulated annealing, genetic algorithms.Logic based representations (PL, FoL) and inference, Prolog.Rule based representations, forward and backward chaining, matching algorithms.	**7 Hrs.**

Unit 4:- Planning: Introduction, Definition of Classical Planning, Algorithms for Planning as State-Space Search,Components of planning , Planning Graphs, Partial-order-planning, Graph plan, SATPLAN.	**6 Hrs.**
Unit 5:Probabilistic reasoning and uncertainty : Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks, Efficient Representation of Conditional Distributions, Exact Inference in Bayesian Networks, Approximate Inference in Bayesian Networks.	**7 Hrs.**
Unit 6 :-Learning: Forms of learning.Statistical methods: naive-Bayes, nearest neighbour, kernel, neural network models, noise and overfitting.Decision trees, inductive learning.Clustering - basic agglomerative, divisive algorithms based on similarity/dissimilarity measures.	**7 Hrs.**

Textbooks:
1. Elaine Rich and Kelvin Knight, Nair, "Artificial Intelligence," MGH 3rd ed.
2. Andrew Ng, "Neural Networks and Deep Learning", Coursera course.
3.R.B.Mishra,"ArtificialIntelligence",PHI

References:
1. Townsend, "Introduction to Turbo prolog"
2. Russell and Norvig," Artificial Intelligence – A Modern Approach" Prentice-Hall, 2010 (3rd edition)

Title of the Course: Image Processing and Video Analytics	L	T	P	Credit
Course Code: PCDS0203	3	1	-	4

Course Pre-Requisite:
Design and Analysis of Algorithms. Fundamentals of Discrete Mathematics, Fourier Transform, Probability and Statistics is desired.

Course Description: The course will enable computer science undergraduates to apply their mathematical knowledge and understanding of algorithms to problems in image and video processing: from preprocessing, to quantitation, video compression and video interpretation. The methods have numerous applications e.g. in medicine, biology, robotics (computer vision), surveillance, security, biometrics, database searching, TV and entertainment

Course Objectives:

Course Learning Outcomes:

	Course Outcome
CO 1	Understand the algorithms available for performing analysis on video data and address the challenges
CO 2	Understand the approaches for identifying and tracking objects and person with motion based algorithms.
CO 3	Understand the algorithms available for searching and matching in video content
CO 4	Analyze approaches for action representation and recognition
CO 5	Identify, Analyze and apply algorithms for developing solutions for real world problems

CO-PO Mapping:

CO	PO1	PO2	PO3
CO1	1		
CO2	1		
CO3			2
CO5			2

Assessments :
Teacher Assessment:
Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and

one EndSemester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1:- **Introduction to Image and Video Processing:** Fundamentals of Digital Image and Video; acquisition, sampling and quantization. Representation of digital images as matrices, types of images (binary, grayscale, color, indexed). Basic topology: neighbors and neighborhoods, adjacency, connectivity, Regions and boundaries	**6Hrs**
Unit 2:-Object Detection: Local Features-Mean Shift: Clustering, Tracking - Object Tracking using Active Contours – Tracking & Video Analysis: Tracking and Motion Understanding – Kalman filters, condensation, particle, Bayesian filters, hidden Markov models, change detection and model based tracking.	**7Hrs**
Unit 3:-Motion estimation and Compensation: Block Matching Method, Hierarchical Block Matching, Overlapped Block Motion and compensation,Pel-Recursive Motion Estimation, Mesh Based Method, Optical Flow Method - Motion Segmentation -Thresholding for Change Detection, Estimation of Model parameters.	**7 Hrs.**
Unit 4:Optical Flow Segmentation : Modified Hough Transform Method- Segmentation for Layered Video Representation-Bayesian Segmentation -Simultaneous Estimation and Segmentation-Motion Field Model	**6 Hrs.**
Unit 5 :-Action Recognition: Low Level Image Processing for Action Recognition: Segmentation and Extraction, Local Binary Pattern, Structure from Motion - Action Representation Approaches	**7 Hrs.**
Unit 6:- Classification of Various Dimension of Representation: View Invariant Methods, Gesture Recognition and Analysis, Action Segmentation. Case Study: Face Detection and Recognition, Natural Scene Videos, Crowd Analysis, Video Surveillance, Traffic Monitoring, Intelligent Transport System	**7 Hrs.**

Textbooks:
1.RichardSzeliski, "Computer Vision: Algorithms and Applications", Springer, 2011.
2.Yao Wang, JornOstermann and Ya-Qin Zhang, "Video Processing and Communications", Prentice Hall, 2001.
3.A.MuratTekalp, "Digital Video Processing", Pearson, 1995

References:
1.ThierryBouwmans, FatihPorikli, Benjamin Höferlin and Antoine Vacavant, "Background Modeling and Foreground Detection for Video Surveillance: Traditional and Recent Approaches, Implementations, Benchmarking and Evaluation", CRC Press, Taylor and Francis Group, 2014.
2.Md. AtiqurRahmanAhad, "Computer Vision and Action Recognition-A Guide for Image Processing and Computer Vision Community for Action Understanding", Atlantis Press, 2011

Title of the Course: Professional Elective-III(Business Intelligence Systems)	L	T	P	Credit
Course Code:PCDS0221	3	1	-	4

CoursePre-Requisite:
1. DBMS
2. Object OrientedConcepts
3. Overview of DataWarehouse

Course Description:

Course Objectives:
1. GainanawarenessofthebasicissuesinBISandModelingtechniques
2. Compare and contrast emerging architecturesfor BIS
3. Familiarize with the E-T-L techniques inBIS
4. Interpret BISapplications

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	
CO1	Define and explain the overall technical aspects of BI system	1	Define
CO2	Apply dimensional modeling for the business problem	3	Apply
CO3	Design Dimensional modeling for the given problem	6	Design
CO4	Define ETL and its components	1	Define
CO5	Explain applications of Business intelligence	2	Explain

CO-PO Mapping:

CO	PO1	PO2	PO3
CO1	2	-	1
CO2	3	-	2
CO3	2	-	1
CO4	2	-	1
CO5	2	-	2

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:	
Unit 1: Introducing the Technical Architecture The Value of Architecture Technical Architecture Overview , Back Room Architecture, PresentationServerArchitecture,FrontRoomArchitecture,Infrastructure,Metadata, Security	7 Hrs.
Unit 2: Introducing Dimensional Modeling: Making the Case for Dimensional Modeling, Dimensional Modeling Primer, Enterprise Data Warehouse Bus Architecture, More on Dimensions and facts	6Hrs.
Unit 3: Designing the Dimensional Model: Modeling Process Overview, Getting Organized, Four-Step Modeling Process, Design the Dimensional Model	5 Hrs.
Unit 4:.Introducing Extract, Transformation, and Load: Round Up the Requirements, The 34 Subsystems of ETL, Extracting Data, Cleaning and Conforming Data	6 Hrs.
Unit 5: Introducing Business Intelligence Applications: Importance of Business Intelligence Applications, Analytic Cycle for Business Intelligence, Types of Business Intelligence Applications, Navigating Applications via the BI Portal	6 Hrs.
Unit 6: Designing and Developing BIApplications: Business Intelligence Application Resource Planning, Business Intelligence Application Specification, Business Intelligence Application Development, Business Intelligence Application Maintenance	6 Hrs.
Textbooks: 1 The Data Warehouse Lifecycle Toolkit By Raiph Kimball, Ross, 2ndedition, Wiley Publication	

References:
    1. Data Warehousing in Real World- Anahory& Murray,Pearson Edt.
    2. Data Warehousing Fundamentals- Ponniah, WileyPublication	

Title of the Course: Professional Elective-III(Cloud Computing)	L	T	P	Credit
Course Code:PCDS0222	3	1		4

Course Pre-Requisite: Students shall have basic knowledge of Distributed Systems, Clusters, Virtualization Concepts, Network Security

Course Description: In this course students will acquire the skills of Cloud Computing Platform. The course will help students understand cutting edge Cloud Computing Platforms and experiment with it.

Course Objectives: To expose students to
1. Different Cloud Computing platforms available.
2. Models of Cloud Computing based on the services it provides.
3. Storage options available in Cloud.
4. Security Management of application running in Cloud.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Define Cloud Computing platform and its types.	I	Define
CO2	Classify Cloud Computing platforms based on Service.	II	Classify
CO3	Choose appropriate storage service required for application	III	Choose
CO4	Build Virtual Machines in Cloud Platform.	III	Build
CO5	Examine IAM roles for Security Management.	IV	Select

CO-PO Mapping:

CO	PO1	PO2	PO3
CO1	1		
CO2	2	1	
CO3	2	1	3
CO4	2		3
CO5	2	1	3

Assessments :
Teacher Assessment:
Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one EndSemester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1: Introduction: Introduction to cloud computing and Cloud Platforms- AWS, Google App Engine, Microsoft Azure, Aneka, Salesforce.	4 **Hrs.**
Unit 2:--- Architecture: Virtualization, Iaas, Paas, Saas Models. Types of Clouds. Google	7 **Hrs.**

Cloud Platform architecture:- Containerizing, Kubernetes. AWS architecture.	
Unit 3:--- Storage option in cloud: Structured and Unstructured Storage, SQL Managed Services, Cloud SQL, Cloud Spanner, NoSQL Managed Services Cloud Datastore a NoSQL Document Store, Cloud Bigtable as NoSQL, Amazon s3.	7 **Hrs.**
Unit 4:--- API- Purpose of API, Cloud Endpoints, Apigee, Managed Message Services, Cloud Pub/Sub, The REST approach.	5 **Hrs.**
Unit 5:--- Security:- Introduction, Shared Security Model, Authentication and Authorization. IAM model in GCP and AWS.	6 **Hrs.**
Unit 6:--- Network:- Virtual Private Cloud, public/private network, Google N/w Architecture. Routers and Firewall, VPC Networks, Hybrid Clouds, Load Balancing.	7 **Hrs.**
Reference: Mastering Cloud Computing , by RajkumarBuyya, Christian Vecchiola, S. ThamaraiSelvi, publisher McGraw Hill Mobile Application Development in Cloud by Richard Rodger, Wrox publication. https://docs.aws.amazon.com/index.html https://cloud.google.com/docs/	

Title of the Course: Professional Elective-III(Optimization Techniques)		L	T	P	Credit
Title of the Course: Professional Elective-III(Optimization Techniques) Course Code: PCDS0223		**3**	**1**	**-**	**4**

Course Pre-Requisite: Linear Algebra, Probability, Calculus, Graph Theory

Course Description: This course introduces the principal algorithms for linear, network, discrete,dynamic optimization and nonlinear optimization. Emphasis is on methodology and the underlying mathematical structures. Topics include the simplex method, network flow methods, branch and bound and cutting plane methods for discrete optimization, interior point methods for convex optimization, Newton's method, heuristic methods, dynamic programming and brief introduction to nonlinear optimization.

Course Objectives:
1. To introduce the fundamental concepts of Optimization Techniques
2. To make the learners aware of the importance of optimizations in real scenarios
3. To provide the concepts of various classical and modern methods of for constrained and unconstrained problems in both single and

Course Learning Outcomes:

CO	After the completion of the course the student should be able to
CO1	Explain types of optimization techniques.
CO2	Apply optimization techniques to problems in computer science
CO3	Evaluate complexity of optimization problems
CO4	Model computer science problems as optimization problems

CO-PO Mapping:

CO	1	2	3
CO1	1		
CO2			
CO3			2
CO4	1		2

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one EndSemester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1:- Introduction to Operation Research: Operation Research approach, scientific methods, introduction to models and modeling techniques, general methods for Operation Research models, methodology and advantages of Operation Research, history of Operation Research.	8 Hours
Unit 2:--- Introduction to Linear programming Modeling and formulation of optimization problems. Linear costs and convex domains. Mean-square (distance) minimizations. Linear programming and the Simplex algorithm. Duality and the primal dual method.	8 Hours
Unit 3:--Robust optimization and Network Flows Introduction, Large scale optimization, Introduction to Network flows, Max flow, Min-flow, Algorithms for optimization of network flows	6 Hrs.
Unit 4: Convex Optimization Convex Sets, Convex Functions, Convex optimization problems, Lagrange Duality, Saddle-point interpretation, KKT Conditions, Applications of Convex Optimization: Approximation and fitting	8 Hrs.
Unit 5:--- Non-Linear optimization Brief introduction, Line searches, Newton's methods, Modification of Newton's Methods, Quasi-Newton Method, Levenberg-Marquardt, Conjugate and Stochastic Gradient Descent, Applications in Computer Vision, Natural Language Processing(NLP)	8 Hrs.
Unit 6:---Discrete optimization Integer Programming, Constraint Programming, Branch and bound and cutting planes	6 Hrs.
Textbooks: 1. Linear Algebra and its Applications By Gilbert Strang,, 2. Introduction to linear optimization by Dimitris Bertsimas, Athena Scientific Series 3. Linear Programming and Applications By V. Chvatal 4.Optimization Techniques – An Introduction, Author: Foulds, L. R. , Optimization Techniques – ChanderMohan,Kusum Deep.	
References: 1. Convex Optimization by Stephen Boyd 2. Nonlinear Programming: Theory and Algorithms by MokhtarBazaraa, HanifSherali and C. M. Shetty 3. https://ocw.mit.edu/courses/sloan-school-of-management/15-093j-optimizationmethods-fall-2009/readings	

Title of the Course: Professional Elective-IV(IoT and Cognitive Computing) Course Code:PCDS0224	L	T	P	Credit
	3	1	-	4

Course Pre-Requisite:
- **Fundamentals of Computer Networks**
- **Fundamentals of Embedded Systems**

Course Description: The course is designed to learn the importance of IoT and Congnitive Computing in society, the current components of typical IoT devices, IoT design considerations, constraints and interfacing between the physical world and your device, understanding basics of Cognitive Computing. Students will also learn how to connect their device to the Internet.

Course Objectives:
1.To understand the concepts and protocols related to Internet of Things and basics of Cognitive Computing.
2. To study the IoT standards and APIs for prototyping
3. To study the application areas of the Internet of Things.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Explain the concept of Internet of Things and Cognitive Computing	2	
CO2	Illustrate key technologies, protocols and standards in Internet of Things.	2	
CO3	Application of IoT in automation of Commercial and Real World examples	3	
CO4	Design a simple IoT system comprising sensors, edge devices and wireless network connections involving prototyping, programming and data analysis.	6	

CO-PO Mapping:

CO	PO1	PO2	PO3
CO1	1		
CO2	3		1
CO3	3		3
CO4	3		3

Assessments :
Teacher Assessment:
Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one EndSemester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1:---Introduction Overview and Motivations, IPv6 Role, IoT Definitions, IoT Frameworks.	04 **Hrs.**
Unit 2:--- Prototyping Embedded Devices Electronics, Embedded Computing Basics, Arduino, Raspberry Pi, BeagleBone Black, Electric Imp, Other Notable Platforms	06 **Hrs.**
Unit 3:---Evolving IoT Standards Overview and Approaches, IETF IPv6 Routing Protocol for RPL Roll , Constrained Application Protocol (CoAP) , Representational State Transfer (REST) , ETSI M2M , Third-Generation Partnership Project Service Requirements for Machine-Type Communications, IETF IPv6 Over Lowpower WPAN (6LoWPAN) , ZigBee IP (ZIP), IP in Smart Objects (IPSO)	08 **Hrs.**
Unit 4:--- : IPv6 Technologies for the IoT Overview and Motivations, Address Capabilitie, IPv6 Protocol Overview , IPv6 Tunneling , IPsec in IPv6, Header Compression Schemes , Quality of Service in IPv6	08**Hrs.**
Unit 5:--- IoT Application Examples Overview, Smart Metering/Advanced Metering Infrastructure, e-Health/Body Area Networks, City Automation, Automotive Applications, Home Automation, Smart Cards, Tracking (Following and Monitoring Mobile Objects),Over-The-Air-Passive Surveillance/Ring of Steel.	06 **Hrs.**
Unit 6:-- Internet of Things Cognitive Transformation Technology Research Trends and Applications Internet of Things Evolving Vision, IoT Cognitive Transformation, IoT Strategic Research and Innovation Directions, IoT and Related Future Internet Technologies, Edge Computing, Networks and Communication, IoT Platforms	04 **Hrs.**

Textbooks:
 1) Building the Internet of Things with IPv6 AND MIPv6 by DANIEL MINOLI Published by John Wiley & Sons, Inc., Hoboken, New Jersey.(UNIT-I, III, IV, V)
 2) Designing the Internet of Things by Adrian McEwen and Hakim Cassimally Published by John Wiley & Sons (UNIT-II)
 3) IoT_Cognitive_Transformation_Technology_Research_Trends_IERC_2017_Cluster_eBook_978-87-93609-10-5_P_Web

References:
   1) Getting Started with the Internet of Things by CunoPfister Published by O'Reilly Media, Inc.
   2) Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things" Key Applications and Protocols, ISBN 978-1-119-99435-0, Wiley Publications.

Unit wise Measurable students Learning Outcomes:

1. Explain the concept of IoT and Cognitive Computing
2. Describe different types of IoT devices
3. AnalyzeIoT protocols and Standards
4. Illustrate IPv6 addressing
5. Illustrate applications of IoT in real world

Title of the Course: Professional Elective-IV(Big Data Storage and Hadoop) Course Code:PCDS0225	L	T	P	Credit
	3	1		4

Course Pre-Requisite: Distributed Systems ,Database Management Systems

Course Description:

This course subject is intended to give the knowledge of Big Data evolving in every real-time applications and how they are manipulated using the emerging technologies.

This course breaks down the walls of complexity in processing Big Data by providing a practical approach to developing Java applications on top of the Hadoop platform. It describes the Hadoop architecture and how to work with the Hadoop Distributed File System (HDFS) and HBase in Ubuntu platform.

Course Objectives:

CO1: Able to understand the Big Data concepts in real time scenario

CO2: Understand the architecture of Hadoop with practical

CO3: Apply map reduce concept to implement in cloud

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Build and maintain reliable, scalable, distributed systems with Apache Hadoop.	4	
CO2	Develop Map-Reduce based Applications, by applying HIVEQL, PIG to solve big data queries.	5	
CO3	Design, build and query MongoDB based big data Applications after understanding the architecture of Hadoop with the help of practical implementations	6	
CO4	Analyze and Apply Big Data use cases, map reduce concepts and solutions, in cloud	5	

CO-PO Mapping:

CO	PO1	PO2	PO3
CO1			
CO2			
CO3			
CO4			
CO4			
CO5			
CO6			

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one EndSemester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:	
Unit 1:- INTRODUCTION **Introduction to Big Data: Distributed file system–** Big data and its importance, Data sets, Data analysis, Data analytics, Business intelligence, KPI, Big data characteristics, Different types of data, Drivers for big data adoption. **Big Data Analysis Techniques**: Quantitative analysis, Qualitative analysis, Data mining, Statistical analysis, Machine learning, Semantic analysis, Visual analysis, Case studies.	4-- **Hrs.**
Unit 2:--- CONFIGURATIONS OF HADOOP **Hadoop Architecture:** Hadoop eco-system, Hadoop core components, Hadoop distributions, Developing enterprise applications with Hadoop.	10-- **Hrs.**
Unit 3:- **Storing Data in Hadoop**: Moving data in and out of Hadoop, HDFS architecture, HDFS files, Hadoop specific file types, HDFS federation and high availability, Fundamentals of HBASE, Zookeeper concepts and methods to build applications with zookeeper. **Advanced Map -Reduce Techniques** Simple, advanced, and in-between Joins, Graph algorithms, using language-independent data structures. Hadoop configuration properties - Setting up a cluster, Cluster access control, managing the NameNode, Managing HDFS, MapReduce management, Scaling.	10- **Hrs.**
Unit 4: Processing Data with Map-Reduce: Knowing map-reduce, Map-reduce execution pipeline, Runtime coordination and task management in map-reduce, Word count map-reduce application, Building and executing map-reduce programs, Designing map-reduce implementations.	10- **Hrs.**
Unit 5: HIVE, HIVQL and PIG: HIVE architecture and installation, Comparison with traditional database, HIVQL querying data, Sorting and aggregating, Joins & sub queries, HIVE Vs PIG Types of NoSQL databases, Advantages of NoSQL, Use of NoSQL in industry, SQL vsNoSQL.	10- **Hrs.**
Unit 6: Database for the Modern Web: Introduction to MongoDB key features, Core Server tools, MongoDB through the JavaScript's shell, Creating and querying through indexes, Document-Oriented, Principles of schema design, Constructing queries on databases, Collections and documents, MongoDB Query language.	10- **Hrs.**

Textbooks:
[1] Boris lublinsky, Kevin t. Smith, Alexey Yakubovich, Professional Hadoop Solutions, Wiley, Wiley, ISBN: 9788126551071, 2015 2015.
[2] Thomas Erl ,"Big Data Fundamentals-Concepts, Drivers and Techniques", Pearson publication,2016
[3]Kyle Banker, PiterBakkum, Shaun Verch, "MongoDB in Action", Second Edition, Dream tech Press
[4] Tom White, Hadoop: The Definitive Guide, O'Reilly Media Inc., 2015.

[5] . Garry Turkington, Hadoop Beginner's Guide, Packt Publishing, 2013..

References:
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Unit wise Measurable students Learning Outcomes:

1

2

3

4

5

6

Title of the Course: Professional Elective-IV(Financial Risk Analyticsand Management) Course Code: PCDS0223	L	T	P	Credit
	3	1	-	4

Course Pre-Requisite:
Course Description:
Course Objectives:

Course Objectives:
1. To identify the different risks involved in Finance arena.
2. To understand and solve the different risks pertaining to stock market
3. To analyze the legal issues affecting the business

Course Learning Outcomes:

CO	After the completion of the course the student should be able to
CO1	Identify and categorize the various risks faced by an organization
CO2	Explore the tools and practices needed to assess and evaluate financial risks
CO3	Explore risk management practices in an industry

CO-PO Mapping:

CO	PO1	PO2	PO3
CO1	2		3
CO2	2		3
CO3	2		3

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one EndSemester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1:- **Introduction to Risk** -Understanding Risk- Nature of Risk, Source of Risk, Need for riskmanagement, Benefits of Risk Management, Risk Management approaches.	8 Hours
Unit 2:- **RiskClassification**- credit risk, market risk, operational risk and other risk	8 Hours
Unit 3:--**Risk Measurements** - Credit risk measurement, market riskmeasurement, interest rate risk measurement, Asset liability management,measurement of operational risk	6 Hrs.
Unit 4: **Risk Management**- Managing credit risk, managing operational risk,managing market risk, insurance	8 Hrs.
Unit 5:--- **Risk in Instruments** -Tools for risk management – Derivatives, combinations ofderivative instruments, Neutral and volatile strategies, credit derivatives, credit ratings,swaps	8 Hrs.
Unit 6:---**Regulation and Other Issues:** Other issues in risk management – Regulatory framework,Basel committee, legal issues, accounting issues, tax issues,	6 Hrs.

MIS and reporting,integrated risk management.	

Textbooks:

1. Dun, Bradstreet, "Financial Risk Management", TMH, 2006.
2. John C Hull, "Risk management and Financial Institutions", Pearson, 2015.

References:

1. AswathDamodharan, "Strategic Risk Taking", Pearson, 2008

Title of the Course: Programming Lab II	L	T	P	Credit
Course Code: PCDS0231	0	0	2	1

Course Prerequisite: nil

Course Description:

This course aims at providing students with basic knowledge of artificial intelligent systems and image and video analysis.

Course Objectives:

1. To impart basic proficiency in representing difficult real life problems in a state spacerepresentation so as to solve them using AI techniques.
2. Fundamental concepts of a digital image and video processing system

Course Learning Outcomes:

CO	After the completion of the course the student should be able to
CO1	Implement and apply machine learning techniques in predictionproblems.
CO2	Apply various algorithms for processing digital images and videos

Assessments :

Teacher Assessment:

One component of In Semester Evaluation (ISE) and one End Semester Examination (ESE) having 50%, and 50% weights respectively.

Assessment	Marks
ISE	50
ESE	50

ISE is based on laboratory assignments performed / Quiz / Mini-Project assigned / Presentation / Group Discussion / Internal oral etc.

ESE: Assessment is based on Oral Examination.

Course Contents:

1. Write a program for image compression.	2 Hrs
2. Write a program for implementing kalman filters for video analytics.	2 Hrs
3. Write a program to implementhidden markow algorithm	2 Hrs
4. Write a program for Object Tracking using Active Contours	2 Hrs
5. Case study- Face Detection and Recognition	2 Hrs

6.	Implementation of pattern matching algorithm in AI	2 Hrs
7.	Implementation of SATPLAN program.	2 Hrs
8.	Program for constructing Bayesian Networks model	2 Hrs
9.	Program for basic agglomerative clustering algorithm.	2 Hrs

Title of the Course: Professional Elective Lab-II	L	T	P	Credit
Course Code:PCDS0232			4	2

Course Pre-Requisite:
Course Description: This lab encompasses the courses studied under the title Professional Elective III and Professional Elective IV.

Course Objectives:
1.   To implement different algorithms studied in the professional electives courses
2.   To identify real life problems suitable to represent using the models studied in the professional elective courses
3.   To implement models developed for real life problems

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		level	Descriptor
CO1	implement different algorithms studied in the professional electives courses	3	Apply
CO2	identify real life problems suitable to represent using the models studied in the professional elective courses	4	Analyze
CO3	implement models developed for real life problems	3	Apply

CO-PO Mapping:

CO	PO1	PO2	PO3
CO1	1		1
CO2	2		2
CO3	1		1

Assessments :
Teacher Assessment:
One component of In Semester Evaluation (ISE) and one End Semester Examination (ESE) having 50%, and 50% weights respectively.

Assessment	Marks
ISE	50
ESE	50

ISE are based on practical performance/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc.
ESE: Assessment is based on oral examination

Course Contents:	
Professional Elective (III) Lab Courses:	2 **Hrs.**
1. Business Intelligence System	
Experiment No. 1: Creating Warehouse Database **Aim and Objectives:** To create ,connect and browse warehouse database	

Outcomes: Warehouse Database	
Experiment No. 2: Scheduling warehouse processes **Aim and Objectives:** To define, test and schedule processes **Outcomes:** Transformed Database	2 **Hrs.**
Experiment No. 3: Cataloging data and schema in warehouse for end users **Aim and Objectives:** To create catalog and schema in warehouse **Outcomes:** Database with catalog and schema	2 **Hrs.**
Experiment No. 4: Starting OLAP model **Aim and Objectives:** To select fact table and joining and editing dimension tables **Outcomes:** OLAP Model	2 **Hrs.**
Experiment No. 5: Creating OLAP Application **Aim and Objectives:** To explore OLAP model interfaces **Outcomes:** OLAP Application	2 **Hrs.**
Professional Elective (III) Lab Courses: **2. Cloud Computing** **Experiment No. 1:** Creating Root and IAM user	2 **Hrs.**
Experiment No. 2: Create and access Free Tier EC2 instance in AWS	2 **Hrs.**
Experiment No. 3: Deploy web page in EC2 instance- configure Load Balancer and Auto Scaling Group in EC2	2 **Hrs.**
Experiment No. 4: Create Free Tier RDS EC2 instance	2 **Hrs.**
Experiment No. 5: Configure Cache service for RDS	2 **Hrs.**
Professional Elective (III) Lab Courses: **3. Optimization Techniques** **Experiment No. 1:** Implementation of the Simplex algorithm in linear programming	
Experiment No. 2: Implementation of Max flow,Min-flow algorithm	2 **Hrs.**
Experiment No. 3: Program for Saddle-point interpretation, KKT Conditions	2 **Hrs.**
Experiment No. 4: Program for Quasi-Newton Method	2 **Hrs.**
Experiment No. 5: Implementation of Levenberg-Marquardt algorithm for optimization	2 **Hrs.**
Professional Elective (IV) Lab Courses: **1. IoT and Cognitive Computing** **Exp. No. 1:Basic setup of Raspberry Pi and installing OS on Raspberry Pi.** Aim and Objectives: To understand Raspberry Pi Pin configuration, Raspberry Pi OS setup and starting with Raspberry Pi Outcomes: Student will be able to setup, configure and use Raspberry Pi	2 **Hrs.**
Exp. No. 2: Writing a Blinking LED program on Raspberry Pi using Python.	2 **Hrs.**

Aim and Objectives: Installing GPIO Libraries and Writing a program for Blinking LED. Theoretical Background: Python Programming and Raspberry Pi basics. Experimentation: Write a program to implement Blinking LED using Raspberry Pi and GPIO libraries.	
Exp. No. 3: Writing a Blinking LED program with Switch on Raspberry Pi using Python. Aim and Objectives: Understanding GPIO Input and Output pin for programming and writing a program for Blinking LED using Switch. Theoretical Background: Python Programming and Raspberry Pi basics. Experimentation: Write a program to implement Blinking LED using a Swithc on Raspberry Pi and GPIO libraries. Understanding GPIO Input and Output pin for programming.	2 **Hrs.**
Exp. No. 4: Introduction to Arduino and Writing a simple program on Arduino Kit. Aim and Objectives: To understand Arduino Pin configuration, Arduino setup, starting with Arduino and writing a simple program on Arduino for blinking LED with switch.	2 **Hrs.**
Exp. No. 5: Implementing DHT sensor interface with Arduino and finding temperature, humidity etc. Aim and Objectives: To understand DHT sensor and programming on Arduino kit.	2 **Hrs.**
Professional Elective (IV) Lab Courses: **2. Big Data Storage and Hadoop** **Exp. No. 1:** Word count application in Hadoop.	2 **Hrs.**
Exp. No. 2: Sorting the data using MapReduce.	2 **Hrs.**
Exp. No. 3: Finding max and min value in Hadoop.	2 **Hrs.**
Exp. No. 4: Implementation of decision tree algorithms using MapReduce.	2 **Hrs.**
Exp. No. 5: Implementation of K-means Clustering using MapReduce	2 **Hrs.**

Title of the Course: Seminar	L	T	P	Credit
Course Code:PCDS0241			2	1

Course Pre-Requisite:

Course Description: Students are trained for research and presentation skills in this course.

Course Objectives:
5. To promote and develop presentation skills
6. Learn how to evaluate research papers
7. Identify and use variety of academic resources available
8. Learn fundamental principles, concepts or theories

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Demonstrate ability to use technical resources available	2	Demonstrate
CO2	Write technical documents and give oral presentations related to the work completed	5	Write
CO3	Explain some specific skills, competences and points of view needed by computing professionals	6	Explain

CO-PO Mapping:

CO	PO1	PO2	PO3
CO1	3	2	3
CO2	2	3	2
CO3	1	3	2

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE)

Assessment	Marks
ISE-I	50
ISE-II	50

ISE are based on Presentation/ Internal oral etc.

Course Contents/Guidelines:
- Attendance at each seminar is mandatory for all students enrolled
- Abstract should be concise(<250 words), well written and free of grammatical and typographical errors
- Each student will give 30- minute presentation
- Your seminar should cover several(5 or more) related papers
- The topic should be in an area closely related to your research.
- You should strive to organize your seminar into a cohesive presentation, and be selective about what you present
- Final grade will be determined by several factors: the quality and content of your seminars, presentation and the ability to meet scheduled deadlines.

Title of the Course: Mini Project		L	T	P	Credit
Course Code:PCDS0251				2	1

Course Pre-Requisite:
Course Description: Students are required to carry out Mini Project work under the supervision of a Guide provided by Programme Coordinator.

Course Objectives:
1. To apply the acquired knowledge and techniques
2. Develop software solutions for real problems
3. Identify and use variety of academic resources available
4. Learn fundamental principles, concepts or theories

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Formulate a real world problem and develop a solution for a set of requirements	6	Formulate
CO2	Test and validate the conformance of the developed prototype against the original requirements of the problem	6	Test
CO3	Analyze new tools, algorithms, and/or techniques that contribute to the software solution of the project	5	Analyze

CO-PO Mapping:

CO	PO1	PO2	PO3
CO1			3
CO2	2		
CO3			3

Assessments :

Teacher Assessment:

One component of In Semester Evaluation (ISE)

Assessment	Marks
ISE	50

ISE are based on Presentation/ Internal oral etc.

Course Contents/Guidelines:

- Every student is required to carry out Mini Project work under the supervision of a Guide provided by the Programme Coordinator.
- The Guide shall monitor progress of the student continuously.
- Mini Project proposal should be prepared in consultation with the Guide. It should clearly state the objectives and environment of the proposed Mini Project to be undertaken
- A student is required to present the progress of the Mini Project work during the semester as per the schedule provided
- Final grade will be determined by several factors: the quality and content of your presentation and the ability to meet scheduled deadlines.
- Each student is required to make a copy of Mini Project in CD and submit along with his/her Mini Project report.