



HINDUSTAN
INSTITUTE OF TECHNOLOGY & SCIENCE
(DEEMED TO BE UNIVERSITY)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CURRICULUM AND SYLLABUS

(Applicable for Students admitted from Academic Year 2021-22)

M.Tech (COMPUTER SCIENCE AND ENGINEERING)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SCHOOL OF COMPUTER SCIENCES

HINDUSTAN INSTITUTE OF TECHNOLOGY & SCIENCE

VISION AND MISSION

Motto:

To Make Every Man a Success and No Man a Failure

VISION

“TO MAKE EVERY MAN A SUCCESS AND NO MAN A FAILURE”

MISSION

- To create an ecosystem that promotes learning and world class research.
- To nurture creativity and innovation.
- To instill highest ethical standards and values.
- To pursue activities for the development of the Society.
- To develop national and international collaborations with institutes and industries of eminence.
- To enable graduates to become future leaders and innovators.

VALUE STATEMENT

- Integrity, Innovation, Internationalization

DEPARTMENT OF COMPUTER SCIENCE

VISION AND MISSION

VISION

To excel in Computer Science and Engineering education, research and project management by empowering the students with strong conceptual knowledge.

MISSION

- M1.** To educate the students with basic foundation blocks of core and allied disciplines of Computer Science and Engineering.
- M2.** To provide practical skills in the advancements of the Computer Science and Engineering field required for the growing dynamic IT and ITES industries.
- M3.** To sculpt strong personal, technical, research, entrepreneurial, and leadership skills.
- M4.** To inculcate knowledge in lifelong learning, professional ethics and contribution to the society.

M.Tech (COMPUTER SCIENCE AND ENGINEERING)

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

The program is expected to enable the students to

- PEO I** Excel in their professional career by applying advanced knowledge and/or pursue higher education including research by applying the knowledge of Computer Science and Engineering.
- PEO II** Assess the industry requirements and provide tangible solutions with social consciousness and ethical values.

PROGRAM OUTCOMES (ALIGNED WITH GRADUATE ATTRIBUTES) (PO)

At the end of this program, graduates will be able to

- PO1 Scholarship of knowledge:** Acquire in-depth knowledge of specific discipline or professional area, including wider and global perspective, with an ability to discriminate, evaluate, analyse and synthesize existing and new knowledge, and integration of the same for enhancement of knowledge.
- PO2 Critical Thinking:** Analyze complex engineering problems critically, apply independent judgement for synthesizing information to make intellectual and/or creative advances for conducting research in a wider, theoretical, practical and policy context.
- PO3 Problem Solving:** Think laterally and originally, conceptualize and solve engineering problems, evaluate a wide range of potential solutions for those and arrive at feasible, optimal solutions after considering public health and safety, cultural, societal and environmental factors in the core areas of expertise.
- PO4 Research Skill:** Extract information pertinent to unfamiliar problems through literature survey and experiments, apply appropriate research methodologies, techniques and tools, design, conduct experiments, analyze and interpret data,,

demonstrate higher order skill and view things in a broader perspective, contribute individually / in group(s) to the development of scientific of scientific / technological knowledge in one or more domains of engineering.

- PO5 Usage of modern tools:** Create, select, learn, and apply appropriate techniques, resources, and engineering and IT tools, including prediction and modeling, to complex engineering activities with an understanding of the limitations.
- PO6 Collaborative and multidisciplinary work:** Process knowledge and understanding of group dynamics, recognize opportunities and contribute positively to collaborate-multidisciplinary scientific research, demonstrate a capacity for self-management and teamwork, decision—making based on open-mindedness, objectivity and rational analysis in order to achieve common goals and further the learning of themselves as well as others.
- PO7 Project Management and Finance:** Demonstrate knowledge and understanding of engineering and management principles and apply the same one’s own work, as a member and leader in a team, manage projects efficiently in respective disciplines and multidisciplinary environments after consideration of economic and financial factors.
- PO8 Communication:** Communicate with engineering community, and with society at large, regarding complex engineering activities confidentially an effectively, such as, being able to comprehend and write effective reports and design documentation by adhering to appropriate standards, make effective presentations, and give and receive clear instructions.
- PO9 Life-Long Learning:** Recognize the need for, and have the preparation and ability to engage in life-long learning independently, with a high level of enthusiasm and commitment to improve knowledge and competence continuously.
- P10 Ethical Practices and Social Responsibility:** Acquire professional and intellectual integrity, professional code of conduct, ethics of research and scholarship, consideration of the impact of research outcomes on professional practices and an

understanding of responsibility to contribute to the community for sustainable development of society.

- P11 Independent and Reflective Learning:** Observe and examine critically the outcomes of one's actions and make corrective measures subsequently, and learn from mistakes without depending on external feedback

PROGRAM SPECIFIC OUTCOMES (PSO)

- PSO1:** To impart knowledge in Advanced Operating System, Advance Data Base Technology, Advanced Data Structures & Algorithms for analyzing and the solving complex problem.
- PSO2:** To develop the skill set of the students especially in Data Science and Engineering, Software Engineering and Information Security.
- PSO3** To inculcate the analytical knowledge in the students for innovative system design using modern tools and techniques.

M.Tech - COMPUTER SCIENCE AND ENGINEERING

(65 CREDIT STRUCTURE)

SEMESTER - I

SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
1	BS	MAA3706	Statistics for Computer Science ⁺	3	0	2	4	0	5
2	PC	CSA3701	Advanced Data Structures and Algorithms ⁺	2	0	2	3	0	4
3	PC	CSA3702	Machine Learning ⁺	2	0	2	3	0	4
4	PE	CSA****	Department Elective - I	2	0	2	3	0	4
5	PE	CSA****	Department Elective - II	2	0	2	3	0	4
6	PE	ZZZ3715	Research Methodology & IPR*	2	0	0	2	0	2

PRACTICAL

7	BS	CSA3781	Mini project	0	0	6	2	0	6
Total							20		29

SEMESTER - II

SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
1	PC	CSA3703	Advanced Operating Systems	2	0	2	3	0	4
2	PC	CSA3704	Soft computing	3	0	2	3	0	5
3	PC	CSA3705	Advanced Data Base Technology	2	1	2	3	0	4
4	PC	CSA3706	MOOC Course	3	0	0	3	0	3

5	PE	CSA****	Department Elective - III	3	1	0	4	0	3
6	OE	*****	Open Elective	2	0	0	2	0	3
PRACTICAL									
7	PC	CSA3751	Seminar	0	0	3	2	0	2
Total							20		25

*Research Methodology & IPR is a compulsory Course

*Professional Core papers Common for M.Tech. CSE with Specialization of Data Science, Artificial Intelligence and Cyber Security

M.Tech - COMPUTER SCIENCE AND ENGINEERING									
SEMESTER - III									
SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
1	PC	CSA****	Department Elective – IV	3	0	0	3	0	3
PRACTICAL									
2	PC	CSA3782	Project Phase –I	0	0	24	8	0	24
Internship/Mini Project							2	0	
Total							13		27
SEMESTER - IV									
SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
PRACTICAL									
7	CSA3783	PC	Project Phase –II	0	0	24	12	0	24

Total									12		24
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M.Tech - COMPUTER SCIENCE AND ENGINEERING										
DEPARTMENT ELECTIVES(ARTIFICIAL INTELLIGENCE)										
ELECTIVE I										
SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH	
1	PE	CSC3721	Optimization Techniques	2	0	2	3	0	2	
2	PE	CSC3722	Computational Neuroscience	2	0	2	3	0	2	
3	PE	CSB3723	Agent Based Intelligent Systems	2	0	2	3	0	2	
4	PE	CSC3723	Industrial AI	2	0	2	3	0	2	
ELECTIVE II										
SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH	
1	PE	CSA3733	Computer Vision	3	0	0	3	0	3	
2	PE	CSC3723	Game Theory for AI	3	0	0	3	0	3	
3	PE	CSB3722	Recommender System	3	0	0	3	0	3	
4	PE	CSC3724	Reinforcement Learning	3	0	0	3	0	3	
ELECTIVE III										
SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH	

	Y								
1	PE	CSC3725	Nature-Inspired Computing	3	0	0	3	0	3
2	PE	CSC3727	Cognitive Computing	3	0	0	3	0	3
3	PE	CSC3728	Emotional Intelligence	3	0	0	3	0	3
4	PE	CSB3729	Principles of Deep Learning	3	0	0	3	0	3

ELECTIVE IV

SL. NO	COURSE CATEGOR Y	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
1	PE	CSC3726	Natural Language Processing	3	0	0	3	0	3
2	PE	CSC3727	Speech Information Processing	3	0	0	3	0	3
3	PE	CSC3731	Human Centered Computing	3	0	0	3	0	3
4	PE	CSC3729	AI in Cyber Security	2	0	2	3	0	3

COURSE TITLE	STATISTICS FOR COMPUTER SCIENCE			CREDITS	4
COURSE CODE	MAA3706	COURSE CATEGORY	BS	L-T-P-S	3-0-2-0
Version	1.0	Approval Details	23 ACM, 06.02.2021	LEARNING LEVEL	BTL 4
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%
Course Description	This course serves as an introduction to the world of Statistical models. It describes how to use forecasting methods to support managerial, financial, and operational.				
Course Objective	<ol style="list-style-type: none"> 1. In-depth knowledge in the mathematical, probabilistic, and statistical foundations. 2. Programming software engineering skills. 3. Ability to apply statistical analysis and modeling to reason from data in a principled manner. 4. Combined theoretical and technical skills to use for real-world applications. 				
Course Outcome	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> 1. Develop statistical models for business analytics 2. Perform marketing analytics using statistical models. 3. Analyze customer data for customer acquisition, retention, and profitability. 4. Analysis time series analysis. 				

	5. Analysis of variance.
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Prerequisites: NIL

CO, PO AND PSO MAPPING

CO	PO - 1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO - 10	PO- 11	PO- 12	PSO- 1	PSO- 2	PSO- 3
CO-1	-	2	2	-	1	-	-	1	-	-	-	-	-	-	-
CO-2	-	3	3	3	-	-	3	-	2	2	-	-	-	-	-
CO-3	-	-	2	2	2	1	2	2	2	-	-	-	-	-	-
CO-4	2	-	2	2	2	2	-	-	-	-	-	-	-	2	1
CO-5	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-

1: Weakly related, 2: Moderately related and 3: Strongly related

MODULE 1: PROBABILITY

(12)

Introduction to probability–Bayes theorem-Random variables-discrete random variable (Binomial, Poisson, Geometric), Continuous random variable (Uniform, Exponential and Normal distribution). Moment generating function.

**CO-1
BTL-2**

Suggested Activities: Basic knowledge on probability

Suggested sources: Introduction to probability

MODULE 2: TWO DIMENSIONAL RANDOM VARIABLES

(12)

Joint distribution –Marginal and conditional distribution covariance –correlation and regression (linear and Multiple). Central limit theorem, Chebyshev’s inequality.

**CO-2
BTL-2**

Suggested Activities: Basic knowledge on probability

Suggested sources: Probability, Statistics and Random Processes-T.Veerarajan

MODULE3: THEORY OF SAMPLING AND TEST OF HYPOTHESIS

(12)

Introduction to hypothesis, large and small samples test-mean and variance (single and double), test, Independent of attributes and contingency table.

**CO-3
BTL-3**

Suggested Activities: Basic knowledge of sampling

Suggested sources: Probability, Statistics and Random Processes-T.Veerarajan		
MODULE4:TIME SERIES ANALYSIS		(12)
<p>Introduction to Stochastic process, Time series as a discrete stochastic process. Stationarity, Main characteristics of stochastic process (mean, auto covariation and auto correlation function). Autoregressive models AR(p),Yull-Worker equation Auto regressive moving average models ARMA. Seasonality in Box–Jenkins model.</p> <p>Suggested Activities: Basic knowledge of Time series analysis</p> <p>Suggested sources: Time series-Maurice George kendall,j.k.Ord</p>		<p>CO-4</p> <p>BTL-2</p>
MODULE 5: DESIGN OF EXPERIMENTS (12)		
<p>Analysis of variance (one way & two ways) classification – completely randomized design –randomized block design – Lattin square design.</p> <p>Suggested Activities: Basic knowledge of design of experiments</p> <p>Suggested sources: Probability, Statistics and Random Processes-T.Veerarajan</p>		<p>CO-5</p> <p>BTL-3</p>
TEXT BOOKS		
1	T.Veerarajan , “Probability,Statisticsand Random Processes” Tata McGraw-Hill,Education,2008	
2	Maurice George Kendall, J. K. Ord,“Time series” Oxford University Press, 1990	
REFERENCE BOOKS		
1	K.S.Trivedi.John , “Probability and statistics with reliability, Queuing and computerScience Application”, Second edition, Wiley&Son, 2016	
2	Levin Richard and Rubin Davids, “Statistics for Management “, Pearson Publications,2016	
3	Robert Stine, Dean Foster , “Statistical for Business: Decision Making and Analysis”. Pearson Education, 2nd edition,2013	
E BOOKS		
1	http://www.math.harvard.edu/~knill/teaching/math144_1994/probability.pdf	
2	http://www.dartmouth.edu/~chance/teaching_aids/books_articles/probability_book/book.pdf	
MOOC		

1	https://nptel.ac.in/courses/IIT-MADRAS/Principles_of_Communication1/Pdfs/1_5.pdf
2	https://nptel.ac.in/courses/110104024/

COURSE TITLE	ADVANCED DATA STRUCTURES AND ALGORITHMS			CREDITS	3
COURSE CODE	CSA3701	COURSE CATEGORY	PC	L-T-P-S	2-0-2-0
Version	1.0	Approval Details	23 ACM, 06.02.2021	LEARNING LEVEL	BTL-4
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%
Course Description	This course serves as an introduction to the world of Advanced Data Structures and algorithms. And used to Estimate time and space complexities for a given algorithm.				
Course Objective	<ol style="list-style-type: none"> 1. To Estimate time and space complexities for a given algorithm. 2. Describe the heap property and the use of heaps as an implementation of priority queues. 3. Illustrate parallel algorithm models. 4. Use a heuristic approach to solve an appropriate problem. 				
Course Outcome	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> 1. Illustrate the various self- balanced trees and their operations. 2. Apply an appropriate algorithmic approach to a given problem. 3. Illustrate parallel algorithm models. 				

4. Use a heuristic approach to solve an appropriate problem.

Prerequisites: 1. Fundamentals of Data Structures 2. Design and Analysis of Algorithm

CO, PO AND PSO MAPPING

CO	PO -1	PO- 2	PO- 3	PO- 4	PO- 5	PO- 6	PO- 7	PO- 8	PO- 9	PO -10	PO- 11	PO- 12	PSO- 1	PSO- 2	PSO- 3
CO-1	-	2	2	2	1	2	3	3	3	1	1	2	1	-	-
CO-2	-	2	2	2	2	2	2	2	2	2	3	3	-	-	3
CO-3	1	2	3	3	3	1	2	2	2	1	1	-	-	2	-
CO-4	2	1	3	2	2	2	2	2	2	2	2	2	1	2	-
CO-5	-	-	3	2	2	2	2	2	2	2	3	3	-	1	3

1: Weakly related, 2: Moderately related and 3: Strongly related

MODULE1: INTRODUCTION (9)

Abstract Data Types-Time and Space Analysis of Algorithms-Big Oh and Theta Notations- Average, best and worst case analysis-Simple recurrence relations-Mappings.

Suggested Activities: Find the time and space complexities of the following algorithms

1.Sum of n numbers 2.Factorial of n3.Matrix multiplication 4.Insertion sort

Suggested sources:

<https://nptel.ac.in/courses/106105164/><https://nptel.ac.in/courses/106105085/18>

CO-1

BTL-2

MODULE 2:HEAP STRUCTURES (9)

Min-maxheaps-Heaps-Leftistheaps-Binomialheaps-Fibonacciheaps-Skewheaps-Lazy-binomial heaps.

CO-2

<p>Suggested Activities: Implement the following Heap structures using C,C++,Java or Python</p> <p>1. Max-min Heap 2. Binomial Heap 3. Fibonacci Heap</p> <p>Suggested sources: https://nptel.ac.in/courses/106102064/20, 21</p>	<p>BTL-2</p>
<p>MODULE3:SEARCH STRUCTURES (9)</p>	
<p>Binarysearchtrees-AVLtrees-2-3trees-2-3-4trees-Red-blacktrees-B-trees-splaytrees-k-d trees,Tries.</p> <p>Suggested Activities: Implement the following tree structures using C, C++, Java or Python</p> <p>1.AVLTree 2.Red-Blacktree 3. Splay Trees 4. K-d Trees5. Tries</p> <p>Suggested sources: https://nptel.ac.in/courses/106102064/11, 12,14,15,18</p>	<p>CO-3</p> <p>BTL-3</p>
<p>MODULE 4: ALGORITHM DESIGN TECHIQUES(9)</p>	
<p>Divide and conquer and Greedy: Quicksort-Strassen’s matrix multiplication-convex hull-Tree- vertex splitting-Job sequencing with deadlines-Optimal storage on tapes Dynamic Programming and Backtracking: Multistage graphs - 0/1 knapsack - 8- queens problem - graph coloring, Palindrome partitioning.</p> <p>Suggested Activities: Solve the following problems</p> <p>1. Quick sort</p> <p>2. Strassen’s matrix multiplication</p> <p>3. 8-queensproblem</p> <p>4. Palindrome Partitioning</p> <p>Suggested Source:</p> <p>https://nptel.ac.in/courses/106106131/15https://nptel.ac.in/courses/106102011/7</p>	<p>CO-4</p> <p>BTL-2</p>
<p>MODULE 5:ADVANCED ALGORITHMS (9)</p>	
<p>Parallel Algorithms: Basic Techniques- Work & Efficiency - Distributed Computation - Heuristic &Approximation Approaches.</p> <p>Suggested Activities: Implement following heuristic algorithms</p>	<p>CO-5</p> <p>BTL-2</p>

<ol style="list-style-type: none"> 1. HillClimbing 2. SimulatedAnnealing 3. ParticleSwarmOptimization 4. GeneticAlgorithm <p>Suggested sources: https://nptel.ac.in/courses/106104120/4, https://nptel.ac.in/courses/106106126/9 - 15</p>	
TEXT BOOKS	
1	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to algorithms", Third edition, MIT press, 2013
REFERENCE BOOKS	
1	E. Horowitz, S. Sahni and Dinesh Mehta, Fundamentals of Data structures in C++, University Press, 2009.
2	E. Horowitz, S. Sahni and S. Rajasekaran, Computer Algorithms/C++, Second Edition, University Press, 2007.
3	Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Third Edition, Pearson Education, Asia. 2007.
4	Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar, "Introduction to Parallel Computing", Second Edition, Addison Wesley, 2003
E BOOKS	
1	Omid Bozorg-Haddad, Mohammad Solgi, Hugo A. Loáiciga, "Meta-heuristic and Evolutionary Algorithms for Engineering Optimization 1st Edition", Wiley, 2017
2	Introduction to Parallel Computing - ResearchGate - Free Ebook
MOOC	
1	Advanced Data structures and Algorithms, https://nptel.ac.in/courses/106105164/
2	Artificial Intelligence Search methods for problem solving

https://onlinecourses.nptel.ac.in/noc18_cs51/

COURSE TITLE	MACHINE LEARNING			CREDITS	3
COURSE CODE	CSA3702	COURSE CATEGORY	PC	L-T-P-S	2-0-2-0
Version	1.0	Approval Details	23 ACM, 06.02.2021	LEARNING LEVEL	BTL-4
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%
Course Description	This course serves as an introduction to Machine learning and to understand real time applications.				
Course Objective	<ol style="list-style-type: none">1. To Apply multilayer perceptron using simple machine learning techniques.2. To Use decision trees and statistics models3. To introduce students to the basic concepts and techniques of Machine Learning4. To become familiar with regression methods, classification methods, clustering methods5. To become familiar with Dimensionality reduction Techniques.				

Course Outcome	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> 1. Gain knowledge about basic concepts of Machine Learning 2. To Use data analysis for machine learning 3. Identify machine learning techniques suitable for a given problem 4. Use the optimization technique for solving machine learning problem. 5. Design application using machine learning techniques.
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Prerequisites: Fundamentals of Programming

CO, PO AND PSO MAPPING

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	-	3	2	2	1	2	2	3	3	2	3	2	-	2	3
CO-2	-	2	2	3	1	2	2	3	3	2	3	2	-	2	-
CO-3	3	2	2	1	2	2	3	3	2	3	2	-	2	-	1
CO-4	2	-	2	1	2	2	3	3	2	3	2	-	2	-	2
CO-5	-	-	3	-	2	1	2	2	3	3	2	3	2	-	2

1: Weakly related, 2: Moderately related and 3: Strongly related

MODULE1: INTRODUCTION (9)

<p>Learning - Types of machine learning - Supervised learning - The brain and the neurons, Linear Discriminants - Perceptron - Linear Separability - Linear Regression - Multilayer perceptron - Examples of using MLP - Back propagation of error.</p> <p>Suggested Activities: Design a Multilayer Perceptron for Rain Forecasting system</p> <p>Suggested sources: Enrico C, Simon W, Jay R, Machine Learning Techniques for Space Weather, Elsevier, 2018</p>	<p>CO-1</p> <p>BTL-2</p>
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MODULE 2: CLASSIFICATION ALGORITHMS (9)

<p>Decision trees-Constructing decision trees-Classification of regression trees-Regression example-Probability and Learning: Turning data in to probabilities-Some basic statistics-Gaussian mixture models-Nearest Neighbor methods.</p> <p>Suggested Activities: Explore the Regression Examples in Machine Learning</p> <p>Suggested sources: Norman Matlof, "Statistical Regression and Classification: From Linear Models to Machine Learning", CRC Press, 2017.</p>	<p>CO-2</p> <p>BTL-2</p>
<p>MODULE3: ANALYSIS (9)</p>	
<p>The k-Means Algorithm-Vector Quantization's-Linear Discriminant Analysis-Principal component analysis-Factor Analysis-Independent component analysis-Locally Linear embedding-Isomap- Least squares optimization-Simulated annealing.</p> <p>Suggested Activities: Simulated annealing/Modelling on any data science application.</p> <p>Suggested sources: L.M.Rasdi, Simulated Annealing Algorithm for Deep Learning, Procedia Computer Science, Volume: 72, 2015.</p>	<p>CO-3</p> <p>BTL-3</p>
<p>MODULE4: OPTIMIZATION TECHNIQUES (9)</p>	
<p>The Genetic algorithm-Genetic operators-Genetic programming-Combining sampling with genetic programming-Markov Decision Process-Markov Chain Monte Carlo methods:sampling- Montecarlo- Proposal distribution.</p> <p>Suggested Activities: Design an Encryption algorithm using Genetic algorithm</p> <p>Suggested sources: <u>Harsh Bhasin</u>, Application of Genetic Algorithms in Machine learning,, International Journal of Computer Science and Information Technologies, Vol. 2 (5), 2011.</p>	<p>CO-4</p> <p>BTL-2</p>
<p>MODULE5: PYTHON FOR MACHINE LEARNING (9)</p>	
<p>Bayesian Networks-Markov Random Fields-Hidden Markov Models-Tracking methods.Python: Installation-Python for MATLAB AND R users-Code Basics-Using NumPy and Matplotlib.</p> <p>Suggested Activities: Design a simple application using NumPy and Matplotlib.</p> <p>Suggested sources: <u>Rakshith Vasudev</u>, Introduction to Numpy-1: An absolute beginners guide to</p>	<p>CO-5</p> <p>BTL-2</p>

MachineLearningandDatascience.,2017.	
TEXT BOOKS	
1	Kevin P. Murphy, "Machine Learning – A probabilistic Perspective", MIT Pres, 2016.
2	Randal S, "Python Machine Learning, PACKT Publishing, 2016.
REFERENCE BOOKS	
1	EthemAlpaydin, "Machine Learning: The New AI", MIT Press, 2016.
2	Shai Shalev-Shwartz, Shai Ben-David, "Understanding Machine Learning: From Theory to Algorithms", Cambridge University Press, 2014.
3	Sebastian Raschka, "Python Machine Learning", Packt Publishing Ltd, 2015.
E BOOKS	
1	http://www.cs.huji.ac.il/~shais/UnderstandingMachineLearning/index.html
2	http://www.mlyearning.org/
MOOC	
1	https://www.coursera.org/learn/machine-learning
2	https://www.my-mooc.com/en/categorie/machine-learning

COURSE TITLE	RESEARCH METHODOLOGY & IPR			CREDITS	2
COURSE CODE	ZZZ3715	COURSE CATEGORY	PC	L-T-P-S	2-0-0-0
Version	1.0	Approval Details	23 ACM, 06.02.2021	LEARNING LEVEL	BTL-2

ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%
Course Description	This course is designed to understand the research problem, literature studies, plagiarism and ethics, To get the knowledge about technical writing, to analyze the nature of intellectual property rights and new developments				
Course Objective	<ol style="list-style-type: none"> 1. To give an overview of the research methodology and explain the technique of defining a research problem 2. To explain the functions of the literature review in research. 3. To explain carrying out a literature search, its review, developing theoretical and conceptual framework sand writing a review. 4. To explain various research designs and their characteristics. 				
Course Outcome	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> 1. Understand research problem formulation. 2. Understand the way of doing Literature review and to write proposal in an effective way. 3. Understanding the data collection, sampling techniques used in the statistical analysis for effective data analysis. 4. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits. 5. Understand the nature of Intellectual property rights in national and international level collaborations 				
Prerequisites: nil					
CO, PO AND PSO MAPPING					

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	-	2	1	1	1	2	3	2	3	2	3	2	-	3	2
CO-2	-	2	2	3	1	1	2	3	3	2	3	2	-	2	-
CO-3	3	2	2	1	2	2	3	3	2	3	2	-	2	-	1
CO-4	2	-	2	1	2	2	3	3	2	3	2	-	2	-	2
CO-5	-	-	3	-	2	1	2	2	3	3	2	3	2	-	2
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE1: RESEARCH PROBLEM FORMULATION														(9)	
Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations													CO-1 BTL-2		
MODULE 2: RESEARCH PROPOSAL AND ETHICS														(9)	
Effective literature studies approach, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.													CO-2 BTL-2		
MODULE3:DATA ANALYSIS AND INTERPRETATION														(9)	
Classification of Data, Methods of Data Collection, Sampling, Sampling techniques procedure and methods, Ethical considerations in research Data analysis, Statistical techniques and choosing an appropriate statistical technique, Hypothesis, Hypothesis testing, Data processing software (e.g. SPSS etc.), statistical inference, Interpretation of results.													CO-3 BTL-3		
MODULE4: NATURE OF INTELLECTUAL PROPERTY														(9)	

<p>Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.</p>	<p>CO-4 BTL-2</p>
<p>MODULE5: PATENT RIGHTS AND NEW DEVELOPMENTS IN IPR (9)</p>	
<p>Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.</p>	<p>CO-5 BTL-2</p>
<p>TEXT BOOKS</p>	
<p>1</p>	<p>Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.</p>
<p>2</p>	<p>T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008</p>
<p>REFERENCE BOOKS</p>	
<p>1</p>	<p>Ranjit Kumar, 2 nd Edition, "Research Methodology: A Step by Step Guide for beginners"</p>
<p>2</p>	<p>Creswell, John W. Research design: Qualitative, quantitative, and mixed methods, approaches. Sage publications, 2013.</p>
<p>3</p>	<p>Donald Cooper & Pamela Schindler , "Business Research Methods ", TMGH, 9th edition</p>
<p>E BOOKS</p>	
<p>1</p>	<p>https://www.modares.ac.ir/uploads/Agr.Oth.Lib.17.pdf</p>
<p>2</p>	<p>https://drive.google.com/file/d/0Bwk5FIsI0ctxNXBvU2dGVlJhSTg/view?usp=drivesdk</p>
<p>MOOC</p>	
<p>1</p>	<p>https://www.coursera.org/browse/physical-science-and-engineering/research-methods</p>

2	https://www.ccrm.in/register.html
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COURSE TITLE	MINI PROJECT			CREDITS	2
COURSE CODE	CSA3781	COURSE CATEGORY	PC	L-T-P-S	0- 0- 6- 0
Version	1.0	Approval Details	23 ACM, 06.02.2021	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Review (Concept)	Second Review (Design)	Third Review (Experiment/ Analysis)	Project Report and Vivo- voce (Results and Conclusion) Attendance	ESE	
20%	30%	20%	30%	---	
Course Description	This course is designed to provide sufficient hands-on learning experience related to the design, development and analysis of suitable product/project so as to enhance the technical skill sets in the chosen field.				
Course Objective	<ol style="list-style-type: none"> 1. To Identify problems that have relevance to societal / industrial needs 2. To Exhibit independent thinking and analysis skills 3. To Demonstrate the application of relevant science / engineering principles 4. To judge the value of different contributions 5. To identify promising new directions 				

Course Outcome	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> 1. Demonstrate sound fundamentals in a chosen area of computing 2. Identify and formulate a problem of research interest in the chosen area of computing 3. Analyze the computing problem and propose solutions 4. Explain factual knowledge (terminology, classifications, methods, trends)of current areas of research. 5. State and explain some fundamental principles, generalizations, or theories the student has learned in this course.
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Prerequisites: Basic programming knowledge

CO, PO AND PSO MAPPING

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	3	3	-	2	-	-	3	3	3	2	3	3	2
CO-2	3	3	3	3	-	2	-	3	3	3	3	2	3	3	2
CO-3	3	3	3	3	3	-	-	3	3	-	3	2	3	3	3
CO-4	3	3	3	3	3	-	-	3	3	-	3	2	3	3	3
CO-5	3	3	3	3	3	2	-	3	3	-	3	2	3	3	3

1: Weakly related, 2: Moderately related and 3: Strongly related

GUIDELINES

1. The mini project must be done as the individual Project.
2. Each Student must prepare a title that relates to any engineering discipline and the title MUST emulate any real-world situation.
3. Every project work shall have a guide who is the member of the faculty of the Department.

**CO1, CO2,
CO3, CO4,
CO5 /BTL4**

<p>4. Design, develop, test and implement a hardware/software system that is demonstratable with required data set.</p> <p>5. Assessment is based on creativity, applicability to the society, project development skills, team work.</p> <p>6. Technical communication, presentation and report writing skills form an essential component in assessment.</p> <p>7. The project/software MUST include all the topics that have been taught in class.</p>	
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COURSE TITLE	MOOC Course			CREDITS	3
COURSE CODE	CSA3706	COURSE CATEGORY	PC	L-T-P-S	3- 0- 0- 0
Version	1.0	Approval Details	23 ACM, 06.02.2021	LEARNING LEVEL	BTL-4
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Practical Component		ESE	
15%	15%	20%		50%	
Course Description	The objective of this course is to define and clarify the cloud technologies that can be used to deploy cloud-based applications and services. It also explains how they differ in their implementation and usage. Any enterprise may implement any of the cloud deployment models and use the cloud services as per their needs.				

Course Objective	<ol style="list-style-type: none"> 1. To analyse, design and develop products/tools/applications to solve the issues related to real world problems. 2. To apply the concepts, principles and algorithms learnt in the field of computer science. 3. To exercise the lifecycle of project development by following the principles of software engineering.
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Course Outcome	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> 1. Develop an Engineering solution through Analyzing the problem and Applying the Engineering Knowledge. 2. Use research-based knowledge and research methods through modern tools 3. Work as an individual and as a team in solving complex problem. 4. Communicate effectively and write effective reports on the design of Engineering solution. 5. State and explain some fundamental principles, generalizations, or theories the student has learned in this course.
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Prerequisites: Nil

CO, PO AND PSO MAPPING

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	-	-	3	-	-	-	2	-	-	1	1	1	-
CO-2	3	3	-	-	-3	-	-	-	-	2	-	-	1	1	-
CO-3	3	3	-	-	3	1	-	-	-	-	-	-	1	1	-
CO-4	3	3	-	-	3	-	-	-	-	-	-	2	1	1	-
CO-5	3	2	3	-	2	-	-	-	-	-	-	3	1	1	-

1: Weakly related, 2: Moderately related and 3: Strongly related

GUIDELINES

1. The MOOC course will be selected as per the HOD instruction The students must register for the selected MOOC Course. Faculty will be assigned to assist for assignment completion.
2. At the end of the course will be directly transferred to the student's coursework.
3. For all other courses the concurrence from a faculty member to set the question paper and evaluate the performance of the student should be obtained.
4. All the internal examination will be conducted. The candidate will have to appear for the end semester examinations.
5. At the end of the online & contact courses, the student should submit the course completion certificate(s) with grades/marks for record in his/her course work.

**CO1, CO2,
CO3, CO4,
CO5 /BTL4**

MOOC	
1.	https://www.mooc-list.com/course/cloud-computing-applications-part-1-cloud-systems-and-infrastructure-coursera
2.	https://www.mooc-list.com/course/cloud-computing-concepts-part-2-coursera

COURSE TITLE	ADVANCED OPERATING SYSTEMS			CREDITS	3
COURSE CODE	CSA3703	COURSE CATEGORY	PC	L-T-P-S	2-0-2-0
Version	1.0	Approval Details	23 ACM, 06.02.2021	LEARNING LEVEL	BTL-4
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%
Course Description	This course serves as an introduction to Advanced operating systems and to understand real time applications.				
Course Objective	<ol style="list-style-type: none"> 1. To Design distributed operating system 2. To Detect, prevent and avoid the deadlocks in distributed environment. 3. To Explain the need for load distribution and the corresponding techniques. 4. To Design security mechanisms for distributed operating system. 5. To Analyze and find out the requirements to construct a database operating systems 				
Course Outcome	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> 1. Design distributed operating system. 2. Detect, prevent and avoid the deadlocks in distributed environment. 				

	<ol style="list-style-type: none"> 3. Explain the need for load distribution and the corresponding techniques. 4. Design security mechanisms for distributed operating system. 5. Analyze and find out the requirements to construct a database operating systems
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Prerequisites: Fundamentals of Programming

CO, PO AND PSO MAPPING

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	-	3	2	2	1	1	2	3	3	2	3	2	-	2	3
CO-2	-	2	2	3	1	1	2	3	3	2	3	2	-	2	-
CO-3	3	2	2	3	2	1	3	3	2	3	2	-	2	-	1
CO-4	2	-	2	3	2	2	3	3	2	3	2	-	2	-	2
CO-5	-	-	3	-	2	1	2	2	3	3	2	3	2	-	2

1: Weakly related, 2: Moderately related and 3: Strongly related

MODULE1: DISTRIBUTED OPERATING SYSTEM (12)

<p>Synchronization Mechanisms: Introduction – concept of a process – concurrent process – the critical section problem – Synchronization problems – language mechanisms for synchronization: Monitors. System Architecture types – issues in distributed operating systems – communication networks – communication primitives. Theoretical Foundations: inherent limitations of a distributed system – lamport logical clocks – vector clocks – casual ordering of messages – global state – cuts of a distributed computation – termination detection.</p>	<p>CO-1</p> <p>BTL-2</p>
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MODULE 2: DISTRIBUTED DEAD LOCK DETECTION		(12)
Deadlock handling strategies in distributed systems – issues in deadlock detection and resolution – control organizations for distributed deadlock detection – centralized and distributed deadlock detection algorithms – hierarchical deadlock detection algorithms. Agreement protocols – introduction- the system model, a classification of agreement problems, solutions to the Byzantine agreement problem, applications of agreement algorithms.	CO-2 BTL-2	
MODULE 3: DISTRIBUTED SHARED MEMORY		(12)
Architecture– algorithms for implementing DSM – memory coherence and coherence protocols – design issues. Distributed Scheduling: introduction – issues in load distributing – components of a load distributing algorithm – stability – load distributing algorithm – performance comparison – selecting a suitable load sharing algorithm – requirements for load distributing -task migration and associated issues. Failure Recovery and Fault tolerance: introduction – basic concepts – classification of failures – backward and forward error recovery approaches - recovery in concurrent systems – synchronous and asynchronous check pointing and recovery – check pointing for distributed database systems - recovery in replicated distributed databases systems.	CO-3 BTL-3	
MODULE 4: MULTIPROCESSOR OPERATING SYSTEM		(12)
Basic multiprocessor system architectures – basic multiprocessor system architecture - inter connection networks for multiprocessor systems – caching – hypercube architecture – structures of multiprocessor operating system -operating system design issues – threads management- process synchronization – processor scheduling–Memory management- The Mac OS.	CO-4 BTL-2	
MODULE 5: DATABASE OPERATING SYSTEM		(12)
Requirements of a database operating system Concurrency control: theoretical aspects - introduction, database systems - a concurrency control model of database systems- the problem of concurrency control - Serializability theory- distributed database systems, concurrency control algorithms - introduction, basic synchronization primitives, lock based algorithms-timestamp based algorithms, optimistic algorithms - concurrency	CO-5 BTL-2	

control algorithms, data replication.	
PRACTICES	
<ol style="list-style-type: none"> 1. Implementation of semaphores for multiprocessor OS 2. Implementation of multithreading for multiprocessor OS 3. Implementation of multiple sleeping barbers problem for synchronization in distributed OS 4. Implementation of network operating system. 5. Design a real time operating system to control the temperature of a boiler. 6. Implementation of transactions and concurrency in Database operating system. 7. Implement a banking application using distributed Operating system. 	
TEXT BOOKS	
1	Mukesh Singhal, Niranjana G. Shivaratri, "Advanced concepts in operating systems", TMH, 2011
REFERENCE BOOKS	
1	Abraham Silberschatz, Peter B. Galvin, G. Gagne, "Operating System Concepts", Ninth Edition, Addison Wesley Publishing Co., 2013.
2	Andrew S. Tanenbaum, "Modern operating system", PHI, 3rd edition, 2008
3	Pradeep K. Sinha, "Distributed operating system-Concepts and design", PHI, 2003.
4	Andrew S. Tanenbaum, "Distributed operating system", Pearson education, 2003
E BOOKS	
1	https://books.google.co.in/books/about/Advanced_Concepts_In_Operating_Systems.html?id=nel4vdelcqkC
2	http://www.cs.iit.edu/~sun/pdf/cs550-lec1.pdf
MOOC	

1	https://www.coursera.org/learn/practical-machine-learning
2	https://www.coursera.org/learn/python-machine-learning

COURSE TITLE	SOFT COMPUTING			CREDITS	3
COURSE CODE	CSA3704	COURSE CATEGORY	PC	L-T-P-S	3-0-2-0
Version	1.0	Approval Details	23 ACM, 06.02.2021	LEARNING LEVEL	BTL-4
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%
Course Description	This course serves as an introduction to Soft Computing and to Develop case studies to illustrate the intelligent behavior of programs based on soft computing.				
Course Objective	<ol style="list-style-type: none"> 1. To Apply concepts of fuzzy sets, fuzzy logic and heuristics-based systems. 2. To Derive appropriate rules for inference systems. 3. To Use the mathematical background to optimize neural network learning. 4. To Implement optimization algorithms and random search procedures useful to seek global optimum in self-learning 5. To Develop case studies to illustrate the intelligent behavior of programs based on soft computing. 				

Course Outcome	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> 1. Apply concepts of fuzzy sets, fuzzy logic and heuristics-based systems. 2. Derive appropriate rules for inference systems. 3. Use the mathematical background to optimize neural network learning. 4. Implement optimization algorithms and random search procedures useful to seek global optimum in self-learning. 5. Develop case studies to illustrate the intelligent behavior of programs based on soft computing.
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Prerequisites: Artificial Intelligence, Problem solving, Expert Systems

CO, PO AND PSO MAPPING

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	2	1	1	2	3	3	2	3	2	-	2	3	-
CO-2	2	2	3	1	1	2	3	3	2	3	2	-	2	-	-
CO-3	2	2	3	2	1	3	3	2	3	2	-	2	-	1	2
CO-4	1	2	2	2	2	3	3	2	3	2	-	2	-	2	1
CO-5	-	3	-	2	1	2	2	3	3	2	3	2	-	2	-

1: Weakly related, 2: Moderately related and 3: Strongly related

MODULE 1: FUZZY SET THEORY (12)

<p>Introduction to Neuro – Fuzzy and Soft Computing – Fuzzy Sets – Basic Definition and Terminology – Set-theoretic Operations – Member Function Formulation and parameterization – Fuzzy Rules and Fuzzy Reasoning – Extension Principle and Fuzzy Relations – Fuzzy If-Then Rules – Fuzzy Reasoning – Fuzzy Inference Systems – Mamdani Fuzzy Models – Sugeno Fuzzy Models – Tsukamoto Fuzzy Models – Input Space Partitioning and Fuzzy Modeling.</p>	<p>CO-1</p> <p>BTL-2</p>
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<p>Suggested Activities: Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems.</p> <p>Suggested sources: https://swayam.gov.in/course/4574-introduction-to-soft-computing</p>	
MODULE2: OPTIMIZATION (12)	
<p>Derivative-based Optimization – Descent Methods – The Method of Steepest Descent – Classical Newton’s Method – Step Size Determination – Derivative-free Optimization – Genetic Algorithms – Simulated Annealing – Random Search – Downhill Simplex Search- Particle Swarm Techniques - Ant Colony Optimization.</p> <p>Suggested Activities: Develop the application based on Genetic Algorithm and Ant Colony optimization</p> <p>Suggested sources: https://swayam.gov.in/course/4574-introduction-to-soft-computing</p>	<p>CO-2</p> <p>BTL-2</p>
MODULE 3: NEURAL NETWORKS (12)	
<p>Supervised Learning Neural Networks – Perceptron - Adaline – Back propagation Multilayer Perceptron – Radial Basis Function Networks – Unsupervised Learning Neural Networks – Competitive Learning Networks – Kohonen Self-Organizing Networks – Learning Vector Quantization– Hebbian Learning.</p> <p>Suggested Activities: Compare and Analyze the features of supervised and Unsupervised Neural Networks</p> <p>Suggested sources: https://swayam.gov.in/course/4574-introduction-to-soft-computing</p>	<p>CO-3</p> <p>BTL-3</p>
MODULE4: NEURO FUZZY MODELING (12)	

<p>Adaptive Neuro-Fuzzy Inference Systems – Architecture – Hybrid Learning Algorithm – Learning Methods that Cross-fertilize ANFIS and RBFN – Coactive Neuro Fuzzy Modeling – Framework Neuron Functions for Adaptive Networks – Neuro Fuzzy Spectrum.</p> <p>Suggested Activities: Build Adaptive Neuro-Fuzzy Inference Systems (ANFIS), train Sugeno systems using neuro-adaptive learning</p> <p>Suggested sources:http://in.mathworks.com/help/fuzzy/adaptive-neuro-fuzzy-inference-systems.html</p>	<p>CO-4</p> <p>BTL-2</p>
<p>MODULE5: APPLICATIONS OF COMPUTATIONAL INTELLIGENCE (12)</p>	
<p>Printed Character Recognition – Inverse Kinematics Problems – Automobile Fuel Efficiency Prediction – Soft Computing for Color Recipe Prediction.</p> <p>Suggested Activities: Prepare the students for developing intelligent modeling, optimization and control of non-linear systems through case studies.</p> <p>Suggested sources:https://towardsdatascience.com/introductory-guide-to-artificial-intelligence-11fc04cea042</p>	<p>CO-5</p> <p>BTL-2</p>
<p>TEXT BOOKS</p>	
<p>1</p>	<p>J.S.R.Jang, C.T.Sun and E.Mizutani, “Neuro-Fuzzy and Soft Computing”, PHI, 2004,PearsonEducation.</p>
<p>2</p>	<p>N.P.Padhy, “Artificial Intelligence and Intelligent Systems”, Oxford University Press, 2006</p>
<p>REFERENCE BOOKS</p>	
<p>1</p>	<p>SamirRoy”IntroductiontoSoftcomputing“NeuroFuzzyandGeneticAlgorithms”,Firstedition,Pearson Publishers, 2015.</p>
<p>2</p>	<p>J.S.R.Jang, C.T.Sun and E.Mizutani, “Neuro-Fuzzy and Soft Computing”, Pearson, 2004.</p>
<p>3</p>	<p>Timothy J.Ross, “Fuzzy Logic with Engineering Applications”, McGraw-Hill, 1997.</p>
<p>4</p>	<p>DavisE.Goldberg,“GeneticAlgorithms:Search,OptimizationandMachineLearning”,AddisonWesley, 2009.</p>

5	S. Rajasekaran and G.A.V.Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI,2003.
E BOOKS	
1	https://stimmelstep.firebaseio.com/15/Introduction-to-Soft-Computing-Neuro-Fuzzy-and-Genetic-Algorithms.pdf
2	http://www.a-zshiksha.com/forum/viewtopic.php?f=147&t=61593
MOOC	
1	https://www.class-central.com/tag/soft-computing
2	https://www.class-central.com/course/nptel-introduction-to-soft-computing-10053

COURSE TITLE	ADVANCED DATA BASE TECHNOLOGY			CREDITS	4
COURSE CODE	CSA370	COURSE CATEGORY	PC	L-T-P-S	2-1-2-0
Version	1.0	Approval Details	23 ACM, 06.02.2021	LEARNING LEVEL	BTL-5
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%
Course Description	This course serves as an introduction to Advanced Data Base Technology and to learn advanced data models and emerging databases.				

Course Objective	<ol style="list-style-type: none"> 1. To Implement parallel and distributed databases. 2. To Implement object and object relational databases 3. To Learn advanced data models 4. To Learn emerging databases
Course Outcome	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> 1. Implement parallel and distributed databases. 2. Implement object and object relational databases. 3. Learn advanced data models 4. Learn emerging databases

Prerequisites: Database Management System

CO, PO AND PSO MAPPING

CO	PO - 1	PO- 2	PO -3	PO -4	PO -5	PO -6	PO -7	PO -8	PO -9	PO - 10	PO- 11	PO- 12	PSO- 1	PSO- 2	PSO- 3
CO-1	3	2	2	1	1	2	2	3	2	3	2	-	2	3	-
CO-2	2	2	3	1	2	2	2	3	2	3	2	-	2	-	2
CO-3	2	2	3	2	2	3	3	2	3	2	-	2	-	1	1
CO-4	1	2	2	2	1	2	3	2	3	2	-	2	-	2	1
CO-5	-	3	-	2	1	2	2	3	3	2	3	2	-	2	-

1: Weakly related, 2: Moderately related and 3: Strongly related

MODULE 1: PARALLEL AND DISTRIBUTED DATABASES

(12)

Database System Architectures: Centralized and Client-Server Architectures – Server System Architectures – Parallel Systems- Distributed Systems – **Parallel Databases:** I/O Parallelism – Inter and Intra Query Parallelism – Inter and Intra operation Parallelism – Design of Parallel Systems- Distributed Database Concepts - Distributed Data Storage – Distributed Transactions – Commit Protocols – Concurrency Control – Distributed Query

CO-1
BTL-2

<p>Processing – Case Studies</p> <p>Suggested Activities: Assignments and Case Study</p> <p>Suggested sources: NPTEL and http://mazsola.iit.unimiskolc.hu/tempus/discom/doc/db/tema01a.pdf</p>	
<p>MODULE 2: OBJECT AND OBJECT RELATIONAL DATABASES (12)</p>	
<p>Concepts for Object Databases: Object Identity – Object structure – Type Constructors – Encapsulation of Operations – Methods – Persistence – Type and Class Hierarchies – Inheritance – Complex Objects – Object Database Standards, Languages and Design: ODMG Model – ODL – OQL – Object Relational and Extended – Relational Systems: Object Relational features in SQL/Oracle – Case Studies.</p> <p>Suggested Activities: Assignments and Case Study</p> <p>Suggested sources: NPTEL and https://www.uio.no/studier/emner/matnat/ifi/INF3100/v13/undervisningsmateriale/lysark/sect10_3-5.pdf</p>	<p>CO-2</p> <p>BTL-2</p>
<p>MODULE 3: INTELLIGENT DATABASES (12)</p>	
<p>Active Databases: Syntax and Semantics (Starburst, Oracle, DB2)- Taxonomy- Applications- Design Principles for Active Rules- Temporal Databases: Overview of Temporal Databases- TSQL2- Deductive Databases: Logic of Query Languages – Datalog- Recursive Rules- Syntax and Semantics of Datalog Languages- Implementation of Rules and Recursion- Recursive Queries in SQL- Spatial Databases- Spatial Data Types- Spatial Relationships- Spatial Data Structures-Spatial Access Methods- Spatial DB Implementation.</p> <p>Suggested Activities: Assignments and Case Study</p> <p>Suggested sources: https://www.cse.iitb.ac.in/~cs6212011/.../Intelligent%20Database%20Systems.ppt</p>	<p>CO-3</p> <p>BTL-3</p>

MODULE 4: ADVANCED DATAMODELS		(12)
<p>Mobile Databases: Location and Handoff Management - Effect of Mobility on Data Management - Location Dependent Data Distribution - Mobile Transaction Models - Concurrency Control - Transaction Commit Protocols- Multimedia Databases- Information Retrieval- Data Warehousing- Data Mining- Text Mining.</p> <p>Suggested Activities:Assignments and Case Study</p> <p>Suggested sources: https://www.slideshare.net/avnishpatel165/multimedia-database-56310108, https://www.geeksforgeeks.org/dbms-multimedia-database/</p>		<p>CO-4</p> <p>BTL-2</p>
MODULE 5:EMERGING TECHNOLOGIES (12)		
<p>XML Databases: XML-Related Technologies-XML Schema- XML Query Languages- Storing XML in Databases-XML and SQL- Native XML Databases- Web Databases- Geographic Information Systems- Biological Data Management- Cloud Based Databases: Data Storage Systems on the Cloud- Cloud Storage Architectures-Cloud Data Models- Query Languages- Introduction to Big Data-Storage-Analysis.</p> <p>Suggested Activities: Assignments and Case Study</p> <p>Suggested sources: https://www.tutorialspoint.com/xml/, https://www.techwalla.com/articles/what-is-a-web-database https://www.ibm.com/cloud/learn/what-is-cloud-database</p>		<p>CO-5</p> <p>BTL-2</p>
TEXT BOOKS		
1	Approach to Design, Implementation and Management", Sixth Edition, Pearson Education, 2015.	
REFERENCE BOOKS		
1	Ramez Elmasri & Shamkant B. Navathe, "Fundamentals of Database Systems", Seventh Edition, Pearson Education, 2016.	
2	Tamer Ozsu M., Patrick Valdurief, "Principles of Distributed Database Systems", Second Edition, Pearson Education, 2003.	

3	Prabhu C.S.R., "Object Oriented Database Systems", PHI, 2003.
4	Peter Rob and Corlos Coronel, "Database Systems – Design, Implementation and Management",Thompson Learning, Course Technology, 9th Edition, 2011.
5	Henry FKorth,AbrahamSilberschatz,S.Sudharshan,"DatabaseSystemConcepts",SeventhEdition,McGraw Hill, 2010.
E BOOKS	
1	http://aries.ektf.hu/~hz/pdf-tamop/pdf-xx/Radvanyi-hdbms-eng2.pdf
2	https://dsinghpune.wordpress.com/advanced-database-management-system/
MOOC	
1	https://www.coursera.org/learn/distributed-database
2	https://nptel.ac.in/courses/106106093/38

COURSE TITLE	SEMINAR			CREDITS	2
COURSE CODE	CSA3751	COURSE CATEGORY	LAB	L-T-P-S	0-0-3-0
Version	1.0	Approval Details	23 ACM, 06.02.202 1	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Review	Second Review	Third Review	Model Evaluation		ESE

1: Weakly related, 2: Moderately related and 3: Strongly related

GUIDELINES

1. For seminar, a student under the supervision of a faculty member, shall collect the literature on a topic and critically review the literature and submit it to the department in a report form and shall make an oral presentation before the Departmental Academic Committee consisting of Department PG Coordinator, Supervisor and two other senior faculty members of the department.
2. Each student will make a seminar presentation using audio/visual aids for a duration of 20-25 minutes and submit the seminar report prepared in Latex only
3. For Seminar there will be only internal evaluation.
4. Out of the total allocated marks distribution of marks shall be 30% for the report, 50% for presentation and 20% for the queries.
5. A candidate has to secure a minimum of 50% of marks to be declared successful.
6. If the student fails to fulfill minimum marks, the student has to reappear during the supplementary examinations.
7. There shall be no semester end examinations for the seminar.

CO1/BTL3

REFERENCE BOOKS

- | | |
|----|---|
| 1. | NYIF ,”Technical Analysis: A Personal Seminar”, Prentice Hall Press (10 March 2005) |
| 2. | David F. Beer ,”Presenting the Successful Technical Seminar”,Wiley-IEEE Press,2003 |
| 3. | Si FanJill Fielding-Wells,”What is Next in Educational Research?”,Springer 2016 |

E BOOKS

- | | |
|----|---|
| 1. | https://link.springer.com/book/10.1007%2F978-94-6300-524-1 |
|----|---|

COURSE TITLE	PROJECT PHASE –I			CREDITS	8
COURSE CODE	CSA3782	COURSE CATEGORY	PC	L-T-P-S	0- 0- 24- 0
Version	1.0	Approval Details	23 ACM, 06.02.2021	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Review	Second Review	Third Review			ESE
10%	20%	20%			50%
Course Description	This course is designed to provide sufficient hands-on learning experience related to the design, development and analysis of suitable product / process so as to enhance the technical skill sets in the chosen field.				
Course Objective	<ol style="list-style-type: none"> 1. To provide opportunity to involve in research related to science / engineering 2. To inculcate research culture 3. To enhance the rational and innovative thinking capabilities 				
Course Outcome	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> 1. Demonstrate sound fundamentals in a chosen area of computing 2. Identify and formulate a problem of research interest in the chosen area of computing 3. Analyze the computing problem and propose solutions 4. Apply the emerging technologies like – Blockchain, IoT, Robotics, ML, AI, Datamining, Big Data Analytics in solving some challenging problem in chosen area 5. Effectively communicate the work at all stages of the project 				
Prerequisites: NIL					

CO, PO AND PSO MAPPING

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	-	2	-	-	1	-	3	-	-	-	-	-	-	-	3
CO-2	-	-	1	-	-	-	-	2	-	2	-	-	-	2	-
CO-3	-	-	-	-	-	1	-	-	2	-	-	-	2	-	-
CO-4	2	-	-	-	-	-	-	2	-	-	-	1	-	-	3
CO-5	-	-	3	-	-	-	-	-	-	-	-	-	-	2	-

1: Weakly related, 2: Moderately related and 3: Strongly related

GUIDELINES

(12)

1. Project may be a theoretical analysis, modeling & simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of data, software development, applied research and any other related activities.
2. Each student is expected to do an individual project. The project work is carried out in two phases – Phase I in III semester and Phase II in IV semester.
3. Phase II of the project work shall be in continuation of Phase I only.
4. At the completion of a project the student will submit a project report, which will be evaluated (end semester assessment) by duly appointed examiner(s). This evaluation will be based on the project report and a viva voce examination on the project.
5. Project should be for two semesters based on the completion of required number of credits as per the academic regulations.
6. Carried out inside or outside the university, in any relevant industry or research institution.
7. Publications in the peer reviewed journals / International Conferences will be an added advantage

**CO1, CO2,
CO3, CO4,
CO5 /BTL4**

COURSE TITLE	PROJECT PHASE –II			CREDITS	12
COURSE CODE	CSA3783	COURSE CATEGORY	PC	L-T-P-S	0- 0- 24- 0
Version	1.0	Approval Details	23 ACM, 06.02.2021	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%
Course Description	This course is designed to provide sufficient hands-on learning experience related to the design, development and analysis of suitable product/project so as to enhance the technical skill sets in the chosen field.				
Course Objective	<ol style="list-style-type: none"> 1. To provide opportunity to involve in research related to science / engineering 2. To inculcate research culture 3. To enhance the rational and innovative thinking capabilities 				
Course Outcome	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> 1. Identify a suitable problem to be solved computationally 2. Reflectively analyze proposed solutions to the identified computing problem 3. Design and develop solutions to the problem and analyze results 4. Prepare a thesis and defend the thesis on the work done 5. Augment the knowledge base in the chosen area of computing, adhering to ethical practices at every stage 				

Prerequisites: NIL

CO, PO AND PSO MAPPING

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	-	2	-	-	1	-	3	-	-	-	-	-	-	-	3
CO-2	-	-	1	-	-	-	-	2	-	2	-	-	-	2	-
CO-3	-	-	-	-	-	1	-	-	2	-	-	-	2	-	-
CO-4	2	-	-	-	-	-	-	2	-	-	-	1	-	-	3
CO-5	-	-	3	-	-	-	-	-	-	-	-	-	-	2	-

1: Weakly related, 2: Moderately related and 3: Strongly related

Modalities / Requirements

(12)

1. Each student is expected to do an individual project. The project work is carried out in two phases – Phase I in III semester and Phase II in IV semester. Phase II of the project work shall be in continuation of Phase I only.
2. At the completion of a project the student will submit a project report, which will be evaluated (end semester assessment) by duly appointed examiner(s). This evaluation will be based on the project report and a viva voce examination on the project.
3. Use Science/Engineering principles to solve the identified issues
4. Adopt relevant and well-defined / innovative methodologies to fulfill the specified objective
5. Submission of scientific report in a specified format (after plagiarism check)
6. Project should be for two semesters based on the completion of required number of credits as per the academic regulations.
7. Carried out inside or outside the university, in any relevant industry or research institution.

CO-1
BTL-2

8. Publications in the peer reviewed journals / International Conferences will be an added advantage	
9. Student will be allowed to appear in the final viva voce examination only if he / she has submitted his / her project work in the form of paper for presentation / publication in a conference / journal and produced the proof of acknowledgement of receipt of paper from the organizers / publishers.	

ELECTIVE I

COURSE TITLE		OPTIMIZATION TECHNIQUES			CREDITS	3
COURSE CODE	CSC3721	COURSE CATEGORY	PE	L-T-P-S	2-0-2-0	
Version	1.0	Approval Details	23 ACM, 06.02.2021	LEARNING LEVEL	BTL-4	
ASSESSMENT SCHEME						
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE	
15%	15%	10%	5%	5%	50%	
Course Description	This course covers the methods, tools and algorithms used for optimization problems					
Course Objective	1.	2. To Understand the basics and engineering applications of optimization 3. To Understand the basics of Classical Optimization Techniques 4. To Understand the Elimination Methods of Unconstrained Optimization problems 5. To Understand the Interpolation Methods of Unconstrained Optimization 6. To Understand the Direct Root Methods of Unconstrained Optimization				

Course Outcome	Upon the completion of the course the students will be able to
	<ol style="list-style-type: none"> To Understand who your most likely customers are so you can target them more meaningfully Apply Linear Programming for solving AI related problems Solve Unconstrained Optimization problems Use Constrained Optimization to solve AI problems Implement evolutionary algorithms using Python/Matlab

Prerequisites:NIL

CO, PO AND PSO MAPPING

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	2	1	1	2	1	1	-	-	-	-	2	-	-
CO-2	3	3	3	1	1	1	1	1	-	2	-	-	-	-	-
CO-3	3	3	3	2	-	1	1	1	1	1	1	-	-	-	-
CO-4	3	3	3	2	1	2	2	1	1	1	1	2	-	1	1
CO-5	3	3	3	2	2	1	2	1	1	1	2	2	3	1	1

1: Weakly related, 2: Moderately related and 3: Strongly related

MODULE 1:INTRODUCTION (12)

Introduction to Optimization: Engineering application of Optimization – Statement of an Optimization problem - Optimal Problem formulation - Classification of Optimization problem. Optimum design concepts: Definition of Global and Local optima – Optimality criteria - Review of basic calculus concepts – Global optimality.

Practical component: Introduction to MATLAB

Suggested Readings: <https://analytics.googleblog.com/2016/05/announcing-data-studio-our-free-new.html>

CO-1

BTL-2

MODULE 2: LINEAR PROGRAMMING (12)	
Linear programming methods for optimum design: Review of Linear programming methods for optimum design – Post optimality analysis - Application of LPP models in AI. Practical component: Discuss on the classification of optimization problems Suggested Readings: https://www.shsu.edu/~eco_dgf/web_chapter_a.pdf	CO-2 BTL-2
MODULE 3: UNCONSTRAINED OPTIMIZATION (12)	
Optimization algorithms for solving unconstrained optimization problems – Gradient based method: Cauchy’s steepest descent method, Newton’s method, Conjugate gradient method Practical component: Classical Optimization Techniques Suggested Readings: https://www.shsu.edu/~eco_dgf/web_chapter_a.pdf	CO-3 BTL-3
MODULE 4: CONSTRAINED OPTIMIZATION (12)	
Optimization algorithms for solving constrained optimization problems – direct methods – penalty function methods – steepest descent method - Engineering applications of constrained and unconstrained algorithms Practical component: Study on Unconstrained Optimization: Elimination Methods Suggested Readings: https://www.tandfonline.com/doi/full/10.1080/19427867.2019.1702250	CO-4 BTL-3
MODULE 5: OTHER OPTIMIZATION METHODS (12)	
Methods of Optimization: Genetic Algorithms - Simulated Annealing - Ant colony optimization - Tabu search – Neural-Network based Optimization – Fuzzy optimization techniques – Applications. Use of Python/ Matlab to solve optimization problems Practical component: Study on Unconstrained Optimization: Interpolation Methods Suggested Readings: https://www.tandfonline.com/doi/full/10.1080/19427867.2019.1702250	CO-5 BTL-3
TEXT BOOKS	
1	Xin–She Yang , “Optimization Techniques and Applications with Examples”, Wiley-Blackwell,2018. ISBN :9781119490548
REFERENCE BOOKS	
1	J. Nocedal, S. J. Wright, “Numerical Optimization”, Springer, 2 nd Edition, 2006. ISBN :9780387227429

2	Rao S. S. - 'Engineering Optimization, Theory and Practice' – Wiley & Sons, 4th Edition, 2009. ISBN :978-0470183526
3	Yang ,Cui,Xiao, Gandomi, Karamanoglu , "Swarm Intelligence and Bio-Inspired Computing", Elsevier First Edition, 2013. ISBN: 9780124051775
E BOOKS	
1.	https://www.csie.ntu.edu.tw/~r97002/temp/num_optimization.pdf
2.	http://cslt.riit.tsinghua.edu.cn/mediawiki/images/e/e8/Introduction to Evolutionary Computing .pdf
MOOC	
1.	https://www.udemy.com/course/optimisation/

COURSE TITLE	COMPUTATIONAL NEUROSCIENCE			Credit	3
COURSE CODE	CSC3722	COURSE CATEGORY	DE	L-T-P-S	2-0-2-0
Version	1.0	Approval Details	23 ACM, 06.02.2021	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%
Course Description	This course provides an introduction to basic computational methods for understanding what nervous systems do and for determining how they function. We will explore the computational principles governing various aspects of vision, sensory-motor control, learning, and memory.				

Course Objective	<ol style="list-style-type: none"> 1. To discuss different types of BCI signals from instruments 2. To discuss and compare different types of brain signals used for feature extraction 3. To discuss the major components of BCI which makes up the system 4. To explain the applications based on BCI 5. To Use the toolbox BCI LAB
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Course Outcome	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> 1. Discuss different types of BCI signals from instruments 2. Discuss and compare different types of brain signals used for feature extraction 3. Discuss the major components of BCI which makes up the system 4. Explain the applications based on BCI 5. Use the toolbox BCI LAB
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Prerequisites: Human-Computer Interaction, Cognitive Science

CO, PO AND PSO MAPPING

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	2	-	-	2	-	-	-	1	1	3	2	1	-
CO-2	3	3	2	1	2	1	-	1	2	2	2	3	3	2	1
CO-3	2	3	3	2	3	1	-	1	2	2	2	2	3	2	2
CO-4	2	3	3	3	2	2	1	1	1	2	2	2	3	3	1
CO-5	3	3	3	3	3	2	1	1	3	2	2	2	3	3	2

1: Weakly related, 2: Moderately related and 3: Strongly related

MODULE 1: BASIC NEUROSCIENCE (12)

Basic Neuroscience - Neurons - Action Potentials or Spikes -Dendrites and Axons -Synapses - Spike Generation - Adapting the Connections: Synaptic Plasticity -Brain Organization, Anatomy, and Function -Recording and Stimulating the Brain -Invasive Techniques -Non-invasive Techniques-Stimulating the Brain -Simultaneous Recording and Stimulation – Multi electrode Arrays –Neuro chip

Suggested Activities: Acquiring brain signals from within the brain and outside the brain

Suggested sources:<https://www.udemy.com/course/brain-computer-interface/>

MODULE 2: COMPUTATIONAL MODEL OF BRAIN AND BEHAVIOR

(12)

Models of Brain Disorders-Computational Model of Dyslexics perceptual difficulties as impaired inference of sound statistics –computation Approximation to intellectual Disability in Down Syndrome-Computational Psychiatry.

Suggested Activities: Design a model to identify anyone of the Brain Disorder of human.

Suggested sources: <https://www.udemy.com/course/brain-computer-interface/>

MODULE 3:BUILDING A BCI

(12)

Building a BCI --Brain Responses Useful for Building BCIs -Conditioned Responses -Population Activity - Imagined Motor and Cognitive Activity -Stimulus-Evoked Activity. Major Types of BCIs:Invasive BCIs - Invasive BCIs in Animals -Cognitive BCIs -Invasive BCIs in Humans -Cognitive BCIs in Humans - Long-Term Use of Invasive BCIs ,Semi-Invasive BCIs:Electrocortico graphic (ECOG) BCIs - BCIs Based on Peripheral Nerve Signals

Suggested Activities: Create a few variations of ERP BCI using BCILAB using filters and classifiers

Suggested sources: <https://www.udemy.com/course/brain-computer-interface/>

MODULE 4:NONINVASIVE BCIS(12)

Noninvasive BCIs- Electroencephalographic (EEG) BCIs-Other Noninvasive BCIs: fMRI, MEG, and fNIR - Functional Magnetic Resonance Imaging Based BCIs-Magnetoencephalography Based BCIs -Functional Near Infrared and Optical BCIs BCIs that Stimulate: Sensory Restoration-Motor Restoration-Deep Brain Stimulation (DBS) -Sensory Augmentation - Bidirectional and Recurrent BCIs Bidirectional BCI Control of a Mini-Robot-Cortical Control of Muscles via Functional Electrical Stimulation-Establishing New Connections between Brain Regions

Suggested Activities: Conduct the experiment to view and print different amplitude and frequency brain maps.

Suggested sources: <https://www.udemy.com/course/brain-computer-interface/>

MODULE 5: APPLICATIONS AND ETHICS**(12)**

Medical Applications -Sensory Restoration -Motor Restoration-Cognitive Restoration-Rehabilitation Brain-Controlled Wheelchairs -Nonmedical Applications -Web Browsing and Navigating Virtual Worlds-Robotic Avatars -Education and Learning -Security, Identification, and Authentication -Ethics of Brain-Computer Interfacing: Medical, Health, and Safety Issues-Abuse of BCI Technology - BCI Security and Privacy -Legal Issues-Moral and Social-Justice Issues

Suggested Activities: Design of an EEG based Emotion Recognition System

Suggested sources:<https://www.udemy.com/course/brain-computer-interface/>

TEXT BOOKS

1	Rajesh P. N. Rao ,”Brain-Computer Interfacing: An Introduction”Cambridge University Press, 2013. ISBN :9780521769419
2	Chang S. Nam, Anton Nijholt, Fabien Lotte ,”Brain–Computer Interfaces Handbook: Technological and Theoretical Advances”,CRC Press 2018. ISBN: 9780367375454

REFERENCE BOOKS

1	Jonathan Wolpaw and Elizabeth Winter Wolpaw ,”Brain–Computer Interfaces: Principles and Practice”,Oxford university Press, 2012. ISBN :9780195388855
2	Bernhard GraimannGertPfurtschellerBrendanAllison”Brain-Computer Interfaces Revolutionizing Human-Computer Interaction” Springer 2018
3	Guido Dornhege, José del R. Millán, ThiloHinterberger, Dennis J. McFarland and Klaus-Robert Müller “Toward Brain-Computer Interfacing”,MIT Press,2007. ISBN : 978-0262527880
4	Seungchan Lee, Younghak Shin, Soogil Woo, Kiseon Kim and Heung-No Lee “Brain-Computer Interface Systems: Recent Progress and Future Prospects”Intechopen, 2013
5	Graimann, Bernhard, Allison, Brendan Z., Pfurtscheller, Gert “Brain-Computer Interfaces Revolutionizing Human-Computer Interaction”,Springer 2010. ISBN: 978-3642020902.

E BOOKS

1	file:///C:/Users/Rajendran/Downloads/RoutledgeHandbooks-9781351231954-chapter3.pdf
2	https://www.intechopen.com/books/brain-computer-interface-systems-recent-progress-and-future-prospects/review-of-wireless-brain-computer-interface-systems
MOOC	
1	https://www.udemy.com/course/brain-computer-interface/
2	https://www.coursera.org/learn/computational-neuroscience

COURSE TITLE	AGENT BASED INTELLIGENT SYSTEM			CREDITS	3
COURSE CODE	CSB3723	COURSE CATEGORY	PE	L-T-P-S	2-0-2-0
Version	1.0	Approval Details	23 ACM, 06.02.2021	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%
Course Description	The goal of the course is to understand important problems, challenges, concepts and techniques dealing with the use of intelligent agents for computational tasks				
Course Objective	<ol style="list-style-type: none"> 1. To understand Agent development 2. To gain Knowledge in Multi agent and Intelligent agents 3. To understand Agents and security 4. To gain Knowledge in Agent Applications 				

Course Outcome	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> 1. Explain the structure of agents 2. Implement a computational agent with various searching techniques 3. Apply the learning agents in planning 4. Apply the reasoning mechanisms of proposition and predicate logic to agents. 5. Use the learning mechanisms for an artificial agent. 6. Execute different communication and co-operation methodologies in a multi-agent setup.
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Prerequisites: Artificial Intelligence

CO, PO AND PSO MAPPING

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	-	-	3	1	-	2	-	-	-	-	-	2	1	-
CO-2	2	3	3	3		-	-	-	-	2	-	-	2	1	-
CO-3	1	1	3	3	3	1	2	-	3	-	-	1	2	1	-
CO-4	1	1	3	3	3	-	-	-	-	-	-	1	2	1	-
CO-5	3	1	3	3	3	-	2	-	3	-	-	1	2	1	-

1: Weakly related, 2: Moderately related and 3: Strongly related

MODULE 1: INTRODUCTION (12)

<p>Agents as a paradigm for software engineering - Agents as a tool for understanding human societies- Intelligent Agent: Agents and Objects - Agents and Expert Systems - Agents as Intentional Systems - Abstract Architectures for Intelligent Agents - How to Tell an Agent What to Do.</p> <p>Practical Component: Develop an AI based application for solving any real time problem</p>	<p>CO-1</p> <p>BTL-2</p>
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MODULE 2: LEARNING IN AGENTS (12)

<p>Proportional case - Handling variables and qualifiers - Dealing with intractability - Reasoning with horn clauses - Procedural control of reasoning - Rules in production – Reasoning with Higher order Logics</p> <p>Practical Component:Apply the knowledge Representation System</p>	<p>CO-2</p> <p>BTL-3</p>
<p>MODULE 3: COMMUNICATION AND COOPERATION IN AGENTS(12)</p>	
<p>Software tools for ontology - OWL - XML - KIF - Speech acts - Cooperative Distributed Problem Solving - Task Sharing and Result Sharing - Result Sharing - Combining Task and Result Sharing - Handling Inconsistency - Coordination - Multi agent Planning and Synchronization</p> <p>Practical Component:Working on Ontology Software Tools</p>	<p>CO-3</p> <p>BTL-3</p>
<p>MODULE 4: DEVELOPING INTELLIGENT AGENT SYSTEMS (12)</p>	
<p>Situated Agents: Actions and Percepts - Proactive and Reactive Agents: Goals and Events - Challenging Agent Environments: Plans and Beliefs - Social Agents - Agent Execution Cycle - Deciding on the Agent Types - Grouping functionalities - Review Agent Coupling - Acquaintance Diagrams - Develop Agent Descriptors</p> <p>Practical Component:Build the Application using Social Agent(like Facebook Marketing Campaign)</p>	<p>CO-4</p> <p>BTL-3</p>
<p>MODULE 5:APPLICATIONS(12)</p>	
<p>Agent for workflow and business process management- Mobile agents - Agents for distributed systems - agents for information retrieval and management - agents for electronic commerce - agent for human- computer interface - agents for virtual environments - agents for social simulation.</p> <p>Practical Component:Develop the human computer interface using AI Agent</p>	<p>CO-5</p> <p>BTL-3</p>
<p>TEXT BOOKS</p>	

1	Michael Wooldridge, An Introduction to Multi Agent Systems, Second Edition, John Wiley and Sons, 2009. ISBN :9780470519462
2	Stuart Russell, Peter Norvig, — Artificial Intelligence: A Modern Approach, Third Edition, Pearson Education, 2009. ISBN: 978-0136042594.
3	Lin Padgham, Michael Winikoff, Developing Intelligent Agent Systems: A Practical Guide, Wiley publications, 2005. ISBN: 9780470861219.
REFERENCE BOOKS	
1	Ronald Brachman, Hector Levesque — Knowledge Representation and Reasoning, The Morgan Kaufmann Series in Artificial Intelligence 2004. ISBN: 978-1558609327.
2	Arthur B. Markman, — Knowledge Representation, Lawrence Erlbaum Associates, 1998. ISBN: 978-0805824414
E BOOKS	
1.	http://guwp.gallaudet.edu/reader/read.php?article=an-introduction-to-multiagent-systems-2nd-edition-pdf&encrypt=22aad92b4b2b88f6d201b2fc7a505169
MOOC	
1.	https://www.coursera.org/lecture/modeling-simulation-natural-processes/multi-agent-systems-kAKyC

COURSE TITLE	INDUSTRIAL AI			CREDITS	3
COURSE CODE	CSC3723	COURSE CATEGORY	PE	L-T-P-S	2-0-2-0
Version	1.0	Approval Details	23 ACM, 06.02.2021	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical	Second Periodical	Seminar/ Assignments/	Surprise Test	Attendance	ESE

Assessment	Assessment	Project	/ Quiz												
15%	15%	10%	5%	5%	50%										
Course Description	The purpose of this course is to provide the students with a comprehensive introduction to the recent developments in AI through the coverage of fundamental AI concepts, practical business applications and the hands-on experiences with modern AI frameworks.														
Course Objective	<ol style="list-style-type: none"> To introduce the importance of automation techniques manufacturing and process industries To impart the role of PLC in industry automation. To expose to various control techniques employed in process automation To develop automation system for manufacturing and process industries. 														
Course Outcome	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> Solve the basic industrial problem using AI Use the AI Algorithm to solve the real time problems Understand the killer applications for manufacturing industries Explore the various Industrial applications Apply the Concepts for new Industrialization Project 														
Prerequisites: NIL															
CO, PO AND PSO MAPPING															
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	-	-	3	1	-	2	-	-	-	-	-	2	1	-
CO-2	2	3	3	3		-	-	-	-	2	-	-	2	1	-
CO-3	1	1	3	3	3	1	2	-	3	-	-	1	2	1	-
CO-4	1	1	3	3	3	-	-	-	-	-	-	1	2	1	-
CO-5	3	1	3	3	3	-	2	-	3	-	-	1	2	1	-
1: Weakly related, 2: Moderately related and 3: Strongly related															

MODULE 1: INTRODUCTION (12)	
<p>Development and Application of AI technology-New Perspectives in Industrial systems for AI-Basic Method of Solving Problem with AI- Neural Networks-Statistical method – Cybernetics Approach-Difference between Industrial Ai and AI-Challenges of AI in Industry-New Opportunity Spaces.</p> <p>Suggested Activities: Identify the challenges of anyone of the AI application for Industry</p> <p>Suggested sources: Kate Lyapina,” Technical challenges for AI in heavy industry and how to overcome them “,2019.</p>	<p>CO-1</p> <p>BTL-2</p>
MODULE 2: DEFINITION AND MEANING OF INDUSTRIAL AI(12)	
<p>Beginnings of Industrial AI-Purpose and Value of industrial AI-GE Predix-Technical Elements of AI –CPS-Architecture for Integrating the 5 technical elements for industrial Intelligence-Categories of Algorithm- Industrial AI Algorithms-Selection and Application.</p> <p>Suggested Activities: Analyze the Artificial intelligence’s impact on manufacturing</p> <p>Suggested sources: IztokPalcicRobert, OjstersekRobertOjstersek,”Artificial Intelligence in Manufacturing Companies and Broader: An Overview”,DAAAM International Scientific BookPublisher: DAAAM International Publishing,2019</p>	<p>CO-2</p> <p>BTL-3</p>
MODULE 3:KILLER APPLICATION OF INDUSTRIAL AI (12)	
<p>Application scenario types for industrial AI-Predictive maintenance of Equipment –Virtual Metrology and Process Quality Control-Energy Management and Energy efficiency optimization-Defect detection and material sorting based on machine vision-Scheduling optimization. Assessment of basic capability maturity- Assessment Tools for global Industries AI - Faxconn Lighthouse factory-organizational Intelligent Transformation ability – open Source Industrial Big Data Competition.</p> <p>Suggested Activities: Develop a system to detect the defect in manufacturing process using</p>	<p>CO-3</p> <p>BTL-3</p>

<p>computer vision</p> <p>Suggested sources: Serhii Maksymenko ,“AI-Based Visual Inspection For Defect Detection”,2020</p>	
<p>MODULE 4: FOURTH INDUSTRIAL REVOLUTION(12)</p>	
<p>Enabler Technology –Disruptors of the current World-Machine-Insurance-In Stream Analytics-Adaptive machine learning-Real time closed loop system-Fourth generation of Industrialized Machine learning-Rapid Information factory-Five system layers-Six data lake Zones-RAPTORE/QUBE.</p> <p>Suggested Activities: Deploy interpretable and inclusive machine learning models with Explainable AI, tools and frameworks designed to instill user trust.</p> <p>Suggested sources:Tracy Frey,” Increasing transparency with Google Cloud Explainable AI”,2019.</p>	<p>CO-4</p> <p>BTL-3</p>
<p>MODULE 5:INDUSTRIALIZED ARTIFICIAL INTELLIGENCE (12)</p>	
<p>Big data Impact-health care-Financial Services-Manufacturing-Media and Entertainment-Games-Simulations-Restrictions on Industrialized Artificial Intelligence –Final Industrialization Project- Requirements-Basic Solution-Geospatial knowledge</p> <p>Suggested Activities: Design a simple AI application for Healthcare.</p> <p>Suggested sources: Sudipto Datta, Ranjit Barua and Jonali Das,” Application of Artificial Intelligence in Modern Healthcare System”,2019</p>	<p>CO-5</p> <p>BTL-3</p>

TEXT BOOKS

1	Jay Lee, "Industrial AI: Applications with Sustainable Performance", Springer; 1st ed. 2020 edition (February 2020). ISBN: 9811521433
2	Vermeulen, Andreas François , "Industrial Machine Learning Using Artificial Intelligence as a Transformational Disruptor". ISBN: 978-1484253151.

REFERENCE BOOKS

1	Nilanjan Dey, Aboul Ella Hassanien, Santosh Kumar Das, Shom Prasad Das, "Machine Learning Algorithms for Industrial Applications", Springer 2020. ISBN: 978-3030506407.
2	Bill Hibbard, " Super-Intelligent Machines", Springer 2020. ISBN: 9781461507598
3	Adelyn Zhou, Mariya Yao, and Marlene Jia, "Applied Artificial Intelligence: A Handbook for Business Leaders", TOPBOTS Inc, 2018. ISBN: 978-0998289021.

E BOOKS

1.	https://www.plattform-i40.de/PI40/Redaktion/EN/Downloads/Publikation/AI-in-Industrie4.0.pdf? blob=publicationFile&v=5
2.	https://www2.deloitte.com/content/dam/Deloitte/ch/Documents/manufacturing/ch-en-manufacturing-industry-4-0-24102014.pdf

MOOC

1.	https://www.coursera.org/learn/introduction-to-ai
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ELECTIVE -II

COURSE TITLE	COMPUTER VISION			CREDITS	3
COURSE CODE	CSA3733	COURSE CATEGORY	DE	L-T-P-S	3-0-0-0
Version	1.0	Approval Details	23 ACM, 06.02.2021	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%
Course Description	This course offers the fundamentals of computer vision and various techniques in feature detection, segmentation and recognition.				
Course Objective	The course will enable the students to <ol style="list-style-type: none">1. Learn the Fundamentals of image formation and image processing.2. Know the feature detection and tracking techniques.3. Expose to various segmentation and alignment techniques.4. Explore Structure from Motion and Dense motion analysis.5. Familiar with different recognition methods.				
Course Outcome	Upon completion of this course, the students will be able to <ol style="list-style-type: none">1. Explain the fundamentals of image formation, transformation and analysis.2. Explain the feature detection and tracking techniques.3. Demonstrate various segmentation and alignment techniques4. Explain Motion andDense Motion Analysis methodologies5. Implement various recognition techniques.				

Prerequisites: Basic Knowledge in Linear Algebra and Vector Calculus														
CO, PO AND PSO MAPPING														
CO	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO- 8	PO -9	PO -10	PO- 11	PSO- 1	PSO- 2	PSO-3
CO-1	3	3	2	3	1	1	1	2	2	1	3	2	2	3
CO-2	3	3	2	3	1	1	1	2	2	1	3	2	2	3
CO-3	3	3	2	3	2	1	1	2	2	1	3	2	2	3
CO-4	3	3	2	3	1	1	1	2	2	1	3	2	2	3
CO-5	3	3	3	1	3	1	1	1	2	1	3	2	2	3
1: Weakly related, 2: Moderately related and 3: Strongly related														
MODULE1:IMAGEFORMATIONANDIMAGEPROCESSING (9)														
<p>Introduction to computer vision-Geometric primitives-2D and 3D transformations-3D to 2D projections- Image formation- Lighting- Reflective and Shading. Histogram Equalization-Linear filtering- Non-Linear Filtering-Morphology-Distance transforms-Interpolation- Decimation.</p> <p>Practical Component:</p> <p>1.Download and install the latest release of OpenCV. Compile it in debug and release</p> <p>Mode</p> <p>2.write a simple OpenCV program that loads an image from disk and displays it on the screen</p>												<p>CO-1</p> <p>BTL-2</p>		
MODULE 2: FEATUREDETECTIONANDTRACKING(9)														
<p>Invariance-key points and 3D flow vectors- RANSAC-SIFT, SURF, ORB- Feature evaluation.Tracking and feature updation-Lucas-Kanade tracker-Kalman filter.</p> <p>Practical Component:1. write a simple OpenCV program for playing a video fi le from disk</p> <p>2. write a Program to add a trackbar slider to the basic viewer window</p>												<p>CO-2</p> <p>BTL-2</p>		

MODULE 3: SEGMENTATION AND ALIGNMENT (9)	
<p>Segmentation- Active contours, Graph based segmentation- Mean shift- Normalized cut. 2D feature based alignment- Least squares- Iterative algorithms- 3D alignment - Pose estimation- Geometric intrinsic calibration.</p> <p>Practical Component:</p> <p>1. Write a program for Loading and then smoothing an image before it is displayed on the screen</p> <p>2. Create a new image that is half the width and height of the input image Using cvPyrDown()</p>	<p>CO-3</p> <p>BTL-3</p>
MODULE 4: STRUCTURE FROM MOTION AND DENSE MOTION ANALYSIS (9)	
<p>Structure from motion (sfm)- Triangulation- Two frame sfm - Bundle adjustment. 3D motion and 2D optical flow- The Horn-Schunck algorithm- Lucas-Kanade Algorithm- Performance evaluation of optical flow results.</p> <p>Practical Component:</p> <p>1. Write a program to read in a color video and write out the same video in grayscale</p> <p>2. Create a three-channel RGB image of size 100-by-100.</p>	<p>CO-4</p> <p>BTL-2</p>
MODULE 5: RECOGNITION (9)	
<p>Object detection- Face detection - Pedestrian detection- Face recognition- Eigenfaces- Active appearance and 3D shape models. Category recognition- Bag-of-words- Part-based models, Recognition with segmentation- Context and scene understanding.</p> <p>Practical Component:</p> <p>Make an application that reads and displays a video and is controlled by sliders.</p>	<p>CO-5</p> <p>BTL-3</p>
REFERENCE BOOKS	
1	Computer Vision: Algorithms and Applications, Richard Szeliski, Springer International, 2011. ISBN : 978-1848829343

2	ConciseComputerVision:AnintroductionintotheoryandAlgorithms,ReinhardKlette,2014,Springer-Verlag London. ISBN: 9781447163206
3	R. Hartley and A. Zisserman, Multiple View Geometry in Computer Vision, CambridgeUniversity Press, 2003. ISBN: 0521540518.
4	DavidAforstyth&Jeanponce,"Computervision–AmodernApproach" „,PrenticeHall,2002. ISBN:9780136085928
5	BerndJahne and Horst HauBecker"ComputervisionandApplications",Academicpress,2000
E BOOKS	
1	http://szeliski.org/Book/drafts/SzeliskiBook_20100903_draft.pdf
MOOC	
1.	https://in.udacity.com/course/introduction-to-computer-vision--ud810
2.	https://www.edx.org/course/computer-vision-image-analysis-1

COURSE TITLE	RECOMMENDER SYSTEM			CREDITS	3
COURSE CODE	CSB3722	COURSE CATEGORY	PE	L-T-P-S	2-0-2-0
Version	1.0	Approval Details	23 ACM, 06.02.2021	LEARNING LEVEL	BTL-6
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE

15%	15%	10%	5%	5%	50%										
Course Description	The course will cover fundamental and practical aspects of Recommender systems, focusing on theory as well as on the practical use and applications of Recommender systems														
Course Objective	To develop state-of-the-art recommender systems that automate a variety of choice-making strategies with the goal of providing affordable, personal, and high-quality recommendations														
Course Outcome	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> 1. Explain the recommendation system for a particular application domain. 2. Apply the techniques for pre-processing, feature extraction and similaritybased retrieval and also analyzing classification algorithms. 3. Analyze the User-based recommendation, Item-based recommendation and build the Model based approaches and also illustrate the Attacks on collaborative recommender systems. 4. Design and develop the Hybrid Approaches such as Monolithic hybridizationdesign, Parallelized hybridization design 5. Evaluate the recommender systems on the basis of metrics such as accuracy,rank accuracy, diversity, product coverage, and serendipity 6. Design and develop the model for any real world application using recommendation system concepts 														
Prerequisites: Data Structures with a C or higher															
CO, PO AND PSO MAPPING															
CO	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO -8	PO -9	PO -10	PO -11	PO-12	PSO -1	PSO -2	PSO -3
CO-1	3	3	3	3	1	-	2	-	-	-	-	-	2	1	-
CO-2	3	3	3	3	3	-	-	-	-	2	-	-	2	1	-

CO-3	3	3	3	-	-	1	2	-	-	-	-	1	2	1	-
CO-4	3	3	3	-	-	-	-	-	-	-	-	1	2	1	-
CO-5	3	3	3	-	-	-	2	-	-	-	-	1	2	1	-
1: Weakly related, 2: Moderately related and 3: Strongly related															
MODULE 1: INTRODUCTION													(12)		
<p>Overview of Information Retrieval, Retrieval Models, Search and Filtering Techniques: Relevance Feedback, User Profiles, Recommender system functions, Matrix operations, covariance matrices, Understanding ratings, Applications of recommendation systems, Issues with recommender system.</p> <p>Suggested Activities: Assignments, MCQ, Reading reports & research projects</p>													<p>CO-1</p> <p>BTL-2</p>		
MODULE 2: CONTENT-BASED FILTERING													(12)		
<p>High level architecture of content-based systems, Advantages and drawbacks of content-based filtering, Item profiles, Discovering features of documents, pre-processing and feature extraction, Obtaining item features from tags, Methods for learning user profiles, Similarity based retrieval, Classification algorithms.</p> <p>Suggested Activities: Assignments, MCQ, Reading reports & research projects</p>													<p>CO-2</p> <p>BTL-3</p>		
MODULE 3: COLLABORATIVE FILTERING													(12)		
<p>User-based recommendation, Item-based recommendation, Model based approaches, Matrix factorization, Attacks on collaborative recommender systems.</p> <p>Suggested Activities: Assignments, MCQ, Reading reports & research projects</p>													<p>CO-3</p> <p>BTL-3</p>		
MODULE 4: HYBRID APPROACHES(12)															
<p>Opportunities for hybridization, Monolithic hybridization design: Feature combination, Feature augmentation, Parallelized hybridization design: Weighted, Switching, Mixed, Pipelined hybridization design: Cascade Meta-level, Limitations of hybridization strategies.</p>													<p>CO-4</p> <p>BTL-3</p>		

Suggested Activities: Assignments, MCQ, Reading reports & research projects		
MODULE 5: EVALUATING RECOMMENDER SYSTEM(12)		
Introduction, General properties of evaluation research, Evaluation designs: Accuracy, Coverage, confidence, novelty, diversity, scalability, serendipity, Evaluation on historical datasets, Offline evaluations.		CO-5 BTL-3
Suggested Activities: Assignments, MCQ, Reading reports & research projects		
TEXT BOOKS		
1	JannachD.,Zanker M. And FelFeringA.,Recommender Systems: An Introduction, Cambridge University Press (2011), 1st edition. ISBN: 9780521493369	
REFERENCE BOOKS		
1	CharuC.Aggarwal,RecommenderSystems:TheTextbook,Springer(2016),1 st editon.	
2	RicciF.,RokachL.,ShapiraD.,KantorB.P.,RecommenderSystemsHandbook,Springer(2011),1st ed.	
3	ManouselisN.,Drachsler H.,VerbertK.,DuvalE.,Recommender Systems For Learning,Springer (2013), 1st ed.	
E BOOKS		
1.	http://rd.springer.com/book/10.1007%2F978-3-319-29659-3	
2.	https://pdfrog.com/download/recommender_systems.pdf	
MOOC		
1.	https://nptel.ac.in/courses/110105083/54	
2.	https://www.coursera.org/specializations/recommender-systems	

COURSE TITLE	REINFORCEMENT LEARNING			Credit	3
COURSE CODE	CSC3724	COURSE CATEGORY	DE	L-T-P-S	2-0-2-0
Version	1.0	Approval Details	23 ACM, 06.02.2021	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%
Course Description	Reinforcement Learning is a subfield of Machine Learning, but is also a general purpose formalism for automated decision-making and AI. This course introduces you to statistical learning techniques where an agent explicitly takes actions and interacts with the world. Understanding the importance and challenges of learning agents that make decisions is of vital importance today, with more and more companies interested in interactive agents and intelligent decision-making.				
Course Objective	<ol style="list-style-type: none"> 1. To implement and apply Multi-Arm Bandit algorithms 2. To explain Markov Decision Processes and Dynamic Programming to solve real-world problems. 3. To implement and apply Monte Carlo and temporal-difference reinforcement learning algorithms 4. To apply on-policy and off-policy reinforcement learning algorithms with function approximation. 5. To apply Eligibility Traces and Policy Gradient Methods for solving any given 				

	problem.
Course Outcome	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> 1. Implement and apply Multi-Arm Bandit algorithms 2. Explain Markov Decision Processes and Dynamic Programming to solve real-world problems. 3. Implement and apply Monte Carlo and temporal-difference reinforcement learning algorithms 4. Construct and apply on-policy and off-policy reinforcement learning algorithms with function approximation. 5. Apply Eligibility Traces and Policy Gradient Methods for solving any given problem.

Prerequisites: Basic Statistics and Linear Algebra

CO, PO AND PSO MAPPING

CO	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO -8	PO -9	PO -10	PO -11	PO -12	PSO -1	PSO -2	PSO -3
CO-1	3	3	2	2	-	2	-	-	2	1	1	3	2	1	-
CO-2	3	3	2	1	2	1	1	1	2	2	2	3	3	2	1
CO-3	3	3	3	2	3	1	-	1	3	2	2	2	2	2	2
CO-4	3	3	3	2	2	2	1	1	1	1	1	2	3	3	1
CO-5	3	3	3	2	1	2	1	1	2	2	2	2	3	2	2

1: Weakly related, 2: Moderately related and 3: Strongly related

MODULE 1: INTRODUCTION AND MULTI-ARM BANDITS (12)

Reinforcement Learning - Elements of Reinforcement Learning- Limitations and Scope – Examples.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 Bandit Algorithms- Associative Search.

MODULE 2: FINITE MARKOV DECISION AND DYNAMIC PROGRAMMING**(12)**

Finite Markov Decision Processes: The Agent–Environment Interface- Goals and Rewards- Returns and Episodes- Unified Notation for Episodic and Continuing Tasks- Policies and Value Functions - Optimal Policies and 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.

MODULE 3: MONTE CARLO METHODS AND TEMPORAL-DIFFERENCE LEARNING(12)

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.

Temporal-Difference Learning: TD Prediction - Advantages of TD Prediction Methods - Optimality of TD(0) - Sarsa: On-policy TD Control - Q-learning: Off-policy TD Control - Expected Sarsa - Maximization Bias and Double Learning -Games, Afterstates, and Other Special Cases.

MODULE 4: APPROXIMATE SOLUTION METHODS**(12)**

On-policy Prediction with Approximation: Value-function Approximation - The Prediction Objective- Stochastic-gradient and Semi-gradient Methods - Linear Methods - Feature Construction for Linear Methods - Selecting Step-Size Parameters Manually -Nonlinear Function Approximation: Artificial Neural Networks - Least-Squares TD – Memory and kernel-based Function Approximation.

On-policy Control with Approximation: Episodic Semi-gradient Control - Semi-gradient n-step Sarsa - Average Reward: A New Problem Setting for Continuing Tasks - Deprecating the Discounted Setting - Differential Semi-gradient n-step Sarsa. Off-policy Methods with Approximation- Semi-gradient Methods - Examples of Off-policy Divergence -Linear Value-function Geometry - Bellman Error.

MODULE 5: ELIGIBILITY TRACES AND POLICY GRADIENT METHODS**(12)**

Eligibility Traces: The λ -return - TD(λ) -n-step Truncated λ -return Methods- Redoing Updates: Online λ -return Algorithm - True Online TD(λ) - Sarsa(λ) - Variable λ and Y - Off-policy Traces with Control Variates - Watkins’s Q(λ) to Tree-Backup(λ)- Stable Off-policy Methods with Traces- Implementation Issues .

Policy Gradient Methods: Policy Approximation and its Advantages - The Policy Gradient Theorem-

REINFORCE: Monte Carlo Policy Gradient - REINFORCE with Baseline - Actor-Critic Methods - Policy Gradient for Continuing Problems - Policy Parameterization for Continuous Actions. Applications and Case Studies.

REFERENCE BOOKS

1	Richard S. Sutton and Andrew G. Barto, "Reinforcement Learning: An Introduction", 2 nd Edition, MIT Press, 2018. ISBN: 978-0262039246.
2	Csaba Szepesvári, "Algorithms for Reinforcement Learning", Morgan & Claypool, 2013.
3	Kevin Murphy, "Machine Learning - A Probabilistic Perspective", MIT press, 2012.
4	Christopher Bishop, "Pattern Recognition and Machine Learning", Springer, 2006

E BOOKS

1	https://web.stanford.edu/class/psych209/Readings/SuttonBartoIPRLBook2ndEd.pdf
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MOOC

1	https://www.coursera.org/specializations/reinforcement-learning
2	https://www.edx.org/course/reinforcement-learning-explained-2

ELECTIVE -III

COURSE TITLE	NATURE-INSPIRED COMPUTING			Credit	3
COURSE CODE	CSC3725	COURSE CATEGORY	DE	L-T-P-S	2-0-2-0
Version	1.0	Approval Details	23 ACM, 06.02.2021	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First	Second Periodical	Seminar/	Surprise Test	Attendance	ESE

Periodical Assessment	Assessment	Assignments/ Project	/ Quiz		
15%	15%	10%	5%	5%	50%

Course Description	As technology continues to become more sophisticated, mimicking natural processes and phenomena also becomes more of a reality. The topic of natural computing, including emerging technologies being developed for the purpose of simulating natural phenomena, applications across industries, and the future outlook of biologically and nature-inspired technologies.
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Course Objective	<ol style="list-style-type: none"> 1. To identify the need of appropriate Nature-Inspired Algorithms for Optimization. 2. To explain and implement random walk, simulated annealing and GA 3. To implement Differential Evolution and Swarm intelligence. 4. To implement Firefly, Cuckoo Search and Bat Algorithms. 5. To explain Self Tuning and other hybrid Algorithms.
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Course Outcome	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> 1. Identify the need of appropriate Nature-Inspired Algorithms for Optimization. 2. Explain and implement random walk, simulated annealing and GA 3. Implement Differential Evolution and Swarm intelligence. 4. Implement Firefly, Cuckoo Search and Bat Algorithms. 5. Explain Self Tuning and other hybrid Algorithms.
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Prerequisites:Artificial Intelligence

CO, PO AND PSO MAPPING

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	2	2	-	2	-	-	2	1	1	3	2	1	-

CO-2	3	3	2	1	2	1	1	1	2	2	2	3	3	2	1
CO-3	3	3	3	2	3	1	-	1	3	2	2	2	2	2	2
CO-4	3	3	3	2	2	2	1	1	1	1	1	2	3	3	1
CO-5	3	3	3	2	1	2	1	1	2	2	2	2	3	2	2

1: Weakly related, 2: Moderately related and 3: Strongly related

MODULE 1:INTRODUCTION

(12)

Introduction to Algorithms - Newton's method - Optimization - Search for Optimality- No-Free-Lunch Theorems - Nature-Inspired Metaheuristics.

Analysis of Algorithms: Analysis of Optimization Algorithms – Nature-Inspired Algorithms -Parameter Tuning and Parameter Control.

MODULE 2: RANDOM WALKS, SIMULATED ANNEALING AND GA

(12)

Random variables - Isotropic random walks - Levy distribution and flights - Markov chains -Step sizes and Search efficiency - Modality and intermittent search strategy - Importance of randomization- Eagle strategy.

Simulated Annealing: Annealing and Boltzmann Distribution - Parameters -SA Algorithm - Stochastic Tunneling. Genetic algorithms (GA): Introduction - Role of genetic operators - Choice of parameters -GA variants - Schema theorem - Convergence analysis.

MODULE 3: DIFFERENTIAL EVOLUTION AND PSO

(12)

Introduction to Differential Evolution- Variants - Choice of parameters - Convergence analysis - Implementation.

Particle Swarm Optimization (PSO): Swarm intelligence - PSO algorithm - accelerated PSO - implementation – Convergence analysis - Binary PSO.

MODULE 4: FIREFLY, CUCKOO SEARCH AND BAT ALGORITHMS

(12)

The Firefly algorithm - Algorithm analysis - Implementation – Variants- Firefly Algorithms in Applications.

Cuckoo Search: Cuckoo Breeding Behavior- Lévy Flights - Cuckoo Search – Applications. Bat Algorithms: Echolocation of Bats- Bat Algorithms- Implementation- Variants of the Bat Algorithm- Convergence Analysis-

Applications.

MODULE 5: SELF TUNING AND OTHER ALGORITHMS (12)

Self-Tuning Algorithms: Introduction- Algorithm Analysis and Parameter Tuning- Framework for Self-Tuning Algorithms- A Self-Tuning Firefly Algorithm.

Ant Algorithms- Bee-Inspired Algorithms- Harmony Search- Hybrid Algorithms.

TEXT BOOKS

1 Xin-She Yang, "Nature Inspired Optimization Algorithms", Elsevier, First Edition 2014.

REFERENCE BOOKS

1 Eiben,A.E.,Smith,James E, "Introduction to Evolutionary Computing", Springer 2015.

ISBN: 978-3642072857.

2 Helio J.C. Barbosa, "Ant Colony Optimization - Techniques and Applications", Intech, 2013.

ISBN: 9789535157175.

3 Yang ,Cui,Xlao,Gandomi,Karamanoglu ,"Swarm Intelligence and Bio-Inspired Computing", Elsevier First Edition, 2013.

E BOOKS

1 <http://www.cleveralgorithms.com/nature-inspired/index.html>

2 [http://csl.t.riit.tsinghua.edu.cn/mediawiki/images/e/e8/Introduction to Evolutionary Computing.pdf](http://csl.t.riit.tsinghua.edu.cn/mediawiki/images/e/e8/Introduction_to_Evolutionary_Computing.pdf)

MOOC

1 <https://www.udemy.com/course/geneticalgorithm/>

COURSE TITLE	COGNITIVE COMPUTING			Credit	3
COURSE CODE	CSC3727	COURSE CATEGORY	DE	L-T-P-S	2-0-2-0
Version	1.0	Approval Details	23 ACM, 06.02.2021	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%
Course Description	Cognitive computing refers to systems that encompass machine learning, reasoning, natural language processing, speech recognition and vision (object recognition), human-computer interaction, dialog and narrative generation, to name a few.				
Course Objective	<ol style="list-style-type: none"> 1. To understand the concepts of formal modelling. 2. To describe the field of AI and how Watson technology is being applied to solve real world problems 3. To understand the acquisition of Natural Language and its processing 4. To know the advancement of Computer Vision and Identify some of the tools and services of Computer Vision 5. To develop cognitive based applications like Chatbot 				
Course Outcome	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> 1. Understand the concepts of formal modelling. 2. Describe the field of AI and how Watson technology is being applied to solve real world problems 3. Understand the acquisition of Natural Language and its processing 				

	<p>4. Know the advancement of Computer Vision and Identify some of the tools and services of Computer Vision</p> <p>5. Design and develop cognitive based applications like Chatbot</p>
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Prerequisites:Basics of Machine Learning, Artificial Intelligence, Natural Language Processing, Image Processing

CO, PO AND PSO MAPPING

CO	P O- 1	PO -2	PO- 3	PO- 4	PO -5	PO -6	PO -7	PO -8	PO -9	PO -10	PO -11	PO -12	PSO- 1	PSO- 2	PSO- 3
CO-1	3	3	2	-	1	2	-	-	2	1	1	3	2	3	-
CO-2	3	3	2	1	2	1	1	1	2	2	2	3	3	2	1
CO-3	3	3	3	2	3	1	-	1	3	2	2	2	3	2	2
CO-4	3	3	2	1	2	2	1	1	2	1	1	2	2	3	1
CO-5	3	3	3	2	1	2	1	1	2	1	1	2	3	2	1

1: Weakly related, 2: Moderately related and 3: Strongly related

MODULE 1: FORMAL MODELLING(12)

Bayesian Inference and Hierarchical Bayesian Models, Frameworks for Knowledge Representation: First-order Logic, Formal Grammars, Associative Networks, Taxonomic Hierarchies, Relational Schemas - Probabilistic and Causal Graphical Models - Relational Probabilistic Models - Controlling Complexity: Minimum Description Length, Bayesian Occam's Razor, Nonparametric Bayesian Models - Inductive Logic Programming - Sampling Algorithms for Inference in Complex Probabilistic Models

Practical Component:1.Implement Bayesian Model

MODULE 2: ARTIFICIAL INTELLIGENCE FOUNDATIONS(12)	
Introduction to Artificial Intelligence - Computer Vision, Cognitive computing Introduction to IBM Watson, Evolution from Deep QA to Watson services on IBM Cloud, Build with Watson	
Practical Component: Working on simple exercise based on IBM Watson Application	
MODULE 3: NATURAL LANGUAGE PROCESSING (12)	
Natural Language Processing, Pipeline& concepts, NLP and IBM Watson.	
Practical Component: Working on simple exercise using NLP Tools	
MODULE 4: COMPUTER VISION(12)	
Introduction to Computer Vision, Computer Vision fundamentals, IBM Watson visual recognition service	
Practical Component: Working on simple exercise using OpenCV Computer Vision Tool	
MODULE 5: CASE STUDY : CHATBOTS (12)	
Introduction to Chatbots, Chatbot fundamentals, IBM Watson conversation service	
Practical Component: Develop the simple chatbot using IBM Watson	
TEXT BOOKS	
1.	Cognitive Computing with IBM Watson,TanmayBakshi. ISBN: Cognitive Computing with IBM Watson,TanmayBakshi. ISBN:9781788478298
REFERENCE BOOKS	
1	Judith S. Hurwitz, Marcia Kaufman,Adrian Bowles ,“Cognitive Computing and Big Data Analytics,”, ISBN: 978-1-118-89662-4 April 2015 288 Pages
2	Peter Fingar, Vinton G. Cerf, “Cognitive Computing: A Brief Guide for Game Changers All's Changed Utterly”Meghan-Kiffer Press,2015.
MOOC	
1.	Cognitive Computing (Perception, Learning, Reasoning) - AI Concepts, Terminology, and Application Areas Coursera

COURSE TITLE	EMOTIONAL INTELLIGENCE			Credit	3
COURSE CODE	CSC3728	COURSE CATEGORY	DE	L-T-P-S	2-0-2-0
Version	1.0	Approval Details	23 ACM, 06.02.2021	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%
Course Description	Humans have always been able to claim mastery above machines when it comes to understanding emotion. But that won't be the case for long. While some may doubt that machines will encroach on emotion, those working in the field of artificial emotional intelligence				
Course Objective	<ol style="list-style-type: none"> 1. To understand the basic industrial problem using AI 2. To apply the AI Algorithm to solve the real time problems 3. To understand the killer applications for manufacturing industries 4. To explore the various Industrial applications 5. To apply the concepts for new Industrialization Project 				
Course Outcome	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> 1. Solve the basic industrial problem using AI 2. Use the AI Algorithm to solve the real time problems 3. Understand the killer applications for manufacturing industries 4. Explore the various Industrial applications 5. Apply the Concepts for new Industrialization Project 				

Prerequisites:

CO, PO AND PSO MAPPING

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	3	2	1	2	-	-	2	1	1	3	2	3	-
CO-2	3	3	2	1	2	1	1	1	2	2	2	3	3	2	1
CO-3	3	3	3	2	3	1	-	1	3	2	2	2	3	2	2
CO-4	3	3	3	1	2	2	1	1	2	1	1	2	2	3	1
CO-5	3	3	3	2	3	2	1	1	2	2	1	2	3	2	1

1: Weakly related, 2: Moderately related and 3: Strongly related

MODULE 1: INTRODUCTION TO EMOTIONAL INTELLIGENCE

(12)

What is Emotional Intelligence?-Causes of Emotions-Typical Characteristics of Emotion-Basic Components of Emotion-Rationality of Emotion-Regulation and Control of Emotion-The Biological Basis of Emotion-Self Regulation Models of Emotion-Emotional Learning-Mathematical Modeling of Emotional Dynamics-Controlling Emotion by Artificial Means-Effect of Emotion Modeling on Human Machine Interactions

Practical Component:

Develop the model to monitor the Effect of Emotion on Human Machine Interactions

MODULE 2: MATHEMATICAL MODELING AND ANALYSIS OF DYNAMICAL SYSTEMS	(12)
<p>Introduction-System Modeling and Stability-Stability Analysis of Dynamics by Lyapunov Energy Functions-Stability Analysis of Fuzzy Systems-Chaotic Neuro Dynamics and Lyapunov Exponents-Emotional Dynamics and Stability Analysis-The Lyapunov Exponents and the Chaotic Emotional Dynamics-Preliminaries on Image Processing-Discrete Fourier and Cosine Transforms-Preprocessing and Noise Filtering-Image Segmentation Algorithms-Boundary Description-Object Recognition from an Image-Scene Interpretation</p>	
<p>Practical Component:Build a framework to recognize the object from an Image.</p>	
MODULE 3: BRAIN IMAGING	(6+6)
<p>Emotion Processing by the Human Brain-The Role of Medial Frontal Cortex in Self-regulation of Emotion-The Anterior Cingulate Cortex as a Self-regulatory Agent-Voluntary Self-regulation of Emotion-EEG Conditioning and Affective Disorders-Emotion Dysregulation and Psycho-pathological Issues-Fuzzy Models for Facial Expression-Based Emotion Recognition and Control-Filtering, Segmentation and Localization of Facial Components-Determination of Facial Attributes-Fuzzy Relational Model for Emotion Detection-Validation of the System Performance-Proposed Model of Emotion Transition and Its Control</p>	
<p>Practical Component:Develop the model for Emotion Transition and Its Control</p>	
MODULE 4: CONTROL OF MENTAL STABILITY	(6+6)
<p>Stable Points of Non-temporal Logic-Stable Points in Propositional Temporal Logic-Stability of Propositional Temporal System Using Lyapunov Energy Function-Human Emotion Modeling and Stability Analysis-The Fuzzy Temporal Representation of Phenomena Involving Emotional States-Stabilization of Emotional Dynamics-Psychological Stability in Emotion-Logic Counter-Actions-Proposed Model for Chaotic Emotional Dynamics-Effect of Variation in Parameters of the Emotional Dynamics-Chaotic Fluctuation in Emotional State-Stability Analysis of the Proposed Emotional Dynamics by Lyapunov Energy Function-Parameter Selection of the Emotional Dynamics by Experiments with Audio-Visual Stimulus-Stabilization Scheme for the Mixed Emotional Dynamics</p>	
<p>Practical Component:Implement Audiovisual integration of emotional signals and test with suitable dataset</p>	
MODULE 5: ELECTROENCEPHALOGRAPHIC SIGNAL PROCESSING	(6+6)
<p>EEG Prediction by Adaptive Filtering-EEG Signal Prediction by Wavelet Coefficients-Bio-potential Signals in Emotion Prediction-Emotion Clustering by Neural Networks-Application in Human-Machine Interactive Systems-Application in Multi-agent Co-operation of Mobile Robotics-Emotional Intelligence in Psycho-</p>	

therapy-Detection of Anti-social Motives from Emotional Expressions-Applications in Video Photography/Movie Making-Applications in Personality Matching of People for Matrimonial Counseling-Synthesizing Emotions in Voice-Application in User Assistance Systems-Emotion Recognition from Voice Samples

Practical Component:Develop the model to Recognize the human emotions from Voice Samples

TEXT BOOKS

1	Aruna Chakraborty and Amit Konar, "Emotional Intelligence: A Cybernetic Approach", 2009 Springer-Verlag Berlin Heidelberg. ISBN: 9783540-686064
2	Richard Yonck, "Heart of the Machine: Our Future in a World of Artificial Emotional Intelligence", Arcade (11 February 2020)

REFERENCE BOOKS

1	Alessandro Parisi, "Hands-On Artificial Intelligence for Cyber security: Implement smart AI systems for preventing cyber attacks and detecting threats and network anomalies"
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E BOOKS

1	https://www.plattform-i40.de/PI40/Redaktion/EN/Downloads/Publikation/AI-in-Industrie4.0.pdf?__blob=publicationFile&v=5
2	https://www2.deloitte.com/content/dam/Deloitte/ch/Documents/manufacturing/ch-en-manufacturing-industry-4-0-24102014.pdf

MOOC

1	https://www.coursera.org/learn/introduction-to-ai
2	https://www.my-mooc.com/en/mooc/artificial-intelligence-ai-columbiacx-csmm-101x/

COURSE TITLE	PRINCIPLES OF DEEP LEARNING			CREDITS	3
COURSE CODE	CSB3729	COURSE CATEGORY	PE	L-T-P-S	3- 0- 0- 0
Version	1.0	Approval Details	23 ACM, 06.02.2021	LEARNING LEVEL	BTL-5
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%
Course Description	This course covers in-depth knowledge for Building the deep learning models				
Course Objective	<ol style="list-style-type: none"> 1. To know complexity of Deep Learning algorithms and their limitations 2. To understand modern notions in data analysis oriented computing; 3. To be capable of confidently applying common Deep Learning algorithms in practice and implementing their own; 4. To be capable of performing distributed computations; 5. To be capable of performing experiments in Deep Learning using real-world data. 				
Course Outcome	<p>Upon the completion of the course the students will be able to</p> <ol style="list-style-type: none"> 1. Develop algorithms simulating human brain. 2. Analyze ANN learning and memory based learning 3. Explore the essentials of Deep Learning and Deep Network architectures. 4. Implement Neural Networks in Tensor Flow for solving problems. 5. Use deep learning methodology in real world application 				

Prerequisites: Neural Networks

CO, PO AND PSO MAPPING

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	1	1	1	2	1	-	-	-	-	-	2	-	-
CO-2	3	3	1	-	-	-	-	-	-	2	-	-	-	-	-
CO-3	3	3	3	2	-	1	-	2	-	-	-	-	-	-	-
CO-4	2	1	3	3	3	3	1	1	1	2	2	2	-	-	1
CO-5	1	1	3	3	3	3	3	1	1	2	2	2	3	-	1

1: Weakly related, 2: Moderately related and 3: Strongly related

MODULE1:INTRODUCTION

(9)

Basics of Deep learning-Deep learning architectures: Convolutional Neural Networks:Neurons in Human Vision-The Shortcomings of Feature Selection-Vanilla Deep Neural Networks Don't Scale-Filters and Feature Maps-Full Description of the Convolutional Layer-Max Pooling-Full Architectural Description of Convolution Networks-Closing the Loop on MNIST with Convolutional Networks Image Preprocessing Pipelines Enable More Robust Models-Accelerating Training with Batch Normalization-Building a Convolutional Network for CIFAR-10 Visualizing Learning in Convolutional Networks Leveraging Convolutional Filters to Replicate Artistic Styles-Learning Convolutional Filters for Other Problem Domains-Training algorithms.

Practical component: Study on Tools for AI and DL

Suggested Readings: <https://machinelearningmastery.com/what-is-deep-learning/>

CO-1
BTL-2

MODULE2:MEMORY AUGMENTED NEURAL NETWORKS

(9)

<p>Memory Augmented Neural Networks: Neural Turing Machines-Attention-Based Memory Access- NTM Memory Addressing Mechanisms-Differentiable Neural Computers-Interference-Free Writing in DNCs-DNC Memory Reuse-Temporal Linking of DNC Writes-Understanding the DNC Read Head- The DNC Controller Network Visualizing the DNC in Action-Implementing the DNC in TensorFlow- Teaching a DNC to Read and Comprehend.</p> <p>Practical component:Mathematical computing with Python, Data migration and visualization:</p> <p>Suggested Readings: https://machinelearningmastery.com/what-is-deep-learning/</p>	<p>CO-2</p> <p>BTL-3</p>
<p>MODULE3:DEEP REINFORCEMENT LEARNING (9)</p>	
<p>Deep Reinforcement Learning Masters Atari Games What Is Reinforcement Learning? - Markov DecisionProcesses(MDP)-ExploreVersusExploit-PolicyversusValueLearning-Pole-CartwithPolicy Gradients-Q-LearningandDeepQ-Networks-ImprovingandMovingBeyondDQN.</p> <p>Practical component: Hands-on on ML concepts with Deep Playground.</p> <p>Suggested Readings: https://machinelearningmastery.com/what-is-deep-learning/</p>	<p>CO-3</p> <p>BTL-4</p>
<p>MODULE 4:TENSORFLOW (9)</p>	
<p>Implementing Neural Networks in tensorFlow: What Is tensorFlow?-How Does TensorFlow Compare to Alternatives?-Installing tensorFlow-Creating and Manipulating tensorFlow Variables- tensor Flow Operations-Placeholder Tensors-Sessions in tensor Flow-Navigating Variable Scopes and Sharing Variables- Managing Model solver the CPU and GPU-Specifying the Logistic Regression Model in tensor Flow-Logging and Training the Logistic Regression Model-Leveraging Tensor Board to Visualize 24 Computation Graphs and Learning-Building a Multilayer Model for MNIST in Tensor Flow.</p> <p>Practical component:</p> <p>Hands on TensorFlow libraries to implement deep learning</p> <p>Suggested Readings:</p> <p>https://towardsdatascience.com/what-is-deep-learning-and-how-does-it-work-2ce44bb692ac</p>	
<p>MODULE 5: APPLICATIONS(6L+6L=12)</p>	
<p>Applications: Deep learning for computer vision, Deep Learning Applications at the Enterprise Scale, Deep Learning Models for Healthcare Applications</p>	<p>CO-5</p>

Practical component: Mini project on DL	BTL-5
Suggested Readings: https://towardsdatascience.com/what-is-deep-learning-and-how-does-it-work-2ce44bb692ac	

TEXT BOOKS

1	Simon Haykins, “Neural Network- A Comprehensive Foundation”, Pearson Prentice Hall, 2nd Edition, 1999. ISBN-13: 978-0-13-147139-9/ISBN-10: 0-13-147139-2
2	Zurada and Jacek M, “Introduction to Artificial Neural Systems”, West Publishing Company, 1992, ISBN: 9780534954604
3	Nikhil Buduma, Nicholas Locascio, “Fundamentals of Deep Learning: Designing Next Generation Machine Intelligence Algorithms”, O'Reilly Media, 2017.

REFERENCE BOOKS

1	IanGoodfellow,YoshuaBengio,AaronCourville,“DeepLearning(AdaptiveComputationand Machine Learning Series MIT Press 2017
2	MTHagan,HBDemoth,MBeale,“NeuralNetworksDesign”,ThomsonLearning,2002.ISBN-10: 0-9717321-1-6/ ISBN-13: 978-0-9717321-1-7

E BOOKS

1.	http://www.deeplearningbook.org/
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MOOC

1	https://onlinecourses.nptel.ac.in/noc18_cs26/
2	https://www.upgrad.com/machine-learning-and-artificial-intelligence

ELECTIVE IV

COURSE TITLE	NATURAL LANGUAGE PROCESSING			Credit	3
COURSE CODE	CSC3726	COURSE CATEGORY	DE	L-T-P-S	2-0-2-0
Version	1.0	Approval Details	23 ACM, 06.02.2021	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%
Course Description	This course covers a wide range of tasks in Natural Language Processing from basic to advanced: Grammar and parsing, semantic analysis, neural language models and neural networks for language processing and question answering and Chatbots.				
Course Objective	<ol style="list-style-type: none">1. To know the basic concepts related to language processing2. To understand the fundamentals of Grammar and parsing algorithms for syntax analysis3. To analyze the semantic content of a given text4. To familiarize neural language models and neural networks for language processing5. To build the question answering and Chatbots				

Course Outcome	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> 1. Understand the basic concepts related to language processing 2. Understand the Grammar and parsing algorithms for syntax analysis 3. Analyze the semantic content of a given text 4. Familiarize neural language models and neural networks for language processing 5. Develop question answering and Chatbots
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Prerequisites:Artificial Intelligence

CO, PO AND PSO MAPPING

CO	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO -8	PO -9	PO -10	PO -11	PO -12	PSO -1	PSO -2	PSO -3
CO-1	3	3	2	2	-	2	-	-	2	1	1	3	2	1	-
CO-2	3	3	2	1	2	1	1	1	2	2	2	3	3	2	1
CO-3	3	3	3	2	3	1	-	1	3	2	2	2	2	2	2
CO-4	3	3	3	2	2	2	1	1	1	1	1	2	3	3	1
CO-5	3	3	3	2	1	2	1	1	2	2	2	2	3	2	2

1: Weakly related, 2: Moderately related and 3: Strongly related

MODULE 1: INTRODUCTION

(12)

Introduction to NLP, Regular Expressions, Words, Corpora, Text Normalization, Minimum Edit distance, N gram Language Models, Evaluating Language Models, Generalization and Zeros, Smoothing, Kneser-Ney Smoothing, The web and the stupid backoff, Advanced: Perplexity's Relation to Entropy.

Practical Component:

1. Installation of NLP toolkit,Get familiar with Python programming
2. Practice NLTK and Numpy library

3. Simple NLP Exercise – Tokenization, stop words removal, punctuations removal

MODULE 2: PART OF SPEECH TAGGING AND SYNTAX PARSING

(12)

English Word Classes, The Penn Treebank Part-of-Speech Tagset, Part-of-Speech Tagging, HMM Part-of-Speech Tagging, Maximum Entropy Markov Models, Probabilistic Context-Free Grammars, Probabilistic CKY Parsing of PCFGs, Ways to Learn PCFG Rule Probabilities, Problems with PCFGs, Improving PCFGs by Splitting Non-Terminals, Probabilistic Lexicalized CFGs, Probabilistic CCG Parsing.

Practical Component:

1. Programming exercises for using existing NLP tools (CoreNLP/NLTK) and obtaining the syntactic parsing of the text.

MODULE 3: SEMANTIC ANALYSIS

(12)

Lexical Semantics, Vector Semantics, Words and Vectors, Cosine for measuring similarity, TF-IDF: Weighing terms in the vector, Applications of the tf-idf vector model, Pointwise Mutual Information (PMI), Word2vec, Visualizing Embeddings, Semantic properties of embeddings, Bias and Embeddings, Evaluating Vector Models.

Practical Component:

1. Extract the word vector representation of the word using word2vec model
2. Implement Word embedding on the given texts and visualize it

MODULE 4: NEURAL NETWORKS AND NEURAL LANGUAGE MODELS

(12)

The XOR problem, Feed-Forward Neural Networks, Training Neural Nets, Neural Language Models, Simple Recurrent Neural Networks, Applications of Recurrent Neural Networks, Deep Networks: Stacked and Bidirectional RNNs, Managing Context in RNNs: LSTMs and GRUs, Words, Subwords and Characters.

Practical Component:

1. Demonstration and familiarization with deep learning libraries
2. Programming exercises for employing a multi-layer feedforward network on PoS tagging and NER tasks

MODULE 5: QUESTION ANSWERING & DIALOGUE SYSTEMS

(12)

IR based Factoid QA, Knowledge based QA, IBM's Watson, Properties of human conversation, Chatbots, Simple frame based dialogue systems, Dialogue system architecture, Evaluation of Dialogue system, Dialogue system design.

Practical Component:

Build a Question Answering model that answers questions from the given context using transformers package

REFERENCE BOOKS

1 Dan Jurafsky and James H. Martin. Speech and Language Processing (3rd ed. draft), 2019.
ISBN: 978-0135041963

2 Jacob Eisenstein. Natural Language Processing, MIT Press, 2018. ISBN :978-0262042840

E BOOKS

1 <https://www.amazon.com/Natural-Language-Processing-SEO-Optimization-ebook/dp/B07X1LB686?tag=uuid10-20>

2 <https://www.amazon.com/Natural-Language-Processing-Fundamentals-applications-ebook/dp/B07KX263Y4?tag=uuid10-20>

MOOC

1 <https://www.coursera.org/learn/language-processing>

COURSE TITLE	SPEECH INFORMATION PROCESSING			CREDITS	3
COURSE CODE	CSC3727	COURSE CATEGORY	DE	L-T-P-S	3-0-0-0
Version	1.0	Approval Details	23 ACM, 06.02.2021	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					

First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%

Course Description
 The course is aimed for students who are interested to work in the area of speech processing as well as those who are interested in doing research in speech. The course covers techniques for analysis and modeling of speech both from signal processing and machine learning aspects covering a number of applications including speech recognition, enhancement and coding.

- Course Objective**
1. To Understand the human speech communication system
 2. To know about Time varying signals and system for modeling speech
 3. To learn more about Short-time analysis for speech signal
 4. To get knowledge about the applications of various techniques for speech coding, enhancement and recognition

- Course Outcome**
- Upon completion of this course, the students will be able to
1. Demonstrate the conventional acoustic models.
 2. Apply deep neural networks for building acoustic models.
 3. Explain and implement hybrid system for automatic speech recognition.
 4. Perform feature Representation Learning in Deep Neural Networks
 5. Demonstrate Representation Sharing and Transfer in Advanced Deep Neural Networks

Prerequisites: Digital Signal Processing, Probability and Random Processes

CO, PO AND PSO MAPPING

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	2	-	1	-	-	-	-	-	-	-	1	1	-
CO-2	3	3	2	2	-	-	-	-	-	-	-	-	1	1	-

CO-3	3	3	2	2	-	1	-	-	-	-	-	-	1	1	-
CO-4	3	3	2	2	-	-	-	-	-	-	-	-	1	1	-
CO-5	3	3	2	2	-	-	-	-	-	-	-	-	1	1	-

1: Weakly related, 2: Moderately related and 3: Strongly related

MODULE 1: CONVENTIONAL ACOUSTIC MODELS (9)

Introduction, Gaussian Mixture Models- Random Variable-Parameter Estimation, Hidden Markov Models and the Variants- Markov Chain-Hidden Markov Sequences and Model-M Algorithm and Its Application to Learning HMM Parameter-Viterbi Algorithm for Decoding HMM State Sequence- the HMM and Variants for Generative Speech Modeling and Recognition.	CO-1 BTL-2
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MODULE 2: DEEP NEURAL NETWORKS(9)

The Deep Neural Network Architecture- Parameter Estimation with Error Back propagation- Practical Consideration, Advanced Model Initialization Techniques- Restricted Boltzmann Machines- Deep Belief Network Pre-training- Pre-training with De-noising Auto-encoder- Discriminative –Hybrid-Dropout Pre-trainings.	CO-2 BTL-3
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MODULE 3: HYBRID SYSTEMS FOR AUTOMATIC SPEECH RECOGNITION(9)

Deep Neural Network-Hidden Markov Model Hybrid Systems- Architecture -Key Components and Their Analysis- Kullback-Leibler Divergence-Based HM, Training and Decoding Speedup- Deep Neural Network Sequence-Discriminative Training - Sequence-Discriminative Training Criteria - Practical Considerations - Noise Contrastive Estimation.	CO-3 BTL-3
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MODULE 4: REPRESENTATION LEARNING IN DEEP NEURAL NETWORKS(9)

Feature Representation Learning in Deep Neural Networks- Joint Learning of Feature Representation and Classifier- Feature Hierarchy- Flexibility- Robustness of Feature and Across All Condition -Lack of Generalization Over Large Distortions, Fuse Deep Neural Network and Gaussian Mixture Model Systems-Use DNN-Derived Features in GMM-HMM Systems-Fuse Recognition Results- Fuse Frame-Level Acoustic Scores - Multistream Speech Recognition, Adaptation of Deep Neural Networks - The Adaptation Problem for Deep Neural Networks - Linear Transformations - Linear Hidden Networks - Conservative Training - Subspace Methods - Effectiveness of DNN Speaker Adaptation.	CO-4 BTL-3
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MODULE 5: ADVANCED DEEP MODELS	(9)
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Representation Sharing and Transfer in Deep Neural Networks- Multitask and Transfer Learning - Multilingual and Crosslingual Speech Recognition – Multi objective Training of Deep Neural Networks for Speech Recognition- Robust Speech Recognition Exploiting Audio-Visual Information, Recurrent Neural Networks and Related Models - State-Space Formulation of the Basic Recurrent Neural Network - The Back propagation-Through-Time Learning Algorithm - A Primal-Dual Technique for Learning Recurrent Neural Networks - Recurrent Neural Networks Incorporating LSTM Cells - Analyzing Recurrent Neural Networks — A Contrastive Approach- Parameterization- Methods of Model Learning- Recognition Accuracy Comparisons, Computational Network - Forward Computation - Model Training - Typical Computation Nodes - Convolutional Neural Network - Recurrent Connections.	CO-5 BTL-3
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TEXT BOOKS

1.	Yu, Dong, Deng, Li, <i>Automatic Speech Recognition, A Deep Learning Approach</i> , Springer, 2015. ISBN: 978-1447157786
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REFERENCE BOOKS

1.	Rabiner and Juang, <i>Fundamentals of speech recognition</i> , Prentice Hall, 1993. ISBN : 9780130151575
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2.	Thomas F. Quatieri, <i>Discrete-Time Speech Signal Processing: Principles and Practice</i> , Prentice Hall, 2001.
3.	Lawrence R. Rabiner, <i>Digital Processing of Speech Signals</i> , Pearson Education, 2008.
4.	Daniel Jurafsky & James H. Martin, <i>Speech and Language Processing - An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition</i> , 3rd Edition 2019.

E BOOKS

1.	https://www.amazon.com/dp/1532811616/ref=rdr_ext_tmb
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MOOC

1.	https://assp2015.wordpress.com/2015/08/03/mooc-on-speech-science-by-virtual-linguistic-campus/
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COURSE TITLE	HUMAN CENTERED COMPUTING			CREDITS	3
COURSE CODE	CSC3731	COURSE CATEGORY	DE	L-T-P-S	3-0-0-0
Version	1.0	Approval Details	23 ACM, 06.02.2021	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%
Course Description	Human-Centered Computing (HCC) focuses on the design, implementation, and evaluation of interactive information technology systems that are both usable and accessible. The goal of Human-Centered Computing is an understanding of how humans				

	interact with information technologies and to use this information to improve the lives of those individuals.
Course Objective	<ol style="list-style-type: none"> 1. To know the concept of interactive information technology 2. To learn the Human interaction with information technologies 3. To explore the design and implementation goals 4. To know more about the interface's requirement
Course Outcome	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> 1. Elaborate the basics and fundamentals of human centered computing 2. Illustrate the concept of different type of cognition. 3. Design a new type of user interface 4. Interpret the use of interface in various applications 5. Explore various use cases of User Interface Design

Prerequisites: Basic computing knowledge

CO, PO AND PSO MAPPING

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	2	-	-	-	-	-	-	-	-	-	1	1	-
CO-2	3	2	2	-	-	2	-	-	-	-	-	-	1	1	-
CO-3	3	2	2	-	-	2	-	-	-	-	-	-	1	1	-
CO-4	3	2	2	-	-	2	-	-	-	-	-	-	1	1	-
CO-5	3	2	2	-	-	2	-	-	-	-	-	-	1	1	-

1: Weakly related, 2: Moderately related and 3: Strongly related

MODULE 1: INTRODUCTION TO HCI (9)

Introduction- Conceptualizing HCI: From Paradigms to Frameworks- Transforming Society- Reframing Theory- The Role and contribution of theory in HCI- Classical Theories:Body of Knowledge, Applying Basic Research, Cognitive Modelling.		CO-1 BTL-2
MODULE 2: MODERN & CONTEMPORARY THEORIES OF HCI		(9)
Modern Theories: External Cognition, Distributed Cognition, Ecological Psychology, Situated Action, Ethnography, Computed-Supported Collaborative Work Theories, Activity Theory, Grounded Theory, Hybrid Theories. Contemporary theories.		CO-2 BTL-3
MODULE 3: DESIGNING HCI		(9)
Visual Design: Principles for Usable interfaces, Intercultural User Interface Design, Multimedia User Interface Design, Multimodal Interfaces, Adaptive Interfaces & agents, Tangible UI, Information Visualization, Computer-supported Cooperative Work, HCI design of Decision -support systems.		CO-3 BTL-3
MODULE 4: DOMAIN SPECIFIC DESIGN		(9)
HCI Interaction in Healthcare- User centered design in games- Motor vehicle Driver Interface- HCI in Aerospace-HCI and Autonomous Vehicles		CO-4 BTL-3
MODULE 5: DESIGNING FOR DIVERSITY(USE CASES) (9)		
Reasoning Based Virtual Machine Mapping Toward Physical Machine, Reinforcement Learning Based Signal Quality Aware Handover Scheme, A Smart Contract based RBAC Model for Dapps, Real-Time Collaborative Annotation System		CO-5 BTL-2
TEXT BOOKS		
1.	Julie A. Jacko. Human-Computer Interaction Handbook: Fundamentals, Evolving Technologies, and Emerging Applications, Third Edition. CRC Press, 2012. ISBN: 978-1439829431	
REFERENCE BOOKS		
1.	Yvonne Rogers. HCI Theory Classical, Modern, and Contemporary. Synthesis Lectures on Human-Centered Informatics, Morgan & Claypool Publishers, 2012. ISBN :978-1608459001	

2.	Danijela Milošević, Yong Tang, Qiaohong Zu, Human Centered Computing, Information Systems and Applications, incl. Internet/Web, and HCI book sub series, Springer, 2019.
E BOOKS	
1.	http://findmedianow.com/book82.php?asin=B08435ZHQ
MOOC	
1.	https://www.interaction-design.org/courses/human-computer-interaction
2.	https://www.classcentral.com/course/hciucsd-306

COURSE TITLE	AI IN CYBER SECURITY			CREDITS	3
COURSE CODE	CSC3729	COURSE CATEGORY	DE	L-T-P-S	2-0-2-0
Version	1.0	Approval Details	23 ACM, 06.02.2021	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%
Course Description	Students will Gain an in-depth understanding of artificial intelligence concepts, principles and technologies that affect cyber security. The security of business systems and data is vital, and with most business having an online presence you will learn to implement AI to monitor and protect against cyber-attacks.				

Course Objective	<ol style="list-style-type: none"> To know more on basics of CIA in network security To learn cryptographic algorithms together with major attacks To Learn deep learning fundamentals from a security perspective To know in-depth view of threat hunting in memory, file system and network data and an introductory analysis of malicious programs.
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Course Outcome	<p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> Explore the Network Concepts Security and Cyber Situational. Identify the Security Attacks in Machine Learning Develop a Patching for Software Vulnerabilities Use AI to Identify Network Attack and Intrusion Detection Analysis of Android Application Security using Machine Learning
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Prerequisites: Cryptography and Cyber Security

CO, PO AND PSO MAPPING

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	3	1	-	3	-	-	-	-	-	-	-	1	1	-
CO-2	3	3	1	-	3	-	-	-	-	2	-	-	1	1	-
CO-3	3	3	3	-	3	1	-	-	-	-	-	-	1	1	-
CO-4	3	3	1	-	3	-	-	-	-	-	-	-	1	1	-
CO-5	3	3	1	3	3	-	-	-	-	-	-	-	1	1	-

1: Weakly related, 2: Moderately related and 3: Strongly related

MODULE 1: Knowledge Engineering in Cyber Security (6+6=12)

<p>Introduction, Domain Ontologies for Cyber Security, Communication Network Concepts, Cyber Situational.</p> <p>Practical Component:</p> <ul style="list-style-type: none"> (i) Network Data Provenance (ii) Network Data Uncertainty (iii) Network Data Vagueness <p>Suggested reading: Reasoning Support for Cyber Situational Awareness</p>	<p>CO-1</p> <p>BTL-2</p>
<p>MODULE 2: Security in Machine Learning Systems (6+6=12)</p>	
<p>Threat Model – Capability of the Attacker, Goal of the Attacker, Knowledge of the Attacker, Data Poisoning – Poisoning Attacks, Test Time Attacks – Evasion Attack.</p> <p>Practical Component:</p> <ul style="list-style-type: none"> (i) Transferability of Poisoning Attacks (ii) Defense Against Poisoning Attacks (iii) Defense Against Evasion Attacks <p>Suggested reading: Threats by Attack Strategy</p>	<p>CO-2</p> <p>BTL-2</p>
<p>MODULE 3: DESIGNING HCI (6+6=12)</p>	
<p>Identify Targeted Software Vulnerabilities – Supervised Learning, Challenges of Exploit Prediction, Exploit Prediction Model, Vulnerability and Exploit Model.</p> <p>Practical Component:</p> <ul style="list-style-type: none"> (i) Performance Evaluation on Exploit Analysis <p>Suggested reading: Adversarial Data Manipulation</p>	<p>CO-3</p> <p>BTL-3</p>
<p>MODULE 4: DOMAIN SPECIFIC (6+6=12)</p>	

<p>Binary Classifiers – Neural Networks, Neuro-Fuzzy Networks, Support Vector machines, Training Binary Classifiers for Detecting Network Attacks, Combining Binary Classifiers, Machine Learning in Network Intrusion Detection Systems,</p> <p>Practical Component:</p> <ul style="list-style-type: none"> (i) Genetic Optimization to detect Network Attacks (ii) Evaluation for Intrusion Detection <p>Suggested reading: Role of Dataset to Identify Network Attacks and Intrusion</p>	<p>CO-4</p> <p>BTL-2</p>
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MODULE 5: DESIGNING FOR DIVERSITY(USE CASES(6+6=12))

<p>Structure of Android Application, Identify the Android Malware, Dataset Preparation, Detecting Malware in Android Applications.</p> <p>Practical Component:</p> <ul style="list-style-type: none"> (i) APK File Analysis (ii) DroidRiskPerformance <p>Suggested reading: Challenges and Limitations of Android Security.</p>	<p>CO-5</p> <p>BTL-2</p>
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TEXT BOOKS

1.	<p>AI in Cyber Security, Leslie F. Sikos, <i>Intelligent Systems Reference Library</i>, Springer, 2019. ISBN: 978-3319988412.</p>
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REFERENCE BOOKS

1.	<p>Alessandro Parisi, Hands-On Artificial Intelligence for Cybersecurity: Implement smart AI systems for preventing cyber-attacks and detecting threats and network anomalies, Packt, Publishing, 2019. ISBN: 9781789804027.</p>
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E BOOKS

1.	<p>https://www.packtpub.com/in/data/hands-on-artificial-intelligence-for-cybersecurity</p>
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MOOC

1.	<u>https://www.coursera.org/learn/machine-learning</u>
2.	<u>https://www.coursera.org/learn/ai-for-everyone</u>