B. Tech Computer Science and Engineering (Artificial Intelligence and Machine Learning)
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	PC- CS-AIML-401A	Data Science with R Programming	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	OE	OE Elective*-II	3:0:0	3	3	75	25	0	100	3
4	PE	Elective* - I	3:0:0	3	3	75	25	0	100	3
5	PE	Elective* - II	3:0:0	3	3	75	25	0	100	3
6	PE-LA	Elective* – II Lab	0:0:2	2	1	0	40	60	100	3
7	PC- CS-AIML-407LA	R Programming Lab	0:0:2	2	1	0	40	60	100	3
8	PC- CS-AIML-409LA	Project** - 1	0:0:10	10	5	0	40	60	100	3
9	PC- CS-AIML-413LA	Industrial Training***	0:0:0	0	3	0	100	0	100	3
		Total		**29**	**25**	**300**	**320**	**180**	**800**	

Code	PE Elective*-I	Code	PE Elective* -II
PE- CS- AIML- 415A	Advance Computer Architecture	PE- CS- AIML- 421A	Big Data Analytics for Internet of Things
PE- CS- AIML- 417A	Soft Computing	PE- CS- AIML- 423A	Deep Learning
PE- CS- AIML- 419A	Data Mining & Predictive Modelling	PE- CS- AIML- 425A	Working with Raspberry pi & Arduino platform

Code	PE-LA Elective* –II	Code	OE Elective*-II
PE- CS- AIML-421LA	Big Data Analytics for Internet of Things Lab	OE-CS- AIML-401	Robotics and Intelligent Systems
PE- CS- AIML-423LA	Deep Learning Lab	OE-CS- AIML-403	Probability for Data Science
PE- CS- AIML-425LA	Working with Raspberry pi & Arduino platform Lab	OE-CS- AIML-405	Cluster Computing
		OE-CS- AIML-407	Microprocessor

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 by the end of 7th semester with good Report and power-point Presentation etc. *****4-6 weeks' hand on training completed after 6th Semester Exams**

PC-CS-AIML-401A	Data Science with R Programming						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hrs.**
Purpose	**To Describe what Data Science is and the skill sets needed to be a data scientist..**						
Course Outcomes (CO)							
CO1	To understand Basics of Data Science statistics, Identify probability distributions.						
CO2	To perform basics statistical analysis Using R.						
CO3	To Apply basic tools to carry out Exploratory data analysis.						
CO4	To explore the components data science Process to interact via machine learning models.						

UNIT -I

Introduction to Data Science - Data Science, History of Data Science, Data Science Process, Benefits and Uses of data science and big data, how does Data Science relate to other fields, data science tools, Data analysis and its types.

Data Preprocessing – Introduction, Data types and forms, Various data preprocessing operations -Data cleaning, data integration, data transformation, data reduction, data discretization.

UNIT -II

Data plotting and visualization – Introduction, Data visualization software, Data visualization libraries, Types of data visualization, Basic and specialized data visualization tools.

Statistical Data analysis and probability: Role of statistics and probability in data science, Descriptive statistics – Measures of frequency, central tendency, dispersion, position, Dependence and Independence, Conditional Probability, Bayesian probability, Random Variables, probability distribution

UNIT -III

Introduction to R Programming: What is R, Uses, Advantages and disadvantages, Basics in R-Syntax, Comments in R, reserved words, identifiers, constants, variables, operators and its precedence, Strings -Reading strings.

Data types and operations in R: Basic Data types, Vectors, Lists, Matrices, Arrays, Factors, Data Frames, Data type conversion

UNIT -IV

Connecting R to external Interfaces: CSV Files: Getting and Setting working Directory, creating, reading, analyzing, writing, Microsoft Excel: Install xlsx package, verifying and loading, creating, reading, writing.

Machine Learning for Data Science: Regression Methods-Linear, polynomial and logistic, classification methods, clustering methods, Hidden Markov Model

Data Science Case studies – Data science in Healthcare, Data Science in Ecommerce, Data Science in Entertainment Industry (preferably on Tableau)

Reference Books:

1. R for Data Analysis in Easy Steps by Mike Mc Grath .
2. Beginning Data Science in R: Data Analysis, Visualization, and Modelling for the Data Scientist by Thomas Mailund.
3. The Elements of Statistical Learning, 2nd edition. — Springer, 2009. Hastie, T., Tibshirani, R., Friedman, J.
4. Statistical Analysis with R for Dummies by: Joseph Schmuller.
5. Machine Learning: A Probabilistic Perspective. Murphy, K. - MIT Press, 2012.
6. "Practical Data Science with R". Nina Zume l, John Mount. Manning, 2014.
7. Advanced R: Data Programming and the Cloud by by: Matt Wiley,Joshua F. Wiley.
8. Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython ,2nd edition, Wes McKinney,O'Reilly Media (2017)

HSS-403A	Universal Human Values II: Understanding Harmony						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3.0**	**75**	**25**	**100**	**3 Hours**
Purpose	Purpose and motivation for the course, recapitulation from Universal Human Values-I						
Course Outcomes (CO)							
CO 1	Development of a holistic perspective based on self-exploration about						
CO 2	Understanding (or developing clarity) of the harmony in the human being,						
CO 3	Strengthening of self-reflection.						
CO 4	Development of commitment and courage to act.						

Module 1: Course Introduction - Need, Basic Guidelines, Content and Process for ValueEducation

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I
2. Self-Exploration– what is it? - Its contentand process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment ofaspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfil the above human aspirations: understanding and living in harmony at variouslevels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrarinessin choice based on liking-disliking

Module 2: Understanding Harmony in the Human Being - Harmony in Myself!

1. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
2. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
3. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
4. Understanding the characteristics and activities of 'I' and harmony in 'I'
5. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail
6. Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

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 in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as thefoundational values of relationship
2. Understanding the meaning of Trust; Difference between intention and competence
3. Understanding the meaning of Respect, Difference between respect and differentiation; the othersalient values in relationship
4. Understanding the harmony in the society (society being an extension of family): Resolution,Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
5. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- fromfamily to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value inrelationships. Discuss with scenarios. Elicit examples from students' lives

Module 4: Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

1. Understanding the harmony in the Nature
2. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature
3. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space
4. Holistic perception of harmony at all levels of existence.

Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" canbe used), pollution, depletion of resources and role of technology etc.

Module 5: Implications of the above Holistic Understanding of Harmony on ProfessionalEthics

1. Natural acceptance of human values
2. Definitiveness of Ethical Human Conduct
3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
4. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people- friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
5. Case studies of typical holistic technologies, management models and production systems
6. Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations
7. Sum up.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. todiscuss the conduct as an engineer or scientist etc.

READINGS:

Text Book

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel

Books,New Delhi, 2010

Reference Books

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J CKumarappa
8. Bharat Mein Angreji Raj - PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

MODE OF CONDUCT

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

Lectures hours are to be used for interactive discussion, placing the proposals about the topics at handand motivating students to reflect, explore and verify them.

Practice hours are to be used for practice sessions.

While analysing and discussing the topic, the faculty mentor's role is in pointing to essential elementsto help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements.

In the discussions, particularly during practice sessions, the mentor encourages the student to 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 rather than" extra-ordinary" situations. Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting.

Practice experiments are important for the course. The difference is that the laboratory is everyday life, and practical are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignment and/or activity are included. The practice sessions would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to development of commitment, namely behaving and working based onbasic human values.

It is recommended that this content be placed before the student as it is, in the form of a basic foundation course, without including anything else or excluding any part of this content. Additional content may be offered in separate, higher courses.

This course is to be taught by faculty from every teaching department, including HSS faculty. Teacherpreparation with a minimum exposure to at least one 8-day FDP on Universal Human Values is deemedessential.

ASSESSMENT:

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

Example:

Assessment by
faculty mentor: 5 marks
Self-assessment: 5 marks
Assessment by peers: 5 marks
Socially relevant project/Group Activities/Assignments: 10 marks
Semester End Examination: 75 marks
The overall pass percentage is 40%. In case the student fails, he/she must repeat the course.

OE-CS-AIML-401	Robotics and Intelligent Systems						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3hrs.**
Purpose	To impart understanding of the main abstractions and reasoning for Robotics and Intelligent Systems						
Course Outcomes (CO)							
CO1	To Understand the basic terminologies in Robotics to develop intelligent systems						
CO2	To Apply the random search and heuristic search for intelligent systems.						
CO3	To Understand the abstractions and reasoning for intelligent systems, Apply the rule-based methods in intelligent systems						
CO4	To Identify the characteristics and architectures of algorithms of multi agent systems, Identify different application areas of Intelligent Systems						

UNIT-I

Introduction to robotics- History, Characteristics; Robot applications- Manufacturing industry, defense, rehabilitation, medical, Robot mechanisms, type of robots, Basic tasks of a robot, Advantages & Disadvantages of robot, Challenges in Robotics

UNIT-II

Components of robot: Robot components, power source, controllers, manipulator, actuator drive and its types, end effector, classifying robots, sensors in robots and its types, transducers, means for programming (Robot programming and interfaces), Degrees of freedom(DOF)

UNIT-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, Uncertainty 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:

1. Crina Grosan, Ajith Abraham, “Intelligent Systems: A Modern Approach “, Springer-Verlag, 2011
2. Bogdan M. Wilamowski, J. David Irwin, “The Industrial Electronics Handbook. Second Edition: Intelligent Systems”, CRC Press, 2011
3. Abraham-Kandel, Gideon-Langholz, “Hybrid-Architectures for Intelligent Systems”, CRC-Press, 1992
4. Augmented Human, PAPAGIANNIS, Helen, ist print, SPD.

5. Ian Goodfellow, YoshuaBengio and Aaron Courville, "Deep Learning", MIT Press, http://www.deeplearningbook.org

OE-CS-AIML-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	To Understand the mathematical framework for probability theory						
CO2	To Understand various kinds of Random Variables that are fundamental to probabilistic modeling.						
CO3	To Learn statistical concepts that are fundamental to conducting statistical tests on data and understanding whether the data you are analyzing is likely occurring due to an experimental method or to chance.						
CO4	To Explore some introductory concepts from statistics that are helpful in analyzing data and machine learning.						

Unit I

First Tools for looking at data: Datasets, Plotting Data (Bar Charts, Histograms), Summarizing 1D data – (Mean, standard deviation, Variance, median, interquartile range), Plotting 2D data – (categorical data, counts and charts, series, scatter plots for spatial data), Correlation.

Unit II

Basic Ideas in probability –Experiments, outcomes and probability, events, independence, conditional probability Random variables and expectations- Random variables, expectations and expected values. Useful probability distributions – Discrete distributions, continuous distributions, normal distribution, approximating binomials with large N

Unit III

Samples and populations – The sample mean, confidence intervals, significance of evidence – Significance, evaluating significance, p values, comparing mean of two populations, F tests and standard deviations, Chi square tests of model fit Extracting important relationships in high dimensions – Summaries and simple plots (Mean, stem plots and scatterplot matrices), Using mean and covariance to understand high dimensional data, principal component analysis, multidimensional scaling

Unit IV

Regression- regression to make predictions, regression to spot trends, linear regression and least Squares-Linear regression, choosing B, solving least squares problems, residuals, R-squared, producing good linear regressions Markov chains and hidden Markov models

Textbooks:

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

Reference Books:

1. Morris H. DeGroot and Mark J. Schervish, Probability and Statistics (4/e)(2012), Addison-Wesley.
2. Blitzstein and Hwang, Introduction to Probability (2015), CRC Press.
3. William Feller, An Introduction to Probability, (3/e) (2008), Volume 1, Wiley.

OE-CS-AIML-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	To Remember and understand the basic concepts/Principles of distributed Systems						
CO2	To Analyze the Various Concepts of Cluster Computing						
CO3	To Able to describe different parallel processing platforms involved in achieving high performance computing						
CO4	To Develop efficient and high performance parallel programming.						

UNIT I

Basic concepts in Distributed Systems: Notion of time Distributed Mutual exclusion, Consensus, Failure models Paradigms for process interaction in distributed programs, Programming Paradigms, shared memory, Message passing, Workflows

UNIT II

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 Cluster, Overview of Cluster Computing, Cluster Computer and its Architecture, Clusters Classifications, Components for Clusters, Cluster Middleware and Single System Image.

UNIT III

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

UNIT IV

Beowulf Cluster: The Beowulf Model, Application Domains, Beowulf System Architecture, Software Practices, Parallel Programming with MPL, Parallel Virtual Machine(PVM). System Infrastructure, Traditional paradigms for distributed computing, Web Services, Grid standards: OGSA and WSRF, Case Studies of Cluster Systems: COMPaS, NanOS and PARAM

REFERENCES:

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

2. High Performance Cluster Computing: Architectures and Systems, Vol.1, Prentice Hall
3. Grid and Cluster Computing, Prabhu C.S.R, PHIL earning Private Limited
4. In search of clusters(2nded.), Gregory F.Pfister, IBM, Austin, TX, Prentice-Hall
5. Distributed and Cloud Computing, First Edition, Geoffrey C.Fox, KaiHwang, Jack J.Dongarra, Elsevier India Pvt. Ltd.-New Delhi
6. Laurence T.Yang, Minyi Guo – High Performance Computing Paradigm and Infrastructure JohnWiley

OE-CS-AIML-407	Microprocessor						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	3	75	25	100	**3Hour**
Purpose	To learn the architecture and programming of Intel family microprocessors and its interfacing.						
Course Outcomes(CO)							
CO1	To study the Architecture of 8086 microprocessors						
CO2	To implement the interfacing of memories to 8086 Microprocessor						
C O3	To learn and analyze the instruction set of 8086 Microprocessor and implementation of assembly language programming of 8086 Microprocessor.						
CO4	To design and implement the interfacing of interrupts, basic I/O and DMA with 8086 Microprocessor						

UNIT-I

8086 CPU ARCHITECTURE: 8086 Block diagram; description of data registers, address registers; pointer and 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, 8086 minimum mode and maximum mode CPU module.

UNIT-II

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

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; Assembler directives.

8086 Programming Techniques: Writing assembly Language programs for logical processing, arithmetic processing, timing delays; loops, data conversions.

UNIT-IV

Basic I/O Interface: Parallel and Serial I/O Port design and address decoding. Memory mapped I/O Vs Isolated 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, and stepper motor, optical encoder with 8086.

Interrupts and DMA: 8086 Interrupt mechanism; interrupt types and interrupt vector table. Applications of interrupts, Intel's 8259. DMA operation. Intel's 8237.

Suggested Books:

1. BarryB.Brey, "TheIntelMicroprocessor8086/8088,80186", PearsonEducation, EighthEdition,2009 1st and 4th Edition
2. D.V. Hall, Microprocessors and Interfacing, McGrawHill2nded.
3. Liu, Gibson, "Microcomputer Systems: The8086/88Family", 2ndEdition, PHI,2005
4. Kenneth Ayala, "The8086Microprocessor: Programming & Interfacing the PC",

Cengage Learning,
5. Indian Edition, 2008
6. Kip Irvine," Assembly language for IBM PC", PHI,2ndEdition,1993, 40% 3rd Edition
7. Peter Abel," Assembly language programming", PearsonEdu,5thEdition,2002
8. Uffen back, "The8086FamilyDesign" PHI 1st and 2ndEdition.
9. Walter A Triebel and Avtar Singh; The8088 and8086Microprocessors 4th Edition

PE-CS-AIML-415A	Advance Computer Architecture						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**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	To 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	To Identify the roles of VLIW & superscalar processors and branch handling techniques for performance improvement						
CO3	To 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	To 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

Parallel Computer Models – Introduction to parallel computing, Need for parallel computing, Constraints of conventional architecture, Evolution of parallel processors -Basic terminologies, Features, evolution and future trends, Parallelism in uniprocessor system -Uniprocessor architecture and mechanism, Multiprocessors and multicomputer -UMA, NUMA, COMA and NORMA models, Multivector and SIMD computers

Unit-II

Parallel Architectural Classification Schemes – Flynn, Feng, Handler classification, classification based on coupling between Processing elements, based on grain size, based on modes of access memory; Instruction level parallelism and thread level parallelism.

Program and Network properties: Introduction, Conditions of parallelism, Types of dependencies, hardware and software parallelism, Program partitioning and scheduling, program flow mechanisms, control flow, data flow, reduction computers

Unit-III

Parallel Algorithms and Programming **–** Introduction, characteristics of parallel algorithms, Parallel programming techniques, Models of parallel programming, Classification of parallel algorithms, Performance of parallel algorithms

Vector processing - Introduction, comparison of vector and array processors, basic vector architecture and its classification, Terminologies related to vector processing, vector instruction types, vector performance modeling, vectorization, Design of a vectorizing compiler

UNIT – IV

Pipelining – Introduction, Pipeline-Principle and implementation (Linear pipeline processor, Clock period, speed up, efficiency, throughput), Nonlinear pipeline processor, Classification of pipeline processor – Based on levels of processing, based on pipeline configuration, General pipelines, Different pipeline design – multiply and divide pipeline design, Instruction pipeline design, mechanisms for instruction pipelining

Reference Books:

1. D.Sima, T.Fountain, P.Kasuk, Advanced Computer Architecture-A Design Space Approach, Pearson Education.
2. Kai Hwang and Naresh Jotwani, Advanced Computer Architecture-Parallelism, Scalability, Programmability, McGraw Hill.
3. M.J. Quinn, Parallel Computing: Theory and Practice, Second Edition, McGraw Hill.
4. J. L. Hennessy and D. A. Patterson, Computer Architecture: A Quantitative approach, Morgan Kaufmann/Elsevier.
5. T.G. Lewis and H. EI- Rewini, Introduction to parallel computing, Prentice Hall.
6. Nicolas Carter, Computer Architecture, McGraw Hill.

PC-CS-AIML -417A	Soft Computing						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hrs.**
Purpose	Soft Computing is a consortium of methodologies which collectively provide a body of concepts and techniques for designing intelligent systems.						
Course Outcomes(CO)							
CO1	The main objective of the Soft Computing Techniques to Improve Data Analysis						
CO2	Tostrengthenthedialoguebetweenthestatisticsandsoftcomputingresearchcommunitiesin order to cross-pollinate both fields						
CO3	To develop Solutions and generate mutual improvement activities						
CO4	To develop practical data analysis skills, which can be applied to practical problems						

Unit-I

Introduction: What is Soft Computing. Difference between Hard and Soft computing, Requirement of Soft computing, Major Areas of Soft Computing, Applications of Soft Computing.

Unit-II

Neural Network, Learning rules and various activation functions, Single layer Perceptron, Back Propagation networks, Architecture of Backpropagation (BP) Networks, Backpropagation Learning, Introduction to counter propagation, Adaptive Resonance theory and Self Organizing Map, Recent Applications.

Unit-III

Fuzzy Systems: Fuzzy logic, fuzzy sets - properties - operations on fuzzy sets, fuzzy relations - operations on fuzzy relations

Fuzzy membership functions, fuzzification, Methods of membership value assignments – intuition – inference – rank ordering, Lambda – cuts for fuzzy sets, Defuzzification methods

Unit-IV

Genetic Algorithm**:** History of Genetic Algorithms(GA), Working Principle, Various Encoding methods, Fitness function, GA Operators-Reproduction, Crossover, Mutation, Convergence of GA, Bitwise operation in GA, Multi-level Optimization, Genetic-neuro hybrid systems, Genetic Fuzzy rule based system

Suggested Books:

1. Principles of Soft Computing by S. N. Sivanandam &S. N. Deepa byWiley, India edition. 1st and 2ndEdition
2. Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications, S.Rajasekaran,G. A. Vijayalakshami, PHI. 2nd and 4th Edition
3. Genetic Algorithms: Search and Optimization, E.Goldberg.
4. Neuro-FuzzySystems,ChinTengLin,C.S.GeorgeLee,PHI.
5. Build_Neural_Network_With_MS_Excel_sample by Joechoong.

PE-CS-AIML-419A	Data Mining and Predictive Modelling						
L	**T**	**P**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hour**
Purpose	The course provides grounding in basic and advanced methods to learn, how to develop models to predict categorical and continuous outcomes, using such techniques as neural networks, decision trees, logistic regression, support vector machines and Bayesian network models. To know the use of the binary classifier and numeric predictor nodes to automate model selection. To advice on when and how to use each model. Also learn how to combine two or more models to improve prediction.						
Course Outcomes (CO)							
CO1	To learn, how to develop models to predict categorical and continuous outcomes, using such techniques as neural networks, decision trees, logistic regression, support vector machines and Bayesian network models.						
CO2	To know the use of the binary classifier and numeric predictor nodes to automate model selection.						
CO3	To advice on when and how to use each model. Also learn how to combine two or more models to improve prediction.						
CO4	To Apply predictive modeling approaches using a suitable package such as SPSS Modeler						

Unit 1

Introduction to Data Mining Introduction, what is Data Mining, Concepts of Data mining, Technologies Used, Data Mining Process, KDD Process Model, CRISP – DM, Mining on various kinds of data, Applications of Data Mining, Challenges of Data Mining.

Unit 2

Data Understanding and Preparation Introduction, Reading data from various sources, Data visualization,Distributions and summary statistics, Relationships among variables, Extent of Missing Data. Segmentation, Outlier detection, Automated Data Preparation, combining data files, Aggregate Data, Duplicate Removal, Sampling DATA, Data Caching, Partitioning data, Missing Values.

Unit 3

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 4:

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 ModelPerformance, Updating a Model.

Reference Books:

1. Predictive & Advanced Analytics (IBM ICE Publication)
2. Data Mining: Concepts and Techniques by Jiawei Han
3. Data Mining: Practical Machine Learning Tools and Techniques by Mark A. Hall, Ian H. Witten

PE-CS-AIML-421A	Big Data Analytics for Internet of Things						
L	**T**	**P**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hour**
Purpose	The course provides grounding in basic and advanced methods to big data technology and tools.						
Course Outcomes (CO)							
CO1	To Understand Big Data and its analytics in the real world.						
CO2	To Analyze the Big Data framework like Hadoop and NOSQL to efficiently store and process Big Data to generate analytics.						
CO3	To Design of Algorithms to solve Data Intensive Problems using MapReduce Paradigm						
CO4	To Design and Implementation of Big Data Analytics using pig and spark to solve data intensive problems and to generate analytics.						

UNIT I

Introduction: Big data Concepts, Needs and Challenges of big data. Types and source of big data. Component of system data, access, storage. Data intelligence, Data integration.

UNIT II

Distributed file system, Big Data and its importance, Four Vs, Driversfor Big data, big data analytics, big data applications. Algorithms using map reduce, Matrix-VectorMultiplicationby Map Reduce.

UNIT III

Introduction to Hadoop- Big Data – Apache Hadoop & Hadoop EcoSystem – Moving Data in and out of Hadoop– Understanding inputs and outputs of Map Reduce-Data Serialization.

UNIT IV

Hadoop Architecture - Hadoop Architecture, Hadoop Storage: HDFS, Common Hadoop Shell commands, Anatomy of File Write and Read. Name Node, Secondary Name Node, and Data Node, Hadoop Map Reduce.

Reference Books:

1. Borislublinsky,Kevint.Smith,AlexeyYakubovich,

"ProfessionalHadoopSolutions", Wiley, ISBN:9788126551071,2015.

2. ChrisEaton,Dirkderoos, etal.,"UnderstandingBigdata",McGrawHill,2012.

3. TomWhite, "HADOOP: ThedefinitiveGuide", OReilly2012.

4. VigneshPrajapati, "BigDataAnalyticswithRandHadoop", PacketPublishing2013.

PE-CS-AIML-423A	Deep Learning						
L	**T**	**P**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hour**
Purpose	The course provides grounding in basic and advanced methods to understand the theoretical foundations, algorithms and methodologies of Neural Network. To design and develop an application using specific deep learning models. To provide the practical knowledge in handling and analysing real world applications.						
Course Outcomes (CO)							
CO1	To Recognize the characteristics of deep learning models that are useful to solve real-world problems.						
CO2	To Understand different methodologies to create application using deep nets.						
CO3	To Identify and apply appropriate deep learning algorithms for analyzing the data for variety of problems.						
CO4	To Implement different deep learning algorithms. Design the test procedures to assess the efficacy of the developed model. Combine several models in to gain better results						

Unit:1

Basics of Machine Learning algorithms, Maximum likelihood estimation, Building machine learning algorithm, Neural Networks Multilayer Perceptron, Back-propagation algorithm and its variants Stochastic gradient decent, Curse of Dimensionality

Unit 2

Deep Learning Architectures, Representation Learning, Width and Depth of Neural Networks, Activation Functions: RELU, LRELU, ERELU, Unsupervised Training of Neural Networks, Restricted Boltzmann Machines, Auto Encoders, Deep Learning Applications

Unit 3

Convolutional Neural Networks, Architectural Overview, Motivation, Layers, Filters, Parameter sharing, Regularization, Popular CNN Architectures: ResNet, AlexNet - Applications

Unit 4

Transfer Learning Techniques, Variants of CNN: DenseNet, PixelNet, Recurrent Neural Networks, Bidirectional RNNs, Encoder-decoder sequence to sequence architectures - BPTT for training RNN, Long Short Term Memory Networks.

TEXT BOOKS

1.Ian Goodfellow, YoshuaBengio and Aaron Courville, “Deep Learning”, MIT Press, 2017.
2. Josh Patterson, Adam Gibson "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017
3. Umberto Michelucci “Applied Deep Learning. A Case-based Approach to Understanding DeepNeural Networks” Apress, 2018.

Reference Books

1. Kevin P. Murphy "Machine Learning: A Probabilistic Perspective ", The MIT Press, 2012.
2. EthemAlpaydin, "Introduction to Machine Learning”, MIT Press, Prentice Hall of India, Third
Edition 2014.
3.Giancarlo Zaccone, Md. RezaulKarim, Ahmed Menshawy"Deep Learning with TensorFlow:

PE-CS-AIML-425A	Working with Raspberry pi & Arduino platform						
L	**T**	**P**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hour**
Purpose	The course provides the IOT related infrastructure and various IOT devices. This course will help you know about the embedded system, IOT architecture. To understand the various applications and future aspects of IOT world. This course will help to do various Arduino related projects like intelligent home locking system. Along with Arduino, in the later on sections, we will study Raspberry pi. Sensors and actuators related to raspberry pi and various applications and related projects.						
Course Outcomes (CO)							
CO1	To learn the embedded system and their working and IOT fundamentals.						
CO2	To know the use of Arduino and its basic concepts. Also understand the various Arduino based projects.						
CO3	To understand the raspberry Pi and programming done with it.						
CO4	To Apply programming and hardware interfaces with Raspberry Pi and various projects.						

Unit I

Introduction to embedded system, Understanding Embedded System, Overview of basic electronics and digital electronics, Microcontroller vs. Microprocessor, Common features of Microcontroller, Different types of microcontrollers, Overview of IoT, Understanding IoT fundamentals, IoT Architecture, protocols, Various Platforms for IoT, Real time Examples of IoT, Overview of IoT components and IoT Communication Technologies

Unit II

Getting Started with Arduino: Introduction to Arduino, Pin configuration and architecture., Device and platform features, Concept of digital and analog ports, Arduino Basic Concepts: Arduino data types, Variables and constants, Operators, Control Statements, Arrays, Functions

Arduino Projects: Intelligent home locking system, Intelligent water level management system, Home automation using RFID, Real time clock-based home automation, Intelligent Automatic Irrigation System

Unit III

Getting Started with Raspberry Pi: Basic functionalities of Raspberry Pi board and its processor, Pin Description of Raspberry Pi, Understanding SoC architecture and SoCs used in Raspberry Pi

Programming the Raspberry Pi: Python: Introduction to Python Programming language, Python vs Other Languages, Python Programming Environment, Variables, Keywords, Data Types in Python, Loops, Conditional Statement, Function, Function Argument, Flow Control, Numpy, Importing Libraries, PIP (Python Installation Package) and Customized libraries, Application of Pythons

Unit IV

Interfacing of Sensors and Actuators with RPi:Temperature and Humidity Sensor (DHT11), Motion Sensor (PIR), Obstacle detection using Ultrasonic sensor, etc.Robotics Motion Raspberry Pi: DC, Servo, Stepper Motor, Camera Interfacing

References Books:

1. Arduino Cookbook by Michael Margolis, O'Reilly Media, Inc., 1st edition.

2. Arduino for beginners: Essential Skills Every Maker Needs, John Baichtal, Person Education, Inc., 1st edition

3.Raspberry Pi 3 An Introduction to Using with PythonScratch, Javascript and more, Gary Mitnick, CreateSpace Independent Publishing Platform, 2017.

4.Raspberry Pi for Python Programmers Cookbook, Tim Cox, Packt Publishing Limited; 2nd Revised edition, 2016.

5.Raspberry Pi User Guide, Eben Upton and Gareth Halfacreee, John Wiley & Sons, 2016.

6. Internet of Things – A hands-on approach, Arshdeep Bahga, Vijay Madisetti, Universities Press, 2015

7. Raj Kamal, “Internet of Things: Architecture and Design Principles”, 1st Edition, McGraw Hill Education,2017.

PE-CS-AIML-421LA	Big Data Analytics for Internet of Things Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**2**	**1**	**40**	**60**	**100**	**3 Hrs.**
Purpose	**To Describe what Data Science is and the skill sets needed to be a data scientist..**						
Course Outcomes (CO)							
CO1	Install and use R for simple programming tasks. Extend the functionality of R by using add-on packages.						
CO2	To perform basics statistical analysis Using R.						
CO3	To Apply basic tools to carry out Exploratory data analysis.						
CO4	To explore the components data science Process to interact via machine learning models.						

LIST OF PRACTICALS

1. Installation of Single Node Hadoop Cluster on Ubuntu
2. Hadoop Programming: Word Count Map Reduce Program Using Eclipse
3. Implementing Matrix Multiplication Using One Map-Reduce Step.
4. Implementing Relational Algorithm on Pig.
5. Implementing database operations on Hive.
6. Implementing Bloom Filter using Map-Reduce
7. Implementing Frequent Item set algorithm using Map-Reduce.
8. Implementing Clustering algorithm using Map-Reduce
9. Implementing Page Rank algorithm using Map-Reduce
10. Mini Project:

    Few topics for Projects:

    a. Twitter data analysis

    b. Fraud Detection

    c. Text Mining

    d. Equity Analysis etc.

PC-CS-AIML-423LA	Deep learning Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**2**	**1**	**40**	**60**	**100**	**3 Hrs.**
Purpose	**To Describe what Data Science is and the skill sets needed to be a data scientist..**						
Course Outcomes (CO)							
CO1	To understand the deep learning.						
CO2	To perform basics deep learning networks						
CO3	To apply various deep learning networks in real world life..						
CO4	To implement deep learning modules.						

LIST OF PRACTICALS

1. Write a program to implement different activation functions to train Neural Network.

2. Write a program to implement different Learning Rules.

3. Write a program to implement Perceptron Networks.

4. Write a program to implement Adaline network for system identification.

5. Write a program to implement Madaline network

6. Write a program to implement Pattern matching using different rules.

7. Create a project that focuses on how machine learning is used in healthcare.

8. Project related to application of machine learning in business analysis.

9. Project related to application of machine learning in sports analytics.

10. Project related to application of machine learning in Time Series Analysis & Forecasting.

PE-CS-AIML-425LA	Working with Raspberry pi & Arduino platform Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**2**	**1**	**40**	**60**	**100**	**3 Hrs.**
Purpose	**To describe what Data Science is and the skill sets needed to be a data scientist.**						
Course Outcomes (CO)							
CO1	To understand the Raspberry Pi.						
CO2	To perform basics practicals using Arduino platform						
CO3	To apply various Raspberry pi & Arduino platform in real world life..						
CO4	To implement and connect with MySQL database						

LIST OF PRACTICALS

1. Study and installation of Raspberry- pi

2. To write a program to sense the available networks using Arduino

3. To write a program to measure the distance using ultrasonic sensor and make LED blink using Arduino.

4. To write a program to detects the vibration of an object with sensor using Arduino.

5. To write a program to connect with the available Wi-Fi using Arduino

6. To write a program to sense a finger when it is placed on the board Arduino.

7. To write a program to get temperature notification using Arduino.

8. To write a program for LDR to vary the light intensity of LED using Arduino.

9. To write a program to install MySQL database in Raspberry pi.

10. To write a program to work with basic MySQL queries by fetching data from database in Raspberry pi.

11. To write a program to switch light on when the input is 1 and switch the light off when the input is 0 using Raspberry

Raspberry Pi Projects: Set up a Pi motion detector, set up Pi ADC/DAC, construct a digital weather station, construct a traffic light controller.

PC-CS-AIML-407LA	R Programming lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**2**	**1**	**40**	**60**	**100**	**3 Hrs.**
Purpose	**To Describe what Data Science is and the skill sets needed to be a data scientist..**						
Course Outcomes (CO)							
CO1	Install and use R for simple programming tasks. Extend the functionality of R by using add-on packages.						
CO2	To perform basics statistical analysis Using R.						
CO3	To Apply basic tools to carry out Exploratory data analysis.						
CO4	To explore the components data science Process to interact via machine learning models.						

LIST OF PRACTICALS

1. Write an R script, to create R objects for calculator application and save in a specified location in disk.

2. Write an R script to find basic descriptive statistics using summary, str, quartile function on sample datasets.

3. Write an R script to find subset of dataset by using subset (), aggregate () functions on sample dataset.

4. Write an R script for Reading different types of data sets (.txt, .csv) from web and disk and writing in file in

specific disk location.

5. Write an R script for Reading Excel data sheet and XML dataset.

6. Find the data distributions using box and scatter plot of sample dataset.

a. Find the outliers using plot.

b. Plot the histogram, bar chart and pie chart on same data.

7. How to find a correlation matrix and plot the correlation on sample data set.

a. Plot the correlation plot on dataset and visualize giving an overview of relationships among data

b. Analysis of covariance: variance (ANOVA), if data have categorical variables

8. Import a data from web storage. Name the dataset and now do Logistic Regression to find out relation between variables that are affecting the admission of a student in a institute based

on his or her GRE score, GPA obtained and rank of the student. Also check the model is fit or not. require (foreign), require(MASS).

9. Apply multiple regressions, if data have a continuous independent variable. Apply on above dataset (in Que

10. Apply regression Model techniques to predict the data on above dataset (in Que 8).

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-AIML-409LA	Project**-I	0:0:10	10	5	0	40	60	100	3 hours

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-AIML-413LA	Industrial Training***	0	0	3	0	100	0	100	3 hours

B. Tech Computer Science and Engineering (Artificial Intelligence and Machine Learning)
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- AIML-402A	Optimization Method in ML	3:0:0	3	3	75	25	0	100	3
2	HSS-404A	Entrepreneurship and Start-ups	3:0:0	3	3	75	25	0	100	3
2	OE	OE Elective*-III	3:0:0	3	3	75	25	0	100	3
3	PE	Elective* – III	2:0:0	2	2	75	25	0	100	3
4	PE	Elective* - IV	2:0:0	2	2	75	25	0	100	3
5	PC- CS- AIML-406LA	Optimization Lab	0:0:2	2	1	0	40	60	100	3
6	PC- CS- AIML-408LA	Advance AI Application Lab	0:0:2	2	1	0	40	60	100	3
7	PC- CS- AIML-410LA	Project**-II	0:0:10	10	5	0	100	100	200	3
8	HM- CS- AIML-412A	General Fitness & Proficiency	0:0:0	0	0	0	0	100	100	3
		Total		**27**	**20**	**300**	**280**	**320**	**900**	

Code	PE-Elective* III	Code	PE-Elective* IV
PE- CS- AIML- 402A	Reinforcement Learning	PE- CS- AIML- 422A	Augmented Reality
PE- CS- AIML- 416A	Social Networks	PE- CS- AIML- 424A	Advance Machine Learning
PE- CS- AIML- 420A	Neural Network and Fuzzy Logic systems	PE- CS- AIML- 426A	Natural Language Processing

Code	OE Elective*-III
OE-CS-AIML-402	Cyber Law and Ethics
OE-CS-AIML-404	Cryptographic Fundamentals
OE-CS-AIML-406	Network Operating System
OE-CS-AIML-408	Reasoning, Problem Solving and Robotics
OE-CS-AIML-410	Image Processing and Recognition

Note: *The students will choose any two departmental Electives courses and One Open Elective course out of the given elective list in VIII Semester.
****Project should be initiated in the beginning of 8thsemester, and should be completed by the end of 8thsemester with good Report and power-point Presentation etc.**

PC-CS-AIML-402A	Optimization Method in ML						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hour**
Purpose	To equip students with advanced techniques and methods in optimization that are tailored to large-scale statistics and machine learning problems						
Course Outcomes (CO)							
CO1	To understand the basics of convex optimization.						
CO2	To learn the basics of gradient based methods.						
CO3	To apply the operator's splitting methods.						
CO4	To know about stochastic and non-convex optimization dual averaging.						

UNIT I

Basics of convex optimization: convex sets, convexity-preserving operations, examples of convex programs (linear programming (LP), second-order cone programming (SOCP), semi-definite programming (SDP)), convex relaxation, KKT conditions, duality

UNIT II

Gradient-based methods: gradient descent, sub-gradient, mirror descent, Frank–Wolfe method, Nesterov's accelerated gradient method, ODE interpretations, dual methods, Nesterov's smoothing, proximal gradient methods, Moreau–Yosida regularization

UNIT III

Operator splitting methods: Augmented Lagrangian methods, alternating direction method of multipliers (ADMM), monotone operators, Douglas–Rachford splitting, primal and dual decomposition

UNIT IV

Stochastic and non-convex optimization dual averaging, Polyak–Juditsky averaging, stochastic variance reduced gradient (SVRG), Langevin dynamics, escaping saddle points, landscape of non-convex problems, deep learning

Suggested Books:

1. Optimization in Machine Learning and Applications, Anand J. Kulkarni, Suresh Chandra Satapathy, 2019
2. Linear Algebra and Optimization for Machine Learning, Charu C. Aggarwal, 2020.

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)

Reference books:

- Guillebeau, C (2015) The $100 Startup: Fire Your Boss, Do What You Love and Work Better To Live
- Prasad, Rohit (2013), Start-up sutra: what the angels won't tell you about business and life, Hachette India.
- Charantimath, P. (2009). Entrepreneurship Development: Small Business Enterprises. Pearson

OE-CS-AIML-402	Cyber Law and Ethics						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hours**
Purpose	The course deals with all the aspects of Cyber law as per Indian/IT act. It also covers overview of Cyber Ethics, Intellectual Property Right and Trademark Related laws with respect to Cyber Space.						
Course Outcomes (CO)							
CO 1	To give overview of Cyber Ethics, Intellectual Property Right and Trademark Related laws with respect to Cyber Space.						
CO 2	To analyze and evaluate existing legal framework and laws on cyber security.						
CO 3	To analyze and evaluate the Intellectual rights and copyrights.						
CO 4	To understand 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-AIML-404	Cryptographic Fundamentals						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hours**
Purpose	To Understand various cryptographic algorithm, public-key cryptosystem and fundamental ideas of public-key cryptography.						
Course Outcomes(CO)							
CO1	To Student will be able to understand basic cryptographic algorithms.						
CO2	To Able to understand the fundamental ideas of public-key cryptography.						
CO3	To Analyze and compare symmetric-key encryption public-key encryption schemes based on different security models						
CO4	To Able to understand the PKI infrastructure.						

Unit-I

Cryptography Concept: Introduction, plain text and cipher text, substitution techniques, transposition techniques, encryption and decryption, symmetric and asymmetric key cryptography, steganography, key range and key size, possible types of attacks Historical Ciphers, Computational Security, Semantic Security, Pseudorandom Generators (PRGs) PRF, PRP and SPRP.

Unit-II

Symmetric key Ciphers: Block Cipher principles, Modes of Operations of Block Ciphers, DES, AES, Stream ciphers.

Cryptographic Hash Functions**:** MAC, Information-theoretic Secure MAC, Cryptographic Hash Functions, Birthday Attacks on Cryptographic Hash Functions, Applications of Hash Functions, Generic Constructions of Authenticated Encryption Schemes.

Unit-III

Asymmetric key Ciphers: Discrete-Logarithm Problem, Computational Diffie-Hellman Problem, Decisional Diffie-Hellman Problem, Elliptic-Curve Based Cryptography and Public-Key Encryption, El Gamal Encryption Scheme, RSA Assumption, CCA -secure Public-key Hybrid Ciphers Based on Diffie-Hellman Problems and RSA-assumption, Digital Signatures.

Unit-IV

Key Management and Distribution: Symmetric Key Distribution Using Symmetric & Asymmetric Encryption, Distribution of Public Keys, Kerberos, X.509 Authentication Service, Public – Key Infrastructure, overview of SSL/TLS.

Suggested Books:

1. Cryptography and Network Security: Forouzan Mukhopadhyay, Mc Graw Hill, 1st and 2nd Edition.
2. Katz and Y. Lindell, Introduction to Modern Cryptography, CRC press, 2020. 1st and 4th Edition
3. Cryptography and Network Security - Principles and Practice: William Stallings, Pearson Education, 6th Edition

OE-CS-AIML-406	Network Operating System						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hr.**
Course Outcomes							
CO1	To Identify the features of modern Microsoft operating systems including UNIX and UNIX-like operating systems.						
CO2	To Explain the fundamentals of operating system and its use in network communication.						
CO3	To Analyze how to manage user accounts, group accounts, and shared resources.						
CO4	To Devise a security policy for your client and server computers.						

Unit-1

Computer basics—Understanding operating systems, Fundamentals of operating systems, Functions of operating system,Types, Resource Management, Operating system basics

Unit-2

Modern Client and Server Operating Systems, client server model, Concepts of Linux, OS Alternatives and Recommendations, Account and Resource Management

Unit-3

Central processing unit (CPU), file system, Types of Computer File Systems and How They Work, Examples, Linux File System/Structure, Understanding active directory and group policy

Unit-4

Network operating system, Types of operating system, Network Fundamentals and Configuration, The Next Platform - one network operating system to unite them all, Securing and Maintaining an Operating System

References:

1. GCF Global. (n.d.). Computer basics—Understanding operating systems.
2. Operating system by Galvin
3. Computer Networks by Andrew S. Tanenbaum,1981
4. Kindson the Tech Pro. (2020, October 2). Windows Server 2019 Administration Complete Course – 2020
5. Kottayil, N.K. (2020, August 14). Central processing unit (CPU). Techopedia.

OE-CS-AIML-408	Reasoning, Problem Solving and Robotics						
L	**T**	**P**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hour**
Purpose	The course provides grounding in basic and advanced method how to solve problem						
Course Outcomes –At the end of this course students will be able to:							
CO1	To list and explain the basic elements of robots						
CO2	To analyze robot kinematics and its control methods						
CO3	To Classify the various sensors used in robots for better performance						
CO4	To summarize various industrial and non-industrial applications of robots						

UNIT-I

Introduction to Robot- Basic concepts, Need, Law, History, Anatomy, specifications. Robot configurations- Cartesian, cylinder, polar and articulate. Robot wrist mechanism, Precision and accuracy of robot.

UNIT-II

End Effectors-Classification, Types of Mechanical actuation, Gripper design, Robot drive system Types, Position and velocity feedback Devices-Robot joints and Links-Types, Motion interpolation. Robot kinematics – Basics of direct and inverse kinematics, Robot trajectories, 2D and 3D Transformation-Scaling, Rotation, Translation Homogeneous transformation.

UNIT-III

Sensors in robot – Touch Sensors-Tactile sensor – Proximity and range sensors. Force Sensor-Light sensors, Pressure sensors, Introduction to Machine Vision and Artificial Intelligence

UNIT-IV

Control of robot manipulators – Point to point, Continuous Path Control, Robot programming. applications of robots, Medical, Household, Entertainment, Space, Underwater, Defense, Disaster management. Applications, Micro and Nanorobots, Future Applications.

Reference Book:

1. Mikell P. Groover, Mitchell Weiss, Roger N Nagel, Nicholas G Odrey, “Industrial Robotics Technology, Programming and Applications”, Tata –McGraw Hill Pub. Co., 2008. Half 1st
2. Deb.S.R and Sankha Deb, "Robotics Technology and Flexible Automation", Tata McGraw Hill Publishing Company Limited, 2010. 1st and 4th Edition
3. Klafter.R.D, Chmielewski.T.A, and Noggin’s., “Robot Engineering: An Integrated Approach”’, Prentice Hall of India Pvt. Ltd., 1994. 3rd Edition
4. Fu.K.S, Gonzalez.R.C&Lee.C.S.G, “Robotics control, sensing, vision and intelligence”, Tata- McGraw Hill Pub. Co., 2008
5. Yu. “Industrial Robotics”, MIR Publishers Moscow, 1985.

OE-CS-AIML-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-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, Basics of pattern recognition, Design principles of pattern recognition system, Learning and Adaption, Pattern recognition approaches,Mathematical Foundation-Linear Algebra, Probablity theory, Expectation, mean, covariance,NormalDistribution, Multivariate normal densities, chi square test.
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

1. Digital Image Processing – Ganzalez and Wood, Addison Wesley, 1993.
2. Fundamental of Image Processing – Anil K.Jain, Prentice Hall of India.
3. Pattern Classification – R.O. Duda, P.E. Hart and D.G. Stork, Second Edition John Wiley, 2006
4. An Introduction to Digital Image Processing – Wayne Niblack, Prentice Hall, 1986
5. Pattern Recognition and Machine Learning – C. M. Bishop, Springer, 2009.
6. Pattern Recognition – S. Theodoridis and K. Koutroumbas, 4th Edition, Academic Press,2009

PE-CS-AIML-402A	Reinforcement Learning						
L	**T**	**P**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**2**	**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 Book: 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

PE-CS-AIML-416A	Social Networks						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**2**	**75**	**25**	**100**	**3 Hour**
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	To Demonstrate proficiency in the use of social networks for business and personal use						
CO2	To Demonstrate proficiency in the use of social network analysis concepts and techniques.						
CO3	To Demonstrate proficiency in the use of social network developer tools.						
CO4	To Examine the various types of processors and demonstrate proficiency in the use of social network concepts for solving real world issues.						

Unit-1

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-2

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-3

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-4

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:

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

REFERENCES

1. GuandongXu ,Yanchun Zhang and Lin Li, Web Mining and Social Networking Techniques and applications‖, First Edition, Springer, 2011.

2. Dion Goh and Schubert Foo, Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively‖, IGI Global Snippet, 2008.

PE-CS-AIML-420A	Neural Network and Fuzzy Logic systems						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**2**	**75**	**25**	**100**	**3Hr.**
Course Outcomes							
CO1	To The course is designed to give a solid grounding of fundamental concepts of fuzzy logic and its applications. The level of the course is chosen to be such that all students aspiring to be a part of computational intelligence directly or indirectly in near future should get a foundation of these concepts through this course.						
CO2	To Understanding reasoning and fuzzy logic for artificial intelligence						
CO3	To Students will be able to learn defuzzification and fuzzy measures						
CO4	To studentswillbeabletolearntheapplicationsoffuzzylogicandhybridsoftcomputingtechniques						

Unit-I

Neural Networks-I (Introduction & Architecture): Neuron, Nerve structure and synapse, Artificial Neuron and its model, activation functions, Neural network architecture: single layer and multilayer feed forward networks, Auto-associative and hetro-associative memory.
Neural Networks-II Back propagation network Architecture, back propagation learning methods,Applications of Artificial Neural Networks- Social Media, Marketing and Sales, Healthcare, Personal Assistants.

Unit II

Uncertainty in information, Fuzzy sets and membership, Chance versus ambiguity, Fuzzy set vs. Crisp set, Classical sets – operations on classical sets, Fuzzy sets – fuzzy set operations, Properties of fuzzy sets. A brief history of Fuzzy logic, Fuzzy logic vs. Crisp logic, Concept of fuzzy system, Concept of fuzzy set, Examples of fuzzy set, Some basic terminologies and notations for fuzzy sets.

Unit III

Fuzzy Membership Functions, Operations on Fuzzy Sets, Fuzzy Relations, Rules and Inferences, Fuzzy Relations, Crisp relations, Operations on crisp relations, Composition of two crisp relations, Operations on Fuzzy relations, Fuzzy Propositions, Fuzzy Implications, Fuzzy Inferences, Generic structure of a Fuzzy system, Defuzzification Techniques, Lambda-cut method, Weighted average method, Maxima methods, Centroid methods

Unit IV

Problems in some areas of applications: Medical diagnosis, Person identification / Computer vision, Handwritten character recognition, Pattern recognition and Machine Intelligence (MI), Weather forecasting, VLSI design, Network optimization, Fuzzy Systems: Fuzzy Logic Control System, Industrial applications

References:

1. Kliryvan- FuzzySystem&FuzzylogicPrenticeHallofIndia, FirstEdition.
2. LawrenceFussett-fundamental of Neural Network Prentice Hall, First Edition and 4th Edition

3. Bart Kosko, “NeuralnetworkandFuzzySystem”-PrenticeHall Pub.-1994.
4. Fuzzy Logic: A Practical approach, F. Martin, , Mc neill, and Ellen Thro, AP Professional, 2000.
5. Fuzzy Logic with Engineering Applications (3rd Edn.), Timothy J. Ross, Willey, 2010.
6. Foundations of Neural Networks, Fuzzy Systems, and Knowldge Engineering, Nikola K. Kasabov, MIT Press, 1998.
7. Fuzzy Logic for Embedded Systems Applications, Ahmed M. Ibrahim, Elesvier Press, 2004.Education

PE-CS-AIML-422A	Augmented Reality						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**2**	**75**	**25**	**100**	**3Hr.**

Course Outcomes	
CO1	The course is designed to describe how VR systems work and list the applications of VR.
CO2	Understand the design and implementation of the hardware that enables VR systems tobe built
CO3	Understand the system of human vision and its implication on perception and rendering
CO4	Explain the concepts of motion and tracking in VR systems and Describe the importance of interaction and audio in VR systems

Unit I

Introduction to Augmented Reality (A.R): What Is Augmented Reality**:** - Introduction to AR, History of AR, Purpose of AR, Relation Between AR and other Technology, Application of AR, How AR work, Scope of AR, overview of AI in AR

Unit II:

Augmented Reality Hardware

Displays: - Audio Displays, Haptic Displays, Visual Displays, Other sensory displays, Visual Perception, Requirements and Characteristics.

Processors: - Role of Processors, Processor System Architecture, Processor Specifications.

Tracking & Sensors: - Tracking, Calibration, and Registration, Characteristics of Tracking Technology, Stationary Tracking Systems, Mobile Sensors, Optical Tracking, Sensor Fusion.

Unit III:

Computer Vision for Augmented Reality & A.R. Software

Computer Vision for Augmented Reality: - Marker Tracking, Multiple-Camera Infrared Tracking, Natural Feature Tracking by Detection, Simultaneous Localization and Mapping, Outdoor Tracking

Augmented Reality Software: - Introduction, Major Software Components for Augmented Reality Systems, Software used to Create Content for the Augmented Reality Application.

Unit IV:

AR Techniques- Marker based & Marker-less tracking

Marker-based approach**:** - Introduction to marker-based tracking, types of markers, marker camera pose and identification, visual tracking.

Marker types: -Template markers, 2D barcode markers, imperceptible markers.

Marker-less approach: -Localization based augmentation, real world examples.

Tracking methods: -Visual tracking, feature based tracking, hybrid tracking, and initialisation and recovery.

Text Books:

1. Virtual Reality, Steven M. LaValle, Cambridge University Press, 2016

2. Understanding Virtual Reality: Interface, Application and Design, William R Sherman and Alan B Craig, (The Morgan Kaufmann Series in Computer Graphics)". Morgan Kaufmann Publishers, San Francisco, CA, 2002

3. Developing Virtual Reality Applications: Foundations of Effective Design, Alan B Craig, William R Sherman and Jeffrey D Will, Morgan Kaufmann, 2009.

Reference Books:

1. Gerard Jounghyun Kim, "Designing Virtual Systems: The Structured Approach", 2005.

2. Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, "3D User Interfaces, Theory and Practice", Addison Wesley, USA, 2005.

3. Oliver Bimber and Ramesh Raskar, "Spatial Augmented Reality: Meging Real and Virtual Worlds", 2005.

4. Burdea, Grigore C and Philippe Coiffet, "Virtual Reality Technology", Wiley Interscience, India, 2003.

PE- CS- AIML-424A	Advance Machine Learning						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**2**	**75**	**25**	**100**	**3 Hr.**
Course Outcomes							
CO1	To understand advanced methods of machine learning.						
CO2	To Emphasis on approaches of deep learning with practical relevance.						
CO3	To Analyze recent applications of advanced machine learning.						
CO4	To Understand implementation of advanced machine learning.						

UNIT-I

Binary Classification, Logistic Regression, Gradient Descent, Derivatives, Computation graph, Vectorization, Vectorizing logistic regression – Shallow neural networks: Activation functions, non-linear activation functions,

UNIT-II

Deep Neural Networks: Deep L-layer neural network, Forward and Backward propagation, Deep representations, Parameters vs Hyperparameters, building a Deep Neural Network (Application) – Supervised Learning with Neural Networks – Practical aspects of Deep Learning: Train/Dev / Test sets, Bias/variance, Overfitting and regularization, Linear models and optimization, Vanishing/exploding gradients, Gradient checking – Logistic Regression.

UNIT-III

Back-propagation: architecture, training algorithm, selection of parameters, learning application algorithm, local and global minima, merits and demerits, application. Optimization algorithms: Mini-batch gradient descent, exponentially weighted averages, RMSprop, Learning rate decay, problem of local optima, Batch norm – Parameter tuning process.

UNIT-IV

Convolution Neural Networks: introduction, architecture, padding, strided convolutions, pooling layers, ResNet, MobileNet, applications of CNN, Recurrent Neural Network: Expressiveness of recurrent networks, Architecture, Challenges of training Recurrent networks, Long short-term memory, Gated recurrent units, Applications of RNNs. Self-Organizing Maps, Restricted Boltzmann Machines.

References:

1. Deep Learning, Ian Goodfellow, YoshuaBengio and Aeron Courville, MIT Press,First Edition, 2016.
2. Deep Learning, A practitioner's approach, Adam Gibson and Josh Patterson, O'Reilly, First Edition, 2017.
3. Hands-On Learning with Scikit-Learn and Tensorflow, AurelienGeron, O'Reilly, First Edition, 2017.
4. Deep Learning with Python, Francois Chollet, Manning Publications Co, First Edition, 2018.
5. Python Machine Learning by Example, Yuxi (Hayden) Liu, First Edition, 2017.
6. A Practical Guide to Training Restricted Boltzmann Machines, Geoffrey Hinton, 2010,

PE-CS-AIML-426A	Natural Language Processing						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**2**	**75**	**25**	**100**	**3Hrs.**
Purpose	Toprovidetheunderstandingofthemathematicalandlinguisticfoundationsunderlyingapproachestothe various areas inNLP.						
Course Outcomes(CO)							
CO1	Be familiar with syntax and semantics in NLP.						
CO2	To implement various concepts of knowledge representation using Prolog.						
CO3	To classify different parsing techniques and understand semantic networks.						
CO4	To identify/explain various applications of NLP.						

Unit-I

Basic Concepts: concept overview, Intro to NLP, history of NLP, Applications of NLP

Key algorithms in the noisy channel paradigm. Fundamental components of Natural Language Processing: Lexicography, syntax, semantics, prosody, phonology, pragmatic analysis, world knowledge.

Knowledge Representation schemes: Semantic net, Frames, Conceptual Dependency, Scripts.

Unit-II

Representing knowledge using rules: Logic Programming, Introduction to LISP and Prolog, Rules based deduction systems, General concepts in knowledge acquisition.

Syntax Analysis: Formal Languages and grammars, Chomsky Hierarchy, Left- Associative Grammars, ambiguous grammars, resolution of ambiguities.

Unit-III

Computation Linguistics: Recognition and parsing of natural language structures- ATN and RTN, General Techniques of parsing-CKY, Earley and Tomitas algorithm. Semantics: Knowledge representation, semantics networks logic and inference pragmatics, graph models and optimization.

Unit-IV

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

References Books:

1. Daniel Jurafsky, James H. Martin, “Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition”, 2nd edition, Pearson Edu., 2013.
2. James Allen, “Natural Language Understanding”, Pearson Education, Second Edition, 2003
3. Ivan Bratko, “Prolog: Programming for Artificial Intelligence”, 3rd Edition, Pearson

PC-CS-AIML-406LA	Optimization Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**2**	**1**	**40**	**60**	**100**	**3 Hrs.**
Purpose	To Understand and implement various optimization methods in machine learning						
Course Outcomes-At the end of this course students will be able to:							
CO1	Apply mathematical and computational skills needed for the practical utility operation research.						
CO2	Implement various linear programming problems						
CO3	Implement various optimization methods in machine learning						
CO4	Understand and implement genetic algorithms						

Education, Fifth Impression 2009.
4. G. Gazder, "Natural Language processing in prolog", Addison Wesley, 1989.

List of experiments:

1. Write a python program to solve the linear problem:

Minimize: Z = 3x + 5y
Subject to the constraints:
2x + 3y >= 12
-x + y <= 3
x >= 4
y <= 3
x, y >= 0

2. Write a program in python to find the EVD (Eigen Value Decomposition) of A, where

$$A = \begin{bmatrix} 1 & 0 & -1 \\ 1 & 2 & 1 \\ 2 & 2 & 3 \end{bmatrix}$$

3. Write a program in python to find the SVD (Singular Value Decomposition) of A, $U\Sigma V^T$, where

$$A = \begin{pmatrix} 3 & 2 & 2 \\ 2 & 3 & -2 \end{pmatrix}.$$

4. Write a program to implement Second Order Cone Program (SOCP).
5. Write a program to demonstrate KKT conditions.
6. Write a program to implement gradient Descent algorithm for finding local minima.
7. Write a program to implement Frank-Wolfe algorithm.
8. Write a program to implement Stochastic Gradient Descent Algorithm.
9. Write a program to create target string starting from random string using Genetic Algorithm.
10. Write a program to implement Particle Swarm optimization to find optimal solution.

PC- CS-AIML-408LA	Advance AI Application Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Minor Test**	**Practical**	**Total**	**Time**
0	**0**	**2**	**1**	**40**	**60**	**100**	**3 Hrs.**
Purpose	To Understand and implement various artificial intelligence						
Course Outcomes							
CO1	Implementation of various type of algorithm in AI applications for better use of application						
CO2	In-depth learning of machine learning, Deep learning and neural networks						
CO3	Implement various artificial intelligence technique						
CO4	Understand artificial intelligence and its analytics in real world						

List of Experiments:

1. Chat bot
2. Music Recommendation App
3. Stock Prediction
4. Social Media Suggestion
5. Lane line detection while driving
6. Monitoring crop health
7. Medical diagnosis
8. AI powered Search engine
9. AI powered cleaning robots