



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 Asses 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, analyses 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 and 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 |

M.Tech - COMPUTER SCIENCE AND ENGINEERING**DEPARTMENT ELECTIVES (DATA SCIENCE)****ELECTIVE I**

| SL. NO | COURSE CATEGORY | COURSE CODE | NAME OF THE COURSE | L | T | P | C | S | TCH |
|--------|-----------------|-------------|---------------------------------|---|---|---|---|---|-----|
| 1 | PE | CSB3721 | Data Storage Technologies | 2 | 0 | 2 | 3 | 0 | 2 |
| 2 | PE | CSB3722 | Recommender System | 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 | CSB3724 | Data Warehousing and Data Mining | 2 | 0 | 2 | 3 | 0 | 2 |
| 2 | PE | CSB3725 | Big Data Analytics | 2 | 0 | 2 | 3 | 0 | 2 |
| 3 | PE | CSB3726 | Data Classification Methods and Evaluation | 2 | 0 | 2 | 3 | 0 | 2 |
| 4 | PE | CSC3733 | Data Wrangling Techniques | 2 | 0 | 2 | 3 | 0 | 2 |

ELECTIVE III

| SL. NO | COURSE CATEGORY | COURSE CODE | NAME OF THE COURSE | L | T | P | C | S | TCH |
|--------|-----------------|-------------|--------------------------------|---|---|---|---|---|-----|
| 1 | PE | CSB3727 | Data Visualization Techniques | 3 | 0 | 0 | 3 | 0 | 3 |
| 2 | PE | CSB3728 | Hadoop Administration | 3 | 0 | 0 | 3 | 0 | 3 |
| 3 | PE | CSB3729 | Principles of Deep Learning | 3 | 0 | 0 | 3 | 0 | 3 |
| 4 | PE | CSC3734 | High-Dimensional Data Analysis | 3 | 0 | 0 | 3 | 0 | 3 |

ELECTIVE IV

| SL. NO | COURSE CATEGORY | COURSE CODE | NAME OF THE COURSE | L | T | P | C | S | TCH |
|--------|-----------------|-------------|------------------------------|---|---|---|---|---|-----|
| 1 | PE | CSB3730 | Human Computer Interaction | 3 | 0 | 0 | 3 | 0 | 3 |
| 2 | PE | CSB3731 | Virtual Reality | 3 | 0 | 0 | 3 | 0 | 3 |
| 3 | PE | CSB3732 | Risk analysis and Management | 3 | 0 | 0 | 3 | 0 | 3 |
| 4 | PE | CSC3735 | Digital Marketing Analytics | 3 | 0 | 0 | 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"> In-depth knowledge in the mathematical, probabilistic, and statistical foundations. Programming software engineering skills. Ability to apply statistical analysis and modeling to reason from data in a principled manner. Combined theoretical and technical skills to use for real-world applications. |

| | |
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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 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. |
|-----------------------|---|

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),Continues random variable(Uniform, Exponential and Normal distribution). Moment generating unction.

Suggested Activities: Basic knowledge on probability

Suggested sources: Introduction to probability

**CO-1
BTL-2**

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.

Suggested Activities: Basic knowledge on probability

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

**CO-2
BTL-2**

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) |
| 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. | | CO-4 BTL-2 |
| Suggested Activities: Basic knowledge of Time series analysis | | |
| Suggested sources: Time series-Maurice George kendall,j.k.Ord | | |
| MODULE 5: DESIGN OF EXPERIMENTS | | (12) |
| Analysis of variance (one way & two ways) classification – completely randomized design –randomized block design – Lattin square design. | | CO-5 BTL-3 |
| Suggested Activities: Basic knowledge of design of experiments | | |
| Suggested sources: Probability, Statistics and Random Processes-T.Veerarajan | | |
| 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"> To Estimate time and space complexities for a given algorithm. Describe the heap property and the use of heaps as an implementation of priority queues. Illustrate parallel algorithm models. 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"> Illustrate the various self-balanced trees and their operations. Apply an appropriate algorithmic approach to a given problem. Illustrate parallel algorithm models. 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 | PO- | PO- | PO- | PO- | PO- | PO- | PO- | PO- | PO | PO- | PO- | PSO- | PSO- | PSO- |

| | -1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | -10 | 11 | 12 | 1 | 2 | 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.

Suggested Activities: Implement the following Heap structures using C,C++,Java or Python

1. Max-min Heap 2. Binomial Heap 3. Fibonacci Heap

Suggested sources: [https://nptel.ac.in/courses/106102064/20, 21](https://nptel.ac.in/courses/106102064/20,21)

CO-2

BTL-2

MODULE3:SEARCH STRUCTURES (9)

Binarysearchtrees-AVLtrees-2-3trees-2-3-4trees-Red-blacktrees-B-trees-splaytrees-k-d trees,Tries.

Suggested Activities: Implement the following tree structures using C, C++, Java or Python

1.AVLTree 2.Red-Blacktree 3. Splay Trees 4. K-d Trees5. Tries

CO-3

BTL-3

| | |
|--|--|
| Suggested sources: https://nptel.ac.in/courses/106102064/11,12,14,15,18 | |
| MODULE 4: ALGORITHM DESIGN TECHNIQUES(9) | |
| <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> <ol style="list-style-type: none"> 1. Quick sort 2. Strassen’s matrix multiplication 3.8-queensproblem 4.Palindrome Partitioning <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> |
| MODULE 5:ADVANCED ALGORITHMS (9) | |
| <p>Parallel Algorithms: Basic Techniques- Work & Efficiency - Distributed Computation - Heuristic &Approximation Approaches.</p> <p>Suggested Activities: Implement following heuristic algorithms</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,</p> <p>https://nptel.ac.in/courses/106106126/9 - 15</p> | <p>CO-5</p> <p>BTL-2</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 Kuma, "Introduction to Parallel Computing", Second Edition, Addison Wesley, 2003 |
| E BOOKS | |
| 1 | Omid Bozorg-Haddad, Mohammad Solgi, Hugo A. Loaiciga, "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 models 3. To introduce students to the basic concepts and techniques of Machine Learning 4. To become familiar with regression methods, classification methods, clustering methods 5. 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. |
|-----------------------|---|

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> | | |
| 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> | | |
| MODULE3: ANALYSIS (9) | | | | | | | | | | | | | | | |
| <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> | | |

| MODULE4: OPTIMIZATIONTECHNIQUES | | (9) |
|---|---|--|
| <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> |
| MODULE5: PYTHON FOR MACHINELARNING | | (9) |
| <p>Baysean Networks-Markov Random Fields-Hidden Markov Models-Tracking methods.Python: Installation-Python for MATLAB ANDRusers-Code Basics-Using NumPy and MatPolitB.</p> <p>Suggested Activities: Design a simple application using NumPy and MatPolitB.</p> <p>Suggested sources:<u>Rakshith Vasudev</u>, IntroductiontoNumpy-1:Anabsolutebeginnersguideto MachineLearningandDatascience.,2017.</p> | | <p>CO-5</p> <p>BTL-2</p> |
| 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 | | |

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|------|---|
| 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 |

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|--|---|--|---------------------------------|---------------------------|----------------|
| 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. | | | | |

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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. 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 |
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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 | 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

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| 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) | |
| 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. | CO-4 BTL-2 |
| MODULE5: PATENT RIGHTS AND NEW DEVELOPMENTS IN IPR (9) | |
| 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. | CO-5 BTL-2 |
| TEXT BOOKS | |
| 1 | Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016. |
| 2 | T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008 |
| REFERENCE BOOKS | |
| 1 | Ranjit Kumar, 2 nd Edition, "Research Methodology: A Step by Step Guide for beginners" |
| 2 | Creswell, John W. Research design: Qualitative, quantitative, and mixed methods, |

| | |
|----------------|---|
| | approaches. Sage publications, 2013. |
| 3 | Donald Cooper & Pamela Schindler ,”Business Research Methods “, TMGH, 9th edition |
| E BOOKS | |
| 1 | https://www.modares.ac.ir/uploads/Agr.Oth.Lib.17.pdf |
| 2 | https://drive.google.com/file/d/0Bwk5FIsI0ctxNXBvU2dGVlJhSTg/view?usp=drivesdk |
| MOOC | |
| 1 | https://www.coursera.org/browse/physical-science-and-engineering/research-methods |
| 2 | https://www.ccrm.in/register.html |

| 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. | | | | |

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| 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 |
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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. 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. |
|-----------------------|--|

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

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|---|--|
| <ol style="list-style-type: none"> 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. 4. Design, develop, test and implement a hardware/software system that is demonstratable with required data set. 5. Assessment is based on creativity, applicability to the society, project development skills, team work. 6. Technical communication, presentation and report writing skills form an essential component in assessment. 7. The project/software MUST include all the topics that have been taught in class. | CO1, CO2, CO3, CO4, CO5 /BTL4 |
|---|--|

| 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. | | | | | |

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| 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

| | |
|---|--|
| <ol style="list-style-type: none"> 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 5. end semester examinations. 6. 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 |
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| 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% |

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| 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 system |
| 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. 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 system |

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)

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

CO-1
BTL-2

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| 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. | |
| 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 | CO-5 BTL-2 |

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| <p>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 control algorithms, data replication.</p> | |
| <p>PRACTICES`</p> | |
| <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. | |
| <p>TEXT BOOKS</p> | |
| 1 | Mukesh Singhal, Niranjana G. Shivaratri, "Advanced concepts in operating systems", TMH, 2011 |
| <p>REFERENCE BOOKS</p> | |
| 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 |
| <p>E BOOKS</p> | |
| 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 |
| <p>MOOC</p> | |

| | |
|---|---|
| 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. | | | | |

| | |
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| | 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)

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.

Suggested Activities: Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems.

Suggested sources: <https://swayam.gov.in/course/4574-introduction-to-soft-computing>

CO-1
BTL-2

MODULE2: OPTIMIZATION (12)

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-

CO-2
BTL-2

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| <p>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> | |
| 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:</p> <p>http://in.mathworks.com/help/fuzzy/adaptive-neuro-fuzzy-inference-systems.html</p> | <p>CO-4</p> <p>BTL-2</p> |
| MODULE5: APPLICATIONS OF COMPUTATIONAL INTELLIGENCE (12) | |
| <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:</p> <p>https://towardsdatascience.com/introductory-guide-to-artificial-intelligence-</p> | <p>CO-5</p> <p>BTL-2</p> |

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TEXT BOOKS

| | |
|---|---|
| 1 | J.S.R.Jang, C.T.Sun and E.Mizutani, "Neuro-Fuzzy and Soft Computing", PHI, 2004, Pearson Education. |
| 2 | N.P.Padhy, "Artificial Intelligence and Intelligent Systems", Oxford University Press, 2006 |

REFERENCE BOOKS

| | |
|---|--|
| 1 | Samir Roy "Introduction to Soft Computing: Neuro-Fuzzy and Genetic Algorithms", First Edition, Pearson Publishers, 2015. |
| 2 | J.S.R.Jang, C.T.Sun and E.Mizutani, "Neuro-Fuzzy and Soft Computing", Pearson, 2004. |
| 3 | Timothy J. Ross, "Fuzzy Logic with Engineering Applications", McGraw-Hill, 1997. |
| 4 | Davis E. Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, 2009. |
| 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 |

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|---------------------|--------------------------------------|-------------------------|-------------------------------|-----------------------|----------------|
| 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% |

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| Course Description | This course serves as an introduction to Advanced Data Base Technology and to learn advanced data models and emerging databases. |
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| Course Objective | <ol style="list-style-type: none"> To Implement parallel and distributed databases. To Implement object and object relational databases To Learn advanced data models To Learn emerging databases |
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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"> Implement parallel and distributed databases. Implement object and object relational databases. Learn advanced data models 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 | - |

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|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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

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| MODULE 1: PARALLEL AND DISTRIBUTED DATABASES | | | | | | | | | | | | | | | (12) |
| <p>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 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>CO-1</p> <p>BTL-2</p> | |
| MODULE 2: OBJECT AND OBJECT RELATIONAL DATABASES | | | | | | | | | | | | | | | (12) |
| <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> | |
| MODULE 3: INTELLIGENT DATABASES | | | | | | | | | | | | | | | (12) |
| <p>Active Databases: Syntax and Semantics (Starburst, Oracle, DB2)- Taxonomy- Applications- Design Principles for Active Rules- Temporal Databases: Overview of Temporal Databases- TSQL2-</p> | | | | | | | | | | | | | | CO-3 | |

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|---|---------------------------------|
| <p>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> | BTL-3 |
| 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> | CO-4 BTL-2 |
| 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> | CO-5 BTL-2 |
| 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 Ualduriel, "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 F. Korth, Abraham Silberschatz, S. Sudharshan, "Database System Concepts", Seventh Edition, 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 |

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|---------------------------|---|-------------------------|------------------------------------|-----------------------|----------------|
| 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, 06.02.20 21 | LEARNING LEVEL | BTL-3 |
| ASSESSMENT SCHEME | | | | | |
| First Review | Second Review | Third Review | Model Evaluation | | ESE |
| 20% | 20% | 20% | 40% | | --- |
| Course Description | In this course, students will develop the scientific and technical reading, writing and presentation skills they need to understand and construct research articles. | | | | |
| Course Objective | <ol style="list-style-type: none"> To develop the skills in doing literature survey, technical presentation and report preparation To Selecting a subject, narrowing the subject into a topic To Link the papers and preparing a draft of the paper. To Stud the papers and understanding the authors contributions and critically analysing each paper. | | | | |
| Course Outcome | <p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> Acquired the basic skills to for performing literature survey and paper presentation Provide students better communication skills. Describe the current topics in computer science and related areas based on current publications. Prepare the report | | | | |
| 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 | 1 | 2 | 3 | - | 3 | - | - | - | - | - | - | 3 | - | - | 3 |
| CO-2 | 1 | 2 | 3 | - | - | - | - | - | - | - | - | - | - | - | 3 |
| CO-3 | 1 | 2 | 3 | - | - | - | - | - | - | - | - | - | - | - | 3 |
| CO-4 | 1 | 2 | 3 | - | - | - | - | - | - | - | - | - | - | - | 3 |
| 1: Weakly related, 2: Moderately related and 3: Strongly related | | | | | | | | | | | | | | | |
| GUIDELINES | | | | | | | | | | | | | | | |
| <ol style="list-style-type: none"> 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. 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 For Seminar there will be only internal evaluation. Out of the total allocated marks distribution of marks shall be 30% for the report, 50% for presentation and 20% for the queries. A candidate has to secure a minimum of 50% of marks to be declared successful. If the student fails to fulfil minimum marks, the student has to reappear during the supplementary examinations. 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 | | | | |

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| | <p>area</p> <p>5. Effectively communicate the work at all stages of the project</p> |
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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 | - | - | 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.

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

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| <p>6. Carried out inside or outside the university, in any relevant industry or research institution.</p> <p>7. Publications in the peer reviewed journals / International Conferences will be an added advantage</p> | |
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| 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 | | | | |

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| | <p>4. Prepare a thesis and defend the thesis on the work done</p> <p>5. Augment the knowledge base in the chosen area of computing, adhering to ethical practices at every stage</p> |
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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 | - | - | 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)

- 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.
- 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.
- Use Science/Engineering principles to solve the identified issues
- Adopt relevant and well-defined / innovative methodologies to fulfill the specified objective
- Submission of scientific report in a specified format (after plagiarism check)
- Project should be for two semesters based on the completion of required number

CO-1
BTL-2

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| <p>of credits as per the academic regulations.</p> <p>7. Carried out inside or outside the university, in any relevant industry or research institution.</p> <p>8. Publications in the peer reviewed journals / International Conferences will be an added advantage</p> <p>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.</p> | |
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ELECTIVE - I

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|------------------------------------|--|--------------------------------------|-------------------------------|-----------------------|----------------|
| COURSE TITLE | DATA STORAGE TECHNOLOGIES | | | CREDITS | 3 |
| COURSE CODE | CSB3721 | 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 introduces the core principles and techniques required in the design and implementation of database systems. | | | | |
| Course Objective | <p>The course enables the students to</p> <ol style="list-style-type: none"> 1. To explain basic database concepts, applications, data models, schemas and instances 2. To demonstrate the use of constraints and relational algebra operations. | | | | |

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| | <ol style="list-style-type: none"> 3. To Describe the basics of SQL and construct queries using SQL. 4. To emphasize the importance of normalization in databases 5. To facilitate students in Database design | | | | | | | | | | | | | |
| Course Outcome | <p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> 1. Explain the Storage Media and Technologies 2. Illustrate the Memory Hierarchy and design the Hardware and Software for access 3. Discuss the Large Storages and Scalability issues 4. Analyse and discuss the Storage Partitioning, Storage System Design, Legacy Systems 5. Analyse the Performance, Reliability, and Security issues 6. Design and develop the model for any real world application using Data Storage Technologies with respect to Scalability issues and Security issues | | | | | | | | | | | | | |
| Prerequisites: Basic concepts and functionality of Hardware and Software | | | | | | | | | | | | | | |
| 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 | PS-O-1 | PS-O-2 | PS-O-3 |
| CO-1 | 2 | 3 | 3 | 2 | 1 | 2 | 3 | 2 | 1 | 1 | 2 | 1 | 3 | 1 |
| CO-2 | 2 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 1 | 3 | 2 |
| CO-3 | 3 | 2 | 2 | 2 | 1 | 2 | 3 | 2 | 2 | 1 | 2 | 1 | 3 | 1 |
| CO-4 | 3 | 3 | 3 | 2 | 1 | 2 | 3 | 3 | 2 | 2 | 2 | 1 | 3 | 1 |
| CO-5 | 3 | 1 | 2 | 1 | 1 | 1 | 2 | 3 | 2 | 1 | 1 | 1 | 3 | 1 |
| 1: Weakly related, 2: Moderately related and 3: Strongly related | | | | | | | | | | | | | | |
| MODULE 1: STORAGE MEDIA AND TECHNOLOGIES (9) | | | | | | | | | | | | | | |
| Magnetic, Optical and Semiconductor Media, Techniques for read/write Operations, Issues and Limitations. Suggested Activity: Assignments, MCQ | | | | | | | | | | | | CO-1 BTL-2 | | |
| MODULE 2: USAGE AND ACCESS (9) | | | | | | | | | | | | | | |

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| Positioning in the Memory Hierarchy, Hardware and Software Design for Access, Performance issues Suggested Activity: Assignments,MCQ | | CO-2 BTL-3 |
| MODULE 3:LARGESTORAGES(9) | | |
| Hard Disks, Networked Attached Storage, Scalability issues Suggested Activity: Assignments,MCQ | | CO-3 BTL-2 |
| MODULE 4: STORAGEARCHITECTURE(9) | | |
| Storage Partitioning, Storage System Design, Caching, Legacy Systems. Suggested Activities: Assignments,MCQ | | CO-4 BTL-3 |
| MODULE 5:STORAGEAREANETWORKS(9) | | |
| Hardware and Software Components, Storage Clusters/Grids. Storage QoS– Performance, Reliability, and Security issues Suggested Activities: Assignments,MCQ | | CO-5 BTL-3 |
| TEXT BOOKS | | |
| 1 | Principles of Distributed Database Systems, Second Edition, M. Tamer Ozsu Patrick Valduriez | |
| REFERENCE BOOKS | | |
| 1 | Franklyn E. Dailey Jr. ,”The Complete Guide to Data Storage Technologies for Network-centric Computing” ,Computer Technology Research Corporation, Mar 1998 | |
| 2 | Nigel Poulton ,”Data Storage Networking: Real World Skills for the CompTIA Storage” ,2014 | |
| E BOOKS | | |

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|-------------|---|
| 1 | https://eu.dlink.com/es/es/-/media/resource-centre/b2b-briefs/es/dlinkstoragetechologiesandterminology.pdf |
| 2 | https://the-eye.eu/public/Books/qt.vidyagam.es/library/humble-Network-Security-Certification-bundle/Data%20Storage%20Networking_%20Real%20World%20IA%20Storage_%20Certification%20and%20Beyond/Data%20Storage%20Networking_%20Real%20World%20Skills_%20Certification%20and%20Beyond%20-%20Nigel%20Poulton.pdf |
| MOOC | |
| 1. | https://nptel.ac.in/downloads/106108058/ |

| 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 | | | | |

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| 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 similarity based 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 hybridization design, 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)

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| <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> |
| <p>MODULE 2: CONTENT-BASED FILTERING (12)</p> | |
| <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> |
| <p>MODULE 3: COLLABORATIVE FILTERING (12)</p> | |
| <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> |
| <p>MODULE 4: HYBRID APPROACHES(12)</p> | |
| <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>Suggested Activities: Assignments, MCQ, Reading reports & research projects</p> | <p>CO-4</p> <p>BTL-3</p> |
| <p>MODULE 5: EVALUATING RECOMMENDER SYSTEM(12)</p> | |
| <p>Introduction, General properties of evaluation research, Evaluation designs: Accuracy, Coverage, confidence, novelty, diversity, scalability, serendipity, Evaluation on historical datasets, Offline evaluations.</p> <p>Suggested Activities: Assignments, MCQ, Reading reports & research projects</p> | <p>CO-5</p> <p>BTL-3</p> |
| <p>TEXT BOOKS</p> | |

| | |
|------------------------|---|
| 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 | 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, 06.02.202 1 | 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. |

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)

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

CO-1

BTL-2

| | |
|--|---------------------------------|
| What to Do. Practical Component: Develop an AI based application for solving any real time problem | |
| MODULE 2: LEARNING IN AGENTS (12) | |
| 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 Practical Component: Apply the knowledge Representation System | CO-2 BTL-3 |
| MODULE 3: COMMUNICATION AND COOPERATION IN AGENTS (12) | |
| 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 Practical Component: Working on Ontology Software Tools | CO-3 BTL-3 |
| MODULE 4: DEVELOPING INTELLIGENT AGENT SYSTEMS (12) | |
| 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 Practical Component: Build the Application using Social Agent(like Facebook Marketing Campaign) | CO-4 BTL-3 |
| MODULE 5: APPLICATIONS(12) | |
| 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. Practical Component: Develop the human computer interface using AI Agent | CO-5 BTL-3 |
| TEXT BOOKS | |

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|---|---|
| 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

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|---|---|
| 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

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

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|---------------------------|---|
| 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. |
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|-------------------------|---|
| 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)

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.

Suggested Activities: Identify the challenges of anyone of the AI application for Industry

Suggested sources: Kate Lyapina,” Technical challenges for AI in heavy industry and how to

CO-1
BTL-2

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| overcome them “,2019. | |
| 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 computer vision</p> <p>Suggested sources: Serhii Maksymenko ,“AI-Based Visual Inspection For Defect Detection”,2020</p> | <p>CO-3</p> <p>BTL-3</p> |
| MODULE 4: FOURTH INDUSTRIAL REVOLUTION(12) | |
| (12) | |
| <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>CO-4</p> <p>BTL-3</p> |

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|--|---|--|
| <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>MODULE 5: INDUSTRIALIZED ARTIFICIAL INTELLIGENCE</p> | | <p>(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> |
| <p>TEXT BOOKS</p> | | |
| 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. | |
| <p>REFERENCE BOOKS</p> | | |
| 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. | |
| <p>E BOOKS</p> | | |

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|-------------|---|
| 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 |

ELECTIVE II

| COURSE TITLE | | DATA WAREHOUSING AND DATA MINING | | | CREDITS | 3 |
|-----------------------------|---|----------------------------------|---------------------------|----------------|---------|---|
| COURSE CODE | CSB3724 | COURSE CATEGORY | PE | L-T-P-S | 2-0-2-0 | |
| Version | 1.0 | Approval Details | 23 ACM, 06.02.20 21 | 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 gives an introduction to methods and theory for development of data warehouses and data analysis using data mining | | | | | |
| Course Objective | <ol style="list-style-type: none"> 1. To introduce students to the basic concepts and techniques of Data Mining. 2. To introduce a wide range of clustering, estimation, prediction, and classification algorithms. 3. To introduce mathematical statistics foundations of the Data Mining Algorithms. | | | | | |

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| | 4. To introduce basic principles, concepts and applications of data warehousing. |
| Course Outcome | <p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> 1. To understand data warehouse concepts, architecture, business analysis and tools 2. To apply the functionality of the various data warehousing components 3. To understand data pre-processing and data visualization techniques 4. To understand and apply various classification and prediction techniques using tools. 5. To study and apply algorithms Cluster analysis for finding hidden and interesting patterns in data 6. To understand Mining of Object, Spatial, Multimedia, Text and Web Data |

Prerequisites: Database management 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 | - | - | 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: DATA WAREHOUSING AND BUSINESS ANALYSIS (12)

| | |
|--|-----------------------------|
| Data warehousing Components –Building a Data warehouse –Data Warehouse Architecture – DBMS Schemas for Decision Support – Data Extraction, Cleanup, and Transformation Tools –Metadata – reporting – Query tools and Applications – Online | CO-1 BTL-2 |
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| <p>Analytical Processing (OLAP) – OLAP and Multidimensional Data Analysis.</p> <p>Suggested Activities: Create a use case on OLAP</p> <p>Suggested sources: https://www.researchgate.net/publication/220672995_Using_OLAP_Tools_for_eHRM_A_case_study</p> | |
| MODULE 2:DATA MINING(12) | |
| <p>Data Mining Functionalities – Data Preprocessing – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization and Concept Hierarchy Generation- Architecture of A Typical Data Mining Systems- Classification Of Data Mining Systems. Association Rule Mining: - Efficient and Scalable Frequent Item set Mining Methods – Mining Various Kinds of Association Rules – Association Mining to Correlation Analysis – Constraint-Based Association Mining.</p> <p>Suggested Activities: Application of Data Mining any one domain – Eg : Education</p> <p>Suggested sources:Bakhshinategh, Behdad, et al. "Educational data mining applications and tasks: A survey of the last 10 years." Education and Information Technologies 23.1 (2018): 537-553.</p> | <p>CO-2</p> <p>BTL-3</p> |
| MODULE 3:CLASSIFICATIONANDPREDICTION(12) | |
| <p>Issues Regarding Classification and Prediction – Classification by Decision Tree Introduction – Bayesian Classification – Rule Based Classification – Classification by Back propagation – Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods – Prediction – Accuracy and Error Measures – Evaluating the Accuracy of a Classifier or Predictor – Ensemble Methods – Model Section.</p> <p>Suggested Activities: Create Prediction and Classification models for any use case</p> <p>Suggested sources:Eg: https://blog.revolutionanalytics.com/2012/08/cheat-sheet-for-prediction-and-classification-models-in-r.html</p> | <p>CO-3</p> <p>BTL-3</p> |
| MODULE 4: CLUSTERANALYSIS | |
| (12) | |

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| <p>Types of Data in Cluster Analysis – A Categorization of Major Clustering Methods – Partitioning Methods – Hierarchical methods – Density-Based Methods – Grid-Based Methods – Model-Based Clustering Methods – Clustering High-Dimensional Data – Constraint-Based Cluster Analysis – Outlier Analysis.</p> <p>Suggested Activities: Fun way cluster analysis using the source given</p> <p>Suggested sources: http://www.greatideasforteachingmarketing.com/fun-approach-to-cluster-analysis/</p> | <p>CO-4</p> <p>BTL-3</p> |
| <p>MODULE 5: MINING OBJECT, SPATIAL, MULTIMEDIA, TEXT AND WEBSITE DATA (12)</p> | |
| <p>Multidimensional Analysis and Descriptive Mining of Complex Data Objects – Spatial Data Mining – Multimedia Data Mining – Text Mining – Mining the World Wide Web- Case Studies.</p> <p>Suggested Activities: Mini Project on mining any one Text/Object/Multimedia/Spatial</p> <p>Suggested sources:</p> <p>https://www.slideshare.net/Tommy96/chap-10-mining-object-spatial-multimedia-text-and-web-data</p> | <p>CO-5</p> <p>BTL-3</p> |
| <p>TEXT BOOKS</p> | |
| <p>1</p> | <p>Jiawei Han and Micheline Kamber, “Data Mining: Concepts and Techniques”, 3rd Edition, Morgan Kaufmann Publishers, 2011.</p> |
| <p>2</p> | <p>Alex Berson and Stephen J. Smith, “Data Warehousing, Data Mining & OLAP”, 10th Edition, Tata Mc Graw Hill Edition, 2007</p> |
| <p>REFERENCE BOOKS</p> | |
| <p>1</p> | <p>Adelchi Azzalini, Bruno Scapa, “Data Analysis and Data Mining”, 2nd Edition, Oxford University Press Inc., 2012.</p> |
| <p>2</p> | <p>G.K. Gupta, “Introduction to Data Mining with Case Studies”, 1st Edition, Eastern Economy Edition, PHI, 2006.</p> |
| <p>E BOOKS</p> | |

| | |
|-------------|---|
| 1. | http://guidetodatamining.com/ |
| 2. | https://www.cs.waikato.ac.nz/ml/weka/book.html |
| MOOC | |
| 1. | https://www.mooc-list.com/tags/data-warehousing |

| COURSE TITLE | BIG DATA ANALYTICS | | | CREDITS | 3 |
|-----------------------------|--|-------------------------------------|-------------------------|----------------|---------|
| COURSE CODE | CSB3725 | 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 main goal of this course is to help students learn, understand, and practice big data analytics and machine learning approaches, which include the study of modern computing big data technologies and scaling up machine learning techniques focusing on industry applications. | | | | |
| Course Objective | <ol style="list-style-type: none"> 1. To provide an overview of an exciting growing field of big data analytics. 2. To introduce the tools required to manage and analyze big data like Hadoop, NoSql MapReduce. 3. To teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability. 4. capability. 5. To enable students to have skills that will help them to solve complex real-world problems. | | | | |

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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. Work with big data platform and explore the big data analytics techniques 2. business applications. 3. Design efficient algorithms for mining the data from large volumes. 4. Analyze the HADOOP and Map Reduce technologies associated with big data 5. analytics. 6. Explore on Big Data applications Using Pig and Hive. 7. Build a complete business data analytics solution |
|-----------------------|---|

Prerequisites: Datamining

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>Introduction to big data: Introduction to Big Data Platform – Challenges of Conventional Systems – Intelligent data analysis – Nature of Data – Analytic Processes and Tools – Analysis vs Reporting.</p> <p>Suggested Activity:</p> <p>Practice with MapReduce and Hadoop</p> | <p>CO-1</p> <p>BTL-2</p> |
|---|--|

MODULE 2 : DATA STREAMS (12)

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| <p>Mining data streams: Introduction To Streams Concepts – Stream Data Model and Architecture – Stream Computing – Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating Moments – Counting Oneness in a Window – Decaying Window –</p> | <p>CO-2</p> <p>BTL-3</p> |
|---|--|

| | | |
|---|--|---------------------------------|
| RealtimeAnalyticsPlatform(RTAP)Applications-CaseStudies-RealTimeSentimentAnalysis-StockMarket Predictions. Suggested Activity: Examining a simple MapReduce Class | | |
| MODULE 3:HADOOPADMINISTRATION(12) | | |
| Hadoop:HistoryofHadoop-theHadoopDistributedFileSystem–ComponentsofHadoop Analyzing the Data with Hadoop- Scaling Out- Hadoop Streaming- Design of HDFS-Java interfaces to HDFS Basics-DevelopingaMapReduceApplication-HowMapReduceWorks- AnatomyofaMapReduce JobrunFailures-JobScheduling-ShuffleandSort–Taskexecution- MapReduceTypesandFormats- MapReduce Suggested Activity: Practice on how to modify a MapReduce job and how to use the configure | | CO-3 BTL-3 |
| MODULE 4: HADOOPFRAMEWORK(12) | | |
| PredictiveAnalytics-Simplelinearregression-Multiplelinearregression-Interpretation5of regression coefficients. Visualizations - Visual data analysis techniques- interaction techniques - Systems andapplications. Suggested Activity: Practice on how to use external .jar files with a project | | CO-4 BTL-3 |
| MODULE 5 :REGRESSIONMODELS(12) | | |
| MultidimensionalAnalysisandDescriptiveMiningofComplexDataObjects–SpatialDataMining– Multimedia Data Mining – Text Mining – Mining the World Wide Web- Case Studies. Suggested Activity: Practice on how to create and launch MapReduce tasks. | | CO-5 BTL-3 |
| TEXT BOOKS | | |
| 1 | Tom White “Hadoop: The Definitive Guide” Third Edition, O’reilly Media, 2012. | |
| 2 | Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos, “Understanding BigData:AnalyticsforEnterpriseClassHadoopandStreamingData”,McGrawHillPublishing,2012. | |
| REFERENCE BOOKS | | |
| 1 | Anand Rajaraman and Jeffrey David Ullman, “Mining of Massive Datasets”, CUP, 2012. | |
| 2 | BillFranks,“TamingtheBigDataTidalWave:FindingOpportunitiesinHugeDataStreamswith | |

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| | Advanced Analytics”, John Wiley& sons, 2012. |
| 3 | Glenn J. Myatt, “Making Sense of Data”, John Wiley & Sons, 2007. |
| E BOOKS | |
| 1. | http://www.bdbanalytics.ir/media/1121/big-data-analytics_turning-big-data-into-big-money.pdf |
| MOOC | |
| 1. | https://www.coursera.org/courses?query=big%20data%20analytics |

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|------------------------------------|---|--|---------------------------------|-----------------------|----------------|
| COURSE TITLE | DATA CLASSIFICATION METHODS AND EVALUATION | | | CREDITS | 3 |
| COURSE CODE | CSB3726 | COURSE CATEGORY | PE | L-T-P-S | 2-0-2-0 |
| 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 aims to capture new developments and applications in data mining and knowledge discovery, while summarizing the computational tools and techniques useful in data analysis | | | | |
| Course Objective | <ol style="list-style-type: none"> 1. To consolidate the volume of data in such a way that similarities and differences can be quickly understood. Figures can consequently be ordered in sections with common traits. 2. To aid comparison. 3. To point out the important characteristics of the data at a flash. | | | | |

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| | <ol style="list-style-type: none"> 4. To give importance to the prominent data collected while separating the optional elements. 5. To allow a statistical method of the materials gathered. |
| Course Outcome | <p>Upon completion of this course, the students will be able to</p> <ol style="list-style-type: none"> 1. Analyze the clustering applications like Market segmentation and Social network analysis 2. analysis 3. Discriminate between clustering and classification problems. 4. Apply data reduction and data preprocessing techniques for clustering 5. Appraise feature extraction methods and identify the suitable method for a given problem 7. Compare and contrast between pattern recognition techniques. 8. Apply the optimization techniques and algorithm for system analysis |

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)

| | |
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| <p>Reasonsforclassification-Definingacluster-Examplesofuseofclusters:MarketResearch-Astronomy-Psychiatry-Weatherclassification-Archaeology-Bioinformaticsandgenetics.</p> <p>Suggested Activity:Implement the clustering Algorithm and test the accuracy of the system with test sets</p> | <p>CO-1</p> <p>BTL-2</p> |
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| MODULE 2:FEATUREEXTRACTION(12) | |
| Feature Extraction - Distance Measure - Euclidean distance - Mahalonobis distance – Manhattandistance. Suggested Activity: Practice on How to Use Feature Extraction | CO-2 BTL-3 |
| MODULE 3:CLASSIFICATION(12) | |
| Classification:Classification–DecisionTreeInduction–BayesianClassification–Prediction– BackPropagation Suggested Activity: Practice on classification algorithms | CO-3 BTL-3 |
| MODULE 4: OPTIMIZATIONCLUSTERINGTECHNIQUES(12) | |
| Clusteringcriteriaderivedfromthedissimilaritymatrix- Clusteringcriteriaderivedfromcontinuousdata – Optimization algorithms – Choosingthenumberofclusters-Applicationsofoptimizationmethods. Suggested Activity: Practice on clustering algorithms | CO-4 BTL-3 |
| MODULE 5: CLUSTERANALYSIS(12) | |
| Cluster analysis: Types of data – Clustering Methods – K-Means clustering-K- Medoid clustering- Hierarchical clustering-agglomerative clustering- Partitioning methods – Model based clustering methods – Outlieranalysis. Suggested Activity: Practice on Advanced clustering algorithms | CO-5 BTL-3 |
| TEXT BOOKS | |
| 1 | SugatoBasu,IanDavidson,KiriL.wagsstaff,“ConstrainedClustering:AdvancesinAlgorithms,Theory, and Applications”, 1st Edition, Chapman and Hall/CRC press, 2009. |
| 2 | PaulrajPonnaiah,“ Data Warehousing Fundamentals”, 1st Edition, Wiley Publishers, 2008. |
| REFERENCE BOOKS | |
| 1 | BrianS.Everitt,SabineLandau,MorvenLeese,andDanielStah,“ClusterAnalysis”,5 th Edition,,Wiley, 2011. |
| 2 | MarkNixon,AlbertoSAguado,“FeatureExtraction&ImageProcessing”,2ndEdition,Academic Press, 2008 |
| E BOOKS | |

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|------|---|
| 1. | https://epdf.tips/constrained-clustering-advances-in-algorithms-theory-and-applications.html |
| 2. | http://haralick.org/ML/data_clustering.pdf |
| MOOC | |
| 1. | https://www.coursera.org/specializations/data-mining |

| COURSE TITLE | DATA WRANGLING TECHNIQUES | | | CREDITS | 3 |
|-----------------------------|---|-------------------------------------|-------------------------|----------------|---------|
| COURSE CODE | CSC3733 | 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 | This course provides fundamental skills required to acquire, munge, transform, manipulate, and visualize data in a computing environment that fosters reproducibility | | | | |
| Course Objective | <ol style="list-style-type: none"> To Perform your data analysis in a literate programming environment To Import and manage structured and unstructured data To Manipulate, transform, and summarize the data To Join disparate data sources Methodically to explore and visualize the data To Develop the functions to the perform basic predictive analytic modeling | | | | |

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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. Understand the basics of Data Clean up and work on NoSQL 2. Understand data clean up and test the new dataset 3. Transform and wrangle data 4. Visualize the data using different libraries 5. Scrap data from websites using Beautiful Soap library |
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Prerequisites: Basic knowledge of python

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)

Acquiring and Storing Data: Readability, Cleanliness, and Longevity – NoSQL: Installation and usage-Data Cleanup-Investigation, Matching, and Formatting

Suggested Activity:Practice on processing the data in various formats like - merging, grouping, concatenating etc

CO-1

BTL-2

MODULE 2:STANDARDIZING AND SCRIPTING (12)

Normalizing and Standardizing, Determining What Data Cleanup Is Right for Your Project, Scripting Your Cleanup, Testing with New Data, Data Exploration and Analysis- Importing Data, Joining Numerous Datasets

Suggested Activity:Practice on Data Exploration: Checking for feature data types, unique

CO-2

BTL-3

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| values, and describing data. | | |
| MODULE 3:DATA WRANGLING(12) | | |
| Handling Missing Data- Data Transformation- String Manipulation, Join, Combine, andReshape: Hierarchical Indexing Combining and Merging Datasets Reshaping and Pivoting Suggested Activity: Practice on various Indexing operations | | CO-3 BTL-3 |
| MODULE 4:VISUALIZATION OF DATA(12) | | |
| Charts, Time-Related Data, Maps, Interactives, Words, matplotlib, Plotting with pandas and seaborn, Other Python Visualization Tools Suggested Activity: Working on various forms of Graphs | | CO-4 BTL-3 |
| MODULE 5:WEB SCRAPING(12) | | |
| Acquiring and Storing Data from the Web- Analyzing a Web Page, Reading a Web Page with Beautiful Soup. Screen Scrapers and Spiders- Browser-Based Parsing, Spidering the Web Suggested Activity: Analyze the web content using data wrangling tool | | CO-5 BTL-3 |
| TEXT BOOKS | | |
| 1 | Jacqueline Kazil& Katharine Jarmul, "Data Wrangling with Python", O'Reilly Media, Inc, 2016. | |
| 2 | Wes McKinney, Python for Data Analysis Data Wrangling with Pandas, NumPy, and IPython, O'Reilly Media, Inc, 2016. | |
| REFERENCE BOOKS | | |
| 1 | Jeffrey Heer, Sean Kandel & Connor Carreras, Principles of Data Wrangling: Practical Techniques for Data Preparation, O'Reilly Media, Inc, 2017 | |
| 2 | Allan Visochek , "Practical Data Wrangling: Expert Techniques for Transforming Your Raw Data Into a Valuable Source for Analytics", Packt Publishing; 1st edition (15 November 2017) | |
| 3 | Boehmke, "Bradley, Data Wrangling with R", Springer; 1st ed. 2016 edition (17 November 2016) | |
| E BOOKS | | |

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|-------------|---|
| 1. | https://www.fintechfutures.com/files/2017/10/Trifacta_Principles-of-Data-Wrangling.pdf |
| MOOC | |
| 1. | https://www.coursera.org/learn/data-wrangling-analysis-abtesting |
| 2. | https://www.coursera.org/learn/data-analysis-with-python |

ELECTIVE III

| COURSE TITLE | DATA VISUALISATION TECHNIQUES | | | CREDITS | 3 |
|-----------------------------|---|-------------------------------------|-----------------------|----------------|---------|
| COURSE CODE | CSB3727 | 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 this course is to introduce students to data visualization including both the principles and techniques | | | | |
| Course Objective | <ol style="list-style-type: none"> 1. Know the basics of data visualization 2. Understand the importance of data visualization and the design and use of many visual components 3. Learn to wisely use various visualization structures such as tables, spatial data, time-varying data, tree and network, etc. 4. Learn the basics of colors, views, and other popular and important visualization-based issues. <p>Learn basic algorithms in data visualization</p> | | | | |

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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. Critically evaluate visualizations and suggest improvements and refinements 2. Use standalone visualization applications to quickly explore data 3. Apply a structured design process to create effective visualizations 4. Conceptualize ideas and interaction techniques using sketching 5. Create web-based interactive visualizations using JavaScript and D3. 6. Use storytelling principles to design coherent and clear visualizations |
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Prerequisites: 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 | - | - | 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)

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| <p>Introduction – Data- Visualization-Design, Data & Tasks- Data Types- Dataset Types- Spatial Data- Scivis and Infovis, Graphic Design, Graphical Integrity, Data-Ink Ratio, Aspect Ratios & Scales</p> <p>Suggested Activity:</p> <p>Practice on basicdata visualization techniques(Pie Chart, Bar Chart, Histogram etc..)</p> | <p>CO-1</p> <p>BTL-2</p> |
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MODULE 2:DATA-DRIVENDOCUMENTS(12)

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| <p>Introduction to D3- Relative vs. Absolute Judgments- Luminance Perception- D3 Key Features- Concepts.Visualization Process. Design Iterations. Sketching. Data Types. Statistical Graphs. Interaction Design. Overview & Detail. Dynamic Queries. Brushing & Linking. Animation. Trees & Networks. Radial Layouts.Tree maps. Linear Layouts.Maps. Choropleth</p> | <p>CO-2</p> <p>BTL-3</p> |
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| <p>Maps. Cartograms. Symbol Maps. Flow Maps. Real-Time Maps.</p> <p>Suggested Activity:Working on Choropleth Maps and Cartograms</p> | |
| <p>MODULE 3:DESIGN STUDIO &TEXTVISUALIZATION(12)</p> | |
| <p>Design Studio:High-Dimensional Data. Filtering. Parallel Coordinates. Glyphs. Aggregation.</p> <p>Text Visualization: Document Visualization. Images & Video.</p> <p>Maps: Choropleth Maps. Cartograms. Symbol Maps. Flow Maps. Real-Time Maps.</p> <p>Perception: Visual Channels. Weber's Law. Pre-attentive Processing. Visual Channel Rankings</p> <p>Suggested Activity:Practice on Symbol Maps and flow Maps</p> | <p>CO-3</p> <p>BTL-3</p> |
| <p>MODULE 4:COLORPROCESSING(12)</p> | |
| <p>Color. Color Processing. Color Spaces. Color Aesthetics. Colors for Visualization -Cognition. Looking vs. Seeing. Image Gist. Gestalt Principles. Visual Attention. Visual Working & Long-Term Memory.</p> <p>Suggested Activity:Working on Colors for Visualization</p> | <p>CO-4</p> <p>BTL-3</p> |

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| MODULE 5: DATA VISUALISATION SYSTEM (12) | |
| Visual Story Telling. Messaging. Effective Presentations. Design for Information Visualization and Arts, Visualization Systems- Database Visualization Suggested Activity: Design, evaluate and develop Information visualization. | CO-5 BTL-3 |
| TEXT BOOKS | |
| 1 | Ben Fry "Visualizing Data: Exploring and Explaining Data with the Processing Environment" O'Reilly Media, 2007. |
| 2 | Scott Murray "Interactive Data Visualization for the Web" O'Reilly Media, 2013. |
| REFERENCE BOOKS | |
| 1 | Edward Tufte "The Visual Display of Quantitative Information" 2001. |
| 2 | Colin Ware, "Visual Thinking for Design", Morgan Kaufman Series, 2008. |
| 3 | Alberto Cairo, "The Functional Art: An Introduction to Information Graphics and Visualization", New Riders, 2012. |
| E BOOKS | |
| 1. | http://alignedleft.com/tutorials/d3/ |
| MOOC | |
| 1. | https://www.coursera.org/learn/datavisualization |

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|---------------------|------------------------------|-------------------------|-------------------------------|-----------------------|----------------|
| COURSE TITLE | HADOOP ADMINISTRATION | | | CREDITS | 3 |
| COURSE CODE | CSB3728 | COURSE CATEGORY | PE | 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% |

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| Course Description | This course covers in-depth knowledge on Big Data and Hadoop Ecosystem tools such as HDFS, YARN, MapReduce, and Hive |
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| Course Objective | <ol style="list-style-type: none"> To understand the use of Hadoop to solve Big data problems To understand Hadoop Ecosystem and Hadoop Architecture, HDFS, To understand Anatomy of File Read and Write & how Map Reduce works. To understand the Hadoop administration To understand HBase Architecture |
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| Course Outcome | <p>Upon the completion of the course the students will be able to</p> <ol style="list-style-type: none"> Gain conceptual understanding of Hadoop Distributed File System and use the features of MapReduce. Creating an map reduce program Understand the concepts of map reduce and its functional programming Explain the basis techniques in managing and monitoring Hadoop cluster Identify appropriate techniques and tools to solve actual Big Data problems Demonstrate various challenges in processing Big data and Hadoop |
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Pre requisites: 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 | - | - | - | - | - | 2 | - | - |
| CO-2 | 3 | 3 | 3 | - | - | - | - | - | - | 2 | - | - | - | - | - |
| CO-3 | 3 | 3 | 3 | 2 | - | 1 | - | 2 | - | - | - | - | - | - | - |
| CO-4 | 2 | 1 | 3 | 3 | 3 | - | | 1 | 1 | 2 | 2 | 2 | - | - | 1 |

| | | | | | | | | | | | | | | | |
|---|---|--|---|---|---|---|---|---|---|---|---|---|---|-----------------------------|---|
| CO-5 | 1 | 1 | 3 | 3 | 3 | - | - | 1 | 1 | 2 | 2 | 2 | 3 | - | 1 |
| | | 1: Weakly related, 2: Moderately related and 3: Strongly related | | | | | | | | | | | | | |
| MODULE1: MAPREDUCE (9) | | | | | | | | | | | | | | | |
| DataStorageandAnalysis–ApacheHadoopandtheHadoopEcosystem–Analyzing the data with Hadoop Scaling Out – Hadoop Streaming – Hadoop Pipes. Practical component: Study on Data Storing Tool- Hive, Sqoop, MongoDB. Suggested Readings: https://data-flair.training/blogs/hadoop-mapreduce-tutorial/ | | | | | | | | | | | | | | CO-1 BTL-2 | |
| MODULE2: HADOOP (9) | | | | | | | | | | | | | | | |
| The Hadoop Distributed Filesystem – Hadoop I/O –Developing a MapReduce Application. Practical component: Study on Data integrating Tool- Zookeeper. Suggested Readings: https://data-flair.training/blogs/hadoop-tutorial/ | | | | | | | | | | | | | | CO-2 BTL-2 | |
| MODULE3: MAP REDUCE FORMATS AND FEATURES(9) | | | | | | | | | | | | | | | |
| MapReduceTypes–InputFormats–OutputFormats–Counters–Sorting–Joins–SideData Distribution–MapReduce Library Classes. Practical component: Study on Data Analyzing Tool- HBase, Pig. Suggested Readings: https://data-flair.training/blogs/hadoop-tutorial/ | | | | | | | | | | | | | | CO-3 BTL-3 | |
| MODULE 4: HADOOP ADMINISTRATION (9) | | | | | | | | | | | | | | | |
| Setting Up a Hadoop Cluster – Administrating Hadoop. Practical component: Study on Data Mining Tool: Oracle Data Mining Suggested Readings: https://data-flair.training/blogs/hadoop-tutorial/ | | | | | | | | | | | | | | CO-4 BTL-3 | |
| MODULE 5: TOOL (9) | | | | | | | | | | | | | | | |
| Hive- Installing Hive, An Example, Running Hive. HBase– Hbasics, Concepts, Installation, Clients, Example.–Zoo Keeper – Sqoop. Practical component: Study on Data integrating Tool- Zookeeper; Suggested Readings: http://apache.bytenet.in/hive/ | | | | | | | | | | | | | | CO-5 BTL-3 | |

| TEXT BOOKS | |
|-----------------|---|
| 1 | Vijay Srinivas Agneeswaran - Big Data Analytics Beyond Hadoop Pearson Education, Inc. |
| 2. | Vignesh Prajapati, "Big Data Analytics with R and Hadoop", Packet Publishing |
| 3. | Robert D. Schneider, "Hadoop for Dummies", Wiley. |
| REFERENCE BOOKS | |
| 1 | Tom White, "Hadoop: The Definitive Guide", 3rd Ed., O'Reilly Media, 2012 |
| 2 | ShuminGuo, Hadoop Operations and Cluster Management Cookbook, Safari, 2013 |
| 3 | Chuck Lam, "Hadoop in action", Dreamtech Press, 2011. |
| 4 | Dirk Deroos, Paul C. Zikopoulos, Roman B. Melnyk, Bruce Brown, "Hadoop for dummies", Wiley publication, 2015. |
| E BOOKS | |
| 1. | https://www.isical.ac.in/~acmsc/WBDA2015/slides/hg/Oreilly.Hadoop.The.Definitive.Guide.3rd.Edit ion. Jan.2012.pdf |
| MOOC | |
| 1. | https://nptel.ac.in/courses/106105186/26 |

| 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) | | | | | | | | | | | | | | | |

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| <p>Basics of Deep learning-Deep learning architectures: Convolutional Neural Networks:Neurons in Human Vision-The Shortcomings of Feature Selection-Vanilla Deep Neural Networks Don'tScale-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 BatchNormalization-BuildingaConvolutionalNetworkforCIFAR-10 Visualizing Learningin Convolutional Networks Leveraging Convolutional Filters to Replicate Artistic Styles-Learning Convolutional Filters for Other Problem Domains-Training algorithms.</p> <p>Practical component:Study on Tools for AI and DL</p> <p>Suggested Readings: https://machinelearningmastery.com/what-is-deep-learning/</p> | <p>CO-1</p> <p>BTL-2</p> |
| <p>MODULE2:MEMEORY AUGUMENTED NEURAL NETWORKS (9)</p> | |
| <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 Decision Processes(MDP)-Explore Versus Exploit-Policy versus Value Learning-Pole-Cart with Policy Gradients-Q-Learning and DeepQ-Networks-Improving and Moving Beyond DQN.</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</p> | |

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| <p>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:Hands on TensorFlow libraries to implement deep learning</p> <p>Suggested Readings: 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>Practical component:Mini project on DL</p> <p>Suggested Readings: https://towardsdatascience.com/what-is-deep-learning-and-how-does-it-work-2ce44bb692ac</p> | | <p>CO-5</p> <p>BTL-5</p> |
| <p>TEXT BOOKS</p> | | |
| 1 | <p>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</p> | |
| 2 | <p>Zurada and Jacek M, “Introduction to Artificial Neural Systems”, West Publishing Company, 1992, ISBN: 9780534954604</p> | |
| 3 | <p>Nikhil Buduma, Nicholas Locascio, “Fundamentals of Deep Learning: Designing Next Generation Machine Intelligence Algorithms”, O'Reilly Media, 2017.</p> | |
| <p>REFERENCE BOOKS</p> | | |
| 1 | <p>Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning (Adaptive Computation and Machine Learning Series MIT Press 2017</p> | |
| 2 | <p>M. T. Hagan, H. B. Demuth, M. Beale, “Neural Networks Design”, Thomson Learning, 2002. ISBN-10: 0-9717321-1-6/ ISBN-13: 978-0-9717321-1-7</p> | |
| <p>E BOOKS</p> | | |
| 1. | <p>http://www.deeplearningbook.org/</p> | |
| <p>MOOC</p> | | |

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

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|------------------------------------|---|--------------------------------------|-----------------------------|-----------------------|-------------------|
| COURSE TITLE | HIGH DIMENSIONAL DATA ANALYSIS | | | CREDITS | 3 |
| COURSE CODE | CSC3734 | COURSE CATEGORY | PE | 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 will cover the analysis of high-dimensional data, with an emphasis on the use of penalized regression models | | | | |
| Course Objective | <ol style="list-style-type: none"> 1. To broaden the mind in terms of thinking about the methods useful for high-dimensional data 2. To introduce useful statistical methods for high-dimensional data 3. To familiarize you with important topics in high-dimensional data that you may wish to research 4. To bring you up to speed concerning terminology and concepts in high-dimensional data analysis and penalized regression 5. To do more easily read research articles in the field of high dimensional data | | | | |
| Course Outcome | <p>Upon the completion of the course the students will be able to</p> <ol style="list-style-type: none"> 1. Analyze the various classifiers for high dimensional classification. 2. Understand the model building and various approaches 3. Identify the methods for high dimensional statistics | | | | |

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| | 4. Analyze the survival and longitudinal data. 5. Study of statistical procedures. |
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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 | 1 | 1 | 2 | 1 | - | - | - | - | - | 2 | - | - |
| CO-2 | 3 | 3 | 3 | - | - | - | - | - | - | 2 | - | - | - | 2 | - |
| CO-3 | 3 | 3 | 3 | 2 | - | 1 | - | 2 | - | - | - | - | - | 2 | - |
| CO-4 | 3 | 3 | 3 | 1 | 2 | 3 | 1 | 1 | 1 | 2 | 2 | 2 | - | - | 1 |
| CO-5 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 3 | - | 1 |

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

MODULE1:HIGH-DIMENSIONAL CLASSIFICATION (9)

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|---|-----------------------------|
| High Dimensional Classification-Elements of Classifications-Distance based Classification rules- Feature selection by Independence rule, Loss Based Classification, Regularization Framework, Multi Category classifiers. Practical component: Analyses of SVM with other classifiers Suggested Readings: https://fan.princeton.edu/ | CO-1 BTL-2 |
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MODULE2:MEMEORY AUGUMENTED NEURAL NETWORKS (9)

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| Model Building with variable selection, Classical Approaches, Bayesian and stochastic search, Regularization, Statistical models, Estimation. Practical component: Discuss various estimation for binary hard classifiers. Suggested Readings: https://projecteuclid.org | CO-2 BTL-3 |
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MODULE3:HIGH-DIMENSIONAL STATISTICS IN GENOMICS (9)

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| High-Dimensional Statistics in Genomics-Identification of active transcription factors using time-course gene expression data-Methods for analysis of genomic data with a graphicalstructure- Statistical method in eQTL studies | CO-3 BTL-4 |
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| <p>Practical component:Case study to compare Adequate Yearly progress.</p> <p>Suggested Readings:https://www.hindawi.com/journals/bmri/2015/564273/ Statistical Analysis of High-Dimensional Genetic Data in Complex Traits</p> | | |
| <p>MODULE 4: ANALYSIS OF SURVIVAL AND LONGITUDINAL DATA (9)</p> | | |
| <p>Analysis of Survival and Longitudinal Data-Regularized Cox regression-Hierarchically penalized Cox regression with grouped variables-Regularized methods for the accelerated failure time model-Tuning parameter selection and a concluding remark</p> <p>Practical component:Discuss the various Estimation methods of SDR</p> <p>Suggested Readings:https://www.hindawi.com/journals/jps/2012/ Analysis of Longitudinal and Survival Data: Joint Modeling, Inference Methods, and Issues</p> | | <p>CO-5</p> <p>BTL-4</p> |
| <p>MODULE 5:SUFFICIENT DIMENSION REDUCTION IN REGRESSION (9)</p> | | |
| <p>Sufficient Dimension Reduction in Regression -Sufficient variable selection (SVS)-SDR for correlated data and large-p-small-n-Combining for adaptation-Combining procedures for improvement</p> <p>Practical component:Compare the various statistical procedures</p> <p>Suggested Readings:https://www.worldscientific.com/ Sufficient Dimension Reduction in Regression</p> | | <p>CO-5</p> <p>BTL-5</p> |
| <p>TEXT BOOKS</p> | | |
| 1 | Tony Cai , Xiao tong Shen,"High-Dimensional Data Analysis ",WSPC/HEP (December 15, 2010) | |
| 2 | Roman Vershynin,"High-Dimensional Probability-An Introduction with Applications in Data Science",Cambridge University Press,27 September 2018. | |
| <p>REFERENCE BOOKS</p> | | |
| 1 | Frigessi, A., Bühlmann, P., Glad, I.K., Langaas, M., Richardson, S., Vannucci, M.,"Statistical Analysis for High-Dimensional Data the Abel Symposium", Springer February 17, 2016 | |
| 2 | John and Yi Ma,"High-Dimensional Data Analysis with Low-Dimensional Models: Principles, Computation, and Applications",Cambridge University Press 2021 | |

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|----------------|---|
| 3 | Peter Bellman, Sara van de Geer, "Statistics for High-Dimensional Data: Methods, Theory and Applications", Springer 2021 |
| 4 | David Donoho, "High-Dimensional Data Analysis: The Curses and Blessings of Dimensionality", Springer 2000 |
| E BOOKS | |
| 1. | https://www.math.uci.edu/~rvershyn/papers/HDP-book/HDP-book.html |
| MOOC | |
| 1 | https://www.edx.org/course/high-dimensional-data-analysis |

ELECTIVE IV

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|------------------------------------|---|--------------------------------------|-------------------------------|-----------------------|----------------|
| COURSE TITLE | HUMAN COMPUTER INTERACTION | | | CREDITS | 3 |
| COURSE CODE | CSB3730 | COURSE CATEGORY | PE | 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 covers in-depth knowledge the human computer interaction and the uses in real world applications | | | | |
| Course Objective | <ol style="list-style-type: none"> 1. To understand importance of human computer interaction 2. To carry out user inquiry to understand human needs in particular contexts 3. To reflect on the design process to make learning visible. | | | | |

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| | <ol style="list-style-type: none"> 4. To understand the usability of human computer interaction 5. To understand advanced human computer interaction for real time applications |
| Course Outcome | <p>Upon the completion of the course the students will be able to</p> <ol style="list-style-type: none"> 1. Relate Human Computer Interaction and summarize its importance 2. Identify the user's capabilities and recommend guidelines for interfaces 3. Design Human Computer Interfaces and implement them 4. Test and Evaluate the Usability of Human Computer interaction 5. Formulate advanced user Interaction for real time applications |

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

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

MODULE 1:INTRODUCTION (9)

Human Computer Interaction –Background – Importance of Human Computer Interaction– Software development and Human Computer Interaction– Display devices– Models of interaction– context of interaction.

Practical component: Design the interface that integrate with and influence the world around us

Suggested Readings: https://link.springer.com/chapter/10.1007/978-3-540-24837-8_2

CO-1

BTL-2

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| MODULE2:USERCAPABILITIES (9) | |
| <p>Users' physical capabilities – Cognition – Design considerations – Memory guidelines for interfaces – Memory and learning – Computer Human Systems.</p> <p>Practical component: Create intuitive, usable interfaces, with established design principles like feedback cycles, direct manipulation, affordances, signifiers, and more.</p> <p>Suggested Readings: https://link.springer.com/chapter/10.1007/978-3-540-24837-8_2</p> | <p>CO-2</p> <p>BTL-2</p> |
| MODULE3:INTERFACEDSIGN(9) | |
| <p>Principles of Interface Design – Classification of Interaction Styles – Linguistic manipulations – Design Considerations – User Classification and User Types – Design process – Strategies for design representation – Dialogue design notations – Case Studies</p> <p>Practical component: Study of standard user interfaces on the Internet</p> <p>Suggested Readings: https://link.springer.com/chapter/10.1007/978-3-540-24837-8_2</p> | <p>CO-3</p> <p>BTL-3</p> |
| MODULE 4: TESTING AND EVALUATION (9) | |
| <p>Importance of Evaluation – Evaluation Techniques – Usability Engineering – Usability Process – Usability Metrics - Socio Technical Design - Ergonomics, Health and Safety – Social Implications.</p> <p>Practical component: Apply usability metrics to critically evaluate commercial products</p> <p>Suggested Readings: https://exaud.com/human-computer-interaction</p> | <p>CO-4</p> <p>BTL-3</p> |
| MODULE5:VARIETIESOFINTERACTION(9) | |
| <p>Modeling rich Interactions – Sensor based interactions – Ubiquitous Computing – Virtual and Augmented Reality – Information Visualization. - Multimedia User Interface Design - Mobile Interaction - Human – Computer Interaction and the Web - Human-Centered Design of Decision-Support Systems - Online Communities - Virtual Environments - Privacy, Security and Trust: Human – Computer Interaction Challenges and Opportunities.</p> <p>Practical component: To carry out research on latest human interaction systems and the related technology.</p> <p>Suggested Readings: https://exaud.com/human-computer-interaction/</p> | <p>CO-5</p> <p>BTL-3</p> |

| TEXT BOOKS | |
|------------------------|---|
| 1 | Christine Faulkner, "The Essence of Human-Computer Interaction", First Edition, Pearson Education, 2010. |
| 2. | Julie A.Jacko, "The Human Computer Interaction Handbook Fundamentals, Evolving Technologies, and Emerging Applications", Third Edition, CRC Press, Taylor & Francis Group, 2012 |
| REFERENCE BOOKS | |
| 1 | Wilbert O Galitz, "The essential guide to user interface design", 3rd Edition, Wiley, 2007 |
| 2 | Ben Shneiderman, Catherine Plaisant, "Designing the user interface, Strategies for effective Human Computer Interaction", 3rd Edition, Pearson Education, 2008 |
| 3 | Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, "Human-Computer Interaction", 3 rd Edition, Pearson Education, 2004. |
| E BOOKS | |
| 1. | http://www.ittoday.info/Excerpts/HCI.pdf |
| MOOC | |
| 1. | https://www.class-central.com/course/nptel-introduction-to-human-computer-interaction-9906 |

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|------------------------------------|---|--|---------------------------------|-----------------------|-------------------|
| COURSE TITLE | VIRTUAL REALITY | | | CREDITS | 3 |
| COURSE CODE | CSB3731 | COURSE CATEGORY | PE | 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 covers in-depth knowledge use of Virtual reality in real world application | | | | |
| Course Objective | <ol style="list-style-type: none"> 1. To learn about the hardware like optics, electronics, display, microcontroller 2. To understand software like JavaScript, WebGL, GLSL 3. To learn IMU, rendering, lens distortion shader, model loader etc., 4. To understand the building blocks of Virtual reality 5. To understand the implementation of VR application | | | | |
| Course Outcome | <p>Upon the completion of the course the students will be able to</p> <ol style="list-style-type: none"> 1. Understanding the concepts of Virtual Modeling and Environment 2. Knowledge facts about the Geometric modeling and its Virtual 3. Explain basic techniques in designing transmission systems 4. Apply the software and hardware 5. Explain the technologies related to virtual reality and application of virtual reality system 6. Use virtual reality in real-world applications. Do VRML programming | | | | |
| 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 | 2 | 2 | 1 | 1 | 2 | 1 | - | - | - | - | - | 2 | - | - |
| CO-2 | 1 | 3 | 3 | - | - | - | - | - | - | 2 | - | - | - | - | - |
| CO-3 | 3 | 3 | 1 | 3 | 3 | 1 | - | 2 | - | - | - | - | - | - | - |
| CO-4 | 1 | 1 | 2 | 2 | 1 | 3 | 3 | 3 | 1 | 2 | 2 | 2 | - | - | 1 |
| CO-5 | 1 | 1 | 3 | 3 | 3 | - | - | 3 | 3 | 2 | 3 | 2 | 3 | - | 1 |
| 1: Weakly related, 2: Moderately related and 3: Strongly related | | | | | | | | | | | | | | | |
| MODULE1: INTRODUCTION (9) | | | | | | | | | | | | | | | |
| <p>Virtual Reality and Virtual Environment: Introduction–Computergraphics–Realtime computer graphics–Flight Simulation–Virtual environments–Requirement for virtuality–benefits of virtual reality–Historical development of VR:Introduction–Scientific Landmark-3DComputerGraphics:Introduction–TheVirtualworldspace positioning the virtual of server–the perspective projection–human vision–stereo perspective projection–3Dclipping–Colourtheory–Simple3Dmodeling–Illumination models–Reflectionmodels–Shading algorithms–Radiosity–Hidden-Surface removal-Realism–Stereo graphic usages.</p> <p>Practical component:Analyze the performance of varioussoftwares like OpenGL, WebGL, and GLSL shader programming.</p> <p>Suggested Readings: https://www.schellgames.com/assets/images/microsites/hololab-homepage/HoloLABChampions_TeacherGuide_ip.pdf</p> | | | | | | | | | | | | | CO-1 BTL-2 | | |
| MODULE2: GEOMETRICMODELING (9) | | | | | | | | | | | | | | | |
| <p>Geometric Modeling:Introduction–From2D to 3D–3Dspace curve 3Dboundary representation– Other modeling strategies-Geometrical Transformations: Introduction – Frames of reference – Modeling transformations–Instances–Picking–Flying–Scaling the VE– Collision detection-A Generic VR system:Introduction–The virtual environment–the Computer environment–VR Technology–Model of interaction–VR System.</p> | | | | | | | | | | | | | CO-2 BTL-2 | | |

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| Practical component: Study about Stereoscopic perception and rendering Suggested Readings: http://msl.cs.uiuc.edu/vr/vrbook.pdf | | |
| MODULE3:VIRTUAL ENVIRONMENT (9) | | |
| Animating the Virtual Environment: Introduction–The dynamics of numbers–the animation of objects–shape & object in between–free-form deformation–particle system Physical Simulation: Introduction–Objects falling in a graphical field–Rotating wheels–Elastic collisions–projectiles–simple pendulum–springs–Flight dynamics of an aircraft Practical component: Analyze the function of gyros, accelerators, magnetometers in developing the VR Application Suggested Readings: https://www.mdpi.com/2414-4088/1/2/11/pdf | | CO-3 BTL-3 |
| MODULE 4: VR HARDWARES & SOFTWARES(9) | | |
| Human Factors: Introduction–the age-the ear-the semantic senses–equilibrium–conclusions– VR Hardware: Introduction–sensor hardware–Head-coupled displays–Aquatic hardware–Integrated VR systems– VR Software: Introduction–Modelling virtual world–Physical simulation-VR tool kits. Practical component: Develop the VR application with VR Hardware and Sensor. Suggested Readings: https://www.mdpi.com/2414-4088/1/2/11/pdf | | CO-4 BTL-3 |
| MODULE 5:TOOL (9) | | |
| Introduction–Engineering–Entertainment–Science–Training–The Future: Introduction–Virtual Equipments – modes of interaction – conclusion. Practical component: Build the VR Application for healthcare with Virtual equipments Suggested Readings: https://www.mdpi.com/2414-4088/1/2/11/pdf | | CO-5 BTL-3 |
| TEXT BOOKS | | |
| 1 | John Vince, “Virtual Reality Systems “, Pearson Education Asia, 2001. | |
| REFERENCE BOOKS | | |
| 1 | Adams, “Visualizations of Virtual Reality”,Tata McGraw Hill, 2000. | |
| 2 | Grigore C. Burdea, Philippe Coiffet , “Virtual Reality Technology” , Wiley-Interscience,1 Edition,1994. | |

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| 3 | WilliamR.Sherman,AlanB.Craig,“UnderstandingVirtualReality:Interface,Application,and Design”,Morgan Kaufmann, 1st Edition,2002. |
| 4 | Design and Development of Virtual Reality Application System,TsinghuaPress,March 2012 |

E BOOKS

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|---|--|
| 1 | http://msl.cs.uiuc.edu/vr/ |
| 2 | www.vrac.iastate.edu . |
| 3 | www.w3.org/MarkUp/VRML . |

MOOC

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|---|---|
| 1 | https://www.mooc-list.com/course/making-your-first-virtual-reality-game-coursera |
| 2 | https://www.mooc-list.com/course/vr-360-video-production-coursera |
| 3 | https://nptel.ac.in/syllabus/syllabus_pdf/106106138.pdf |

| COURSE TITLE | RISK ANALYSIS AND MANAGEMENT | | | CREDITS | 3 |
|--------------|------------------------------|------------------|-----------------------|----------------|------------|
| COURSE CODE | CSB3732 | COURSE CATEGORY | PE | L-T-P-C | 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% |

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| Course Description | This course introduces students about the risk management, environmental assessments and social dimensions of risk management |
| Course Objective | <ol style="list-style-type: none"> 1. Identify, formulate, and solve engineering problems in risk management. 2. Apply knowledge of mathematics, science and engineering to the assessment of risk. 3. Understand the environmental assessments and perception of risk assessment 4. Suggest risk reduction and risk management measures, also where there is a lack of information 5. Reflect upon ethical, subjective and societal dimensions of risk assessments. <p>Implement tools and techniques to evaluate risk in projects</p> |

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|--|--|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------|--------------|--------------|--------------|-----------------------|--------------|
| Course Outcome | <ol style="list-style-type: none"> 1. Identify, formulate, and solve engineering problems in risk management. 2. Apply knowledge of mathematics, science, and engineering to the assessment of risk. 3. Understand the environmental assessments and perception of risk assessment 4. Suggest risk reduction and risk management measures, also where there is a lack of information 5. Reflect upon ethical, subjective and societal dimensions of risk assessments. 6. Implement tools and techniques to evaluate risk in projects | | | | | | | | | | | | | | |
| | 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 | 3 | 2 | 1 | - | 1 | 2 | - | - | 1 | 1 | - | 2 | - |
| CO-2 | 2 | 3 | 2 | 1 | - | 1 | 2 | - | - | 1 | 1 | - | 2 | - | - |
| CO-3 | - | - | 2 | 3 | 2 | 1 | - | 1 | 2 | - | - | 1 | 1 | - | 2 |
| CO-4 | 2 | 2 | 3 | 2 | 1 | - | 1 | 2 | - | - | 1 | 1 | - | 2 | - |
| CO-5 | - | - | 3 | 2 | 3 | 2 | 1 | - | 1 | 2 | - | - | 1 | 1 | - |
| 1: Weakly related, 2: Moderately related and 3: Strongly related | | | | | | | | | | | | | | | |
| MODULE1: INTRODUCTION TO RISK ANALYSIS (9) | | | | | | | | | | | | | | | |
| Introduction - Risk analysis –Variability and uncertainty of risk analysis-Risk analysis modeling- Probabilistic risk analysis for complex engineering system Ecological risk analysis- Economic of risk Privacy. | | | | | | | | | | | | | | CO-1 BTL-2 | |
| MODULE2: APPLICATION OF RISK ANALYSIS (9) | | | | | | | | | | | | | | | |
| Role of risk assessment in human health–Role of risk analysis in pollution prevention-Integrated risk analysis and global climate change-Computer software programs-databases–www-Other online systems- Use of internet. | | | | | | | | | | | | | | CO-2 BTL-2 | |
| MODULE 3: RISK PERCEPTION AND COMMUNICATION (9) | | | | | | | | | | | | | | | |
| Risk perception and trust-Insurability of risk–Setting environmental priorities based on risk– Comparative risk analysis – Law and risk assessment –Science and toxic risk assessment. | | | | | | | | | | | | | | CO-3 BTL-3 | |
| MODULE4: RISK MANAGEMENT (9) | | | | | | | | | | | | | | | |
| Risk management process-Identify-assess-plan responses-Manage process–PRAM Process– Three cycles of strategic level risk management. | | | | | | | | | | | | | | CO-4 BTL-2 | |
| MODULE 5: RISK ORGANISATION & CONTROL (9) | | | | | | | | | | | | | | | |
| Organizational structure-Responsibilities–Functional roles–Risk response actions-Control risk | | | | | | | | | | | | | | CO-5 | |

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|---|---|--------------|
| documentation – Risk reporting – Risk governance – Risk reviews –Behavioral influences– Risk identification techniques–SWOT analysis. | | BTL-2 |
| TEXT BOOKS | | |
| 1 | Vlasta Molak, "Fundamentals of Risk Analysis and Risk Management", 2nd Edition, CRC Press, Lewis Publishers, 2000. | |
| 2 | John Bartlet, "Project Risk Analysis and Management Guide", 2nd Edition, ARM Publishing Ltd, 2010 | |
| REFERENCE BOOKS | | |
| 1 | Naagarazan. R.S., "A textbook on Professional Ethics and Human values", New Age International, New Delhi, 2006. | |
| 2 | Ranganatham and Madhumathi, "Derivatives and Risk Management", Pearson, 2011 | |
| 3 | Rajiv Srivastav, "Derivatives and Risk Management", Oxford University Press, 2010 | |
| E BOOKS | | |
| 1 | https://the-eye.eu/.../Fundamentals%20of%20Risk%20Analysis%20and%20Risk%20Man. | |
| 2 | penka.kroser.com.uy/fundamentals_of_risk_and_insurance.pdf | |
| MOOC | | |
| 1 | https://www.mooc-list.com/tags/risk-management | |

| COURSE TITLE | DIGITAL MARKETING ANALYTICS | | | CREDITS | 3 |
|-----------------------------|------------------------------|-------------------------------------|-------------------------|----------------|------------|
| COURSE CODE | CSC3735 | COURSE CATEGORY | PE | 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 | Seminar/ Assignments/ Project | Surprise Test / Quiz | Attendance | ESE |
| 15% | 15% | 10% | 5% | 5% | 50% |

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| Course Description | This course covers the knowledge of tools used analyze and report on marketing data collected through different media |
| Course Objective | <ol style="list-style-type: none"> 1. To Understand who your most likely customers are so you can target them more meaningfully 2. To Retain customers 3. To Increase customer lifetime value 4. To Proactively relate to customers 5. To Deliver the right message at the right time. |
| Course Outcome | <p>Upon the completion of the course the students will be able to</p> <ol style="list-style-type: none"> 1. Relate to need for digital media transformation and components of Digital Media Marketing. 2. Analyze the Media Strategies and perform Search Engine Optimization 3. Formulate different Social Media Advertisements with personalization 4. Manage digital content for marketing and carry out analytics on the outcome 5. Summarize the strategies of Google Analytics and employ strategies for improving the analytics outcome |

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

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

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| MODULE1: DIGITAL WORLD (9) | |
| <p>Doing Business in a Digital world – Digital transformation – Online buying behavior - privacy – Non marketing Digital marketers – Personalization – Viral marketing – Content marketing – Influencers – Affiliate Marketing – Strategic Digital Marketing – Digital Marketing objectives – Search engine optimization – Keyword selection – Onsite and Offsite Optimizations – Strategic SEO - Third party search engine ranking – Metrics and Analytics</p> <p>Practical component: Working on google analytics tools</p> <p>Suggested Readings: https://analytics.googleblog.com/2016/05/announcing-data-studio-our-free-new.html</p> | <p>CO-1</p> <p>BTL-2</p> |
| MODULE2: DIGITAL MARKETING AND SEARCH ENGINE OPTIMIZATION (9) | |
| <p>Four Ps of marketing – Porter’s Five forces – Brand – Customer Life time value – Aligning with Business strategy – Barriers and Considerations – Planning – Budgeting and Forecasting. Search Engine Strategy – Search Engine Optimization – Paid Search – Measurement and Optimization – Advanced Paid Search – Humans and Robots</p> <p>Practical component: Working on Bitly tool</p> <p>Suggested Readings: https://contently.com/2016/08/02/the-top-10-free-content-analytics-tools/</p> | <p>CO-2</p> <p>BTL-2</p> |
| MODULE3: SOCIAL MEDIA ADVERTISING AND PERSONALIZATION (9) | |
| <p>Display – Types and Formats – Ad servers – Planning and targeting Display Campaigns – Social Media – Types of Social media – Social Advertising – User Experience and Transformation – CRM and Retention – Social CRM – Personalization – Types of Personalization – Customer Service</p> <p>Practical component: Working on Piwik tool</p> <p>Suggested Readings: https://contently.com/2016/08/02/the-top-10-free-content-analytics-tools/</p> | <p>CO-3</p> <p>BTL-3</p> |
| MODULE 4: CONTENT MANAGEMENT AND ANALYTICS(9) | |

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| <p>Content Marketing and Content types – People and process for crating content – Measuring the value of content – Analytics – Tools and Technology – Attribution modelling and reporting – Decision making – Budget – Key Channel benefits – Structuring proposal – Advocacy</p> <p>Practical component:Study on Open wen analytics</p> <p>Suggested Readings: https://www.woorank.com/en/blog/analytical-tools-other-than-google-analytics</p> | <p>CO-4</p> <p>BTL-3</p> |
| <p>MODULE 5: GOOGLE ANALYTICS (9)</p> | |
| <p>Analytics – Personal ROI – Business Intelligence – Organizational ROI – Google analytics – Adobe analytics – Opencsource analytics – Social analytics – Search drill – Blogcanalytics – Getting traffic for analytics – Reviewing performance of campaigns – Case studies on analytics – Shopify – Adwords – Gumroads.</p> <p>Practical component:Study on Kissmetrics tool</p> <p>Suggested Readings: https://www.woorank.com/en/blog/analytical-tools-other-than-google-analytics</p> | <p>CO-5</p> <p>BTL-3</p> |
| <p>TEXT BOOKS</p> | |
| <p>1</p> | <p>Alan Charesworth, “Digital Marketing – A Practical Approach”, Routledge Publishers, Third Edition, ISBN 9781315175737 (eBook) ISBN 9781138039520 (hardback), 2018.</p> |
| <p>2.</p> | <p>Simon Kingsworth, “Digital Marketing Strategy – An Integrated Approach to Online Marketing”,Kogan Page Publishers, ISBN 978 0 7494 7470 6, 2016.</p> |
| <p>3.</p> | <p>Todd Kelsey, “Introduction to Google Analytics”, Apress Publishers, ISBN-13 (pbk): 978-1-4842-2828-9, 2017</p> |
| <p>REFERENCE BOOKS</p> | |
| <p>1.</p> | <p>Grant Kennedy, “Master Social Media Marketing, Facebook, Twitter, Youtube, Instagram”, http://ebooklibrary.space/read01/?book=1523709146</p> |
| <p>2.</p> | <p>Dave Chaffey, Fiona Ellis-Chadwick, “Digital Marketing – Strategy, Implementation and Practice”, Pearson Education, Sixth edition, ISBN-13: 978-1292077611, 2016.</p> |
| <p>3.</p> | <p>Chuck Hemann and Ken Burbary, “Digital Marketing Analytics: Making Sense of Consumer</p> |

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|----------------|---|
| | Data in a Digital World”, Que Publishing, 1 edition, ISBN-13: 978-0789750303, 2013. |
| 4. | Gabor Szabo, GungorPolatkan, Oscar Boykin, AntoniosChalkiopoulos, “Social Media Data Mining and Analytics”, Wiley Publications, ISBN: 978-1-118-82485-6 ISBN: 978-1-118-82490-0 (ebk), 2019. |
| E BOOKS | |
| 1. | https://blog.alexa.com/wp-content/uploads/2016/12/How-to-Pro-Turn-Marketing-Analytics-into-Effective-Marketing-Strategies-ebook.pdf |
| MOOC | |
| 1. | https://www.coursera.org/learn/marketing-analytics |