SCHEME OF INSTRUCTION AND SYLLABI (R-20)

OF

B.E. V to VI SEMESTER

IN

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

(An Autonomous Institution)

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CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (AUTONOMOUS)

AICTE Model Curriculum with effect from AY 2023-24

B.E. (Artificial Intelligence &Machine Learning)

SEMESTER – V

S. No	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per Week			Duration of SEE in Hours	Maximum Marks		
			L	T	P / D		CIE	SEE	
THEORY									
1	**20AMC12**	Image Processing	3	-	-	3	40	60	3
2	**20AMC13**	Principles of Artificial Intelligence	3	-	-	3	40	60	3
3	**20CAC04**	Machine Learning	3	-	-	3	40	60	3
4	**20MTC13**	Mathematical Foundation for Data Science & Security	3	-	-	3	40	60	3
5	**20XXXX**	Professional Elective-I	3	-	-	3	40	60	3
6	**20AMC14**	Image Processing Lab	-	-	2	3	50	50	1
7	**20AMC15**	Principles of Artificial Intelligence Lab	-	-	2	3	50	50	1
8	**20CAC05**	Machine Learning Lab	-	-	3	3	50	50	1.5
9	**20AMI02**	Internship – II	3-4 Weeks/90 Hours				50	50	2
TOTAL			**15**	**-**	**7**	**24**	**400**	**500**	**21.5**

L: Lecture **T: Tutorial** **P: Practical**

CIE - Continuous Internal Evaluation **SEE - Semester End Examination**

S. No.	Course Code	Professional Elective - I (T) Semester-V
1	**20AME01**	Speech Recognition
2	**20CSE05**	Optimization Techniques
3	**20CSE06**	Soft Computing
4	**20CSE26**	Human Computer Interaction

20AMC12

IMAGE PROCESSING

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites: Linear algebra and Calculus

Course Objectives: The objectives of this course are

1. To introduce basics of visual perception, sampling, quantization and representation of Digital images.
2. To introduce spatial domain and frequency domain filtering techniques necessary for Image processing operations.
3. To learn advanced image analysis techniques such as image restoration, image Compression, image segmentation.
4. To learn techniques of multi resolution methods, wavelets and morphological Processing.
5. To understand the applications of image processing

Course Outcomes: After completion of course, students would be able to:

1. Understand the basic image enhancement techniques in spatial & frequency domains.
2. Understand the basics of multi-resolution techniques.
3. Understand the basics of segmentation methods.
4. Apply this concept for image handling in various fields.
5. Knowledge about Morphological operations.

UNIT-I

Fundamentals of Image Processing: Introduction, examples, fundamental steps, components, elements of visual perception, light and electromagnetic spectrum, image sensing and acquisition, image sampling and quantization, basic relationships between pixels. Intensity Transformations And Spatial Filtering: Background, some basic intensity transformation functions, histogram processing, fundamentals of spatial filtering, smoothing spatial filters, sharpening spatial filters, combining spatial enhancement methods.

UNIT-II

Filtering In The Frequency Domain: Background, preliminary concepts, sampling and Fourier transform of sampled functions, discrete Fourier transform (DFT) of one variable, extension to functions of two variables, some properties of the 2-D discrete Fourier transform, basics of filtering in the frequency domain, image smoothing, image sharpening, homo- morphic filtering.

UNIT-III

Image Restoration: Noise models, restoration in the presence of noise only-spatial filtering,periodic noise reduction by frequency domain filtering, linear degradation, position-invariant degradation, estimating the degradation function, inverse filtering, minimum mean square error filtering, constrained least squares filtering, geometric mean filter.

UNIT-IV

Wavelets and Multi Resolution Processing: Background, multi-resolution expansions, wavelet transforms in one dimension, the fast wavelet transform, wavelet transforms in two dimensions, wavelet packets. Image Compression: Fundamentals, image compression models, elements of information theory, error free compression, lossy

compression, image compression standards.

UNIT-V

Image Segmentation: Fundamentals, point, line and edge detection, thresholding, region based segmentation, segmentation using morphological watersheds, the use of motion in segmentation.Morphological Image Processing: Preliminaries, erosion and dilation, opening and closing,the Hit-or-Miss transformation, some basic morphological algorithms, some basic gray-scale morphological algorithms.

Text Books:

1. Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, PHI Learning Pvt. Limited, 3rd Edition, 2008.
2. Rafael C.Gonzalez, Richard E.Woods and Steven L.Eddins, Digital Image Processing Using MATLAB, 2nd Edition, McGraw Hill, 2010.
3. AL. Bovik, The Essential Guide to Image processing, 2 nd Edition, Elsevier, 2009.
4. Anil K.Jain, “Fundamentals of Digital Image Processing”, PHI, 2006.
5. William K. Pratt, Digital Image Processing, John Wiley & Sons, Inc., 3rd Edition, 2001

20AMC13

PRINCIPLES OF ARTIFICIAL INTELLIGENCE

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Data structures, Discrete Mathematics, Probability Theory.

Course Objectives: The objectives of this course are

1. To list the significance of AI.
2. To discuss the various components that is involved in solving an AI problem.
3. To analyze the various knowledge representation schemes, reasoning and learning techniques of AI.

Course Outcomes: On Successful completion of the course, students will be able to

1. Explain the role of agents and interaction with the environment to establish goals.
2. Identify and formulate search strategies to solve problems by applying suitable search strategy.
3. Compare and contrast the various knowledge representation schemes of AI.
4. Appraise probabilistic reasoning and model building
5. Apply Markov decision Process to solve real world Problems.

UNIT - I

Introduction: Foundations of AI, History, State of the Art, Risks and Benefits.

Intelligent agents: Agents and Environment, The Concept of Rationality, Structure of an Agent.

Solving problems by Search- Problem-Solving Agents, State space representation, Search graph and Search tree Searching for Solutions,

UNIT - II

Uninformed Search Strategies: Uniform cost search, Iterative deepening Depth-first search, Bidirectional search**.**

Informed (Heuristic) Search Strategies: Heuristic Functions, Hill- climbing, Greedy best-first search, A* search, Simulated Annealing search.

UNIT – III

Adversarial Search: Game Theory, Alpha–Beta Pruning, Constraint Satisfaction Problems.

Logic Concepts and Logic Programming: Introduction, Propositional Calculus Propositional Logic, Natural Deduction System, Axiomatic System, Semantic Tableau, Predicate Logic, Resolution Refutation in Propositional Logic and Predicate Logic

UNIT - IV

Knowledge Representation: Introduction, approaches to knowledge Representation, Knowledge Representation using Semantic Network, Knowledge Representationusing Frames.

Probabilistic Reasoning: Probability, inference using full joint distributions, Bayes rule, Bayesian networks-representation, construction, exact and approximate inference, temporal model, hidden Markov model.

UNIT – V

Markov Decision process: MDP formulation, utility theory, multi attribute utility functions, decision networks, sequential decision problems value iteration, policy iteration partially observable MDP.

Textbooks:

1. Russell, Norvig, “Artificial Intelligence: A Modern Approach”, Pearson Education, 4th Edition, 2020.
2. Saroj Kaushik, “Artificial Intelligence”, Cengage Learning India, First Edition, 2011.

Suggested Reading:

1. Rich, Knight, Nair, “Artificial Intelligence”, Tata McGraw Hill, 3rd Edition 2009.
2. Trivedi. M.C., “A classical approach to Artificial Intelligence”, Khanna Publishing House, Delhi.

Online Resources:

1. http://nptel.ac.in/courses/106106126/
2. http://nptel.ac.in/courses/106105077/

20CAC04

MACHINE LEARNING

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Linear Algebra and Probability theory basics

Course Objectives: The objectives of this course are to,

1. Understand the need for Machine Learning
2. Study various machine learning techniques and its applications
3. Design solutions for real world problems using machine learning techniques

Course Outcomes: On Successful completion of the course, students will be able to

1. Define the basic concepts related to Machine Learning.
2. Recognize the underlying mathematical relationships across ML algorithms and their paradigms.
3. Determine the various applications of Machine Learning.
4. Model, design and develop solutions to real world problems using Machine Learning Algorithms.
5. Evaluate and interpret the results of the various machine learning tools.

UNIT - I

Introduction to Machine Learning: Introduction, Classic and Adaptive machines, Learning Types-Supervised, Unsupervised, deep learning, bio-inspired adaptive systems, Machine Learning, and big data.

Elements of Machine Learning: Data formats, Learnability, Statistical learning concepts, Class balancing, Elements of Information theory.

UNIT - II

Feature Selection and Feature Engineering: Data sets, Creating training and test sets, managing categorical data, missing features, data scaling and normalization, whitening, Feature selection and filtering, PCA, Visualization of high-dimensional datasets.

Regression Algorithms: Linear models for regression, Regression types

UNIT - III

Classification Algorithms: KNN, Linear classification, logistic regression, grid search, classification metrics, ROC curve.

Naïve Bayes and Discriminant Analysis: Bayes theorem, Naïve Bayes classifiers, Discriminant analysis.

Decision Trees and Ensemble Learning: Binary Decision trees, Introduction, to Ensemble Learning-Random Forests, AdaBoost, Gradient Tree Boosting, Voting classifier.

UNIT – IV

Support Vector Machines: Linear SVM, Kernel based Classification.

Clustering Fundamentals: Basics, K-means, Evaluation methods, DBSCAN, Spectral Clustering, Hierarchical Clustering.

UNIT – V

Machine Learning Architectures: Data collection, Normalization and regularization, Dimensionality reduction, Data augmentation, Modeling / Grid Search / Cross-validation, Visualization, GPU support, introduction to distributed architectures, Scikit-learn tools for ML architectures, pipelines and feature Unions.

Text Books:

1. Giuseppe Bonaccorso, “Machine Learning Algorithms”, 2nd Edition, Packt, 2018,
2. Tom Mitchel “Machine Learning”, Tata McGraW Hill, 2017

Suggested Reading:

1. Abhishek Vijavargia “Machine Learning using Python”, BPB Publications, 1st Edition, 2018
2. ReemaThareja “Python Programming”, Oxford Press, 2017
3. Yuxi Liu, “Python Machine Learning by Example”, 2nd Edition, PACT, 2017

Online Resources:

1. https://www.guru99.com/machine-learning-tutorial.htm
2. https://www.tutorialspoint.com/machine_learning_with_python/index.htm

20MTC13

MATHEMATICAL FOUNDATION FOR DATA SCIENCE AND SECURITY

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Course Objectives: The objectives of this course are

1. Able to learn and Analyzing data in Linear and Non-Linear form.
2. Able to fit the hypothetical data using probability distribution.
3. To know the characteristic of various continuous probability distributions
4. To know the impact of number theory before computer age.
5. To know the security issues of Cryptography

Course outcomes: On Successful completion of the course, students will be able to

1. Analyze the coefficient of skewness and fitting of the data by various methods
2. Apply properties of Mathematical Expectations and analyse the various distributions.
3. Evaluate areas of curves by using various distributions.
4. Apply various technics of Number Theory for solving problems
5. Apply RSA –PKC for solving security issues.

UNIT-I: Curve Fitting

Measures of Central Tendency, Measures of Dispersion, Moments (Moments about the mean and moments about a point).Skewness, Karl Pearson's coefficient of skewness and Bowley's coefficient of skewness for frequency distribution, Kurtosis. Correlation, coefficient of correlation, limits of correlation coefficient. Linear Regression, Regression coefficients, Properties of Regression Coefficients. Curve fitting by the Method of Least Squares, Fitting of Straight lines, Second degree parabola and Growth curve ($y = ae^{bx}$, $y = ax^{b} and y = ab^{x}$).

UNIT-II: Mathematical Expectation and Discrete Probability Distribution

Basic Probability, Conditional Probability, Baye's theorem. Random variable, discrete random variable, Probability Mass Function, continuous random variable, probability density function.Mathematical expectation, properties of Expectation, properties of variance and co-variance. Poisson distribution, MGF and Cumulates of the Poisson distribution, Recurrence formula for the probabilities of Poisson distribution (Fitting of Poisson distribution)

UNIT-III: Continuous Probability Distributions

Normal distribution, Characteristics of normal distribution and Normal probability Curve, MGF and CGF of Normal distribution, Areas under normal curve. Uniform distribution, moment generating function, mean and variance of uniform distribution. Exponential distribution, MGF, CGF, Mean and Variance of Exponential distribution.

UNIT-IV: Number Theory

Division Algorithm, Greatest Common Divisor, Euclidean Algorithm, Diophantine Equation ax+by=c, Fundamental Theorem of Arithmetic, Little Fermat's Theorem, Wilson's Theorem, Euler's Phi-Function, Euler's Theorem, Some Properties of the Phi-Function.

UNIT-V: Cryptography (RSA – PKC)

The RSA public key cryptosystem, Implementation and security issues, Pollard's p−1 factorization algorithm, Quadratic Residues and quadratic reciprocity

Text books:

1. S.C.Gupta, V.K.Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, 2014.
2. Burton, David M. (2007) Elementary Number Theory (7^{th}edu.). Tata McGraw Hill Edition, Indian Reprint
3. Mathematical Cryptography by Jeffrey Hoffstein, Jill Pipher, Joseph H. Silverman Springer Science+ Business Media LLC.

Suggested Reading:

1. W. Feller, "An Introduction to Probability Theory and its Applications", Vol. 1, 3rd Ed., Wiley, 1968.
2. Sheldon Ross, "A First Course in Probability", 9th Edition, Pearson publications, 2014.
3. Koshy, T. Elementary Number Theory with Applications, Elsevier Publications, New Delhi, 2002.
4. G.A.Jones & J.M.Jones "Elementary Number Theory", Springer UTM,2007

20AME01

SPEECH RECOGNITION
(Professional Elective – I)

Instruction:	3 Hours per week
Duration of SEE:	3 Hours
SEE:	60
CIE:	40
Credits:	3

Course Objectives: To make the student

1. To understand the fundamentals speech recognition and explore various speech models
2. Gather knowledge about the phonetics and pronunciation processing
3. Perform wavelet analysis of speech

Course Outcomes: Students will be able to

1. Demonstrate algorithms with speech processing
2. Derive new speech models
3. Perform various language phonetic analysis
4. Create a new speech identification system
5. Demonstrate automatic speech recognition and text to speech.

Unit-I

Introduction to Speech Processing

Knowledge in speech and language processing, models and algorithms ,understanding regular expression and automata, words & transducers ,N grams, Speech production process and representing speech in time and frequency domains

Unit-II

Modelling

Word classes and part of speech tagging, hidden markov model and types, computing likelihood: the forward algorithm, training hidden markov model, maximum entropy model, transformation- based tagging, evaluation and error analysis, issues in part of speech tagging, noisy channel model for spelling

Unit-III

Speech Pronunciation and Signal Processing

Phonetics, speech sounds and phonetic transcription, articulatory phonetics, phonological categories and pronunciation variation, acoustic phonetics and signals - phonetic resources, articulatory and gestural phonology

Unit-IV

Speech Identification

Speech synthesis - text normalization - phonetic analysis - prosodic analysis – diphone waveform synthesis - unit selection waveform synthesis – evaluation

Unit-V

Automatic Speech Recognition and Text-to-Speech

Automatic speech recognition task, feature extraction, Speech recognition architecture, Connectionist Temporal Classification CTC-inference and training, Combining CTC and Encoder-Decoder, ASR Evaluation: Word Error Rate.

TEXT BOOK:

1. Daniel Jurafsky and James H. Martin, ― Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition‖, Person education,2013.
2. Lawrence Rabiner, Biing Hawag Juang, Fundamentals of Speech Recognition,Prentice-hall Signal Processing Series, 1993.

REFERENCES

1. Kai-Fu Lee, Automatic Speech Recognition‖, The Springer International Series in Engineering and Computer Science, 1999.
2. Himanshu Chaurasiya, ―Soft Computing Implementation of Automatic Speech Recognition‖, LAP Lambert Academic Publishing, 2010.
3. Claudio Becchetti, Klucio Prina Ricotti, ―Speech Recognition: Theory and C++ implementation,Wiley publications 2008.

ONLINE RESOURCES

1. Online course – Digital Speech Recognition using matlab

   Link :- https://www.udemy.com/course/digital-speech-processing
2. Online course – Applied online course tutorial

   Link- https://www.futurelearn.com/courses/speech-recognition-systems
3. Speech Recognition in AI – online course

Link- https://www.mygreatlearning.com/academy/learn-for-free/courses/speech-recognition-in-ai

20CSE05

OPTIMIZATION TECHNIQUES
(Professional Elective – I)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Mathematical Foundation for Data Science and Security.

Course Objectives: The objectives of this course are,

1. To identify and develop optimization techniques from the verbal description of real system.
2. To learn different techniques to get optimum solution LPP.
3. To understand the Mathematical representations that are needed to solve optimization problem.
4. To analyze the results of the different real-world problems.
5. To construct network and find critical path using network scheduling technique

Course Outcomes: On Successful completion of this course, student will be able to,

1. Calculate the optimum values for given objective function by LPP.
2. Solve the solution for maximize the profit with minimum cost by Transportation problem.
3. Determine the optimum feasible solution for assignment and travelling salesman problems and computing the optimal solution for Job sequencing models.
4. Compute the optimum values for given objective function by IPP and optimal strategy for games.
5. Identify critical path using network scheduling.
6.

UNIT - I

Introduction to Operations Research: Basics definitions, objectives, models, application and limitations. Linear Programming (LP) - Mathematical Formulation of LP problem, Graphical Method, Some Exceptional Cases, Simplex Method - Introduction, computational procedure, artificial variables technique - big-M method and 2-phase method.

UNIT - II

Introduction, Mathematical Formulation of transportation Problem, Balanced / Unbalanced, Minimization / Maximization, Determination of the initial basic feasible solution using (i) North-West Corner Rule (ii) Least cost method & (iii) Vogel‟s approximation method for balanced & unbalanced transportation problems. Optimality Test & obtaining of optimal solution (Considering per unit transportation cost) using MODI method and steppingstone method.

UNIT - III

Introduction, Mathematical Formulation of Assignment Problem, Hungarian method for optimal solution, Solving unbalanced problem, Traveling salesman problem, Sequencing models, Solution of Sequencing Problem – Processing n Jobs through 2 Machines – Processing n Jobs through 3 Machines – Processing 2 Jobs through m machines – Processing n Jobs through m Machines.

UNIT - IV

Integer Programming Problem: Introduction, Types of Integer Programming Problems, Gomory‟s All-IPP Method, All IPP Algorithm, Branch and Bound Technique Game and strategies: Introduction, Game with maximin-minimax principle (Pure Strategies), Game with Mixed Strategies, Dominance Property, Graphical Method for 2 X n or m x 2 Games, Linear Programming Approach for Game Theory.

UNIT - V

Construction of Network – Rules & Precautions, C.P.M. & P.E.R.T. Networks, Obtaining of Critical Path, Time estimates for activities, Probability of completion of project, Determination of floats (total, free, independent)

Text Books:

1. Kanti Swarup, P. K. Gupta, Man Mohan, "Operations Research", Sultan Chand Publications, 2010.
2. R. Pannerselvam, "Operations Research", PHI, 2nd Edition, 2016.

Suggested Reading:

1. Deb K. "Optimization for Engineering Design Algorithms and Examples", PHI, 2000.
2. Arora J. "Introduction to Optimization Design", Elsevier Academic Press, New Delhi, 2004.
3. Saravanan R. "Manufacturing Optimization through Intelligent Techniques", Taylor & Francis (CRC Press), 2006.
4. Hardley G. "Linear Programming", Narosa Book Distributors Private Ltd., 2002.

Online Resources:

1. https://nptel.ac.in/courses/111105039
2. https://nptel.ac.in/courses/105108127

20CSE06

SOFT COMPUTING
(Professional Elective – I)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Linear Algebra & Calculus, Differential Equations and Transform Theory.

Course Objectives: The objectives of this course are,

1. To learn various types of soft computing techniques and their applications.
2. To acquire the knowledge of neural network architectures, learning methods and algorithms.
3. To understand Fuzzy logic, Genetic algorithms and their applications.

Course Outcomes: On Successful completion of this course, student will be able to,

1. Understand various soft computing concepts and techniques.
2. Analyze and design various learning models.
3. Apply the Neural Network Architecture for various Real time applications.
4. Examine and approximate reasoning using fuzzy logic.
5. Design Genetic algorithms in different applications.
6. Develop soft computing techniques to solve different applications.

Unit I:*Introduction to Computer Systems*: Processors, Memory, I/O Devices; Cost, timing and scale (size) models; Program Execution: Process; Virtual Memory; System Calls; Dynamic Memory Allocation. Machine level view of a program; typical RISC instruction set and execution; Pipe lining. Performance issues and Techniques; Cost and frequency models for I/O, paging and caching. Temporal and spatial locality. Typical compiler optimizations. Identifying program bottlenecks - profiling, tracing.

Unit II :- ***Parallel computing***: Parallel Computing: Introduction to parallel architectures and interconnection networks, communication latencies. Program parallelization; task partitioning and mapping; data distribution; message passing; synchronization and deadlocks. Distributed memory programming using MPI/PVM. Shared memory parallel programming. Multi threading.

Unit III:Load Sharing and Balancing: Evolution, Job and Resource Management Systems, State-of-the- Art in RMS and Job, Rigid Jobs with Process Migration, Communication-Based Scheduling, Batch Scheduling, Fault Tolerance, Scheduling Problem for Network Computing, Algorithm - ISH, MCP and ETF, Dynamic Load Balancing, Mapping and Scheduling, Task Granularity and Partitioning, Static and Dynamic Scheduling.

Unit IV:-Grid Computing: Introduction to Grid Computing, Virtual Organizations, Architecture, Applications, Computational, Data, Desktop and Enterprise Grids, Data-intensive Applications, High-Performance Commodity Computing, High-Performance Schedulers, Grid Middleware: Connectivity, Resource and Collective Layer, Globus Toolkit, GSI, GRAM, LDAP, Grid Ftp, GIIS, Heterogeneous Computing Systems,

Unit V:-Cloud Computing: Introduction to Cloud Computing, Types: Deployment and Service Models, Characteristics, Applications, Service-Level Agreement, Virtualization, High-Throughput Computing: Task Computing and Task-based Application Models, Market-Based Management of Clouds, Energy-Efficient and Green Cloud Computing Architecture, Resource Allocation, Leases, Task Scheduling: RR, CLS and CMMS.

Text Books

1. R. Buyya, High Performance Cluster Computing: Architectures and Systems, Volume 1, Pearson Education, 2008.
2. (Edited By) I. Foster and C. Kesselman, The Grid: Blueprint for a New Computing Infrastructure, Morgan Kaufmann, Elsevier, 2004.
3. D. Janakiram, Grid Computing, Tata McGraw-Hill, 2005.
4. R. Buyya, C. Vecchiola and S. T. Selvi, Mastering Cloud Computing Foundations and Applications Programming, Morgan Kaufmann, Elsevier, 2013.

Reference Books

1. A. Chakrabarti, Grid Computing Security, Springer, 2007.
2. B. Wilkinson, Grid Computing: Techniques and Applications, CRC Press, 2009.
3. C. S. R. Prabhu, Grid and Cluster Computing, PHI, 2008.
4. B. Sosinsky, Cloud Computing Bible, Wiley, 2011.

CBIT (A) **With effect from the academic year 2023-24**

20CSE26

HUMAN COMPUTER INTERACTION
(Professional Elective – I)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
CIE	40 Marks
Credits	3

Course Objectives: The objectives of this course are

1. Learn the foundations of Human Computer Interaction
2. Be familiar with the design technologies for individuals and persons with disabilities
3. Be aware of mobile human computer interaction
4. Learn the guidelines for human interface

Course Outcomes:

1. Understand the structure of models and theories of Human Computer Interaction and Vision
2. Design an interactive Web interface on the basis of model studied
3. Identify and compare the different interaction styles.
4. Analyze user interface and user experience design principles.
5. Critically evaluate the usability of user interfaces for interactive systems.

UNIT-I

Human: I/O Channels – Memory- Reasoning and Problem Solving; Interaction: Models –Frameworks – Ergonomics- styles – elements – interactivity- Paradigms Interactive Design Basics – process-scenarios-navigation-screen design –iteration and prototyping

UNIT-II

HCI in software process – usability engineering – prototyping in practice – design rationale Design rules – principles, standards, guidelines, rules, Evaluation techniques- Universal design

UNIT-III

Cognitive models – Socio-Organizational issues and stake holder requirements Communication and collaboration models – Hypertext, Multimedia and WWW

UNIT-IV

Mobile Ecosystem: platforms, Application frameworks – Types of mobile applications: Widgets, applications, Games - Mobile information architecture, Mobile 2.0, Mobile Design: elements of mobile design, tool

UNIT-V

Design of Web interfaces – Drag and Drop, Direct selection, Contextual tools, Overlays, inlays and virtual pages, process flow, case studies, Recent trends: Speech recognition and translation, multimodal system

Text Books:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russel Beale," Human Computer Interaction", 3rd Edition, Pearson Education 2004
2. Brain Fling, "Mobile Design and Development" First edition Orielly Media Inc. 2009
3. Bill Scott and Theresa Neil, "Designing Web Interfaces", First edition, Orielly 2009

Reference books:

1. Dix, A., Finley J., Abowd, G., Beale, R., (2004) Human-Computer Interaction. Harlow, England: Pearson / Prentice Hall.
2. Galitz, W. O. (2007). The essential guide to user interface design:An introduction to GUI design principles and techniques.Indianapolis, IN: Wiley Pub.
3. Jones, M., & Marsden, G. (2006). Mobile interaction design.Chichester, England: John Wiley & Sons.
4. Preece, J., Rogers, Y., & Sharp, H. (2015). Interaction design:Beyond human-computer interaction. New York, NY: J. Wiley & Sons.
5. Schneidermann, B., Plaisant C. (2009). Designing the User Interface. Boston, MA: Addison-Wesley / Pearson.

Online Resources:

https://www.iare.ac.in/sites/default/files/lecture_notes/HCI%20LECTURE%20NOTES.pdf
https://www.studocu.com/row/document/addis-ababa-university/software-engineering/human-computer-interface-tutorial/1981916
https://www.cl.cam.ac.uk/teaching/1011/HCI/HCI2010.pdf

CBIT (A) **With effect from the academic year 2023-24**
20AMC14

IMAGE PROCESSING LAB

Instruction :	3 Hours per week
Duration of SEE :	3 Hours
SEE:	50
CIE:	50
Credits:	1.5

Course Objectives: The objectives of this course are
1. To understand the fundamental concepts of Image processing.
2. To explore Discrete Fourier Transform for 1-D and 2-D signal.
3. To apply filtering techniques on 1-D and 2-D Images.
4. To apply gray scale morphological algorithms for edge image processing.

Course outcomes: On successful completion of the course learner will be able to:

1. Study the image fundamentals, mathematical transforms necessary for image processing.
2. Apply the concept of spatial filtering techniques.
3. Implement Digital Signal Transform techniques DFT .
4. Use the enhancement techniques for digital Image Processing
5. Implement the concept of gray scale morphological algorithms.
6. Develop small projects of 1-D and 2-D Digital image Processing.

Programs List:

1. Display of Gray scale Images.
2. Histogram Equalization.
3. Design of Non-linear Filtering.
4. 2-D DFT and DCT.
5. Filtering in frequency domain.
6. Display of colour images.
7. Conversion between colour spaces.
8. DWT of images.
9. Segmentation using morphological watershed algorithm.
10. Segmentation using gray-scale morphological algorithms.

Text Books:

1. Rafael.C,Gonzalez, Richard E Woods, “Digital Image Processing”,3rdEdition, Pearson India, 2013.
2. Jain A.K, “Fundamentals of Digital Image Processing”, 4th Edition, Prentice hall of India, 2004.

REFERENCE BOOKS/OTHER READING MATERIAL

1. B.Chanda, D. DuttaMajumder, “Digital Image Processing and Analysis”, 2ndEdition, Phi learning, 2011.
2. William K Pratt, “Digital Image Processing”, 4th Edition, Wiley, 2012.

CBIT (A) **With effect from the academic year 2023-24**
20AMC15

PRINCIPLES OF ARTIFICIAL INTELLIGENCE LAB

Instruction	2 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	50 Marks
Credits	1

Pre-requisites: Artificial Intelligence.

Course Objectives: The objectives of this course are,

1. To design and analyze various computing algorithms and techniques using Python.
2. To apply different learning algorithms to solve real time problems.
3. To recognize the underlying mathematical models and logics behind various AI techniques.

Course Outcomes: On successful completion of the course, students will be able to,

1. Understand the basic components of library environment and installations.
2. Analyze the design heuristics and apply various techniques to solve real world problems.
3. Apply variety of algorithms to solve problems.
4. Identify how to use GitHub and submit back genuine contributions.
5. Implement problems using game search algorithms.

Lab Experiments:

1. Design/construct the workflow of a general AI project using draw.io
2. Implement Water Jug Problem using A* search
3. Implement an 8-puzzle solver using Heuristic search technique.
4. Implement the Constraint Satisfaction problem using backtracking.
5. Implement a program for game search.
6. Implement a Bayesian network from a given data and infer the data from that Bayesian network.
7. Implement a MDP to run value and policy iteration in any environment.
8. Understanding of GitHub and conda environments.
9. Use the GitHub packages and libraries to frame a standard project and commit back to GitHub.

Text Books:

1. Stuart Russell and Peter Norvig, “Artificial Intelligence: A Modern Approach”, 3rd Edition, Prentice Hall, 2010.
2. Elaine Rich and Kevin Knight, “Artificial Intelligence”, Tata McGraw Hill, 3rd Edition, 2017.

Suggested Reading:

1. Trivedi, M.C., “A Classical Approach to Artificial Intelligence”, Khanna Publishing House, Delhi, 2018.
2. Saroj Kaushik, “Artificial Intelligence”, Cengage Learning India, 2011.

Online Resources:

1. https://nptel.ac.in/courses/106105077
2. https://nptel.ac.in/courses/106106126
3. https://aima.cs.berkeley.edu
4. https://ai.berkeley,edu/project_overview.html

CBIT (A) **With effect from the academic year 2023-24**
20CAC05

MACHINE LEARNING LAB

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	50 Marks
Credits	1.5

Course Objectives: The objectives of this course are

1. Make use of Data sets in implementing the machine learning algorithms.
2. Implement the machine learning concepts and algorithms in any suitable language of choice.
3. Make use of real world data to implement machine learning models.

Course Outcomes: On Successful completion of the course, students will be able to

1. Identify the fundamental issues and challenges of machine learning: data, model selection, model complexity, etc.
2. Identify and utilize modern tools that are useful for data analysis
3. Recognize and implement various ways of selecting suitable model parameters for different machine learning techniques.
4. Implement and evaluate various Machine Learning approaches
5. Apply Keras and Tensorflow to implement ML techniques

List of Experiments:

1. Identification and Installation of python environment towards the machine learning, installing python modules/Packages Import scikitlearn, keras and tensorflows etc.
2. Build linear regression model using gradient descent, least squares, polynomial, LASSO and RIDGE approaches also compare all the algorithms and draw a table for all the metrics.
3. Demonstration of decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a newsample.
4. Demonstration of Logistic Regression for a sample training data set stored as a .CSV file. Calculate the accuracy, precision, and recall for your dataset.
5. Demonstration of Naïve Bayesian classifier for a sample training data set stored as a .CSV file. Calculate the accuracy, precision, and recall for your dataset.
6. Build the decision tree classifier compare its performance with ensemble techniques like random forest,bagging,boosting and voting Demonstrate it with different decision trees.
7. Demonstration of SVM and use for character recognition task.
8. Implementation of Gradient Descent Algorithm using Tensorflow.
9. Case study on supervised learning algorithms.
10. Demonstration of Clustering algorithms - k-Means, Agglomerative and DBSCAN to classify for the standard datasets. Print both correct and wrong predictions using Java/Python ML library classes can be used for this problem.

Text Books:

1. Giuseppe Bonaccorso, “Machine Learning Algorithms”,2017, Packt Publishing

20AMI02

INTERNSHIP – II
(Industrial / Rural Internship)

Instruction	3 to 4 weeks / 90 Hours
Duration of End Examination	-
Semester End Examination	-
Continuous Internal Evaluation	50 Marks
Credits	2

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (AUTONOMOUS)

AICTE Model Curriculum with effect from AY 2023-24

B.E. (Artificial Intelligence &Machine Learning)

SEMESTER – VI

S. No	CourseCode	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per Week			Duration of SEE in Hours	Maximum Marks		
			L	T	P/D		CIE	SEE	
THEORY									
1	**20CSC21**	Data Communication and Computer Networks	3	-	-	3	40	60	3
2	**MATHS**	Quantum Computing	3	-	-	3	40	60	3
3	**20CSC20**	Operating Systems	3	-	-	3	40	60	3
4	**20XXEXX**	Professional Elective – II	3	-	-	3	40	60	3
5	**20XXEXX**	Professional Elective – III	3	-	-	3	40	60	3
6	**20XXXXX**	Open Elective – I	3	-	-	3	40	60	3
PRACTICAL									
7	**20CSC24**	Data Communication and Computer Networks Lab	-	-	3	3	50	50	1.5
8	**20CSC23**	Operating System Lab	-	-	3	3	50	50	1.5
9	**20XXEXX**	Professional Elective – II Lab	-	-	2	3	50	50	1
10	**20EGC03**	Employability Skills Lab	-	-	2	3	50	50	1
TOTAL			**18**	**-**	**10**	**60**	**440**	**560**	**23**

L: Lecture **T: Tutorial** **P: Practical**

CIE - Continuous Internal Evaluation **SEE - Semester End Examination**

	Professional Elective II(T & L)		Professional Elective III(T)		Open Elective – I
20AME02(T) & 20AME03(P)	Natural Language Processing	**20CAE01**	Reinforcement Learning	**20ECO10**	Fundamentals of Wireless Communication
20AME04(T) & 20AME05(P)	Data and Visual Analytics	**20CAE05**	Multi Agent Intelligent Systems	**20EEO05**	Waste Management
20CSE07(T) &	Internet of Things	**20AME04**	Principles of Cryptography and	**20MEO09**	Organizational Behaviour

20CSE16(P)			Network Security		
20CAE03(T) & 20CAE07(P)	Deep Learning for Computer Vision	**20CAE10**	Computational Neuroscience	**20ECO04**	Principles of Embedded Systems
				20BTO04	Bioinformatics

20CAC21

DATA COMMUNICATION AND COMPUTER NETWORKS

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Programming for problem solving and data structures.

Course Objectives: The objectives of this course are,

1. To understand the principles of data communication and organization of computer networks,
2. To analyze various routing protocols and congestion control algorithms.
3. To study the functions of the transport layer and to understand application layer protocols.

Course Outcomes: On Successful completion of this course, student will be able to,

1. Learn the communication protocol suites like ISO-OSI and TCP/IP.
2. Illustrate and explain Data Communications System and its components.
3. Identify and analyze various congestion control algorithms.
4. Distinguish the internet protocols like IP, ARP, ICMP, IGMP, routing protocols and DHCP.
5. Understand the transport layer protocols like TCP, UDP, RTCP.
6. Identify various application layer protocols like HTTP, WWW, DNS, Email Protocols, FTP and the underlying protocols.

UNIT - I

Introduction: Data communication, network types and models, TCP/IP and OSI Protocol Suite, transmission media (wired and wireless), switching.

UNIT - II

Data Link Layer: Design issues, error detection and correction, elementary data link protocols, sliding window protocols, HDLC, point to point protocols, multiple access protocols.
LAN: Wired LAN, wireless LAN, connecting devices and Virtual LAN.

UNIT - III

Network Layer: Network layer design issues, routing algorithms, congestion control algorithms, Quality of service, IPV4, IPV6, network layer protocols: ARP, RARP, ICMP, IGMP and DHCP.

UNIT - IV

Transport Layer: Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP, congestion control, quality of service.

UNIT - V

Application Layer: DNS, DDNS, SMTP, POP, IMAP, SSH, SFTP, WWW, HTTP, SNMP, Firewalls.

Text Books:

1. Behrouz A. Forouzan, “Data communication and Networking”, Tata McGraw Hill, Fifth Edition, 2017.
2. S. Tanenbaum, "Computer Networks", Pearson Education, Fifth Edition, 2013.
3. William Stallings, “Data and Computer Communication”, Eighth Edition, Pearson Education, 2007.

Suggested Reading:

1. Larry L.Peterson, Peter S. Davie, “Computer Networks”, Elsevier, Fifth Edition, 2012.
2. James F. Kurose, Keith W. Ross, “Computer Networking: A Top–Down Approach Featuring the Internet”, Pearson Education, 2005.

Online Resources:

1. https://nptel.ac.in/courses/106/105/106105081/
2. https://nptel.ac.in/courses/106/106/106106091/

CBIT (A) **With effect from the academic year 2023-24**
20MT***

QUANTUM COMPUTING

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Course Objectives: The objectives of this course are,

1. To learn Quantum bits and compute mathematical foundation
2. To understand the evaluation of the quantum bits.
3. To learn Quantum operations by building blocks of Quantum programming
4. To know the basics of Quantum logic gates and circuits
5. To learn Quantum Algorithms by various Techniques.

Course Outcomes: On successful completion of the course, students will be able to

1. Compute basic mathematical operations on Quantum bits.
2. Execute Quantum operations of Quantum computing
3. Built quantum programs
4. Develop quantum Logical gates and circuits.
5. Develop the quantum algorithm

UNIT - I

Math Foundation for Quantum Computing: Introduction of Vector Space, Subspaces, Basis and Finite Dimensions. Vectors and orthogonality, inner product and Outer product and Hilbert Spaces. Formation of Matrices by Linear Transformation. Linear Independent and dependent Vectors. Unitary operators and projectors, Eigen values and Eigen Vectors.

UNIT – II

Introduction to Quantum Computing: Quantum Mechanics (Huygens wave theory ,Photo electric effect De-Broglie hypothesis and Heisenberg‟s uncertainty Principle), Origin of Quantum Computing, Overview of major concepts in Quantum Commuting ,Qubits and multi-qubits states, Bra-ket notation, Quantum Superposition Motivation for Studying Quantum Computing, Major players in the industry (IBM, Microsoft, Rigetti, D-Wave

UNIT – III

Building Blocks for Quantum Program: Block sphere representations, Multi-qubits, Inner and outer product of Multiple of qubits, Tensor product, Quantum Entanglement, Quantum Teleporation (EPR Model) and Bell State.

UNIT – IV

Quantum Logical gates and Circuits: Pauli, Hadamard, Phase shift, controlled gates, AND, OR and NAND gate, C-Not, CCNOT gate Introduction of Fourier Transform and Discrete Fourier transform.

UNIT – V

Quantum Algorithms: Z-Transform. Basic techniques exploited by quantum algorithms (Amplitude amplification, Quantum Fourier Transform, Quantum Phase estimation, Quantum walks), Major Algorithms (Shore‟s Algorithm, Grover‟s Algorithm, Deutsch‟s Algorithm, Deutsch-Jozsa Algorithm).

Text Books:

1. David McMahon, “Quantum Computing Explained”, Wiley-IEEE Computer Society Pr.., 2008.

Suggested Reading:

1. Michael A. Nielsen, “Quantum Computation and Quantum Information”, Cambridge University Press, 2010.

CBIT (A) **With effect from the academic year 2023-24**
20CSC20

OPERATING SYSTEMS

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Prerequisites: Computer Architecture and Programming Fundamentals.

Course Objectives: The objectives of this course are,

1. Should be able to describe the operating system service, and the design of an operating system.
2. To understand the structure and organization of the file system, process synchronization, process scheduling, system calls and different approaches to memory management.
3. To understand about the cloud infrastructures and technologies.

Course Outcomes: On successful completion of the course, students will be able to,

1. Identify the basics of an operating systems and its major components.
2. Understand the concepts related to process synchronization and deadlocks.
3. Distinguish various memory management techniques.
4. Interpret various threats and defense mechanisms used to protect the system.
5. Evaluate various file allocation methods.
6. Apply security as well as recovery features in the design of algorithms.

UNIT - I

Concepts of Operating Systems: Computer System over view, concept of an operating system, Types of operating systems, general system architecture, system components, operating system services, system calls, system programs, approaches to OS design and implementation: Micro-kernel, Layered, Kernel Approach.

UNIT - II

Processes and Threads: Concept of process, process states, process state transitions, process control block, operations on processes, concurrent processes, mutual exclusion and synchronization, principles of deadlocks, integrated deadlocks strategy, scheduling levels, scheduling criteria, algorithms, Inter Process Synchronization, Inter Process Communication, Linux IPC Mechanisms, RPC, RPC exception handling, Security issues.

UNIT - III

Memory Management and Data Management: Logical and physical address space, storage allocation and management techniques, swapping concept of multi-programming, paging, segmentation, virtual storage management strategies, demand paging, page replacement algorithms, thrashing, File organization, record blocking, access methods, directory structure, protection file system structure, allocation methods, free space management, directory implementation, disk structure, disk scheduling, disk management, buffering, swap space management, RAID levels.

UNIT - IV

OS Security: Types of threats in OS, basic security mechanisms, understanding the threats, malware taxonomy, viruses, worms, rootkits; Defense: overview, logging, auditing, and recovery, OS-level memory protection.

UNIT - V

Case studies and OS Abstractions: Linux/Unix OS design and architecture, Unix shell, Unix OS services, user perspective, representation of files in Unix, system processes and their structure, I/O system, memory management in Unix. Processes management, file management, IPC and network related system calls,

Text Books:

1. Galvin, Silberschatz, "Operating system Concepts", 10th Edition, John Wiley & Sons, 2018.
2. Dhananjay Dhamdhare, "Operating Systems-A Concept Based Approach", 3rd Edition, McGraw Hill

Education, 2017.

Suggested Reading:

1. Ekta Walia, “Operating System Concepts”, Khanna Book Publishing, 2020.
2. William Stallings, “Operating Systems Internals and Design Principles”, Pearson Edition, 2012.
3. Charles Crowley, “Operating Systems –A Design Oriented Approach”, McGraw Hill Education, 2017.
4. Andrew S. Tanenbaum, Albert S Woodhull, “Operating systems Design and Implementation”, Pearson Edition, 2009.

CBIT (A) **With effect from the academic year 2023-24**
20AME02

NATURAL LANGUAGE PROCESSING
(Professional Elective-II)

Instruction:	3 Hours per week
Duration of SEE:	3 Hours
SEE:	60
CIE:	40
Credits:	3

Pre-requisites: Artificial Intelligence.

Course Objectives: The objectives of this course are

1. To gain knowledge on NLP.
2. To deal with morphological processing, syntactic parsing, information extraction.
3. To understand probabilistic NLP and classification of text using Python's NLTK Library.

Course outcomes: On completion of this course, the student will be able to

1. Write Python programs to manipulate and analyze language data.
2. Demonstrate key concepts from NLP and linguistics to describe and analyze language.
3. Understand the data structures and algorithms that are used in NLP.
4. Classify texts using machine learning and deep learning.
5. Understand the applications of NLP.

UNIT-I:
Language Processing and Python: Computing with Language: Texts and Words, A Closer Look at Python: Texts as Lists of Words, Computing with Language: Simple Statistics, Back to Python: Making Decisions and Taking Control, Automatic Natural Language Understanding
Accessing Text Corpora and Lexical Resources: Accessing Text Corpora, Conditional Frequency

UNIT-II:
Processing Raw Text: Accessing Text from the Web and from Disk, Strings: Text Processing at the Lowest Level, Text Processing with Unicode, Regular Expressions for Detecting Word Patterns, Useful Applications of Regular Expressions, Normalizing Text, Regular Expressions for Tokenizing Text.
Categorizing and Tagging Words: Using a Tagger, Tagged Corpora, Mapping Words to Properties Using Python Dictionaries, Automatic Tagging, N-Gram Tagging, Transformation Based Tagging.

UNIT-III:
Learning to Classify Text: Supervised Classification, Evaluation, Naive Bayes Classifiers
Deep Learning for NLP: Introduction to Deep Learning, Convolutional Neural Networks, Recurrent Neural Networks, Classifying Text with Deep Learning

UNIT-IV:
Extracting Information from Text : Information Extraction, Chunking, Developing and Evaluating Chunkers, Recursion in Linguistic Structure, Named Entity Recognition, Relation Extraction.
Analyzing Sentence Structure: Some Grammatical Dilemmas, What's the Use of Syntax. Context-Free Grammar, Parsing with Context-Free Grammar.

UNIT-V:
NLP applications: Topic modeling, Text classification, Sentiment analysis, Word sense disambiguation, Speech recognition and speech to text, Text to speech, Language detection and translation.

Text Books/Suggested Reading:

1. Steven Bird, Ewan Klein, and Edward Lope, Natural Language Processing with Python. O"Reily, 2009.
2. Akshay Kulkarni, Adarsha Shivananda, Natural Language Processing Recipes: Unlocking Text Data with Machine Learning and Deep Learning using Python. Apress, 2019
3. Allen James, Natural Language Understanding, Benjamin/Cumming,1995. Charniack, Eugene, Statistical Language Learning, MIT Press, 1993.
4. Charniack, Eugene, Statistical Language Learning, MIT Press, 1993.

CBIT (A) **With effect from the academic year 2023-24**
20AME04

DATA AND VISUAL ANALYTICS
(Professional Elective-II)

Instruction :	3 Hours per week
Duration of SEE :	3 Hours
SEE:	60
CIE:	40
Credits:	3

Pre-requisites: Fundamentals of Data Science, Mathematical Foundation for Data Science & Security.

Course Objectives: The objectives of this course are

1. To understand techniques and algorithms for creating effective visualizations based on principles from graphic design.
2. To learn visual and computation techniques and tools, for typical data types
3. To learn how to complement each kind of methods and gain a breadth of knowledge
4. To create a compelling and interactive visualization of various real datasets and problems.

Course Outcomes: On Successful completion of the course, students will be able to

1. Understand the key techniques and theory used in visualization, including data models, graphical perception.
2. Analyze techniques for visual encoding and interaction.
3. Apply knowledge to a number of common data domains and corresponding analysis tasks, including multivariate data, networks, text, and cartography.
4. Describe big data and use cases from selected business domains.
5. Explain NoSQL big data management and other technologies such as Hadoop and HDFS

UNIT - I : Introduction: Data for Graphics, Design principles, Value for visualization, Categorical, time series, and statistical data graphics, Introduction to Visualization Tools.

UNIT - II : Graphics Pipeline and Aesthetics and Perception : Introduction, Primitives: vertices, edges, triangles, Model transforms: translations, rotations, scaling, View transform, Perspective transform, window transform, Graphical Perception Theory, Experimentation, and the Application, Graphical Integrity, Layering and Separation, Color and Information, Using Space.

UNIT – III : Visualization Design : Visual Display of Quantitative Information, Data-Ink Maximization, Graphical Design, Exploratory Data Analysis, Heat Map.

UNIT – IV : Multidimensional Data and Interaction : Query, Analysis and Visualization of Multi- Dimensional Relational Databases, Interactive Exploration, tSNE, Interactive Dynamics for Visual Analysis, Visual Queries, Finding Patterns in Time Series Data, Trend visualization, Animation, Dashboard, Visual Storytelling.

UNIT – V : Collaboration : Graph Visualization and Navigation, Online Social Networks, Social Data Analysis, Collaborative Visual Analytics, Text, Map, Geospatial data.

Textbooks:

1. Data Visualization Handbook by J. Koponen, J. Hildén, CRC Press, 2019
2. Beginner‟s Guide for Data Analysis using R Programming, Jeeva Jose, Khanna Publishing 2019.
3. The Visual Display of Quantitative Information by E. Tufte, Graphics Press, 2nd Edition, 2001

Suggested Reading:

1. The Book of Trees: Visualizing Branches of Knowledge by M. Lima, Princeton Architectural Press, 2014
2. Handbook of Graph Drawing and Visualization by R. Tamassia, CRC Press, 2013
3. Interactive Data Visualization for the Web by S. Murray O'Reilly Press, 2nd Edition, 2017

Online Resources:

1. https://nptel.ac.in/courses/110106072
2. https://nptel.ac.in/courses/108105103

CBIT (A) **With effect from the academic year 2023-24**
20CSE07

INTERNET OF THINGS
(Professional Elective – II)

Instruction :	3 Hours per week
Duration of SEE :	3 Hours
SEE:	60
CIE:	40
Credits:	3

Pre-requisites: Computer architecture and microprocessor, Programming for problem solving.

Course Objectives: The objectives of this course are,

1. To understand the architecture, basics and applications of IoT.
2. To impart practical knowledge on components of IoT.
3. To develop skills required for building real-time IIoT based projects.

Course Outcomes: On successful completion of the course, students will be able to,

1. Understand IoT, its hardware and software components.
2. Comprehend I/O interface and programming APIs.
3. Analyze the use of communication protocols in IoT.
4. Explore Solution framework for IoT applications.
5. Illustrate unstructured data storage.
6. Develop real time IoT based projects.

UNIT - I

Introduction to IoT: Architectural Overview, Design principles and requirements of IoT, IoT Applications. **Elements of IoT:** Basics of networking, sensors, actuators, computing devices, software, data management and processing environment and Security issues.

UNIT - II

IoT Hardware Components: Computing (Arduino, Raspberry Pi), Communication modules, Sensors, Actuators, I/O interfaces, Programming API's.

UNIT - III

IoT Data Protocols: MQTT, CoAP, AMQP, DDS, HTTP, WebSocket
Network Protocols for IoT: 6LowPAN, RPL, IPV6, WiFi, Bluetooth, ZigBee, Z-Wave, LoRaWan, MQTT, XMPP

UNIT - IV

IoT Application Development: Solution framework for IoT applications- Implementation of Device integration, Data acquisition and integration, Device data storage- Unstructured data storage on cloud/local server, Authentication, authorization of devices.

UNIT - V

IoT Case Studies: IoT case studies based on Industrial automation, Transportation, Agriculture, Healthcare, Home Automation.

Text Books:

1. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, StamatisKarnouskos, David Boyle,"From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence",1st Edition, Academic Press, 2014.
2. Jeeva Jose, "Internet of Things", Khanna Publishing House, Delhi, 2018.
3. Arshdeep Bahga and Vijay Madisetti, "Internet of Things: A Hands-on Approach", Universities Press, 2014.

Suggested Reading:

1. Dr. SRN Reddy, Rachit Tirnkral and Manasi Mishra, "Introduction to Internet of Things: A practical Approach", ETI Labs, 2018.
2. Adrian McEwen, "Designing the Internet of Things", Wiley, 2013.
3. Raj Kamal, "Internet of Things: Architecture and Design", McGraw Hill, 2017.

4. Cuno Pfister, "Getting Started with the Internet of Things", 0‟ Reilly Media, 2011.

Online Resources / Weblinks / NPTEL Courses:

1. Li Da Xu, Wu He, and Shancang Li, “Internet of Things in Industries: A Survey “, IEEE Transactionson Industrial Informatics, Vol. 10, No. 4, Nov. 2014.
2. T. Winter, P. Thubert, A. Brandt, J. Hui, R. Kelsey, P. Levis, K. Pister, R. Struik , JP. Vasseur, R. Alexander, “RPL: IPv6 Routing Protocol for Low-Power and Lossy Networks”, IETF, Standards Track, Mar. 2012.
3. Z. Shelby, K. Hartke, C. Bormann, “The Constrained Application Protocol (CoAP)”**,** Internet Engineering Task Force (IETF), Standards Track, 2014.
4. L.Fenzel, “What‟s The Difference Between IEEE 802.15.4 And ZigBee Wireless?”,Electronic Design(Online), Mar. 2013.
5. S. N. Das and S. Misra, "Information theoretic self-management of Wireless Sensor Networks", Proceedings of NCC 2013.
6. F. Luo *et al.*, "A Distributed Gateway Selection Algorithm for UAV Networks," in IEEE Transactions on Emerging Topics in Computing, vol. 3, no. 1, pp. 22-33, March 2015.
7. https://onlinecourses.nptel.ac.in/noc19_cs31/
8. https://www.nabto.com/guide-iot-protocols-standards/

CBIT (A) **With effect from the academic year 2023-24**
20CAE03

COMPUTER VISION
(Professional Elective-II)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Linear Algebra and Probability, Digital Image Processing, Deep Learning.

Course Objectives: The objectives of this course are

1. To understand the Fundamental Concepts Related to Multi-Dimensional Signal Processing.
2. To learn Feature Extraction algorithms.
3. To apply Visual Geometric Modeling and Stochastic Optimization.

Course Outcomes: On Successful completion of the course, students will be able to

1. Recognize the basics of computer vision and its challenging issues.
2. Develop algorithms to analyze feature detection and alignment.
3. Interpret images and videos for problems such as tracking and structure from motions.
4. Identify object, scene recognition and categorization algorithms for real time images.
5. Analyze recovery of 3D structure of ill-posed scenes.
6. Apply various techniques to build computer vision applications.

UNIT - I

Introduction to Computer Vision and Image Formation: Introduction, Geometric primitives and transformations, Photometric image formation, Digital Camera image formation. **Image Processing:** Point operators, Linear filtering, More neighborhood operators, Fourier transforms, Pyramids and wavelets, Geometric transformations.

UNIT – II

Feature detection and matching: Points and patches, Edges, Lines. **Segmentation**: Active contours, Split and merge, Mean shift and mode finding, Normalized cuts. **Feature-based alignment**: 2D and 3D feature-based alignment, Pose estimation.

UNIT – III

Structure from motion: Triangulation, Two-frame structure from motion, Factorization, Bundle adjustment, Constrained structure and motion. **Dense motion estimation:** Translational alignment, Parametric motion, Spline-based motion, Optical flow, Layered motion.

UNIT – IV

Recognition: Object detection, Face recognition, Instance recognition, Category recognition, Context and scene understanding.

UNIT – V

3D Reconstruction: Shape from X, Active range finding, Surface representations, Point-based representations, volumetric representations, Model-based reconstruction, Recovering texture maps.

Text Books:

1. Richard Szeliski “Computer Vision: Algorithms and Applications”, Springer-Verlag London Limited, 2011.
2. R. C. Gonzalez and R. E. Woods, “Digital Image Processing”; Addison Wesley, 2008.

Suggested Reading:

1. Robert J. Schallkoff, “Pattern Recognition: Statistical. Structural and Neural Approaches”, John Wiley and Sons; 1992+.
2. D. A. Forsyth and J. Ponce, “Computer Vision: A Modern Approach”, Pearson Education, 2003.
3. R. Hartley and A. Zisserman, “Multiple View geometry”, Cambridge university Press, 2002.
4. Richard Hartley and Andrew Zisserman, “Multiple View Geometry in Computer Vision”, Second Edition, Cambridge University Press, March 2004.
5. K. Fukunaga; “Introduction to Statistical Pattern Recognition”, Second Edition, Academic Press, Morgan Kaufmann, 1990.

Online Resources:

1. CV online: http://homepages.inf.ed.ac.uk/rbf/CVonline
2. Computer Vision Homepage:
3. http://www2.cs.cmu.edu/afs/cs/project/cil/ftp/html/vision.html

CBIT (A) **With effect from the academic year 2023-24**
20AME04

PRINCIPLES OF CRYPTOGRAPHY AND NETWORK SECURITY
(Professional Elective-III)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Data Communication and computer networks.

Course Objectives: The objectives of this course are,
1. To understand the importance of confidentiality, integrity, availability and authentication.
2. To understand various cryptographic algorithms.
3. To understand categories of threats to computer networks.
4. To describe public-key cryptosystem, key generation and distribution.
5. To understand implementation of Firewalls and web security.

Course Outcomes: On Successful completion of this course, student will be able to,
1. Analyze and design classical encryption techniques and block ciphers.
2. Analyze and design hash and MAC algorithms, and digital signatures.
3. Design network application security schemes like PGP, S/MIME, IPSec, SSL, TLS, HTTPS, SSH, etc.
4. Evaluate the authentication and hash algorithms.
5. Create and configure simple firewall architectures.
6. Understand digital sign in emails and files.

UNIT - I
Security Concepts: Introduction, The need for security, Security approaches, Principles of security, Types of Security attacks, Security services, Security Mechanisms, A model for Network Security.
Cryptography Concepts and Techniques: 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.

UNIT - II
Symmetric key Ciphers: Block Cipher principles, DES, AES, Blowfish, RC5, IDEA, Block cipher operation, Stream ciphers, RC4.
Asymmetric key Ciphers: Principles of public key cryptosystems, RSA algorithm, Elgamal Cryptography, Diffie-Hellman Key Exchange, Knapsack Algorithm.

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

UNIT - IV
Transport-level Security: Web security considerations, Secure Socket Layer and Transport Layer Security, HTTPS, Secure Shell (SSH).
Wireless Network Security: Wireless Security, Mobile Device Security, IEEE 802.11 Wireless LAN, IEEE 802.11i Wireless LAN Security

UNIT - V
E-Mail Security: Pretty Good Privacy, S/MIME.
IP Security: IP Security overview, IP Security architecture, Authentication Header, Encapsulating security payload, combining security associations, Internet Key Exchange.
Case Studies on Cryptography and security: Secure Multiparty Calculation, Virtual Elections, Single sign On, Ransomware.

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

Suggested Reading:

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

Online resources:

1. https://onlinecourses.nptel.ac.in/noc21_cs16/

CBIT (A) **With effect from the academic year 2023-24**
20CAE01

REINFORCEMENT LEARNING
(Professional Elective-III)

Instruction:	3 Hours per week
Duration of SEE:	3 Hours
SEE:	60
CIE:	40
Credits:	3

Pre-requisites: Linear algebra and calculus, Machine learning.

Course Objectives: The objectives of this course are

1. To pick the best known action for any given state, which means the actions have to be ranked, and assigned values relative to one another.
2. Knowledge of basic and advanced reinforcement learning techniques.
3. Understand and work with approximate solutions (deep Q network based algorithms)
4. Understand and work with tabular methods to solve classical control problems.
5. Learn the policy gradient methods to more complex cases.

Course Outcomes: On Successful completion of the course, students will be able to

1. Illustrates various elements of reinforcement techniques.
2. Define the key features of reinforcement learning that distinguishes it from AI and non-interactive machine learning.
3. Analyze any given application; decide if it is formulated as reinforcement learning problem.
4. Apply Monte Carlo method and Temporal-Difference(TD) learning for prediction.
5. Apply Planning and Learning with Tabular Methods.
6. Use Value Prediction with Function Approximation concepts.

UNIT – I
The Reinforcement Learning Problem: Reinforcement Learning, Examples, Elements of Reinforcement Learning, Limitations and Scope, An Extended Example: Tic-Tac-Toe, History of Reinforcement Learning.
Multi-arm Bandits: An n-Armed Bandit Problem, Action-Value Methods, Incremental Implementation, Tracking a Nonstationary Problem, Optimistic Initial Values, Upper-Confidence-Bound Action Selection, Gradient Bandits, Associative Search.

UNIT – II
Finite Markov Decision Processes: The Agent–Environment Interface, Goals and Rewards, Returns, Unified Notation for Episodic and Continuing Tasks, The Markov Property, Markov Decision Processes, Value Functions, Optimal Value Functions, Optimality and Approximation.
Dynamic Programming: Policy Evaluation, Policy Improvement, Policy Iteration, Value Iteration, Asynchronous Dynamic Programming, Generalized Policy Iteration, Efficiency of Dynamic Programming.

UNIT – III
Monte Carlo Methods: Monte Carlo Prediction, Monte Carlo Estimation of Action Values, Monte Carlo Control, Monte Carlo Control without Exploring Starts, Off-policy Prediction via Importance Sampling, Incremental Implementation, Off-Policy Monte Carlo Control, Importance Sampling on Truncated Returns.
Temporal-Difference (TD) Learning: TD Prediction, Advantages of TD Prediction Methods, Optimality of TD(0), Sarsa: On-Policy TD Control, Q-Learning: Off-Policy TD Control, Games, Afterstates, and Other Special Cases.

UNIT – IV
Eligibility Traces: n-Step TD Prediction, The Forward View of TD(λ), The Backward View of TD(λ), Equivalences of Forward and Backward Views, Sarsa(λ), Watkins's Q(λ), Off-policy Eligibility Traces using Importance Sampling, Implementation Issues, Variable λ, Conclusions.

Planning and Learning with Tabular Methods: Models and Planning, Integrating Planning, Acting, and Learning, When the Model Is Wrong, Prioritized Sweeping, Full vs. Sample Backups, Trajectory Sampling, Heuristic Search, Monte Carlo Tree Search.

UNIT – V
On-policy Approximation of Action Values: Value Prediction with Function Approximation, Gradient-Descent Methods, Linear Methods, Control with Function Approximation.
Policy Approximation: Actor–Critic Methods, Eligibility Traces for Actor–Critic Methods, R-Learning and the

Average-Reward Setting.

Text Books:

1. Richard S. Sutton and Andrew G. Barto, "Reinforcement Learning: An Introduction", 2nd Edition.

Suggested Reading:

1. Kyriakos G. Vamvoudakis, Yan Wan, Frank L. Lewis, Derya Cansever,"Handbook of Reinforcement Learning and Control (Studies in Systems, Decision and Control, 325)", 1st Edition.
2. Nimish Sanghi,"Deep Reinforcement Learning with Python: With PyTorch, TensorFlow and OpenAI Gym", 1st Edition.
3. Boris Belousov, Hany Abdulsamad, Pascal Klink, Simone Parisi, Jan Peters."Reinforcement Learning Algorithms: Analysis and Applications", 1st Edition.

Online Resources:

1) https://nptel.ac.in/courses/106106143

2) https://www.coursera.org/specializations/reinforcement-learning

CBIT (A) **With effect from the academic year 2023-24**
20CAE05

MULTI AGENT INTELLIGENT SYSTEMS
(Professional Elective-III)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Linear Algebra and Calculus, Artificial Intelligence.

Course Objectives: The objectives of this course are,
1. To learn various types of multi agent systems and their applications.
2. To acquire the knowledge of various multi agent system architectures and their learning methods.
3. To understand multi agent decision making systems and their applications.

Course Outcomes: On Successful completion of this course, student will be able to,
1. Understand various aspects of multi agent systems and architecture of intelligent agents.
2. Understand of various types of reasoning Agents.
3. Acquire knowledge of multi agent systems communication and cooperation methods.
4. Classify various types of decision-making processes for multi agent systems.
5. Use appropriate framework for agent communication and information sharing processes.
6. Explore different kinds of Auctions for multi agent environment and applications.

UNIT - I

Introduction: The Vision Thing, Some Views of the Field, Agents as a paradigm for software engineering, Agents as a tool for understanding human societies

Intelligent Autonomous Agents: Intelligent Agents, agent and objects, agents and expert systems, agents as intentional systems, Abstract Architectures for Intelligent Agents.

UNIT - II

Deductive Reasoning agents: Agents as theorem Provers, Agent-Oriented programming.

Practical Reasoning Agents: Practical Reasoning equals Deliberation plus Means-Ends Reasoning, Means- Ends Reasoning, HOMER, The Procedural reasoning System.

Reactive and Hybrid Agents: Reactive Agents -The subsumption architecture, PENGI, Limitations of reactive agents. Hybrid agents -Touring Machines.

UNIT - III

Understanding Each Other: Ontology Fundamentals, Ontology Languages, RDF.

Communicating: Speech Acts – Austin, Searle, Speech acts as rational action, Agent Communication Languages -KQML.

Working Together: Cooperative Distributed Problem Solving, Task sharing and Result sharing-Task sharing in the Contract Net. Result Sharing, Combining Task and Result Sharing, Handling Inconsistency, coordination.

UNIT - IV

Multi agent Decision Making - Multi Agent Interactions: Utilities and Preferences, Setting the Scene, The Prisoner‟s Dilemma.

Making Group Decisions: Social welfare Functions and Social Choice Functions, Voting Procedures- Plurality, Sequential majority elections.

Forming Coalitions: cooperative Games

UNIT - V

Allocating Scarce Resources: Classifying Auctions, Auctions for Single items - English auctions, Dutch auctions. Combinatorial auctions - Bidding Languages. Auctions in Practice-Online auctions, Adwords auctions

Applications: Agents for Workflow and Business Process Management, Agents for Distributed Sensing, Agents for Information Retrieval and Management, Agents for Electronic Commerce, Agents for Human - Computer Interfaces, Agents for Virtual Environments, Agents for Social Simulation, Agents for X.

Text Books:

1. Michae L Wooldridg E, “An Introduction to Multi Agent Systems”, Wiley publications, 2nd Edition, 2009.

Suggested Reading:

1. Stuart Russell and Peter Norvig, “Artificial Intelligence: A Modern Approach”, 4th Global edition, 2021.
2. Gerhard Weiss, “Multiagent Systems”, Second Edition, 2016.

Online Resources:

1. https://www.coursera.org/lecture/model ng-simulation-natural-processes/multi-agent-systems-kAKyC

20CAE10

COMPUTATIONAL NEUROSCIENCE
(Professional Elective-III)

Instruction:		3 Hours per week
Duration of SEE:	3 Hours	
SEE:		60
CIE:		40
Credits:	3	

Pre-requisites: Artificial Intelligence, Machine Learning.

Course Objectives:

1. To learn computational neuroscience models and their applications.
2. To explore the computational principles governing various aspects of vision, sensory-motor control, learning, and memory.
3. To learn representation of information by spiking neurons, processing of information in neural networks, and algorithms for adaptation and learning.

Course Outcomes: The Student will be able to

1. understand the fundamentals of computational neuroscience
2. analyse the Neural Encoding Models.
3. make use of Neurons & Neural coding to extract information**.**
4. Analyse the Computing in Carbon and Computing with Networks.
5. analyze the various learning methodologies.
6. evaluate the Performance of different neurological models

Unit-I

Introduction: Introduction & Basic Neurobiology Computational Neuroscience: Descriptive Models, Computational Neuroscience: Mechanistic and Interpretive Models, The Electrical Personality of Neurons, Making Connections: Synapses, Time to Network: Brain Areas and their Function.

Unit-II

Neural Encoding Models: Neural Encoding, Simple Models, Feature Selection, Variability, Vectors and Functions, Convolutions and Linear Systems, Change of Basis and PCA.

Unit-III

Extracting Information from Neurons & Neural coding: Neural Decoding and Signal Detection Theory, Population Coding and Bayesian Estimation, Reading Minds: Stimulus Reconstruction, Information and Entropy, Calculating Information in Spike Trains, Coding Principles.

Unit-IV

Computing in Carbon and Computing with Networks: Modelling Neurons, Spikes, Simplified Model Neurons, A Forest of Dendrites, modelling Connections Between Neurons, Introduction to Network Models, The Fascinating World of Recurrent Networks.

Unit-V

Plasticity in the Brain & Learning: Synaptic Plasticity, Hebb's Rule, and Statistical Learning, Introduction to Unsupervised Learning, Sparse Coding and Predictive Coding.

Learning from Supervision and Rewards: Neurons as Classifiers and Supervised Learning, Reinforcement Learning: Predicting Rewards, Reinforcement Learning: Time for Action

Text Books:

1. Fundamentals of Computational Neuroscience, Thomas Trappenberg, OUP Oxford; 2nd edition, 2009.
2. An Introductory Course in Computational Neuroscience, Paul Miller, The MIT Press; 1st edition, 2018
3. Paul Miller, “An Introductory Course in Computational Neuroscience”, The MIT Press, 2018

Suggested Reading:

1. Britt-Anne Anderson, “Computational Neuroscience and Cognitive Modelling: A Student's Introduction to Methods and Procedures”, SAGE Publications Ltd, 2014
2. Ranu Jung, Dieter Jaeger, “Encyclopedia of Computational Neuroscience”, Springer, 2015
3. Trappenberg, Thomas, “Fundamentals of computational neuroscience”, OUP Oxford, 2009.
4. Arbib, Michael A., and James J. Bonaiuto, eds, “From neuron to cognition via computational neuroscience”, MIT Press, 2016.

Web link:

1. https://nptel.ac.in/courses/102106023
2. https://onlinecourses.nptel.ac.in/noc22_ee66
3. https://www.coursera.org/learn/computational-neuroscience#syllabus
4. https://www.edx.org/course/computational-neuroscience-neuronal-dynamics-of-co

20ECO10

FUNDAMENTALS OF WIRELESS COMMUNICATION
(Open Elective – I)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Prerequisite: A course on basics of electronics is required.

Course Objectives: The objectives of this course are,
1. To familiarize the concepts related to cellular communication and its capacity.
2. To teach students the fundamentals of propagation models and multipath fading.
3. To describe diversity schemes applied in wireless communication and understand the latest Wireless technologies

Course Outcomes: On Successful completion of this course, student will be able to,
1. Understand the overview of Wireless Communication.
2. Relate the cellular concepts like frequency reuse, hand off, coverage and capacity.
3. Analyse the mobile radio propagation with large scale and small scale fading.
4. Select the suitable diversity technique to combat the multipath fading effects.
5. Compare the multiple access techniques and apply to wireless standards.

UNIT - I
An overview of wireless communications: Roadmap of cellular communications. First-Generation systems. Second-Generation systems. Third-Generation systems, Fourth-Generation systems and Fifth-Generation Systems.

UNIT – II
The Cellular Concept-System Design Fundamentals: Introduction, Frequency Reuse, Channel Assignment Strategies. Handoff Strategies. Interference and System Capacity. Power Control for Reducing Interference.

UNIT - III
Mobile Radio Propagation: Large-Scale Path Loss, Introduction to Radio Wave Propagation, Free Space Propagation Model, the Three Basic Propagation Mechanisms, **Small-Scale Fading and Multipath:** Small- Scale Multipath Propagation, Factors Influencing Small-Scale Fading, Doppler Shift, Types of Small-Scale Fading.

UNIT – IV
Diversity Techniques: Practical Space Diversity Considerations- Selection Diversity, Feedback or Scanning, Maximal Ratio Combining Diversity Equal Gain Combining. **Orthogonal frequency division multiplexing:** Introduction, Principle of OFDM. OFDM transceivers Cyclic prefix, Spectrum of OFDM, Fading mitigation in OFDM. Intercarrier interference.

UNIT - V
Multiple access techniques: Duplexing: FDD versus TDD. FDMA. TDMA. CDMA. OFDMA. SDMA
Wireless Standards: Global System for Mobile (GSM). GSM Services and Features, GSM System Architecture, GSM Radio Subsystem. GPRS and EDGE- features.

Text Books:
1. Theodore S. Rappaport, "Wireless Communications Principles and Practice", 2nd Edition, Pearson Education, 2003.
2. Andrea Goldsmith, "Wireless Communications", Cambridge University Press, First Edition, 2005.
3. Ke-Lin Du, Concordia University, Montréal,M. N. S. Swamy, "Wireless Communication Systems.From RF Subsystems to 4G Enabling Technologies", April 2010.

Suggested Reading:
1. Sanjay Kumar, "Wireless Communication the Fundamental and Advanced Concepts" River Publishers, Denmark, 2015
2. Andreas F.Molisch, "Wireless Communications", John Wiley, 2nd Edition, 2006. Vijay Garg, "Wireless Communications and Networking", Elsevier Publications, 2007.

20EEO05

WASTE MANAGEMENT
(Open Elective – I)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Course Objectives: The objectives of this course are,

1. To imbibe the concept of effective utilization of any scrap
2. To become familiar with the processes of all disciplines of engineering.
3. To learn the technique of connectivity from waste to utility.

Course Outcomes: On Successful completion of this course, student will be able to,

1. Categorize the waste based on the physical and chemical properties.
2. Explain the Hazardous Waste Management and Treatment process.
3. Illustrate the Environmental Risk Assessment, methods, mitigation and control.
4. Interpret the Biological Treatment of Solid and Hazardous Waste.
5. Identify the waste disposal options, describe the design and construction, Operation, Monitoring, Closure of Landfills

UNIT - I

Introduction to waste management and Municipal Solid Waste Management: Classification of waste: Agro based, Forest residue, Industrial waste, e-Waste, Municipal Solid Waste Management: Fundamentals Sources, composition, generation rates, collection of waste, separation, transfer and transport of waste, treatment and disposal options.

UNIT - II

Hazardous Waste Management and Treatment: Hazardous Waste Identification and Classification, Hazardous Waste Management: Generation, Storage and collection, Transfer and transport, Processing, Disposal, Hazardous Waste Treatment: Physical and Chemical treatment, Thermal treatment, Biological treatment, Pollution Prevention and Waste Minimisation, Hazardous Wastes Management in India.

UNIT - III

Environmental Risk Assessment: Defining risk and environmental risk, Parameters for toxicity quantification, Types of exposure, Biomagnifications, Effects of exposure to toxic chemicals, risk analysis and risk matrix, methods of risk assessment, mitigation and control of the risk, case studies.

UNIT - IV

Biological Treatment: Solid and Hazardous Waste Composting; bioreactors; anaerobic decomposition ofsolid waste; principles of biodegradation of toxic waste; inhibition; co-metabolism; oxidative and reductive processes; slurry phase bioreactor; in-situ remediation.

UNIT - V

Waste Disposal: Key Issues in Waste Disposal, Disposal Options and Selection Criteria: Disposal options, Selection criteria, Sanitary Landfill: Principle, Landfill processes, Landfill Gas Emission: Composition and properties, Hazards, Migration, Control, Leach ate Formation: Composition and properties. Leach ate migration, Control, Treatment, Environmental Effects of Landfill, Landfill Operation Issues, Design and construction, Operation, Monitoring, Closure of Landfills - Landfill Remediation, national and International Waste management programs.

Text Books:

1. John Pichtel, “Waste Management Practices”, CRC Press, Taylor and Francis Group 2005.
2. LaGrega, M.D.Buckingham,P.L. and Evans, J.C. Hazardous, “Waste Management”, McGraw Hill International Editions, New York, 1994.
3. Richard J. Watts, Hazardous, “Wastes - Sources, Pathways, Receptors”, John Wiley and Sons, New York, 1997.

Suggested Reading:

1. KantiL.Shah, “ Basics of Solid and Hazardous Waste Mgmt. Tech”, 1999, Prentice Hall.
2. S.C.Bhatia, “Solid and Hazardous Waste Management”, 2007 , Atlantic Publishers & Dist.

20MEO09

ORGANIZATIONAL BEHAVIOR
(Open Elective – I)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Course Objectives: The objectives of this course are,

1. Define basic organizational behavior principles and analyze how these influence behavior in the work place.
2. Analyze the influence of perceptions and personality on individual human behavior in the work place.
3. Discuss the theories of Motivation and Leadership.
4. Provide knowledge on different organizational structures; and concepts of culture, climate and organizational development and make the students familiarize with individual behavior.
5. Describe the interpersonal and their intrapersonal reactions within the context of the group and also demonstrate effective communication and decision making skills in small group settings.

Course Outcomes: On successful completion of the course, students will be able to

1. Understand Organizational Behavioral principles and practices.
2. Compare various organizational designs and cultures enabling organizational development.
3. Apply motivational theories and leadership styles in resolving employee,,s problems and decision makingprocesses.
4. Understand the group dynamics, communication network, skills needed to resolve organizational conflicts.
5. Analyze the behavior, perception and personality of individuals and groups in organizations in terms of the key factors that influence organizational behavior.

UNIT – I

Introduction: Organizational behaviour, nature and levels of organizational behavior, individuals in organization, individual differences , personality and ability, the big 5 model of personality , organizationally relevant personality traits, the nature of perception , characteristics of the perceiver, target and situation, perceptual problems.

UNIT – II

Organization structure: Organizational designs and structures, traditional and contemporary organizational designs, organizational culture and ethical behavior , factors shaping organizational culture, creating an ethical culture, concepts, organizational climate, organization conflict, and organization development.

UNIT – III

Motivation and leadership: Motivation, early and contemporary theories of motivation, leadership, early and contemporary approaches to leadership.

UNIT – IV

Group dynamics: Groups and group development, turning groups into effective teams, managing change , process, types and challenges, communicating effectively in organizations, communication process, barriers to communication, overcoming barriers to communication, persuasive communication, communication in crisis situations.

UNIT – V

Power, Politics, Conflict and Negotiations: Power, politics, conflict and negotiations, sources of individual, functional and divisional power, organizational politics conflict, causes and consequences, Pondy,,s model of organizational conflict, conflict resolution strategies.

Text Books:

1. Jennifer George and Gareth Jones, “Understanding and Managing Organizational Behavior”, Pearson Education Inc., 2012.
2. Jon L Pierce and Donald G. Gardner, “Management and Organizational behavior”, Cengage Learning

India (P) Limited, 2001.
3. Richard Pettinger, "Organizational Behaviour", Routledge, 2010.

Suggested Reading:

1. Stephen P. Robbins, Jennifer George and Gareth Jones, "Management and Organizational Behaviour", Pearson Education Inc., 2009.
2. John Schermerhorn, Jr., James G. Hunt and Richard N. Osborn, "Organizational Behaviour", 10th edition, Wiley India Edition, 2009.

20ECO04

PRINCIPLES OF EMBEDDED SYSTEMS
(Open Elective – I)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Computer architecture and microprocessor, Digital logic design, Programming for problem solving.

Course Objectives: The objectives of this course are,

1. To be aware of general computing system, embedded system and classification of embedded system.
2. To analyze the core concepts of embedded system and its architecture.
3. To analyze the RTOS for embedded systems.
4. To learn embedded system development environment.
5. To learn to use tools in embedded software development process.

Course Outcomes: On successful of the course student will be able to,

1. Understand the basics of embedded systems.
2. Analyze the core concepts of Embedded System and Embedded System Architecture.
3. Design and develop Embedded System hardware and software using Embedded C.
4. Analyze the operating system for embedded systems.
5. Analyze the embedded system development environment and tools used in embedded software development process.

UNIT - I

Introduction to Embedded Systems: Embedded Systems, Processor embedded into a system, Embedded hardware units and devices in a system, Embedded software in a system, Examples of embedded systems, Design process in Embedded system, Formalization of system design, Design process and design examples(smart card, digital camera, mobile phone), Classification of Embedded Systems, Skills required for embedded system designer.

UNIT - II

Inter process communication and synchronization of processes, Threads and Tasks. Multiple processes in an application, Multiple threads in an application, Tasks, Task states, Task and data, Clear cut distinction between functions, ISRs and tasks and their characteristics. Concept of semaphores, Shared data, Inter process communication, Signal function, Semaphore functions, Message queue functions, Mailbox functions, Pipe functions, Socket functions, RPC functions.

UNIT - III

Real time operating systems: OS services, Process management, Timer functions, Event functions, Memory management, Device , File, IO subsystems management, Interrupt routine in RTOS environment and handling of Interrupt source calls, RTOS, RTOS task scheduling models, Interrupt latency, Response of tasks as performance metrics, OS security issues.

UNIT - IV

8051 interfacing with displays (LED, 7 segment display, LCD), Switch, Relay, Buzzer, D/A and A/D converters, Stepper motor.

Networked Embedded systems, Serial communication protocols, I2C bus, CAN bus, RS232, Introduction to advanced architectures: ARM and SHARC.

UNIT - V

Embedded software Development process tools: Introduction to embedded software development process and tools, Host and Target machines, linking and locating software, Getting embedded software into target system, Issues in hardware - software design and Co-design.

Testing, simulation and debugging techniques and tools: Testing on host machine, Simulators, Laboratory tools

Text Books:

1. Raj Kamal, "Microcontrollers: Architecture, Programming, Interfacing and System Design", Pearson Education India, 2009.

Suggested Reading:

1. David E. Simon, "An Embedded Software Primer", Pearson Education, 1999.
2. Wayne Wolf, "Computers as Components: Principles of Embedded Computing System Design", Elsevier, 2008.

20BTO04

BIOINFORMATICS
(Open Elective – I)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Prerequisites: The school level basic knowledge in Fundamental science is required.

Course Objectives: The objectives of this course are,

1. To provide elementary knowledge in biology and bioinformatics and biological information available to a biologist on the web and learn how to use these resources on their own.
2. To learn the fundamentals of biological databases, Sequence analysis, data mining, sequence alignment and phylogenetics.
3. To learn methods for determining the predicting gene and protein.

Course Outcomes: On successful completion of the course, students will be able to,

1. Explain the basic concepts of biology and bioinformatics.
2. Identify various types of biological databases used for the retrieval and analysis of the information
3. Explain the sequence analysis and data mining.
4. Discuss the methods used for sequence alignment and construction of the phylogenetic tree.
5. Describe the methods used for gene and protein structure prediction.

UNIT - I

Introduction And Basic Biology: Bioinformatics- Introduction, Scope and Applications of Bioinformatics; Basics of DNA, RNA, Gene and its structure, Protein and metabolic pathway; Central dogma of molecular biology; Genome sequencing, Human Genome Project.

UNIT - II

Biological Databases: Introduction to Genomic Data and Data Organization, types of databases, biological databases and their classification, Biological Databases - NCBI, SWISS PROT/Uniport, Protein Data Bank, Sequence formats; Information retrieval from biological databases; Data mining of biological databases

UNIT - III

Sequence Analysis and Data Mining: Scoring matrices, Amino acid substitution matrices- PAM and BLOSUM; Gap, Gap penalty; Database similarity searching - BLAST, FASTA algorithms to analyze sequence data, FASTA and BLAST algorithms comparison; Data Mining- Selection and Sampling, Pre-processing and Cleaning, Transformation and Reduction, Data Mining Methods, Evaluation, Visualization, Designing new queries, Pattern Recognition and Discovery, Text Mining Tools

UNIT - IV

Sequence Alignment And Phylogentics: Sequence Alignment – Local and Global alignment; Pairwise sequence alignment – Dynamic Programming method for sequence alignment - Needleman and Wunsch algorithm and Smith Waterman algorithm. Multiple sequence alignment - Methods of multiple sequence alignment, evaluating multiple alignments, applications of multiple sequence alignment. Concept of tree, terminology, Methods of phylogenetic analysis, tree evaluation – bootstrapping, jackknifing

UNIT - V

Macromolecular Structure Prediction:

Gene prediction, - neural networks method, pattern discrimination methods, conserved domain analysis; Protein structure basics, protein structure visualization, Secondary Structure predictions; prediction algorithms; Chou-Fasman and GOR method, Neural Network models, nearest neighbor methods, Hidden-Markov model, Tertiary Structure predictions; prediction algorithms; homology modeling, threading and fold recognition, ab initio prediction.

Text Books:

1. David Mount, "Bioinformatics Sequence and Genome Analysis", 2nd edition, CBS Publishers and Distributors Pvt. Ltd., 2005
2. Rastogi SC, Mendiratta N and Rastogi P, "Bioinformatics: Methods and Applications Genomics,Proteomics and Drug discovery", 3rdedition, PHI Learning Private Limited, New Delhi, 2010

Suggested Reading:

1. Baxebanis AD and Francis Ouellette BF, "Bioinformatics a practical guide the analysis of genes and proteins", 2nd edition, John Wiley and Sons, Inc., Publication, 2001
2. Vittal R Srinivas, "Bioinformatics: A modern approach. PHI Learning Private Limited", New Delhi,2009
3. JiXiong, "Essential Bioinfomatics", Cambridge University Press, 2006.

20CSC24

DATA COMMUNICATION AND COMPUTER NETWORKS LAB

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	50 Marks
Credits	1.5

Pre-requisites: Operating Systems, Data Communication and Computer Networks.

Course Objectives: The objectives of this course are,

1. To familiarize students with the communication media, devices, and protocols.
2. To expose students to gain practical knowledge of computer networks and i ts configuration.
3. To create simple network topologies using simulation tools.

Course Outcomes: On successful completion of the course, students will be able to,

1. Identify the different types of wiring equipment"s used in the networks lab.
2. Understand the various network devices like repeater, hub, switch, and routers.
3. Practice the basic network configuration commands like ifconfig, ping, traceroute, nslookup, dig, arp, netstat, nmap.
4. Design and demonstrate network topologies using GNS3.
5. Examine the packet transfer using tcpdump.
6. Analyze the network performance using Wireshark or any tool.

List of Experiments:

1. Study of Network media, cables, and devices and Cable Construction.
2. Demonstration of basic network commands/utilities (both in Windows and Linux).
3. PC Network Configuration.
4. Building a switch-based network / Configuration of Cisco Switch CBS250-24T-4G 24-Port.
5. Configuration of Cisco Router ISR-4331.
6. Configuration of VLAN in Cisco switch.
7. Develop different local area networks using GNS3. Connect two or more Local area networks. Explore various sub-netting options.
8. Configure Static routing using GNS3 tool.
9. Basic OSPF configuration using GNS3 tool.
10. Basic EIGRP Configuration using GNS3 tool.
11. Analysis of network traces using tcpdump.
12. Analysis of network traces using Whireshark.

Text Books:

1. S. Tanenbaum, "Computer Networks", Pearson Education, Fifth Edition, 2013.

Online Resources:

1. https://learningnetwork.cisco.com/s/question/0D53i00000Kt7EkCAJ/tools-for-ccnp-network-simulator-lab-tasks
2. https://www.packettracernetwork.com/
3. https://www.ghacks.net/2019/11/13/gns3-is-an-open-source-graphical-network-simulator-for-windows-linux-and- macos/
4. https://www.imedita.com/blog/top-10-list-of-network-simulation-tools/
5. https://www.gns3.com/

20CSE23

OPERATING SYSTEMS LAB

Instruction	2 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	50 Marks
Credits	1.5

Pre-requisites: Operating systems, Programming for problem solving.

Course Objectives: The objectives of this course are,

1. To explore Unix/Linux operating system.
2. To analyze various system calls available in Linux/Unix.

Course Outcomes: On Successful completion of this course, student will be able to,

1. Understand Linux/Unix environment.
2. Identify and interpret various system programs.
3. Understand and implement shell programming.
4. Simulate memory management and file allocation techniques.
5. Analyze process and file management system calls by creating and/or modifying concurrent programs.
6. Build network-oriented applications using system calls.

List of Experiments:

1. Shell programming.
2. Implementation of memory management techniques like paging and segmentation.
3. Implementation of Linked, Indexed and Contiguous file allocation methods.
4. Demonstration of Linux/Unix file related system calls: mkdir, link, unlink, mount, unmount, users+, chown, chmod, open, close, read, write, lseek, stat, sync.
5. Demonstration of Linux/Unix process related system calls: fork, wait, exec, exit, getpid, getuid, setuid brk, nice, sleep.
6. Development of applications using Linux/Unix system calls: signal, socket, accept, snd, recv, connect.

Text Books:

1. Galvin, Silberschatz, “Operating System Concepts”, 10th Edition, John Wiley & Sons, 2018.
2. Dhananjay Dhamdhare, “Operating Systems-A Concept Based Approach”, 3rd Edition, McGraw Hill Education, 2017.

Suggested Reading:

1. Ekta Walia, “Operating System Concepts”, Khanna Book Publishing, 2020.
2. William Stallings, “Operating Systems Internals and Design Principles”, Pearson Ed., 2012.
3. Charles Crowley, “Operating Systems –A Design Oriented Approach”, McGraw Hill Education, 2017.
4. Andrew S. Tanenbaum, Albert S Woodhull, “Operating systems Design and Implementation”, Pearson Ed., 2009.

20AME03

NATURAL LANGUAGE PROCESSING LAB

Instruction	2 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	50 Marks
Credits	1

Pre-requisites: Artificial Intelligence.

Course Objectives: The objectives of this course are

1. To understand natural language processing and to learn how to apply basic algorithms in this field.
2. To design and implement applications based on natural language processing.
3. To implement various language models.

Course outcomes: On completion of this course, the student will be able to

1. Understand fundamental concept of natural language processing basic commands of text processing using Python.
2. Implement various feature engineering and text representation techniques in NLP
3. Implement classification on Text using different classification algorithms.
4. Identify semantic relationships between words using semantic analysis.
5. Implement NLP Pipe lines used to solve real world applications.

List of Experiments

1. Explore NLP Libraries used in Python language.
2. Implement pre-processing steps: Tokenization, Stop Word Removal, Stemming and lemmatization.
3. Develop an application to explore Text Representation techniques: Bag Of Words, TF-IDF, Bag Of N grams, Word Embeddings.
4. Implement a POS tagging
5. Implement chunking to extract Noun phrases.
6. Build a text classification system using different classification algorithms.
7. Implement Deep Learning for Text Classification using RNN/CNN/LSTM.
8. Identify semantic relationships between the words from given text(Use WordNet dictionary)
9. Perform Name Entity Recognition(NER) on given text.
10. One real life Natural language application to be implemented .

Textbooks:

1. Practical Natural Language Processing A Comprehensive Guide to Building Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta & Harshit Surana Published by O"Reilly Media, Inc., June 2020: First Edition
2. James Allen, Bejamin/ cummings, "Natural Language Understanding", 2nd edition, 1995.

Suggested Reading:

1. Real-World NLP SystemsTanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.

Online Resources:

1. https://nptel.ac.in/courses/106101007/
2. http://www.cs.colorado.edu/~martin/sp2.html
3. https://web.standford.edu/~jurafsky/sp3/

20AME05

DATA AND VISUAL ANALYTICS LAB

Instruction	2 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	50 Marks
Credits	1

Pre-requisites: Basic knowledge of Machine Learning.

Course Objectives: The objectives of this course are

1. Learn **visual** and **computation** techniques and tools, for typical data types.
2. Work on **real datasets and problems**.
3. Learn **practical** know-how (useful for jobs, research) through significant hands-on programming assignments.

Course Outcomes: On Successful completion of the course, students will be able to

1. Understand and describe the main concepts of data visualization
2. Create ad-hoc reports, data visualizations, and dashboards using Tableau Desktop, Creating several different charts using Tableau
3. Publish the created visualizations to Tableau Server and Tableau Public.
4. Develop interactive visualizations that couple machine learning with visual interfaces of data for exploration and sense making.
5. Understand and visualize the Time series data.

List of Experiments:

1. Introduction to Tableau, Course introduction, Getting started with Tableau Desktop, Connecting to the tutorial dataset, creating the first charts, Filtering and sorting data
2. Creating common visualizations (bar charts, line charts etc.),
3. Assembling a dashboard layout, Using dashboard filters.
4. Transform the data: Creating simple calculations in Tableau, Using table calculations
5. Visual Interactions: Interactivity with text and visual tooltips Interactivity with actions (filter, highlight, URL) , Drilldown between dashboards
6. Advanced visualizations: Creating more advanced chart types, using multiple source tables
7. Data Storytelling: Intro to data storytelling, creating a data story in Tableau, Overview of the Tableau ecosystem, Further learning opportunities.
8. Distributed Stochastic Neighbor Embedding (t-SNE) .
9. Online Social Networks, Social Data Analysis, Graph Visualization and Navigation.
10. Finding Patterns in Time Series Data.

TEXTBOOK:

1. Visualization Analysis & Design by Tamara Munzner (2014) (ISBN 9781466508910)

REFERENCES BOOKS:

1. Interactive Data Visualization for the Web by Scott Murray 2nd Edition (2017)
2. The Grammar of Graphics by Leland Wilkinson
3. ggplot2 Elegant Graphics for Data Analysis by Hadley Wickham

20CSE16

INTERNET OF THINGS LAB
(Professional Elective – II)

Instruction	2 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	50 Marks
Credits	1

Pre-requisites: Computer architecture and microprocessor, Programming for problem solving.

Course Objectives: The objectives of this course are,

1. To understand the basics of IoT and its components.
2. To impart practical knowledge on IoT applications.
3. To develop skills required for building real-time IoT based projects.

Course Outcomes: On successful completion of the course, students will be able to,

1. Use of various hardware and software IoT components.
2. Perform experiments by Interfacing I/O devices, sensors to Raspberry Pi/Arduino.
3. Understand and analyze communication protocols in IoT.
4. Monitor data and controlling of devices.
5. Develop Real time IoT based projects.

List of Experiments:

1. Introduction to IoT equipments and perform necessary software installation.
2. Write a program to interface LED/Buzzer with Arduino and to turn ON LED for 1sec after every 2 seconds.
3. Write a program to interface Digital sensor PIR with Arduino and to turn ON LED when motion detected.
4. Write a program to interface DHT22 sensor with Arduino and display temperature and humidity readings.
5. Write a program to interface motor using relay with Raspberry Pi. Turn ON motor when the temperature is high.
6. Write a program to interface LCD with Raspberry Pi and print temperature and humidity readings on it.
7. Write a program to interface flame/smoke sensor with Arduino /Raspberry Pi and give an alert message when flame/smoke is detected.
8. Implement any case study using Arduino/Raspberry Pi.

Text Books:

1. Arshdeep Bahga and Vijay Madisetti, "Internet of Things: A Hands-on Approach", Universities Press, 2014.

Suggested Reading:

1. Dr. SRN Reddy, Rachit Tirnkral and Manasi Mishra, "Introduction to Internet of Things: A practical Approach", ETI Labs, 2018.
2. Adrian McEwen, "Designing the Internet of Things", Wiley, 2013.
3. Raj Kamal, “Internet of Things:Architecture and Design”, McGraw Hill, 2017.
4. Cuno Pfister, "Getting Started with the Internet of Things", 0 Reilly Media, 2011.
5. O. Vermesan, P. Fries**s, “**Internet of Things – Converging Technologies for Smart Environments and Integrated Ecosystems”, River Publishers, Series in Communications, 2013.

Online Resources / Weblinks / NPTEL Courses:

1. Li Da Xu, Wu He, and Shancang Li, “Internet of Things in Industries: A Survey “, IEEE Transactions on Industrial Informatics, Vol. 10, No. 4, Nov. 2014.
2. T. Winter, P. Thubert, A. Brandt, J. Hui, R. Kelsey, P. Levis, K. Pister, R. Struik, JP. Vasseur, R. Alexander, “RPL: IPv6 Routing Protocol for Low-Power and Lossy Networks”, IETF, Standards Track, Mar. 2012.

20CAE07

COMPUTER VISION LAB

Instruction	2 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	50 Marks
Credits	1

Course Objectives: The objectives of this course are

1. To learn with practical aspects of computing with images.
2. To improve quality of image by applying enhancement techniques.
3. To understand Feature Extraction algorithms.

Course Outcomes: On Successful completion of the course, students will be able to

1. Recognise the fundamental issues and challenges of computer vision.
2. Interpret edges using various kernels and transformations.
3. Analyse images and videos for problems such as tracking and structure from motion
4. Identify object, scene recognition and categorization algorithms for real time images
5. Evaluate computer vision system for real world problems

Description: Use any tool like OpenCV/ Scilab/ python/R Programming etc.,

List of Programs

1. Familiarization of the tool used for computer vision.
2. Implement basic image operations
    a. Loading and displaying an image.
    b. Color formats
    c. Image enhancement.
3. Demonstrate fourier Transformations.
4. Implement edge detection on images using any two edge detection masks.
5. Detection of motion from structure.
6. Implementation Dense motion estimation
7. Implement texture extraction of a given image.
8. **Case Study: Object** detection like recognizing pedestrians..
9. **Case Study: Face** recognition of an image.
10. **Case Study:** Instance recognition of an image.
11. **Case Study: Demonstrate** model based reconstruction using tensorflow.

Textbooks:

1. Gary Bradski and Adrian Kaehler, "Learning OpenCV", O'Reilly Media, Inc., 1st Edition, 2008.
2. Talita Perciano and Alejandro C Frery, "Introduction to Image Processing Using R:" Learning by Examples, Springer, 1st Edition, 2013.
3. "Computer Vision: Algorithms and Applications" by Richard Szeliski; Springer-Verlag London Limited 2011.

Suggested Reading:

1. R C Gonzalez and R E woods, "Digital Image Processing", Addison Pearson, 3rd Edition, 2013.
2. David A.Forsyth and Jean Ponce, Computer Vision-A Modern Approach, PHI, 1st Edition, 2003.

Online Resources:

1. https://atoms.scilab.org/toolboxes/IPCV/1.1
2. https://docs.opencv.org/2.4/doc/tutorials/tutorials.html.

20EGC03

Employability Skills Lab

Instruction	2 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	50 Marks
Credits	1