B. Tech Computer Science and Engineering (Artificial Intelligence and Data Science)
Modified Scheme of Studies/Examination (w.e.f. Session 2023-24)
Semester VII

S. No.	Course No.	Subject	L:T: P	Hours/ Week	Credits	Examination Schedule				Duration of Exam (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	HM-CS-AIDS-401A	Business Intelligence and Data Visualization	3:0:0	3	3	75	25	0	100	3
2	HSS-403A	Universal Human Values II: Understanding Harmony	3:0:0	3	3	75	25	0	100	3
3	OEC	OEC Elective*-II	3:0:0	3	3	75	25	0	100	3
4	PE	Elective* - I	2:0:0	2	2	75	25	0	100	3
5	PE	Elective* - II	2:0:0	2	2	75	25	0	100	3
6	HM-CS-AIDS-405A	Data Visualization Lab	0:0:2	2	1	0	40	60	100	3
7	PE-LA	Elective-I Lab	0:0:2	2	1	0	40	60	100	3
8	PC-CS-AIDS-409LA	Project**-I	0:0:10	10	5	0	100	100	200	3
9	PC-CS-AIDS-413A	Industrial Training***	0	0	3	0	100	0	100	0
		Total		**27**	**23**	**375**	**405**	**220**	**1000**	24

Code	PE- Elective* - I	Code	PE- Elective* - II
PE-CS-AIDS-415A	ANN and Deep Learning	PE-CS-AIDS-423A	High Performance Computing
PE-CS-AIDS-417A	Data Mining & Predictive Modelling	PE-CS-AIDS-425A	Human AI Interaction
PE-CS-AIDS-419A	Predictive Analysis	PE-CS-AIDS-427A	Software Testing
PE-CS-AIDS-421A	Advance Computer Architecture	PE-CS-AIDS-429A	Natural Language Processing

Code	OEC Elective*-II	Code	PE-LA-Elective*-I Lab
OE-CS-AIDS-401	Cyber Law and Ethics	PE-CS-AIDS-415LA	ANN and Deep Learning Lab
OE-CS-AIDS-403	Probability for Data Science	PE-CS-AIDS-417LA	Data Mining & Predictive Modelling Lab
OE-CS-AIDS-405	Cluster Computing	PE-CS-AIDS-419LA	Predictive Analysis Lab
OE-CS-AIDS-407	Microprocessor	PE-CS-AIDS-421LA	Advance Computer Architecture Lab

Note:

***The students will choose any two departmental Electives courses and One Open Elective course out of the given elective list in VII Semester.**

****Project should be initiated in the beginning of 7th semester, and should be completed bythe end of 7th semester with good Report and power-point Presentation etc.**

*****4-6 weeks hand on training completed after 6th Semester Exams**

HM-CS-AIDS-401A	Business Intelligence and Data Visualization						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hrs.**
Purpose	This course introduces basic BI technologies. BI With data mining, it is possible to better manage product warranties, predict purchases of retail stock, unearth fraud, determine credit risk, and define new products and services.						
CourseOutcomes							
CO1	Students will learn the principles and best practices for how to use data in order to support fact-based decision making.						
CO2	Emphasis will be given to applications in marketing, where BI helps in the Businesses.						
CO3	BI helps performing for sales analysis and in application domains						
CO4	Practical experience will be gained by developing a BI project (case-study) with leading BI software.						

Unit-I

An Overview of Business Intelligence: Analytics and Decision Support A Framework for Business Intelligence (BI). Intelligence Creation Use and BI Governance. Transaction Processing Versus Analytic Processing. Successful BI Implementation. Analytics Overview. Brief introduction to Big Data Analytics.

Unit-II

Data Warehousing: Data Warehousing Process Overview. Data Warehousing Architectures. Data Integration and the Extraction, Transformation, and Load Processes. Data Warehouse Development. Data Warehousing Implementation Issues. Real-Time Data Warehousing. Data Warehouse Administration, Security Issues and Future Trends

Unit-III

Big Data and Analytics: Definition of Big Data. Fundamentals of Big Data Analytics. Big Data Technologies. Data Scientist. Big Data and Data Warehousing. Big Data Vendors. Big Data and Stream Analytics. Applications of Stream Analytics

Unit-IV

Data Visualization: Business Reporting, Visual Analytics and Business Performance Management Business Reporting Definitions and Concepts. Data and Information Visualization. Different Types of Charts and Graphs. The Emergence of Data Visualization and Visual Analytics. Performance Dashboards. Business Performance Management. Performance Measurement. Balanced Scorecards. Six Sigma as a Performance Measurement

System

Suggested Books:

The Visual Display of Quantitative Information by Edward R. Tufte
Business Intelligence: Making Better Decisions Faster by Elizabeth Vitt , Michael Luckevich, Stacia Misner
Business Intelligence Competency Centers: A Team Approach to Maximizing Competitive Advantage (Hardcover)by Gloria J. Miller

HSS-403A	**Universal Human Values II: Understanding Harmony**						
Lecture	**Tutorial**	**Practical**	**Credit**	**MajorTest**	**MinorTest**	**Total**	**Time**
3	**0**	**0**	**3.0**	**75**	**25**	**100**	**3 Hours**
Purpose	Purposeandmotivationforthecourse,recapitulationfromUniversalHumanValues-I						
CourseOutcomes(CO)							
CO1	Developmentofaholisticperspectivebasedonself-explorationabout						
CO2	Understanding(ordevelopingclarity)oftheharmonyinthehumanbeing,family,soci etyand nature/existence.						
CO3	Strengtheningofself-reflection.						
CO4	Developmentofcommitmentandcouragetoact.						

Module1:CourseIntroduction-Need,BasicGuidelines, ContentandProcessforValueEducation

1. PurposeandmotivationforthecourserecapitulationfromUniversalHumanValues-I
2. Self-Exploration–what is it? - Its contentand process;'Natural Acceptance' andExperiential Validation-as the process forself-exploration
3. ContinuousHappinessandProsperity- AlookatbasicHumanAspirations
4. RightunderstandingRelationshipandPhysicalFacility- thebasicrequirementsforfulfilmentofaspirationsofeveryhumanbeingwiththeircorrectpriority
5. UnderstandingHappinessandProsperitycorrectly-Acriticalappraisalofthecurrentscenario
6. Methodtofulfiltheabovehumanaspirationsunderstandingandlivinginharmonyatvariouslevel s.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance forlivingwithresponsibility(livinginrelationship,harmonyandco-existence)ratherthanasarbitrarinessinchoicebasedonliking-disliking

Module2:UnderstandingHarmonyintheHumanBeing-HarmonyinMyself!

1. Understandinghumanbeingasaco-existenceofthesentient'I'andthematerial'Body'
2. UnderstandingtheneedsofSelf('I') and 'Body'-happinessandphysicalfacility
3. UnderstandingtheBodyasaninstrumentof'I'(Ibeingthedoer,seer andenjoyer)
4. Understandingthecharacteristicsandactivitiesof'I'andharmonyin'I'
5. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs,meaningofProsperityindetail
6. Programstoensure SanyamandHealth.

Include practice sessions to discuss the role others have played in making material goods available tome. Identifying from one's own life. Differentiate between prosperity and accumulation. Discussprogramforensuringhealthvs dealingwithdisease

Module 3: Understanding Harmony in the Family and Society- Harmony in Human-HumanRelationship

1. Understanding values in human-human relationship; meaning of Justice (nine universal values inrelationships)andprogramforitsfulfilmenttoensuremutualhappiness;TrustandRespectasthe foundationalvaluesofrelationship
2. UnderstandingthemeaningofTrust;Differencebetweenintentionandcompetence
3. Understanding the meaning of Respect, Difference between respect and differentiation; the othersalientvaluesinrelationship
4. Understanding theharmony inthesociety(societybeinganextensionoffamily): Resolution,Prosperity,fearlessness(trust)and co-existence ascomprehensive Human Goals

5. Visualizing a universal harmonious order in society- Undivided Society, Universal Order-fromfamilytoworldfamily.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family,reallifeexamples,teacher-studentrelationship,goalofeducationetc.Gratitudeasauniversalvalueinrelationships.Discuss withscenarios.Elicitexamplesfromstudents'lives

Module4:UnderstandingHarmonyintheNatureandExistence-WholeexistenceasCoexistence

1. Understandingtheharmony intheNature
2. Interconnectednessandmutual fulfillment amongthefourordersofnature-recyclabilityandself-regulationinnature
3. UnderstandingExistenceasCo-existenceof mutuallyinteractingunitsinall-pervasivespace
4. Holisticperceptionofharmonyatalllevels ofexistence.

Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" canbeused),pollution,depletionofresourcesandroleoftechnologyetc.

Module5:
ImplicationsoftheaboveHolisticUnderstandingofHarmonyonProfessionalEthics

1. Naturalacceptance ofhumanvalues
2. Definitiveness ofEthicalHumanConduct
3. BasisforHumanisticEducation,HumanisticConstitutionandHumanisticUniversalOrder
4. Competenceinprofessionalethics a. Abilitytoutilizetheprofessionalcompetenceforaugmenting universal human order b. Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, c. Ability toidentify and develop appropriatetechnologiesandmanagementpatternsforaboveproductionsystems.
5. Casestudiesoftypicalholistictechnologies,managementmodelsandproductionsystems
6. Strategy for transition from the presentstate to Universal Human Order: a.At the level ofindividual: as socially and ecologically responsible engineers, technologists and managers b. Atthelevelofsociety:asmutuallyenrichinginstitutionsandorganizations
7. Sumup.

IncludepracticeExercisesandCaseStudies will be takenupinPractice(tutorial)Sessionseg.todiscusstheconductas anengineerorscientistetc.

READINGS:

TextBook

1. HumanValuesand ProfessionalEthicsbyRRGaur,RSangal,GP Bagaria,ExcelBooks,New Delhi,2010

ReferenceBooks

1. JeevanVidya:EkParichaya, ANagaraj, JeevanVidyaPrakashan, Amarkantak,1999.
2. HumanValues,A.N.Tripathi,NewAgeIntl.Publishers,NewDelhi,2004.
3. TheStoryofStuff(Book).
4. TheStoryofMyExperimentswithTruth-byMohandas KaramchandGandhi
5. SmallisBeautiful-E.FSchumacher.
6. SlowisBeautiful-CecileAndrews
7. EconomyofPermanence-JCKumarappa
8. BharatMeinAngrejiRaj-PanditSunderlal
9. RediscoveringIndia –byDharampal
10. HindSwarajorIndianHomeRule-byMohandasK.Gandhi
11. IndiaWinsFreedom-MaulanaAbdulKalamAzad
12. Vivekananda-RomainRolland(English)
13. Gandhi-RomainRolland(English)

MODEOFCONDUCT

Lecture hours are to be used for lecture/practice sessions.

Lectureshoursaretobeusedforinteractivediscussion, placingtheproposalsaboutthetopicsathandandmotivatingstudents toreflect,explore andverifythem.

Practicehoursaretobeusedforpracticesessions.

While analyzing anddiscussingthetopic,thefacultymentor'sroleisinpointingtoessentialelementsto help in sorting them out from the surface elements. In other words, help the students explore theimportantorcriticalelements.

In the discussions, particularly during practice sessions, the mentor encourages the studentto connect with one's own self and do self-observation, self-reflection and self-exploration. Scenariosmay be used to initiate discussion. The student is encouraged to take up" ordinary" situations ratherthan" extra-ordinary"situations. Such observations and their analyses are shared and discussed withotherstudents andfacultymentor,inagroupsitting.

Practice experiments are important for the course. The difference is that the laboratoryis everyday life, and practical are how you behave and work in real life. Depending on the nature oftopics, worksheets, home assignment and/or activity are included. The practice sessionswould also provide support to a student in performing actions commensurate to his/her beliefs. It isintendedthatthiswouldleadtodevelopmentofcommitment,namelybehavingandworkingbasedo nbasichuman values.

It is recommended that this content be placed before the student as it is, in the form of a basicfoundation course, without including anything else or excluding any part of this content. Additionalcontentmaybe offeredinseparate,highercourses.

Thiscourseistobetaughtbyfacultyfromeveryteachingdepartment,includingHSSfaculty.Teacherpreparationwithaminimumexposuretoatleastone8-dayFDPonUniversalHumanValuesisdeemedessential.

ASSESSMENT:

This is a compulsory credit course. The assessment is to provide a fair state of development of thestudent, so participation in classroom discussions, self-assessment, peer assessment etc. will be usedinevaluation.

Example:
Assessmentby
Facultymentor:5 marks
Self-assessment:5 marks
Assessmentbypeers:5 marks
Sociallyrelevantproject/GroupActivities/Assignments:10 marks
SemesterEndExamination: 75marks
Theoverallpasspercentageis40%. Incasethestudentfails,he/shemustrepeatthecourse.

S. No.	Course No.	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule				Duration of Exam (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	OEC	**OEC Elective-II**	3:0:0	3	3	75	25	0	100	3

OE-CS-AIDS-401	Cyber Law and Ethics						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hours**
Purpose	To gain a broad understanding in order to get cyber law and ethics.						
Course Outcomes (CO)							
CO 1	To facilitate the basic knowledge of cyber Law.						
CO 2	To learn about how to maintain the Confidentiality, Integrity and Availability of information technology act.						
CO 3	To get enable to fix the various Cyber Law and Related Legislation.						
CO 4	To deal with the Cyber Ethics.						

Unit-1: Introduction to Cyber Law

Evolution of computer technology, emergence of cyber space. Cyber Jurisprudence, Jurisprudence and law, Doctrinal approach, Consensual approach, Real Approach, Cyber Ethics, Cyber Jurisdiction, Hierarchy of courts, Civil and criminal jurisdictions, Cyberspace-Web space, Web hosting and web Development agreement, Legal and Technological Significance of domain Names, Internet as a tool for global access.

Unit-2: Information Technology Act

Overview of IT Act, 2000, Amendments and Limitations of IT Act, Digital Signatures, Cryptographic Algorithm, Public Cryptography, Private Cryptography, Electronic Governance, Legal Recognition of Electronic Records, Legal Recognition of Digital Signature, Certifying Authorities, Cyber Crime and Offences, Network Service Providers Liability, Cyber Regulations Appellate Tribunal, Penalties and Adjudication.

Unit-3: Cyber Law and Related Legislation

Patent Law, Trademark Law, Copyright, Software – Copyright or Patented, Domain Names and Copyright disputes, Electronic Data Base and its Protection, IT Act and Civil Procedure Code, IT Act and Criminal Procedural Code, Relevant Sections of Indian Evidence Act, Relevant Sections of Bankers Book Evidence Act, Relevant Sections of Indian Penal Code, Relevant Sections of Reserve Bank of India Act, Law Relating To Employees And Internet, Alternative Dispute Resolution , Online Dispute Resolution (ODR).

Unit-4: Cyber Ethics

The Importance of Cyber Law, Significance of cyber Ethics, Need for Cyber regulations and Ethics. Ethics in Information society, Introduction to Artificial Intelligence Ethics: Ethical Issues in AI and core Principles, Introduction to Block chain Ethics.

Suggested Books:

1. Cyber Security : Understanding Cyber Crimes , Computer Forensics and Legal Perspectives By Nina Godbole, Sunit Belapur , Wiley
2. Understanding cybercrime: phenomena , and legal challenges response, ITU 2012.

OE-CS-AIDS-403	Probability for Data Science						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hour**
Purpose	To understand the foundations of probability and its relationship to statistics and data science.						
Course Outcomes (CO)							
CO1	Understand the mathematical framework for probability theory						
CO2	Understand various kinds of Random Variables that are fundamental to probabilistic modeling.						
CO3	To Learn Statistical Concept in Data Analytics						
CO4	Explore some introductory concepts from statistics that are helpful in analyzing data and machine learning.						

Unit I

Probability Theory: Counting, combinations, permutations, binomial and multinomial coefficients,Stirling's formula. Discrete probability spaces (with examples). Axiomatic definition of probability, inclusion-exclusion formula, independence, condition probability, Bayes' rule.

Unit II

Random variables: definition, distribution function and its properties, probability mass function (binomial, Bernoulli, Poisson, geometric), probability density function (uniform, exponential, Gaussian).Joint distributions, independence and conditioning of random variables. Function of random variables, change of variable formula.

Unit III

Measures of central tendency, dispersion and association – expectation, median, variance, standard deviation, mean absolute deviation, covariance, correlation and entropy (definitionand guidelines on how to choose a particular measure). Markov and Chebyshev inequalities, Notion of convergence in probability and distribution. Weak law of large numbers andcentral limit theorem (examples demonstrating the use of WLLN and CLT). Montecarlo methods (estimating value of e, π, simulation of birthday paradox). Poisson limit for rare events.

Unit IV

Statistics: Using probability to understand data (give real life examples). Frequentist approach - point and range estimates, confidence intervals, hypothesis testing p-values, significance level, power and t-test. Bayesian inference–maximum likelihood estimation. Regression

Textbooks:

Sheldon Ross, Introduction to Probability and Statistics for Engineers, 5/e (2014), Elsevier

Reference Books:

Morris H. DeGroot and Mark J. Schervish, Probability and Statistics (4/e)(2012), Addison-Wesley.

Blitzstein and Hwang, Introduction to Probability (2015), CRC Press.

William Feller, An Introduction to Probability, (3/e) (2008), Volume 1, Wiley.

Freedman, Pisani, Purves, Statistics (4/e)(2014), W. W. Norton & Company

OE-CS-AIDS-405	Cluster Computing						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hrs.**
Purpose	The objective is to learn emerging techniques in Cluster Computing and its applications.						
Course Outcomes (CO)							
CO1	Remember and understand the basic concepts/Principles of distributed Systems						
CO2	Analyze the Various Concepts of Cluster Computing						
CO3	Able to describe different parallel processing platforms involved in achieving high performance computing						
CO4	Develop efficient and high-performance parallel programming.						

UNITI

BasicconceptsinDistributedSystems:Notion of time Distributed Mutual exclusion, Consensus, Failure models Paradigms for process interaction in distributed programs, Programming Paradigms, Shared memory, Message passing, Workflows.

UNITII

Introduction to Cluster Computing, Cluster Middleware, Early Cluster Architecture and High Throughput Computing Clusters, Networking, Protocols and I/O for Clusters, Setting Up and Administering aCluster , Overview of Cluster Computing, Cluster Computer and its Architecture, Clusters Classifications, Components for Clusters, Cluster Middleware and Single System Image.

UNITIII

Cluster Technology for High Availability, Performance Models and Simulation, Process Scheduling, Resource Management and Scheduling, Programming, EnvironmentsandTools, LoadSharing and Load Balancing, Distributed Shared Memory, Cluster Applications, Cluster Systems.

UNITIV

Beowulf Cluster: The Beowulf Model, Application Domains, Beowulf System Architecture, SoftwarePractices, Parallel Programming withMPL, Parallel Virtual Machine(PVM). System Infrastructure, Traditional paradigms for distributed computing, Web Services, Grid standards:OGSAandWSRF,Case Studies ofCluster Systems: COMPaS,NanOS and PARAM

TEXTBOOKS:

Rajkumar Buyya High Performance Cluster Computing: Architectures and Systems. Prentice-Hall India, 1999.

HighPerformanceClusterComputing:Architecturesand Systems, Vol.1, Prentice Hall
GridandCluster Computing, PrabhuC.S.R,PHILearningPrivateLimited
In search of clusters(2nded.),GregoryF.Pfister,IBM,Austin,TX,Prentice-Hall
DistributedandCloudComputing,FirstEdition,GeoffreyC.Fox,KaiHwang,JackJ.Dongarra ,ElsevierIndia Pvt. Ltd.-NewDelhi
Laurence T.Yang, Minyi Guo – High Performance Computing Paradigm and Infrastructure JohnWiley

OE-CS- AIDS-407	Microprocessor						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	3	75	25	100	**3Hour**
Purpose	Tolearnthearchitectureandprogrammingof Intelfamily microprocessors anditsinterfacing.						
CourseOutcomes							
CO1	TostudytheArchitectureof8086microprocessors						
CO2	Toimplement theinterfacingofmemories to8086Microprocessor						
CO3	Tolearnandanalyzetheinstructionsetof8086Microprocessorandimplementationof assemblylanguageprogrammingof8086Microprocessor.						
CO4	Todesignandimplementtheinterfacingof interrupts,basicI/OandDMAwith8086Microprocessor						

UnitI

8086 CPU ARCHITECTURE: 8086 Block diagram; description of data registers, address registers; pointerand index registers, PSW, Queue, BIU and EU. 8086 Pin diagram descriptions. Generating 8086 CLK and reset signals using 8284. WAIT state generation. Microprocessor BUS types and buffering techniques, 8086minimummodeandmaximummodeCPUmodule.

UNIT-II

Main Memory System Design: Memory devices, 8086 CPU Read/Write timing diagrams in minimum modeand maximum mode. Address decoding techniques. Interfacing SRAMS; ROMS/PROMS. Interfacing andrefreshingDRAMS.

UNIT-III

8086 Instruction Set: Instruction formats, addressing modes, Data transfer instructions, string instructions,logical instructions, arithmetic instructions, transfer of control instructions; process control instructions;Assemblerdirectives.

8086 Programming Techniques: Writing assembly Language programs for logical processing, arithmeticprocessing,timingdelays;loops,data conversions.

UNIT-IV

Basic I/O Interface: Parallel and Serial I/O Port design and address decoding. Memory mapped I/O VsIsolated I/O Intel's 8255 and 8251- description and interfacing with 8086.ADCs and DACs, - types,operation and interfacing with 8086. Interfacing Keyboards, alphanumeric displays, multiplexed displays,andsteppermotor,opticalencoderwith8086.

Interrupts and DMA: 8086 Interrupt mechanism; interrupt types and interrupt vector table. Applications ofinterrupts,Intel's8259.DMAoperation.Intel's8237.

SuggestedBooks:

BarryB.Brey,"TheIntelMicroprocessor8086/8088,80186",PearsonEducation,EighthEdition,2009

D.V.Hall,MicroprocessorsandInterfacing,McGrawHill2nded.

Liu, Gibson, "MicrocomputerSystems:The8086/88Family", 2nd Edition, PHI,2005

KennethAyala,"The8086Microprocessor:Programming&InterfacingthePC",CengageLearning, IndianEdition, 2008

KipIrvine,"AssemblylanguageforIBM PC",PHI,2nd Edition,1993

PeterAbel, "Assemblylanguageprogramming", PearsonEdu,5th Edition,2002

Uffenback, "The8086FamilyDesign"PHI, 2nd Edition.

WalterATriebelandAvtarSingh; The8088 and8086Microprocessors

S. No.	Course No.	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule				Duration of Exam (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	**PE**	**Elective - I**	2:0:0	2	2	75	25	0	100	3

Code	PE- Elective - I
PE-CS-AIDS-415A	ANN and Deep Learning
PE-CS-AIDS-417A	Data Mining & Predictive Modelling
PE-CS-AIDS-419A	Predictive Analysis
PE-CS-AIDS-421A	Advance Computer Architecture

PE-CS-AIDS-415A	ANN and Deep Learning						
L	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	0	0	2	75	25	100	3 hrs
Purpose	Purpose To provide knowledge of various artificial neural networks and deep learning algorithms for optimization						
Course Outcomes (CO)							
CO 1	To learn the basics of artificial neural networks concepts, various neural networks architecture						
CO 2	To explore knowledge of special types of Artificial neural networks						
CO 3	To understand the basics of Deep learning and its applications						
CO 4	To imprise about the different deep learning algorithms and their applications to solve real world problems.						

UNIT-I

Artificial Neural Networks: Human brain, Model of an artificial neuron, Basic concepts of neural networks, fundamentals of biological neural network and artificial neural network, evolution of neural networks, Characteristics of Neural Networks, learning methods-supervised, unsupervised and reinforcement, taxonomy of neural network architectures, terminologies-weights, bias, threshold, learning rate, applications of Neural Networks.

Unit-II

Supervised and Unsupervised Neural Networks: Training Neural Network: Risk minimization, loss function, backpropagation, regularization, model selection, and optimization.Hebb network theory and training algorithm, perceptron networks architecture and training algorithms, Back Propagation networks architecture and Training Algorithms, Associative Memory network architecture and Training Algorithms, Hopfield networks architecture and Training Algorithms, Counter Propagation networks architecture and Training Algorithms, adaptive resonance theory networks architecture and Training Algorithms. Probabilistic Neural Network: Hopfield Net, Boltzman machine, RBMs, Sigmoid net, Autoencoders

Unit-III

Advanced neural networks: Kohonan self organising feature, maps architecture and training algorithm, learning vector quantization architecture and training algorithm, boltzman machine, cognitron network, neocognitron network, optical neural networks electro-optical multipliers and holographic correlators. Conditional Random Fields: Linear chain, partition function, Markov network, Belief propagation, Training CRFs, Hidden Markov Model, Entropy.

Unit-IV

Deep learning: Various paradigms of learning problems, Perspectives and Issues in deep learning framework, review of fundamental learning techniques. Deep Learning research: Object recognition, sparse coding, computer vision, natural language processing Machine learning basics, simple machine learning algorithms-linear regression,underfitting and overfitting challenges in machine learning, supervised learning approach for support vector machine, Deep Forward Networks, Convolutional networks, deep recurrent networks, deep boltzmann machine, applications in speech recognition and natural language processing. Deep Feed Forward network, regularizations, and training deep models, Deep Belief Network..Deep Learning Tools: Caffe, Theano, Torch.

Suggested Books:

Li Min Fu, “Neural Networks in Computer Intelligence”, McGraw-Hill, Inc. 2012.
S N Sivanandam, “Neural Networks using MATLAB 6.0”, TMH, 4 th . Reprint 2015.
S N Sivanandam, “Principles of Soft Computing”, 2 nd . Edition, Wiley, Reprint 2014.
Freeman J.A. & D.M. Skapura, “Neural Networks: Algorithms, Applications and Programming Techniques”, Addison Wesley, Reading, Mass, 2014.
Deep Learning (Ian J. Goodfellow, YoshuaBengio and Aaron Courville), MIT Press, 2016.
Deep Learning with Python: A Hands-On Introduction by Ketkar, Apress
T2. Bishop, C. ,M., Pattern Recognition and Machine Learning, Springer, 2006.

PE-CS-AIDS-417A	Data Mining & Predictive Modelling						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**2**	**75**	**25**	**100**	**3 Hrs.**
Purpose	The objective of this course is to provide the in- depth coverage of data mining and modelling aspects along with its implementation						
Course Outcomes							
CO 1	Understand the fundamental concept of Data Mining.						
CO 2	Learn Data Mining techniques for Prediction and Forecasting.						
CO 3	Compare the underlying Predictive Modelling techniques.						
CO 4	Select appropriate Predictive Modelling approaches to identify cases and apply using a suitable package such as SPSS modeler .						

Unit-I:

Introduction to Data Mining,concepts of Data mining, Technologiesused,Data Mining Process,KDD process models,Mining on various kinds of data,Classification of Data Mining Systems, Application of Data Mining and challenges of Data Mining.

Unit-II:

Data Mining Techniques: Statistical Perspective on Data Mining, Similarity Measures, Clustering- Requirement for Cluster Analysis, Clustering Methods, Decision Tree- Decision Tree Induction, Attribute Selection Measures, Tree Pruning. Association Rule Mining: Frequent Item-set Mining using Apriori Algorithm, Nearest Neighbour Classification: Performance of Nearest Neighbour Classifiers.

Unit-III:

Model development & techniques Data Partitioning, Model selection, Model Development Techniques, Neural networks, Decision trees, Logistic regression, Discriminant analysis, Support vector machine, Bayesian Networks, Linear Regression, Cox Regression, Association rules.

Unit-IV:

Model Evaluation and Deployment Introduction, Model Validation, Rule Induction Using CHAID, Automating Models for Categorical and Continuous targets, Comparing and Combining Models, Evaluation Charts for Model Comparison, MetaLevel Modeling, Deploying Model, Assessing Model Performance, Updating a Model.

Text books:

J Hanes, M. Kamber, Data Mining Concepts and Techniques, Elsevier India.
Predictive & Advanced Analytics (IBM ICE Publication)
G.S. Linoff, M.J.A. Berry, Data Mining Techniques, Wiley India Pvt. Ltd.
Berson, S.J. Smith, Data Warehousing, Data Mining & OLAP, Tata McGraw-Hill

PE-CS-AIDS-419A	Predictive Analysis						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**2**	**75**	**25**	**100**	**3 Hrs.**
Purpose	Predictive analytics is emerging as a competitive strategy across many business sectors and can set apart high performing companies. It aims to predict the probability of the occurrence of a future event such as customer churn, loan defaults, and stock market fluctuations leading to effective business management.						
Course Outcomes							
CO1	Understand how to use predictive analytics tools to analyze real-life business problems.						
CO2	Demonstrate case-based practical problems using predictive analytics techniques to interpret model outputs.						
CO 3	Learn regression, logistic regression, and forecasting using software tools such as MS Excel, SPSS, and SAS.						
CO4	Understand to Forecasting,Time Series Analysis and develop the Model.						

Unit-I

Introduction to Analytics: Analytics in Decision Making, DescriptiveAnalytics, ProbabilityDistribution, HypothesisTesting, Analysis of Variance, Game changers &Innovators, Predictive Analytics.

Unit-II

Simple Linear Regression (SLR): Introduction to Regression, ModelDevelopment, ModelValidation, Multiple Linear Regression, Estimation of Regression Parameters, ModelDiagnostics, Dummy, Derived & Interaction Variables,Multi-collinearity,Model Deployment.

Unit-III

Logistic Regression: Discrete choice models, LogisticRegression Estimation of Parameters, Logistic Model Interpretation, Logistic Model Diagnostics, Logistic Model Deployment, Decision Trees and Unstructured data analysis,Chi-Square Automatic Interaction Detectors (CHAID),Classification and Regression Tree (CART),Analysis of Unstructured data, Naive Bayes algorithm.

Unit-IV

Forecasting and Time series Analysis: Forecasting,Time Series Analysis,Additive& Multiplicative models,Exponential smoothing techniques,ForecastingAccuracy,Auto regressive and Moving average models, Case Study on Forecasting.

Suggested Books:

C.M.Bishop –Pattern Recognition and Machine Learning,Springer,2006

L.Wasserman-All of statistics

PE-CS-AIDS-421A	Advance Computer Architecture						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**2**	**75**	**25**	**100**	**3 Hour**
Purpose	To enable students to learn various computational models, design paradigms of advanced computer architecture, parallelism approaches and techniques for static and dynamic interconnections.						
Course Outcomes (CO)							
CO1	Classify and interpret various paradigms, models and micro-architectural design of advanced computer architecture as well as identify the parallel processing types and levels for achieving optimum scheduling						
CO2	Identify the roles of VLIW & superscalar processors and branch handling techniques for performance improvement						
CO3	Analyze and interpret the basic usage of various MIMD architectures and relative importance of various types of static and dynamic connection networks for realizing efficient networks.						
CO4	Examine the various types of processors and memory hierarchy levels and cache coherence problem including software and hardware based protocols to achieve better speed and uniformity.						

Unit-I

Computational Model: Basic computational models, evolution and interpretation of computer architecture, concept of computer architecture as a multilevel hierarchical framework, classification of parallel architectures, Relationships between programming languages and parallel architectures. Parallel Processing: Types and levels of parallelism, Instruction Level Parallel (ILP) processors, dependencies between instructions, principle and general structure of pipelines, performance measures of pipeline, pipelined processing of integer, Boolean, load and store instructions, VLIW architecture, Code Scheduling for ILP Processors - Basic block scheduling, loop scheduling, global scheduling.

Unit-II

Superscalar Processors: Emergence of superscalar processors, Tasks of superscalar processing – parallel decoding, superscalar instruction issue, shelving, register renaming, parallel execution, preserving sequential consistency of instruction execution and exception processing, comparison of VLIW & superscalar processors. Branch Handling: Branch problem, Approaches to branch handling – delayed branching, branch detection and prediction schemes, branch penalties, multiway branches, guarded execution.

Unit-III

MIMD Architectures: Concepts of distributed and shared memory MIMD architectures, UMA, NUMA, CCNUMA & COMA models, problems of scalable computers. Static

connection networks: Linear array, ring, chordal ring, barrel shifter, star, tree, mesh and torus, fat Tree, systolic array, barrel shifter, hypercubes and Cube connected cycles. Dynamic interconnection networks: single shared buses, comparison of bandwidths of locked, pended & split transaction buses, arbiter logics, crossbar networks, multistage networks, omega networks, butterfly.

UNIT – IV

Processors and Memory Hierarchy: Advanced processor technology, memory hierarchy technology and virtual memory technology. Cache Coherence and Synchronization Mechanisms: Cache coherence problems, hardware based protocols – snoopy cache protocols, directory schemes, hierarchical cache coherence protocols, software based protocols.

Reference Books:

D.Sima, T.Fountain, P.Kasuk, Advanced Computer Architecture-A Design Space Approach, Pearson Education.

Kai Hwang and Naresh Jotwani, Advanced Computer Architecture-Parallelism, Scalability, Programmability, McGraw Hill.

M.J. Quinn, Parallel Computing: Theory and Practice, Second Edition, McGraw Hill.

J. L. Hennessy and D. A. Patterson, Computer Architecture: A Quantitative approach, Morgan Kaufmann/Elsevier.

T.G. Lewis and H. EI- Rewini, Introduction to parallel computing, Prentice Hall.

Nicolas Carter, Computer Architecture, McGraw Hill.

S. No.	Course No.	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule				Duration of Exam (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	PE	**Elective - II**	2:0:0	2	2	75	25	0	100	3

Code	PE- Elective - II
PE-CS-AIDS-423A	High Performance Computing
PE-CS-AIDS-425A	Human AI Interaction
PE-CS-AIDS-427A	Software Testing
PE-CS-AIDS-429A	Natural Language Processing

Unit-1

PE-CS-AIDS-423A	High Performance Computing						
L	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
2	0	0	2	75	25	100	3 hrs
Purpose	The design of high-performance computing (HPC) systems for compelling vision for how computation can seamlessly scale from a single processor to virtually limitless computing power						
Course Outcomes (CO)							
CO 1	To study the need for HPC and parallelism						
CO 2	To study parallel models of computation such as dataflow, and demand-driven computation.						
CO 3	To study state of the art processor architectures						
CO 4	To program and accelerate applications on the new high performance computing devices, we must understand both the computational architecture and the principles of program optimization						

Parallel Processing Concepts; Levels and model of parallelism: instruction, transaction, task, thread, memory, function, data flow models, demand-driven computation. Levels of parallelism (instruction, transaction, task, thread, memory, function), Models (SIMD, MIMD, SIMT, SPMD, Dataflow Models, Demand-driven Computation etc), Parallel architectures: N-wide superscalar architectures, multi-core, multi-threaded, server and cloud.

Unit-2

Parallel Programming with CUDA, Processor Architecture, Interconnect, Communication, Memory Organization, and Programming Models in high performance computing architectures: (Examples: IBM CELL BE, Nvidia Tesla GPU, Intel Larrabee Microarchitecture and Intel Nehalem microarchitecture), Memory hierarchy and transaction

specific memory design, Thread Organization. Fundamental design issues in HPC: Load balancing, scheduling, synchronization and resource management; Operating systems for scalable HPC; Parallel languages and programming environments; OpenMP, Pthread, MPI, java, Cilk

Unit-3

Fundamental Design Issues in Parallel Computing: Synchronization, Scheduling, Job Allocation, Job Partitioning, Dependency Analysis, Mapping Parallel Algorithms onto Parallel Architectures, and Performance Analysis of Parallel Algorithms. Scalable storage systems: RAID, SSD cache, SAS, SAN; HPC based on cluster, cloud, and grid computing: economic model, infrastructure, platform, computation as service; Accelerated HPC: architecture, programming and typical accelerated system with GPU, FPGA, Xeon Phi, Cell BE; Power-aware HPC Design: computing and communication, processing, memory design, interconnect design, power management.

Unit-4

Performance analysis of parallel algorithms, Fundamental Limitations Facing Parallel Computing, Fundamental limitations in HPC: bandwidth, latency and latency hiding techniques, Tolerating Techniques and their limitations, Benchmarking HPC: scientific, engineering, commercial applications and workloads, Power-Aware Computing and Communication, Power-aware Processing Techniques, Power-aware Memory Design, Power-aware Interconnect Design, Software Power Management. Advanced Topics: Petascale Computing, Optics in Parallel Computing, Quantum Computers, Recent developments in Nanotechnology and its impact on HPC

Suggested Books:

Georg Hager and Gerhard Wellein. Introduction to High Performance Computing for Scientists and Engineers (1st ed.). CRC Press, Chapman & Hall/CRC Computational Science, India, 2010.

Vipin Kumar , Ananth Grama , Anshul Gupta , George Karypis. Introduction to Parallel Computing (2nd ed.). Pearson India . 2003.

John L. Hennessy and David A. Patterson. Computer Architecture: A Quantitative Approach (5th ed.). Elsevier India Pvt. Ltd. 2011.

David B. Kirk and Wen-mei W. Hwu. Programming Massively Parallel Processors: A Hands-On Approach (1st ed.). Elsevier India Pvt. Ltd. 2010.

Michael T. Heath. Scientific Computing: An Introductory Survey (2nd ed.). McGraw Hill Education (India) Private Limited, 2011

PE-CS-AIDS-425A	Human AI Interaction						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**2**	**75**	**25**	**100**	**3 Hrs.**
Purpose	This course concerns critical and responsible design, development and evaluation of AI technologies with a focus on human-AI-interaction. The aim of this module is to provide students with a cross-disciplinary background and the advanced skills of utilizing and critically evaluating the impact of Human-AI concepts and technologies within their ecosystems.						
Course Outcomes (CO)							
CO1	To have a broad foundational understanding of types and techniques in AI/ML						
CO2	To be able to demonstrate good understanding of the potential use cases and benefits of artificial intelligence (AI) technologies						
CO3	To have a critical understanding of the ethical, social and legal implications of AI applications on human life and work						
CO4	To be able to understand appropriate design, development and research methods for human-AI interaction						

Unit 1

Introduction to advanced automation, Introduction to Human-AI Interaction, Human Needs, Perceptions, and Experiences of Using AI, personalization, adaptive systems, prediction/forecasting, cognitive services, qualitative analysis (visual and natural language processing), hybrid intelligence systems, black boxing, Concrete Human-AI Interaction Designs

Unit 2

Intelligence, problem solving & decision making in humans and machines,Designing interactions with applied artificial intelligence, machine learning (ML) & recommender systems, AI interaction and experience design and development, Augment AI to Cope with Limitations of Human Users, Concrete Human-Interaction Designs

Unit 3

Human-AI benefits, victims & disasters, Understandable / relatable AI, Ethical & responsible AI, Human-AI ecosystems &markets, Interpretability and Explainability, AI Ethics, Fairness, and Equity Human-AI Co-creation in Different Domains, Interactive Visual Analytics for Machine Learning

Unit 4

Case studies:in autonomous agriculture, manufacturing, transportation, finance, healthcare, security, social media, gaming

Suggested Books:

Explainable Human-AI Interaction: A Planning Perspective (Synthesis Lectures on Artificial Intelligence and Machine Learning, Anagha Kulkarni, Sarath Sreedharan ,January 2022, Synthesi Publishers.

Human-AI Interaction: How We Work with Artificial Intelligence,Readyai , January 2021

PE-CS-AIDS- 427A	Software Testing						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**2**	**75**	**25**	**100**	**3 Hrs.**
Purpose	**To provide an understanding of concepts and techniques for testing software and assuring its quality.**						
	Course Outcomes						
CO 1	Expose the criteria and parameters for the generation of test cases.						
CO 2	Learn the design of test cases and generating test cases.						
CO 3	Be familiar with test management and software testing activities and V&V activities.						
CO 4	Be exposed to the significance of software testing in web and Object orient techniques.						

Unit-I

Introduction: Overview of software evolution, SDLC, Testing Process, Terminologies in Testing: Error, Fault, Failure, Verification, Validation, Difference between Verification and Validation, Definition of software testing, test cases, test oracles, testing process, limitations of testing.

Unit-II

Functional Testing: Boundary Value Analysis, Equivalence Class Testing, Decision Table Based Testing, Cause Effect Graphing Technique.

Structural Testing: Path testing, DD-Paths, Cyclomatic Complexity, Graph Metrics, Data Flow Testing, Mutation testing.

Unit-III

Reducing the number of test cases: Prioritization guidelines, Priority category, Scheme, Risk Analysis, Regression Testing and Slice based testing.

Testing Activities: Unit Testing, Levels of Testing, Integration Testing, System Testing, Debugging, Domain Testing.

Unit-IV

Overview of SQM: Concepts of Software Quality, quality attributes, software quality models: McCall, Boehm, ISO-9000, CMM.

Miscellaneous Topics: Stress testing, Adhoc testing, Buddy testing, Exploratory testing, Agile and extreme testing.

Suggested Books:

Naresh Chauhan, “Softearw Testing Principles and Practices” Oxford publications, 2012.

William Perry, “Effective Methods for Software Testing”, John Wiley & Sons, New York, 1995.

CemKaner, Jack Falk, Nguyen Quoc, “Testing Computer Software”, Second Edition, Van Nostrand Reinhold, New York, 1993.

Boris Beizer, “Software Testing Techniques”, Second Volume, Second Edition, Van Nostrand Reinhold, New York, 1990.

Louise Tamres, “Software Testing”, Pearson Education Asia, 2002

Roger S. Pressman, “Software Engineering – A Practitioner’s Approach”, Fifth Edition, McGraw-Hill International Edition, New Delhi, 2001.

Boris Beizer, “Black-Box Testing – Techniques for Functional Testing of Software and Systems”, John Wiley & Sons Inc., New York, 1995.

K.K. Aggarwal & Yogesh Singh, “Software Engineering”, New Age International Publishers, New Delhi, 2003.

Marc Roper, “Software Testing”, McGraw-Hill Book Co., London, 1994.

PE-CS-AIDS-429A	Natural Language Processing						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**2**	**75**	**25**	**100**	**3Hrs.**
Purpose	Toprovidetheunderstandingofthemathematicalandlinguisticfoundationsunderlyingapproachestothe variousareasinNLP.						
Course Outcomes (CO)							
CO1	Befamiliarwithsyntax andsemantics inNLP.						
CO2	ToimplementvariousconceptsofknowledgerepresentationusingProlog.						
CO3	Toclassifydifferentparsingtechniquesandunderstandsemantic networks.						
CO4	Toidentify/explainvariousapplicationsofNLP.						

Unit-I

Basic Concepts: concept overview, key algorithms in the noisy channelparadigm.FundamentalcomponentsofNaturalLanguageProcessing:Lexicography,syntax,semantics,prosody,phonology,pragmaticanalysis,worldknowledge.KnowledgeRepresentationschemes:Semantic net,Frames,ConceptualDependency,Scripts.

Unit-II

Representing knowledge using rules: Logic Programming, Introduction to LISP and Prolog,
Rulesbaseddeductionsystems,Generalconceptsinknowledgeacquisition.**SyntaxAnalysis:**FormalLanguages and grammars, Chomsky Hierarchy, Left- Associative Grammars, ambiguous grammars,resolutionof ambiguities.

Unit-III

Computation Linguistics: Recognition and parsing of natural language structures- ATN and RTN,GeneralTechniquesofparsing-
CKY,EarleyandTomitasalgorithm.Semantics:Knowledgerepresentation,
semanticsnetworkslogicandinferencepragmatics,graphmodelsandoptimization.

Unit-IV

Applications of NLP: Intelligent work processor, Machine translation, user interfaces, Man-Machineinterfaces, natural language querying, tutoring and authoring systems, speech recognition, commercialuseof NLP.

SuggestedBooks:

Daniel Jurafsky, James H. Martin, "Speech and Language Processing: An Introduction toNaturalLanguageProcessing,ComputationalLinguisticsandSpeechRecognition",2nd edition,PearsonEdu.,2013.
JamesAllen,"NaturalLanguageUnderstanding",PearsonEducation,SecondEdition,2003.
IvanBratko,"Prolog:ProgrammingforArtificialIntelligence",3rdEdition,PearsonEducation,FifthImpression2009.
G.Gazder,"NaturalLanguageprocessinginprolog",AddisonWesley,1989.

HM-CS-AIDS-405A	Data Visualization Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**MinorTest**	**Practical**	**Total**	**Time**
0	**0**	**2**	**1**	**40**	**60**	**100**	**3 Hrs.**
Purpose	This course will introduce the main concepts of visual analytics with a hands-on tutorial using Tableau, a leading self-service data visualization tool. Further, it aims at learning about how to create effective charts and interactive dashboards will provide the student a very useful skill applicable in many business scenarios.						
Course Outcomes							
CO1	Understand and describe the main concepts of data visualization						
CO2	Create ad-hoc reports, data visualizations, and dashboards using Tableau Desktop						
CO3	Publish the created visualizations to Tableau Server and Tableau Public						
CO4	Create Dashboard for real problems in Industry						

Practical-1: Introduction to Tableau

• Course introduction
• Dataviz best practices
• Getting started with Tableau Desktop
• Connecting to the tutorial dataset
• Creating the first charts
• Filtering and sorting data

Practical-2: Common charts

• Creating common visualizations (bar charts, line charts etc.)
• Assembling a dashboard layout
• Using dashboard filters

Practical--3: Transform the data

• Dataviz best practices
• Creating simple calculations in Tableau
• Using table calculations

Practical--4: Interactions

• Interactivity with text and visual tooltips
• Interactivity with actions (filter, highlight, URL)
• Drilldown between dashboards

Practical--5: Advanced visualizations

• Dataviz best practices
• Creating more advanced chart types
• Using multiple source tables

Practical--6: Data Storytelling

• Intro to data storytelling
• Creating a data story in Tableau
• Overview of the Tableau ecosystem
• Further learning opportunities

Practical-7: Implement binning visualizations for any real time dataset, Implement linear regression techniques.

S. No.	Course No.	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule				Duration of Exam (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	PE-LA	**Elective-I Lab**	0:0:2	2	1	0	40	60	100	3

PC-CS-AIDS-415 LA	**ANN and Deep Learning Lab**						
L	**Tutorial**	**Practical**	**Credit**	**Minor Test**	**Practical**	**Total**	**Time**
0	0	2	1	40	60	100	3 hrs
Purpose	Purpose To provide knowledge of various artificial neural networks and deep learning algorithms for optimization						
Course Outcomes (CO)							
CO 1	To learn the basics of artificial neural networks concepts, various neural networks architecture						
CO 2	To explore knowledge of special types of Artificial neural networks						
CO 3	To understand the basics of Deep learning and its applications						
CO4	To imprise about the different deep learning algorithms and their applications to solve real world problems.						

Practical List:

1. To study about MATLAB.
2 Write a program to perform the basics matrix operations.
3 WAP to plot the Straight line.
5. WAP to plot the Sine curve.
6.
5. How the weight & bias value effects the output of neurons.
6. How the choice of activation function effect the output of neuron experiment with the following function purelin(n), bimary threshold(hardlim(n) haradlims(n)) ,Tansig(n) logsig(n)
7. How the weight and biased value are able to represent a decision boundary in the feature space.
8. How the Perceptron Learning rule works for Linearly Separable Problem.
9. How the Perceptron Learning rule works for Non-Linearly Separable Problem.
10. Write a program to draw a graph with multiple curve.

PC-CS-AIDS-417LA	Data Mining & Predictive ModellingLAB						
Lecture	**Tutorial**	**Practical**	**Credit**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**2**	**1**	**40**	**60**	**100**	**3 Hrs.**
Purpose	The objective of this course is to provide the in- depth coverage of data mining and modelling aspects along with its implementation						
Course Outcomes							
CO1	Understand the fundamental concept of Data Mining.						
CO2	Learn Data Mining techniques for Prediction and Forecasting.						
CO3	Compare the underlying Predictive Modelling techniques.						
CO4	Select appropriate Predictive Modelling approaches to identify cases and apply using a suitable package such as SPSS modeller.						

LIST OF EXPERIMENTS

1. Create an Employee Table with the help of Data Mining Tool WEKA.
2. Create a Weather Table with the help of Data Mining Tool WEKA.
3. Apply Pre-Processing techniques to the training data set of Weather Table
4. Apply Pre-Processing techniques to the training data set of Employee Table
5. Normalize Weather Table data using Knowledge Flow
6. Normalize Employee Table data using Knowledge Flow.
7. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree
8. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
9. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.
10. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.

PE-CS-AIDS- 419 LA	Predictive Analysis Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**2**	**1**	**40**	**60**	**100**	**3 Hrs.**
Purpose	Predictive analytics is emerging as a competitive strategy across many business sectors and can set apart high performing companies. It aims to predict the probability of the occurrence of a future event such as customer churn, loan defaults, and stock market fluctuations leading to effective business management.						
Course Outcomes							
CO1	Understand how to use predictive analytics tools to analyze real-life business problems.						
CO2	Demonstrate case-based practical problems using predictive analytics techniques to interpret model outputs.						
CO3	Learn regression, logistic regression, and forecasting using software tools such as MS Excel, SPSS, and SAS.						
CO4	Understand to Forecasting,Time Series Analysis and develop the Model.						

Practical List:

Practical 1: Implement case studies in Predictive Analytics in marketing using Python.

Practical 2: Implement case studies in Predictive Analytics in healthcare using Python.

Practical 3: Implement Classification Model using Python.

Practical 4: Implement Clustering Model using Python.

Practical 5: Implement Time Series Model using Python.

Practical 6: Forecasting patterns in weather using Python

Practical 7: Predicting performance in sports using Python

Practical 8: Predicting employee growth in HR using Python

Practical 9: Predicting maintenance in manufacturing using Python

Practical 10: Detecting sickness in healthcare using Python

Practical 11: Predicting buying behavior in retail using Python.

PE-CS-AIDS-421 LA	Advance Computer Architecture Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**2**	**1**	**40**	**60**	**100**	**3 Hrs.**
Purpose	To study various components of computer architecture.						
Course Outcomes							
CO1	To implement adder circuits using basic gates						
CO2	To understand the converter circuits using basic gates.						
CO3	To understand the working of Multiplexer						
CO4	To understand the various circuits for ALU, Datapath and control units.						

List of Experiments

1. To design the circuit of half adder.
2. To design the circuit of full adder.
3. To design the circuit of half subtractor.
4. To design the circuit of full subtractor.
5. To design an 8×1 Multiplexer.
6. To design a 4 bit combinational shifter.
7. To design a BCD adder.
8. To design a 4-bit adder subtractor.
9. To design an ALU.
10. To design 2:4 Decoder

S. No.	Course No.	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule				Duration of Exam (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	PC-CS-AIDS-409LA	Project-I	0:0:10	10	5	0	100	100	200	3

S. No.	Course No.	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule				Duration of Exam (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	PC-CS-AIDS-413A	Industrial Training	0	0	3	0	100	0	100	0

B. Tech Computer Science and Engineering (Artificial Intelligence and Data Science)
Modified Scheme of Studies/Examination (w.e.f. Session 2023-24)
Semester VIII

S. No.	Course No.	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule				Duration of Exam (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	PC-CS-AIDS-402A	Reinforcement Learning	3:0:0	3	3	75	25	0	100	3 Hrs
2	HSS-404A	Entrepreneurship and Start-ups	3:0:0	3	3	75	25	0	100	3 Hrs
3	OEC	OEC Elective*-III	3:0:0	3	3	75	25	0	100	3 Hrs
4	PE	Elective* - III	2:0:0	2	2	75	25	0	100	3 Hrs
5	PE	Elective* - IV	2:0:0	2	2	75	25	0	100	3 Hrs
6	PC-CS AIDS-404LA	Reinforcement Learning Lab	0:0:2	2	1	0	40	60	100	3 Hrs
7	PE-LA	Elective-III Lab	0:0:2	2	1	0	40	60	100	3 Hrs
8	PC-CS-AIDS-408LA	Project-II	0:0:12	12	6	0	100	100	200	3 Hrs
9	PC-CS-AIDS-410LA	General Fitness	0:0:0	0	0	0	0	100	100	3 Hrs
		Total		**28**	**21**	**300**	**280**	**320**	**900**	

Code	**PE- Elective* - III**	Code	**PE- Elective* – IV**
PE-CS-AIDS- 414A	Social Networks	PE-CS-AIDS- 422A	Internet of Things
PE-CS-AIDS- 416A	Application of Data Science in Industry	PE-CS-AIDS- -424A	Block Chain
PE-CS-AIDS- 420A	Neural Network and Fuzzy Logic	PE-CS-AIDS- 426A	Next Generation Databases

Code	**OEC Elective*-III**	**Code**	**PE-LA- Elective* III Lab**
OE-CS- AIDS-402	Cyber Security	PE-CS-AIDS- 414 LA	Social Networks Lab
OE-CS- AIDS-404	Information Retrieval	PE-CS-AIDS- 416 LA	Application of Data Science in Industry Lab
OE-CS- AIDS-406	Robotics and Intelligent Systems	PE-CS-AIDS- 420 LA	Neural Network and Fuzzy Logic Lab
OE-CS- AIDS-408	Agile Software Engineering	**Note: *The students will choose any two departmental electives courses and One Open Elective course out of the given elective list in VIII**	
OE-CS- AIDS-410	Image Processing and Recognition		

PC-CS-AIDS-402A	Reinforcement Learning						
L	**T**	**P**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hrs**
Purpose	Purpose To provide knowledge of various Reinforcement Learning Algorithms						
Course Outcomes (CO)							
CO 1	To learn the basics of Reinforcement Learning concepts, various Reinforcement Learning architecture						
CO 2	To explore knowledge of various process of Reinforcement Learning						
CO 3	To understand the basics of Reinforcement Learning models						
CO 4	To implies about the different Reinforcement Learning algorithms and their applications to solve real world problems.						

UNIT-1

Introduction to Reinforcement Learning: Origin and history of Reinforcement Learning research. Its connections with other related fields and with different branches of machine learning. The Reinforcement Learning Process Elements of Reinforcement Learning RL Agent Taxonomy Reinforcement Learning Problem.

Unit-II

Markov Decision Process: Introduction to RL terminology, Markov property, Markov chains, Markov reward process (MRP). Introduction to and proof of Bellman equations for MRPs along with proof of existence of solution to Bellman equations in MRP. Introduction to Markov decision process (MDP), state and action value functions, Bellman expectation equations, optimality of value functions and policies, Bellman optimality equations.

Unit-III

Monte Carlo Methods for Model Free Prediction and Control: Overview of Monte Carlo methods for model free RL, First visit and every visit Monte Carlo, Monte Carlo control, On policy and off policy learning, Importance sampling.

TD Methods Incremental Monte Carlo Methods for Model Free Prediction, Overview TD(0), TD (1) and TD(λ), k-step estimators, unified view of DP, MC and TD evaluation methods, TD Control methods - SARSA, Q-Learning and their variants.

Unit-IV

Function Approximation Methods: Getting started with the function approximation methods, Revisiting risk minimization, gradient descent from Machine Learning, Gradient MC and Semi-gradient TD (0) algorithms, Eligibility trace for function approximation, Afterstates, Control with function approximation, least squares, Experience replay in deep Q-Networks

Suggested Books:

Richard S. Sutton and Andrew G. Barto “An Introduction to Reinforcement Learning Enes Bilgin “ Mastering Reinforcement Learning with Python: Build next-generation, self-learning models using reinforcement learning techniques and best practices” 1st Edition Kindle

HSS-404A	Entrepreneurship and Start-ups						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hour**
Purpose	To expose students to the joys and skills of being an entrepreneur.						
Course Outcomes (CO)							
CO1	To understand the basics of Entrepreneurship.						
CO2	To learn the basics of Creative and Design Thinking.						
CO3	To apply the Business Enterprises.						
CO4	To know about business models .						

Unit I

Introduction to Entrepreneurship, Meaning and concept of entrepreneurship, the history of entrepreneurship development, role of entrepreneurship in economic development, Myths about entrepreneurs, types of entrepreneurs.

Unit II

The skills/ traits required to be an entrepreneur, Creative and Design Thinking, the entrepreneurial decision process, entrepreneurial success stories.

Unit III

Crafting business models and Lean Start-ups: Introduction to business models; Creating value propositions-conventional industry logic, value innovation logic; customer focused innovation; building and analysing business models; Business model canvas, Introduction to lean start-ups, Business Pitching.

Unit IV

Institutions Supporting Small Business Enterprises: Central level institutions. State level institutions. Other agencies. Industry Associations. Class exercise- discussions on current government schemes supporting entrepreneurship and finding out which scheme will most suit the business plan devised by the student.

Text Books:

- Kuratko, D , Hornsby J.S. (2017) New Venture Management: Entrepreneur's roadmap
- Hisrich, R.D., Manimala, M.J., Peters, M.P., Shepherd, D.A.: Entrepreneurship, Tata McGraw Hill
- Ries, Eric(2011)The lean Start-up: How constant innovation creates radically
- S. Carter and D. Jones-Evans (2012), Enterprise and small business- Principal Practice and Policy, Pearson Education (2006)

OE-CS-AIDS-402	Cyber Security						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hours**
Purpose	1. Learn the foundations of Cyber security and threat landscape. 2. To equip students with the technical knowledge and skills needed to protect and defend against cyber threats. 3. To develop skills in students that can help them plan, implement, and monitor cyber security mechanisms to ensure the protection of information technology assets.						
Course Outcomes							
CO1	Understand the cyber security threat landscape.						
CO2	Develop a deeper understanding and familiarity with various types of cyber-attacks, cyber crimes, vulnerabilities and remedies thereto.						
CO3	Increase awareness about cyber-attack vectors and safety against cyber-frauds						
CO4	Analyze and evaluate existing legal framework and laws on cyber security.						

Unit-I

Overview of cyber security: Cyber security increasing threat landscape, Cyber security terminologies- Cyberspace, attack, attack vector, attack surface, threat, risk, vulnerability, exploit, exploitation, hacker, non-state actors, Cyber terrorism, Protection of end user machine, Critical IT and National Critical Infrastructure, Cyberwarfare, Case Studies.

Unit-II

Cyber Crimes: Cybercrimes targeting Computer systems and Mobiles- data diddling attacks, spyware, logic bombs, DoS, DDoS, APTs, virus, Trojans, ransomware, data breach, Online scams and frauds- email scams, Phishing, Vishing, Smishing, Online job fraud, Online sextortion, Debit/credit card fraud, Online payment fraud, Cyberbullying, website defacement, Cyber-squatting, Pharming, Cyber espionage, Crypto jacking, Darknet- illegal trades, drug trafficking, human trafficking., Social Media Scams & Frauds- impersonation, identity theft, job scams, misinformation, fake news cybercrime against persons -cyber grooming, child pornography, cyber stalking., Social Engineering attacks, Cyber Police stations, Crime reporting procedure, Case studies.

Unit-III

Cyber Laws and Data Privacy: passive Cybercrime and legal landscape around the world, IT Act,2000 and its amendments. Limitations of IT Act, 2000. Cybercrime and punishments, Cyber Laws and Legal and ethical aspects related to new technologies- AI/ML, IoT, Block chain, Darknet and social media, Cyber Laws of other countries, Case Studies.

Data Privacy and Data Security: Defining data, meta-data, big data, non-personal data. Data protection, Data privacy and data security, Personal Data Protection Bill and its compliance, Data protection principles.

Unit-IV

Data Privacy and Data Security: Big data security issues and challenges, Data protection regulations of other countries- General Data Protection Regulations (GDPR),2016 Personal Information Protection and Electronic Documents Act (PIPEDA)., social media- data privacy and security issues.

Cyber security Management, Compliance and Governance: Cyber security Plan- cyber security policy, cyber crises management plan., Business continuity, Risk assessment, Types of security controls and their goals, Cyber security audit and compliance, National cyber security policy and strategy.

Suggested Books:

Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd.

Nelson Phillips and Enfinger Steuart, "Computer Forensics and Investigations", Cengage Learning, New Delhi, 2009.

Sunit Belapure and Nina Godbole, "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley India Pvt. Ltd.

OE-CS-AIDS-404	Information Retrieval						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hrs.**
Purpose	The Major objective of an Information Retrieval system is minimization of human resources required in the finding of needed information to accomplish a task.						
Course Outcomes							
CO 1	Ability to apply information retrieval principles and retrieval models to locate relevant information from large collections of data						
CO 2	Apply various indexing technique and understanding of different data structures.						
CO 3	Implementation of various clustering and searching techniques.						
CO 4	Understanding of information visualization and various advance topics.						

Unit-I

Introduction to Information Retrieval Systems: Definition of Information Retrieval System, Objectives of Information Retrieval Systems, Functional Overview, Relationship to Database Management Systems, Digital Libraries and Data Warehouses.

Information Retrieval System Capabilities: Search Capabilities, Browse Capabilities, Miscellaneous Capabilities, Retrieval Models: Boolean, vector space, TFIDF, Okapi, probabilistic, language modeling, latent semantic indexing. Vector space scoring. The cosine measure. Efficiency considerations. Document length normalization.

Unit-II

Cataloging and Indexing: History and Objectives of Indexing, Indexing Process, Automatic Indexing, Classes of Automatic Indexing, Statistical Indexing, Natural Language, Concept Indexing, Hypertext Linkages, Information Extraction.

Data Structure: Introduction to Data Structure, Stemming Algorithms, Inverted File Structure, N-Gram Data Structures, PAT Data Structure, Signature File Structure, Hypertext and XML Data Structures, Hidden Markov Models.

Unit-III

Document and Term Clustering: Introduction to Clustering, clustering versus classification, Thesaurus Generation, Item Clustering, Hierarchy of Clusters.Text Clustering: Partitioning methods, k-means clustering, Mixture of Gaussians model, Hierarchical agglomerative clustering, clustering terms using documents.

User Search Techniques: Search Statements and Binding, Similarity Measures and Ranking, Relevance Feedback, Selective Dissemination of Information Search, Weighted Searches of Boolean Systems, Searching the INTERNET and Hypertext.

Text Search Algorithms: Introduction to Text Search Techniques, Software Text Search Algorithms, Hardware Text Search Systems.

Unit-IV

Information Visualization: Introduction to Information Visualization, Cognition and Perception, Information Visualization Technologies.

Advanced Topics: Summarization, Topic detection and tracking, Personalization, Question answering, Cross language information retrieval.

Suggested Books:

Introduction to Information Retrieval. Christopher D. Manning, Prabhakar Raghavan, and Hinrich Schuetze, Cambridge University Press, 2007.

Search Engines: Information Retrieval in Practice. Bruce Croft, Donald Metzler, and Trevor Strohman, Pearson Education, 2009.

Modern Information Retrieval. Baeza-Yates Ricardo and Berthier Ribeiro-Neto. 2nd edition, Addison-Wesley, 2011.

Information Retrieval: Implementing and Evaluating Search Engines. Stefan Buttcher, Charlie Clarke, Gordon Cormack, MIT Press, 2010.

Information Storage and Retrieval Systems – Theory and Implementation, Second Edition, Gerald J. Kowalski, Mark T. Maybury, Springer.

OE-CS-AIDS-406	Robotics and Intelligent Systems						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3**
Purpose	To impart understanding of the main abstractions and reasoning for Robotics and Intelligent Systems						
Course Outcomes (CO)							
CO1	Understand the basic terminologies in Robotics to develop intelligent systems						
CO2	Apply the random search and heuristic search for intelligent systems.						
CO3	Understand the abstractions and reasoning for intelligent systems						
CO4	Apply the rule based methods in intelligent systems						

Unit-I

Introduction to robotics- History, growth; Robot applications- Manufacturing industry, defense, rehabilitation, medical, Robot mechanisms, type of robots and use of robots in different area.

Unit-II

Degree of freedom, classification and specifications of Robots, controller, actuator and drives. Sensors in robot – Touch sensors-Tactile sensor – Proximity and range sensors. Force Sensor-Light sensors, Pressure sensors, Introduction to Machine Vision and Artificial Intelligence.

U**nit-III**

Intelligent Systems: Knowledge acquisition, Computational intelligence, Rule-based systems, Forward-chaining (a data-driven strategy), Conflict resolution, Backward chaining (a goal-driven strategy), Sources of uncertainty, Bayesian updating, Certainty theory.

Unit-IV

Possibility theory: fuzzy sets and fuzzy logic, Object-oriented systems, Data abstraction, Inheritance, Encapsulation, Unified Modeling Language (UML), Dynamic (or late) binding. **Key Application Areas:** Expert System, Decision Support Systems, **Deep Learning:** Speech and vision, natural Language processing, Information Retrieval, Semantic Web.

SUGGESTED BOOKS:

Artificial Intelligence' RB Mishra, PHI
Introduction to Artificial Intelligence, Charnaik, Pearson.
Artificial Intelligence by Elaine Rich, Kevin Knight and Shivashankar B Nair, Tata McGraw Hill. Introduction to Artificial Intelligence and Expert Systems by Dan W Patterson, Pearson Education.

OE-CS-AIDS-408	Agile Software Engineering						
Lecture	**Tutorial**	**Practical**	**Credit**	**MajorTest**	**MinorTest**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hrs.**
Purpose	This course makes student learn the fundamental principles and practices associated with each of the agile development methods. To apply the principles and practices of agile software development on a project of interest and relevance to the student.						
Course Outcomes							
CO1	Analyze existing problems with the team, development process and wider organization						
CO2	Apply a thorough understanding of Agile principles and specific practices						
CO3	Select the most appropriate way to improve results for a specific circumstance or need						
CO4	Judge and craft appropriate adaptations to existing practices or processes depending upon analysis of typical problems and risk analysis.						

Unit-I

Agile Software Development: Basics and Fundamentals, of Agile Process Methods, Values of Agile, Principles of Agile, stakeholders, Challenges Lean Approach: Waste Management, Kaizen and Kanban, add process and products add value. Roles related to the lifecycle, differences between Agile and traditional plans, differences between Agile plans at different lifecycle phases. Testing plan links between testing, roles and key techniques, principles, understand as a means of assessing the initial status of a project/ How Agile helps to build quality

Unit-II

Agile and Scrum Principles: Agile Manifesto, Twelve Practices of XP, Scrum Practices, Applying Scrum. Need of scrum, working of scrum, advanced Scrum Applications, Scrum and the Organization, scrum values Agile Product Management: Communication, Planning, Estimation Managing the Agile Approach Monitoring progress, Targeting and motivating the team, managing business involvement, Escalating issue. Quality, Risk, Metrics and Measurements, Managing the Agile Approach Monitoring progress, Targeting and motivating the team, managing business involvement and Escalating issue

Unit-III

Agile Requirements: User Stories, Backlog Management. Agile Architecture: FeatureDriven Development. Agile Risk Management: Risk and Quality Assurance, Agile Tools Agile Testing: Agile Testing Techniques, Test-Driven Development, User Acceptance Test

Unit-IV

Agile Review: Agile Metrics and Measurements, The Agile approach to estimating and project variables, Agile Measurement, Agile Control: the 7 control parameters. Agile approach to Risk, The Agile approach to Configuration Management, The Atern Principles, Atern Philosophy,The rationale for using Atern, Refactoring, Continuous integration, Automated Build Tools

Suggested Books:

Robert C. Martin ,Agile Software Development, Principles, Patterns, and Practices Alan Apt Series (2018)

Succeeding with Agile : Software Development Using Scrum, Pearson (2017)

OE-CS-AIDS-410	Image Processing and Recognition						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hrs.**
Purpose	To imparts knowledge in the area of image and image processing, fundamentals of digital image processing and also to learn the fundamentals of pattern recognition and to choose an appropriate feature.						
Course Outcomes							
CO 1	To Understand Basics of Image formation and transformation using sampling and quantization						
CO 2	To Understand different types signal processing techniques used for image sharpening and smoothing						
CO 3	To understand the nature and inherent difficulties of the pattern recognition problems.						
CO 4	Understand concepts, trade-offs, and appropriateness of the different feature types and classification techniques such as Bayesian, maximum likelihood, etc						

Unit-I INTRODUCTION TO IMAGE PROCESSING AND RESTORATION

Image formation, image geometry perspective and other transformation, stereo imaging elements of visual perception. Digital Image-sampling and quantization serial & parallel Image processing**.** Image Restoration-Constrained and unconstrained restoration Wiener filter, Motion blur remover.

Unit-II SEGMENTATION TECHNIQUES

Segmentation Techniques-thresh holding approaches, region growing, relaxation, line and edge detection approaches, edge linking, supervised and unsupervised classification techniques, remotely sensed image analysis and applications, Shape Analysis – Gestalt principles, shape number, moment Fourier and other shape descriptors, Skelton detection.

Unit-III PATTERN RECOGNITION

Bayesian Decision Theory, Classifiers, Normal density and discriminant functions, Parameter estimation methods: Maximum-Likelihood estimation, Bayesian Parameter estimation

Unit-IV STATISTICAL PATTERN RECOGNITION: Dimension reduction methods – Principal Component Analysis (PCA), Fisher Linear discriminant analysis, Expectation-maximization (EM), Hidden Markov Models (HMM), Gaussian mixture models.

Suggested Books

Digital Image Processing – Ganzalez and Wood, Addison Wesley, 1993.

Fundamental of Image Processing – Anil K.Jain, Prentice Hall of India.
Pattern Classification – R.O. Duda, P.E. Hart and D.G. Stork, Second Edition John Wiley, 2006
An Introduction to Digital Image Processing – Wayne Niblack, Prentice Hall, 1986
Pattern Recognition and Machine Learning – C. M. Bishop, Springer, 2009.
Pattern Recognition – S. Theodoridis and K. Koutroumbas, 4th Edition, Academic Press,2009

PE-CS-AIDS- 414A	Social Networks						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**2**	**75**	**25**	**100**	**3 Hrs**
Purpose	Students will be able to use Social networks for business and personal use, conducting social network analysis, social network developer tools and social network concepts for solving real-world issues.						
Course Outcomes (CO)							
CO1	Demonstrate proficiency in the use of social networks for business and personal use						
CO2	Demonstrate proficiency in the use of social network analysis concepts and techniques.						
CO3	Demonstrate proficiency in the use of social network developer tools.						
CO4	Examine the various types of processors and demonstrate proficiency in the use of social network concepts for solving real world issues.						

Unit I INTRODUCTION TO SEMANTIC WEB: Limitations of current Web - Development of Semantic Web - Emergence of the Social Web - Social Network analysis: Development of Social Network Analysis - Key concepts and measures in network analysis - Electronic sources for network analysis: Electronic discussion networks, Blogs and online communities - Web-based networks - Applications of Social Network Analysis.

Unit II MODELLING, AGGREGATING AND KNOWLEDGE REPRESENTATION

Ontology and their role in the Semantic Web: Ontology-based knowledge Representation - Ontology languages for the Semantic Web: Resource Description Framework - Web Ontology Language - Modeling and aggregating social network data: State-of-the-art in network data representation - Ontological representation of social individuals - Ontological representation of social relationships - Aggregating and reasoning with social network data - Advanced representations.

Unit III EXTRACTION AND MINING COMMUNITIES IN WEB SOCIAL NETWORKS

Extracting evolution of Web Community from a Series of Web Archive - Detecting communities in social networks - Definition of community - Evaluating communities - Methods for community detection and mining - Applications of community mining algorithms - Tools for detecting communities social network infrastructures and communities - Decentralized online social networks.

Unit IV PREDICTING HUMAN BEHAVIOUR AND PRIVACY ISSUES

Understanding and predicting human behavior for social communities - User data management - Inference and Distribution - Enabling new human experiences - Reality mining - Context - Awareness - Privacy in online social networks - Trust in online environment - Trust models based on subjective logic - Trust network analysis.

TEXT BOOKS:

Peter Mika, Social Networks and the Semantic Web‖, First Edition, Springer 2007.
Borko Furht, Handbook of Social Network Technologies and Applications, 1st Edition, Springer, 2010.

PE-CS-AIDS-416A	Application of Data Science in Industry						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**2**	**75**	**25**	**100**	**3 Hrs.**
Purpose	Introduce the mathematical foundations required for data science and R Programming. Students will learn the data analytics problem solving framework**.**						
Course Outcomes							
CO1	Describe a flow process for data science problems						
CO2	Classify data science problems into standard typology						
CO3	Develop R codes for data science solutions						
CO4	Correlate results to the solution approach followed and Construct use cases to validate approach and identify modifications required						

Unit-I

Linear algebra for Data science: Algebraic view - vectors, matrices, product of matrix & vector, rank, null space, solution of over-determined set of equations and pseudo-inverse, Geometric view - vectors, distance, projections, eigenvalue decomposition.

Unit-II

Statistics for Data Science: descriptive statistics, notion of probability, distributions, mean, variance, covariance, covariance matrix, understanding univariate and multivariate normal distributions, introduction to hypothesis testing, confidence interval for estimates.

Unit-III

Optimization for Data Science: Typology of data science problems and a solution framework, Simple linear regression and verifying assumptions used in linear regression, Multivariate linear regression, model assessment, assessing importance of different variables, subset selection Classification using logistic regression, Classification using kNN and k-means clustering.

Unit-IV

Data Science in Industry: Case Study of Walmart supply Chain Management, Solving Data Analysis Problems using case study of Google Company, Case study ofOLAP tool for the Fast-Food Industry, Real-Time Data Streaming with Apache Kafka with Company data set, Real-Time Data Processing using Spark Streaming, Building Automated Data Pipelines with Airflow, Analytics using PySpark.

Suggested Books:

Guandong Xu ,Yanchun Zhang and Lin Li, Web Mining and Social Networking Techniques and applications‖, First Edition, Springer, 2011.
Dion Goh and Schubert Foo, Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively‖, IGI Global Snippet, 2008.

PE-CS-AIDS-420A	Neural Network and Fuzzy Logic						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**2**	**75**	**25**	**100**	**3Hrs**
Course Outcomes							
CO1	Understand the concept of Artificial Intelligence, search techniques and acknowledge representation issues						
CO2	Understanding reasoning and fuzzy logic for artificial intelligence						
CO3	Students will be able to learn defuzzied fiction and fuzzy measures						
CO4	Students will be able to learn the applications of fuzzy logic and hybrids of computing techniques						

Unit I–INTRODUCTION

Artificial neural network: Introduction, characteristics- learning methods – taxonomy – Evolution of neural networks-basic models-important technologies-applications. Fuzzy logic: Introduction-crisp sets-fuzzy sets
- crisp relations and fuzzy relations: cartesian product of relation - classical relation, fuzzy relations, tolerance and equivalence relations, non-iterative fuzzy sets. Genetic algorithm- Introduction - biological background - traditionaloptimizationandsearchtechniques-Geneticbasicconcepts.

Unit II-NEURAL NETWORKS

McCulloch-Pitts neuron-linear separability-Hebb network-supervised learning network: perceptron networks' adaptive linear neuron, multiple adaptive linear neuron, BPN, RBF, TDNN- associative memory network: auto- associative memory network, hetero-associative memory network, BAM, hop field networks, iterative auto associative memory network & iterative associative memory network – unsupervised learning networks: Kohonen self-organizing feature maps, LVQ–CP networks, ART network.

Unit III- FUZZY LOGIC

Membership functions: features, fuzzification, methods of membership value assignments- Defuzzification: lambda cuts - methods - fuzzy arithmetic and fuzzy measures: fuzzy arithmetic - extension principle - fuzzy measures - measures of fuzziness -fuzzy integrals - fuzzy rule base and approximate reasoning: truth values , fuzzy propositions, formation of rules- ,aggregation of fuzzy rules, fuzzy reasoning-fuzzy inference systems-overview of fuzzy expert system-fuzzy decision making.

Unit IV-HYBRID SOFT COMPUTING TECHNIQUES & APPLICATIONS

Neuro-fuzzy hybrid systems - genetic neuro hybrid systems - genetic fuzzy hybrid and fuzzy genetic hybrid systems – simplified fuzzy ARTMAP - Applications: A fusion approach of multispectral images with SAR, optimization of traveling salesman problem using genetic algorithm approach, soft computing-based hybrid fuzzy controllers.

Suggested Books:

Elaine Rich and Kevin Knight "Artificial Intelligence", 2nd Edition,Tata Mcgraw-Hill, 2005.
Stuart Russel and Peter Norvig,"Artificial Intelligence:AModernApproach",3rd
T1.Kliryvan- Fuzzy System & Fuzzy logic Prentice Hall of India, First Edition.
Lawrence Fussett-fundamental of Neural network Prentice Hall,FirstEdition.
Bart Kosko, ―Neural network and Fuzzy System‖-PrenticeHall-1994.
Vallusu Rao and Hayagvna Rao,―C++Neural network and fuzzy logic‖-BPB Publication, NewDelhi,1996

Code	PE-Elective-IV
PE-CS-AIDS- 422A	Internet of Things
PE-CS-AIDS- -424A	Block Chain
PE-CS-AIDS- 426A	Natural Language Processing

PE-CS-AIDS-422A	Internet of Things						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**2**	**75**	**25**	**100**	**3 Hrs.**
Purpose	This course will illuminate the students in the concepts of calculus. To enlighten the learners in the concept of differential equations and multivariable calculus. To equip the students with standard concepts and tools at an intermediate to advanced level mathematics to develop the confidence and ability among the students to handle various real world problems and their applications.						
Course Outcomes							
CO 1	Understanding of basic concepts of Internet of things.						
CO 2	Implementation of programming fundamentals on Arduino.						
CO 3	Understanding of various sensors and IoT protocols.						
CO 4	Importance of cryptographic fundamentals in Internet of things.						

Unit-1

IOT − OVERVIEW - Introduction to IoT, Key Features, Advantages, Disadvantages, IoT Standards, Components of IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT, Communication models.

Unit-II

The Arduino Platform -The Arduino Open-Microcontroller Platform, Arduino Basics, Arduino Board Layout & Architecture, Introduction to various Functions, reading from Sensors, Programming fundamentals (C language), Arduino Programming & Interface of Sensors, Interfacing sensors with Arduino, Programming Arduino.

Unit-III

IoT Sensor and Actuator – Sensor, Type of Sensor, Use of Sensor, Actuator, Type of Actuator, Basic of IoT Networking, Gateway Technology for IoT, IoT challenge, connectivity technology.

IoT Protocol: Architecture and Design Principles for IoT: Internet connectivity, Internet-based communication, IPv4, IPv6, 6LoWPAN protocol, IP Addressing in the IoT,

Unit-IV

Cryptographic fundamentals for IOT -Cryptographic primitives and its role in IoT – Encryption, and Decryption – Hashes – Digital Signatures – Random number generation – Cipher suites – key management fundamentals – cryptographic controls built into IoT messaging and communication protocols – IoT Node Authentication

IoT & M2M -Machine to Machine, Difference between IoT and M2M, Software define Network Challenges in IoT Design challenges, Development challenges, Security challenges, and other challenges.

Suggested Books:

Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer.

Programming Arduino: Getting Started with Sketches, Second Edition, Mc Graw Hill, Simon Monk.

PE-CS-AIDS-424A	Block Chain						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**2**	**75**	**25**	**100**	**3 Hrs.**
Purpose	To give students the understanding of emerging abstract models for Blockchain Technology and to familiarise with the functional/operational aspects of cryptocurrency eco-system.						
Course Outcomes							
CO 1	Understanding of distributed systems and importance of security in networks.						
CO 2	Basic Concept of blockchain and application of blockchain in various domains.						
CO 3	Knowledge of various hash functions and consensus algorithms.						
CO 4	Understanding the concepts of Ethereum blockchain and tools used for implementation.						

Unit-I

Distributed Systems: Introduction, benefits and limitations, types, applications. Consistency and replication in distributed environment. CAP theorem, Distributed computing: concept, pros and cons of using distributed computing. Client-Server architecture, peer-to-peer architecture. Byzantine Generals problem.

Security in Networks: Concept, Types of Security breaches, attacks, control measures, Classifying cryptosystems, classical cryptosystems, block cipher modes of operation, DES encryption and decryption, triple DES, AES encryption and decryption.

Unit-II

Block chain: Introduction to block chain, Bitcoin and Block ChainHistory, problem of double spending. Architecture of Block chain, structure of block, genesis block, transaction life cycle, centralized and decentralized network, characteristics, Types of Block chain: Public, Private, hybrid. benefits and limitations of Block chain.

Use cases: Block chain in Financial applications, supply chains, healthcare, real estate and media.

Unit-III

Hash Function, secure hash algorithm (SHA) and types, Digital signature, RSA digital signature algorithm, elliptic curve digital signature algorithm, zero-knowledge proofs.

Mining Mechanism: mining, mining reward, mining pool, hash rate, difficulty. Distributed ledger, distributed consensus: proof of work, proof of stake, Delegated Proof of Stake, Practical Byzantine Fault Tolerance, Proof of Elapsed Time. Merkle tree, soft and hard fork, sybil attack.

Unit-IV

Ethereum ecosystem: Ethereum virtual machine, types of accounts, keys and addresses, bytecode, smart contracts, oracle, Ethereum network: mainnet, testnet, private net. Tools: Remix, Nodejs, ganache, digital wallet.

Suggested Books:

Tanenbaum A.S., Steen M.V., "Distributed Systems: Principles and Paradigms", Prentice Hall of India.

Behrouz A. Forouzan, Debdeep Mukhopadhyay, Cryptography and Network Security, 3rd Edition, Mc Graw Hill Education, 2016.

Mastering Blockchain: Distributed ledger technology, decentralization, and smart contracts explained, 2nd Edition by Imran Bashir

Ethereum: Blockchains, Digital Assets, Smart Contracts, Decentralized Autonomous Organizations", by Henning Diedrich

PE-CS-AIDS-426A	Next Generation Databases						
Lecture	**Tutorial**	**Practical**	**Credit**	**MajorTest**	**MinorTest**	**Total**	**Time**
2	**0**	**0**	**2**	**75**	**25**	**100**	**3Hrs.**
Purpose	To understand the basic concepts and terminology related to Unstructured Database. Familiarize students with databases like NOSQL, XML. Implement and evaluate complex, scalable database systems, with emphasis on providing experimental evidence for design decisions.						
Course Outcome							
CO1	Implement and evaluate complex, scalable database systems, with emphasis on providing experimental evidence for design decisions.						
CO2	Demonstrate the management of structured and unstructured data management with recent tools and technologies.						
CO3	Demonstrate competency in designing No SQL database management systems						
CO4	Demonstrate competency in designing XML Databases						

Unit-I

Introduction: Three Database Revolutions, The Third Database Revolution, Google, Big Data, and Hadoop

Unit-II

Sharding, Amazon, and the Birth of NoSQL, Document Databases, JSON Document Databases, Tables are Not Your Friends: Graph Databases, Column Databases, Column Database Architectures

Unit-III

XML, XML Databases – XML Tools and Standards, XML Databases, XML Support in relational systems, JSON Document Databases, MOngoDB, Column Databases, Graph Databases

Unit-IV

Distributed Database Patterns, Nonrelational Distributed Databases, MongoDB Sharding and Replication, HBase. Consistency Models, Consistency in MongoDB, Data Models and Storage, Languages and Programming Interfaces, NoSQL APIs

Suggested Books:

Next Generation Databases, Mr. Guy Harrison, Apress

Beginning JSON,by Mr. Ben Smith, Apress

NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot by Pramod Sadalage, Martin Fowler Persistence, 1st Edition.

PC-CS-AIDS-404LA	Reinforcement Learning Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**2**	**1**	**40**	**60**	**100**	**3 Hrs.**
Purpose	To implement the concepts of Reinforcement Learning Algorithms.						
Course Outcomes							
CO1	Implement Python programming advance and paradigm.						
CO2	Implement various process of Reinforcement Learning						
CO3	Implement various Reinforcement Learning models						
CO4	Implement various Reinforcement Learning algorithms.						

1.	The probability that it is Friday and that a student is absent is 3 %. Sincethereare5schooldaysinaweek, theprobability that it is Friday is 20%.Whatisthe probability that a student is absent given that today is Friday? Apply Bayes rule in python to get the result. (Ans:15%)
2.	Extract the data from database using python
3.	Implement k-nearest neighbors classification using python
4.	Given the following data, which specify classifications for nine combinations of VAR1 and VAR2 predict a classification for a case where VAR1=0.906 and VAR2=0.606,using there sultofk-meansclusteringwith3means(i.e.,3centroids) VAR1 VAR2 CLASS 1.713 1.586 0 0.180 1.786 1 0.353 1.240 1 0.940 1.566 0 1.486 0.759 1 1.266 1.106 0 1.540 0.419 1 0.459 1.799 1 0.773 0.186 1

5.	The following training examples map description so find visuals onto high, medium and low Credit-worthiness. medium skiing design single twenties no ->high Risk high golf trading married forties yes ->low Risk ow speedway transport married thirties yes ->med Risk medium football banking single thirties yes ->low Risk high flying mediamarried fifties yes ->high Risk ow football security single twenties no ->med Risk medium golf media single thirties yes ->med Risk medium golftransport married forties yes ->low Risk high skiing bankingsingle thirties yes ->high Risk ow golf unemployed married forties yes ->high Risk Input attributes are (from left to right) income, recreation, job, status, age- group, home-owner. Find the unconditional probability of `golf' and the conditional probability of `single' given `med Risk' in the dataset?
6.	Implement linear regression using python.
7.	Implement Naïve Bayes theorem to classify the English text
8.	Implement an algorithm to demonstrate the significance of genetic algorithm

PE-CS-AIDS-414 LA	Social Networks Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**2**	**1**	**40**	**60**	**100**	**3 Hours**
Purpose	Students will be able to use Social networks for business and personal use, conducting social network analysis, social network developer tools and social network concepts for solving real-world issues.						
Course Outcomes (CO)							
CO1	Demonstrate proficiency in the use of social networks for business and personal use						
CO2	Demonstrate proficiency in the use of social network analysis concepts and techniques.						
CO3	Demonstrate proficiency in the use of social network developer tools.						
CO4	Examine the various types of processors and demonstrate proficiency in the use of social network concepts for solving real world issues.						

LIST OF PRACTICALS:

1. Understanding uses various social networking sites.
2. Use social networks for business as well as professional use.
3. Understand and learn what social network analysis is.
4. Use any social network analysis development tools.
5. Understand the basic concept of machine learning in social network.
6. Understand public sector media using big data analysis.
7. Use privacy while creating social networking Content.
8. Using social network concepts for solving any real-life world issues.
9. Use natural language processing and linguistics for information and relation extraction.
10. Write a note on Subgroups, Cliques, Block models, Ego networks, Social capital, structural holes, equivalence

PE-CS-AIDS-416LA	Application of Data Science in Industry Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**2**	**1**	**40**	**60**	**100**	**3 Hrs.**
Purpose	Introduce the mathematical foundations required for data science and R Programming. Students will learn the data analytics problem solving framework.						
Course Outcomes							
CO1	Describe a flow process for data science problems						
CO2	Classify data science problems into standard typology						
CO3	Develop R codes for data science solutions						
CO4	Correlate results to the solution approach followed and Construct use cases to validate approach and identify modifications required						

List of Experiments:

Practical 1:

Data Science in in Delivery Logistics using Data Visualization Tool

Practical 2:

Create Dashboard and Story on IPL Cricket Match data using Data Visualization Tool

Practical 3:

Create Dashboard and Story on Transport **data** using Data Visualization Tool

Practical 4:

Create Dashboard and Story on E-Commerce **data** using Data Visualization Tool

Practical 5:

Create Dashboard and Story on Health Care **data** using Data Visualization Tool

Practical 6:

Create Dashboard and Story on Airline Routing Planning **data** using Data Visualization Tool

Practical 7:

Create Dashboard and Story on Medicine and Drug Development **data** using Data Visualization Tool

PE- CS-AIDS-420 LA	Neural Network and Fuzzy Logic Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**2**	**1**	**40**	**60**	**100**	**3 Hrs.**
Purpose	This Lab introduces the basics of Neural Networks and essentials of Artificial Neural Networks with Single Layer,FLCs,PI and Multilayer Feed Forward Networks.						
Course Outcomes							
CO1	To give students an understanding of foundational concepts of fuzzy control primarily based on fuzzy set theory. To know operations on fuzzy sets, fuzzy relations.						
CO2	To understand basic building blocks of Mamdani Fuzzy Logic Controllers (FLCs).						
CO3	To get an insight into Fuzzification, Fuzzy Inferencing, Defuzzification.						
CO4	To understand the nonlinearity of different blocks of FLC and to analyze adaptive issues in the stability issues of FLCs.						

List of Experiments:

1. To implement PI, PD & PID controllers for temperature control of an oven on pilot plant &/or on a simulation kit.

2. To implement PI, PD & PID controllers for water level control of a single & two tank coupled systems on pilot plant &/or on a simulation kit.

3. To implement Fuzzy controller for temperature control of an oven & for water level control of a single & two tank coupled systems

4. To implement Fuzzy controller for speed control of dc motor.

5. To observe the effects of nonlinearities (such as saturation, backlash etc.) on the performance of PI, PD & PID controllers used for a first order system.

6. To observe the effects of nonlinearities (such as saturation, backlash etc.) on the performance of PI, PD & PID controllers used for a second order system.

7. To observe the effects of parametric disturbances on the performance of PI, PD, PID & Fuzzy

controllers.

8. To observe the effects of load disturbances on the performance of PI, PD, PID & Fuzzy controllers.

9. To control speed of a dc motor using choppers.

10. Implementation of speed control of a stepper motor.

11. To implement fuzzy controller on a 2nd/3rd order system.

12. To control the pressure of Hydraulic System.

13. To control the pressure of Pneumatic System.

14. To study vector control of induction motor.

S. No.	Course No.	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule				Duration of Exam (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	PC-CS-AIDS-408LA	Project-II	0:0:12	12	6	0	100	100	200	3

S. No.	Course No.	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule				Duration of Exam (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	PC-CS-AIDS-410LA	General Fitness	0:0:0	0	0	0	0	100	100	3