



## School of Computer Science and Engineering

### CURRICULUM STRUCTURE

**Based on Choice Based Credit System (CBCS) and Outcome Based Education (OBE)**

**Program: M.Tech. Computer Science and Engineering  
Specialization in Data Science**

**M.Tech. [DSC]**

**2024-2026**

**Regulations No: PU/AC-21.X/SOCSE04/DSC/2024-2026**

**Resolution No. 10 of the 21<sup>st</sup> Meeting of the Academic Council held on 6th September 2023,  
and ratified by the Board of Management in its 22<sup>nd</sup> Meeting held on 2nd November 2023**

**April 2024**

## **M. TECH. DATA SCIENCE**

(As amended up to the 21<sup>st</sup> Meeting of the Academic Council held on 6<sup>th</sup> September, 2023. This document supersedes all previous guidelines)

**I. Program Code: M.Tech. [DSC]**

### **II. Program Needs:**

Master of Technology in Data Science is a postgraduate degree program that familiarises students with the conceptual framework which is used in Analytics, this would include statistics, computational physics, algebra, CS and all allied subjects. This course provides an opportunity to learn principles, tools, and techniques to model various real-world problems, analyze them, and discover useful information. The interdisciplinary field of data science uses key skills of a wide range of fields including machine learning, statistics, visualization etc. It enables us to identify meaning and appropriate information from huge volumes of data to make informed decisions in technology, science, business etc.

This course will make the students to understand and master CSE and also make them specialist in the field of Data Science – which is one of the emerging fields of Computer Science and Highest paid in the market. Companies like Google, Microsoft, Face Book, Twitter, Instagram, Cisco, Amazon, Oracle are the major users of Data Science which is highly driven by data.

**Program Educational Objectives [PEOs]:** After four years of successful completion of the program, the graduates shall be:

- PEO 01:** To prepare graduates who will be successful professionals in industry, government, academia, research, entrepreneurial pursuit and consulting firms.
- PEO 02:** To prepare graduates who will contribute to society as broadly educated, expressive, ethical and responsible citizens with proven expertise.
- PEO 03:** To prepare graduates who will achieve peer recognition as individuals or in a team through demonstration of good analytical, research, design and implementation skills.
- PEO 04:** To prepare graduates who will thrive to pursue life-long reflective learning to fulfil their goals.

### **III. Program Outcome [POs]: On successful completion of the Program, the students shall be able to:**

- PO 1:** An ability to analysis, manage and supervise engineering systems and processes with the aid of appropriate advanced tools.
- PO 2:** An ability to design a system and process within constraints of health, safety, security, economics, manufacturability to meet desired needs.
- PO 3:** An ability to carry out research in the respective discipline and publish the findings.
- PO 4:** An ability to effectively communicate and transfer the knowledge/ skill to stakeholders.
- PO 5:** An ability to realize the impact of engineering solutions in a contemporary, global, economical, environmental, and societal context for sustainable development.

**Program Specific Outcomes [PSOs]:** Upon completion of the M.Tech in Data Science programme, students will be able to:

**PSO 01: [Problem Analysis]:** Identify, formulate, research literature, and analysis complex engineering problems related to Data science principles and practices, Programming and Computing technologies reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

**PSO 02: [Design/development of Solutions]:** Design solutions for complex engineering problems related to Data science principles and practices, Programming and Computing technologies and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, cultural, societal and environmental considerations.

**PSO 03: [Modern Tool usage]:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities related to Data science principles and practices, Programming Data science Computing & analytics with an understanding of the limitations.

**IV. Curriculum Structure:** The curriculum structure is composed of the following baskets:

- 1] **School Core** (Common & Compulsory to all the programs of the School consists of 32 Credits)
- 2] **Program Core** (Specific to the M.Tech. [DS] Program, consists of 15 credits).
- 3] **Discipline Electives** (Specific to the M.Tech. [DS] Program and categorized under various specialized groups, the minimum number of credits to be earned in this basket is 15)
- 4] **Open Electives** (Consists of courses from various schools to provide an opportunity for multi-disciplinary learning and the minimum number of credits to be earned from this basket is 06)

**Table 1: Summary of Minimum Credit Contribution from various Baskets**

Baskets	Credit Contribution
SCHOOL CORE	32
PROGRAM CORE	15
DISCIPLINE ELECTIVE	15
OPEN ELECTIVE	06
<b>TOTAL CREDITS</b>	<b>Min. 68</b>

The curriculum structure is designed as per the AI and incorporating OBE Principles. The students are provided with at most flexibility in selection of the courses of their choice. The students are free to prepare their own Course grid for every semester from the Basket of courses

subject to satisfying the pre-requisites for the courses selected and adhering to the Minimum and Maximum Credit requirement as per the Program Regulations.

The students have an option to decide the pace of his/ her learning [The number of semesters to complete the program]. The slot time table system provides the opportunity to the students to decide the time slot of the course and to select the faculty member among those who are offering the course.

The curriculum provides an opportunity to the students to obtain a specific specialization in the basic degree of **MASTER OF TECHNOLOGY IN M. Tech. (DATA SCIENCE) – DSC.**

#### V. Basket wise courses:

**A) School Core:** Minimum Credits to be earned from this basket = 32 Credits

Sl. No.	Course Code	Course Name	L	T	P	Credits	Type of Skill	Course Caters to	Pre-requisites/Co-requisites	Anti-requisites	Future Courses that need this as a Pre-requisite
1	MAT6001	Advanced Engineering Mathematics	3	0	0	3	S		-	-	-
2	ENG5001	English for Employability	2	0	2	3	S		-	-	-
3	SEM5001	Seminar – I	-	-	-	1	S/EM/EN		-	-	-
4	SEM5002	Seminar – II	-	-	-	1	S/EM/EN		-	-	-
5	PIP6001	Dissertation/ Internship - I	-	-	-	10	S/EM/EN		-	-	-
6	PIP6002	Dissertation/ Internship - II	-	-	-	14	S/EM/EN		-	-	-

**B] Program Core:** Minimum Credits to be earned from this basket 15 Credits

1	CSE5008	Programming in Data Science	2	0	2	3	S	-	-	-
2	CSE5007	Machine Learning Algorithms	2	0	2	3	S	-	-	-
3	CSE5009	Data Analytics and Visualization	2	0	2	3	S	-	-	-
4	CSE6001	Deep Learning	2	0	2	3	S	CSE5007	-	-
5	CSE6003	Big Data Analytics Tools and Techniques	2	0	2	3	S	CSE5007	-	-

**C] Discipline Electives:** Minimum Credits to be earned from this basket 15 Credits

1	CSE5011	Data Science with Cloud Computing	3	0	0	3	S/EM	-	-	-
2	CSE5015	Data Security and Access Control	3	0	0	3	S/EM	-		
3	CSE5013	Soft Computing Techniques	3	0	0	3	S/EM	-	-	-
4	CSE6002	Natural Language Processing Techniques	2	0	2	3	S/EM	CSE5007	-	-
5	CSE6004	Time Series Analysis and Forecasting	3	0	0	3	S/EM	CSE5005	-	-
6	CSE6005	Intelligent Information Retrieval	3	0	0	3	S/EM	CSE5005	-	-
7	CSE6007	IOT Data Analytics	3	0	0	3	S/EM	CSE5009	-	-
8	CSE6008	Probabilistic Graph Models	3	0	0	3	S/EM		-	-
9	CSE6009	Artificial Neural Networks	3	0	0	3	S/EM	CSE5007		
10	CSE6010	Social Network Analysis	3	0	0	3	S/EM	-	-	-
11	CSE5016	Essentials for Machine Learning	3	0	0	3	S/EM	-	-	-
1	CSE6011	Application of Probability theory in	3	0	0	3	S/EM	-	-	-

2		Computer Science									
1 3	CSE5017	NoSQL Databases	2	0	2	3	S/EM		-	-	-
1 4	CSE5020	Digital Image Processing	2	0	2	3	S/EM		CSE5007	-	-

**DJ Open Electives:** Minimum Credits to be earned from this basket 6 Credits

S l . N o .	Course Code	Course Name	L	T	P	C	Type	Course Caters to	Pre- requisit es/	Anti- requisit es
							of Skill/		Co- requisit es	
							Focu s			
	Civil Engineering Basket									
1 .	CIV5001	Sustainable Smart Cities	3	0	0	3	EM	ES/ HP	-	
2 .	CIV5002	Systems Design for Sustainability	3	0	0	3	EM	ES/ HP	-	
3 .	CIV5003	Self-Sustainable Buildings	3	0	0	3	EM	ES/ HP	-	

4	CIV5004	Energy and Buildings	3	0	0	3	EM	ES/ HP	-	
	Law Basket									
1	LAW5001	International Trade Law	3	0	0	3		HP		
2	LAW5002	Law relating to Business Establishment	3	0	0	3		HP		
3	LAW5003	Data Protection Law	3	0	0	3		HP		
4	LAW5004	Law Relating to Consumer Protection	3	0	0	3		HP		
5	LAW5005	Law Relating to Infrastructure Projects	3	0	0	3		HP		
	Computer Science and Engineering Basket									
1	CSE5001	Programming Methodologies using Java	3	0	0	3				

2 .	CSE5002	Human Computer Interaction	3	0	0	3				
3 .	CSE5003	IOT Applications	3	0	0	3				
4 .	CSE5004	Programming Essentials in Python	3	0	0	3				
Electronics and Communication Engineering Basket										
1 .	ECE5001	Wearable Computing	3	0	0	3				
2 .	ECE5002	MEMS and Nanotechnology	3	0	0	3				
3 .	ECE5003	Advanced Computer Networks	3	0	0	3				
4 .	ECE5004	Pervasive Computing	3	0	0	3				



	Mechanical Engineering Basket										
1 .	MEC5001	Optimization Techniques	3	0	0	3					
2 .	MEC5002	Industry 4.0	3	0	0	3	EM	ES/ HP			
3 .	MEC5003	Six Sigma for Engineers	3	0	0	3					
4 .	MEC5004	Design for Internet of Things	3	0	0	3					
	Management Basket										
1 .	MBA3026	Essentials of Leadership	3	0	0	3	EM/ EN	HP/ GS			
2 .	MBA3037	Fundamentals of Accounting	3	0	0	3	S/ EM	HP			
3 .	MBA3038	Sales Techniques	3	0	0	3	S/ EM/	HP			

							EN			
4	MBA3039	Principles of Management	3	0	0	3	EM/ EN	HP/ GS		
Media Studies Basket										
1	BAJ5001	Media and Entertainment Business	3	0	0	3	EN	HP	HP	
2	BAJ5002	TV Journalism and News Management	2	0	2	3	EM	HP	HP	
Research Basket										
1	RES5001	Research Methodology	3	0	0	3	S	ES/ HP		
	Research Project (Students are required to carry out research work under the guidance of a faculty member/ research scholar and the same shall be evaluated and credit will be granted as per the academic regulations)									
1	URE6001	Research Experience	-	-	-	3	EM	ES/ HP		
	Apart from the above list, the student is free to enroll for any course offered by any school and earn credits for Open elective provided the student has not completed an anti-requisite course and the student fulfills the prerequisite if any for the course he wishes to enroll									

Type of Skill

Course Caters to

F - Foundation  
S - Skill Development  
EM – Employability  
EN – Entrepreneurship

GS - Gender Sensitization  
ES - Environment and sustainability  
HP - Human values and Professional Ethics

Semester Grid 2024-2026						
<b>SEM - 1</b>						
S. No.	COURSE CODE	COURSE NAME	CREDIT STRUCTURE			
			L	T	P	Basket
1	MAT6001	Advanced Engineering Mathematics	3	0	0	School Core
2	ENG5001	English for Employability	2	0	2	School Core
3	CSE5007	Machine Learning Algorithms	2	0	2	Program Core
4	CSE5008	Programming in Data Science	2	0	2	Program Core
5	CSE5009	Data Analytics and Visualization	2	0	2	Program Core
6	CSEXXXX	Discipline Elective – I	3	0	0	Discipline Elective
7	CSEXXXX	Discipline Elective – II	3	0	0	Discipline Elective
8	SEM5001	Seminar – I	-	-	-	School Core
<b>TOTAL</b>			<b>18</b>	<b>6</b>	<b>22</b>	
<b>SEM - 2</b>						
S. No.	COURSE CODE	COURSE NAME	CREDIT STRUCTURE			
			L	T	P	Basket
1	CSE6001	Deep Learning	2	0	2	Program Core
2	CSE6003	Big Data Analytics Tools and Techniques	2	0	2	Program Core
3	CSEXXXX	Discipline Elective – III	2	0	2	Discipline Elective
4	CSEXXXX	Discipline Elective – IV	3	0	0	Discipline Elective
5	CSEXXXX	Discipline Elective – V	3	0	0	Discipline Elective

6	XXXXXXX	Open Elective – I	3	0	0	3	<b>Open Elective</b>
7	XXXXXXX	Open Elective – II	3	0	0	3	<b>Open Elective</b>
8	SEM 5002	Seminar – II	-	-	-	1	<b>School Core</b>
<b>TOTAL</b>			<b>19</b>	<b>4</b>		<b>22</b>	
<b>SEM – 3</b>							
S. No.	COURSE CODE	COURSE NAME	CREDIT STRUCTURE				
			L	T	P	CREDITS	Basket
1	PIP6001	Dissertation/ Internship - I	-	-	-	10	<b>School Core</b>
<b>SEM – 4</b>							
S. No.	COURSE CODE	COURSE NAME	CREDIT STRUCTURE				
			L	T	P	CREDITS	Basket
1	PIP6002	Dissertation/ Internship - II	-	-	-	14	<b>School Core</b>

## VI. Course Catalogues:

Each course shall have a course catalogue with the following details:

- Pre –Requisites of the course
- Course Description
- Course Outcome
- Course Content
- Reference Resources.

The Course Catalogues for the Courses offered in each basket are attached below:

<b>Course Code:</b> CSE 5005	<b>Course Title: Artificial Intelligence</b>  <b>Type of Course: Program Core</b> <b>Theory and Laboratory Integrated</b>	<b>L-P-C</b>	2	2	3
<b>Version No.</b>	2.0				
<b>Course Pre-requisites</b>	1. Strong knowledge of Computer science, programming languages and coding. 2. Python. 3. Probability and Statistics. 4. Strong data analytics skills.				
<b>Anti-requisites</b>	NIL				
<b>Course Description</b>	Artificial intelligence (AI) is a research field that studies how to realize the intelligent human behaviors on a computer. The ultimate goal of AI is to make a computer that can learn, plan, and solve problems autonomously. This course along with Python explores the concepts and algorithms at the foundation of modern artificial intelligence, diving into the ideas that give rise to technologies like game-playing engines, handwriting				

	recognition, etc. This course contains a theory component about the concepts and principles that underlie modern AI algorithms, and a practice component to relate theoretical principles with practical implementation. By course's end, students emerge with experience in libraries for machine learning as well as knowledge of artificial intelligence principles that enable them to design intelligent systems of their own.			
<b>Course Objective</b>	The objective of the course is to familiarize the learners with the concepts of Artificial Intelligence and attain <b>SKILL DEVELOPMENT</b> through <b>EXPERIENTIAL LEARNING</b> techniques			
<b>Course Out Comes</b>	On successful completion of the course the students shall be able to: CO1.Explain the Concepts and algorithms of Modern Artificial Intelligence CO2.Choose appropriate AI Methods in applying scientific method to models of machine learning CO3.Apply AI Principles and techniques to real-world problems to develop intelligent systems.			
<b>Course Content:</b>				
<b>Module 1</b>	Python for Artificial Intelligence	Assignment	Programming	<b>15 Sessions</b>
Topics: Introduction to Python, Advanced Python: Object Oriented, OOPs concept, Class and object, Attributes, Inheritance, Overloading, Overriding, Data hiding, Exception Handling, Python Libraries, File handling, Regular expression in python, Data migration, and visualization: GGPlot, seaborn Pandas and Matplotlib, Database Interaction in Python.				
<b>Module 2</b>	<b>Introduction to AI</b>	Assignment	Programming	<b>14 Sessions</b>
Topics: Introduction, A.I. Representation, Problem Characteristics, Intelligent Agents and Environments, the concept of rationality, categories of artificial intelligence, the nature of environments, structure of agents, types of agents.				
State Space Search – Searching for Solutions – Uniformed Search Strategies –Informed Search Strategies – Heuristic Function, Hill Climbing, Stimulated Annealing, Constraint Satisfaction Problems (CSP) – Backtracking Search and Adversarial Search – Games – Optimal Decisions in Games Greedy Search algorithms – MINMax algorithm -Alpha-Beta Pruning, A* search algorithm.				
<b>Module 3</b>	Reasoning	Assignment	Case Study	<b>8 Sessions</b>
Topics Reasoning – Introduction to Reasoning – Types of Reasoning, Reasoning under Uncertainty – Probabilistic Reasoning – Bayes Theorem – Bayesian Network – Hidden Markov Model – Dempster Shafer Theory-Logic and Resolution proof.				
<b>Module 4</b>	Learning	Assignment	Case Study	<b>06 Sessions</b>
Topics: Learning: Learning from observations, Forms of Learning, Inductive Learning, Learning decision trees, Theory of learning, Learning in Neural and Belief networks, Learning generative adversarial networks.				
<b>List of Laboratory Tasks:</b>				
<b>Experiment No 1:</b> Write a Python program to implement Basic Elements of Python such as Branching, Recursion, Global Variables, Modules, Files, Inheritance, Encapsulation and Information Hiding.				
<b>Level 1: Programming Scenarios that use control structures to solve simple case scenarios.</b>				
<b>Level 2: Programming assignment to implement python elements to solve relevant case scenarios.</b>				
<b>Experiment No. 2:</b> Write a Python Program to Implement Basic Elements of Python such as Tuples, Functions, Dictionaries, Exceptions and Assertions.				
<b>Level 1: Programming Scenarios which use control structures to solve simple case scenarios.</b>				
<b>Level 2: Programming assignment to implement python elements to solve relevant case scenarios.</b>				
<b>Experiment No. 3:</b> Write a python program to perform data visualization on Canada, Titanic and Customer_data dataset using Matplotlib, Seaborn.				
<b>Level 1: Programming Scenarios which use the methods of Matplotlib and seaborn to produce various</b>				

data visualizations on Canada, titanic datasets.

**Level 2:** Programming assignment which utilizes the methods of Matplotlib and seaborn to produce various data visualizations on wine datasets.

**Experiment No. 4:** Write a Program to Implement Breadth First Search and Depth First Search using Python.

**Level 1:** Programming scenario which implements BFS and DFS on different graph models.

**Level 2:** Programming assignment which implements BFS and DFS on different graph models.

**Experiment No. 5:** Write a Program to implement A\* and AO\* algorithm using Python.

**Level 1:** Programming scenarios to implement A\* and AO\* search algorithm on given dataset.

**Level 2:** Programming assignment to implement A\* and AO\* search algorithm on given Dataset.

**Experiment No. 6:** Write a Program to Implement Tic-Tac-Toe game using Python.

**Level 1:** Programming Scenario to implement AI gaming theory in Tic-Tac-Toe Game

**Experiment No. 7:** Write a Program to Implement 8-Puzzle problem via Hill Climbing algorithm in Python

**Level 1:** Programming Scenarios to implement Hill Climbing Algorithm in 8-Puzzle problem.

**Experiment No. 8:** Write a Program to Implement simulated annealing algorithm on Canada dataset.

**Level 1:** Programming Scenarios to implement simulated annealing algorithm on Canada dataset.

**Experiment No. 9:** Write a Program to Implement Water-Jug problem using Python

**Level 1:** Programming Scenarios to implement AI gaming theory in Water-Jug Problem

**Experiment No. 10:** Write a Program to Implement Travelling Salesman Problem using Python

**Level 1:** Programming Scenarios to implement AI gaming theory in Travelling Salesman Problem.

**Experiment No. 11:** Write a Program to Implement Missionaries-Cannibals Problems using Python

**Level 1:** Programming Scenarios to implement AI gaming theory in Missionaries-Cannibals Problems.

**Experiment No. 12:** Write a Program to Implement N-Queens Problem using Python.

**Level 1:** Programming Scenarios to implement AI gaming theory in N-Queens Problem.

#### **Targeted Application & Tools that can be used:**

#### **Targeted Applications:**

AI applications do not just have the promise to yield better business results but improve the human experience as a whole. The contribution of the technology giants like Microsoft, Google, Apple and IBM in the healthcare sector holds significant importance for the industry. AI is currently being applied for a wide range of healthcare services, Speech recognition, Virtual Agents, AI optimized hardware, Decision Management, Deep Learning, etc. Few of the top recruiters are Amazon, NVIDIA, Microsoft, IBM, Accenture, Facebook, Intel, Samsung, Lenovo, Adobe etc., among numerous others.

#### **AI Tools:**

- Scikit Learn.
- TensorFlow.
- Auto ML.
- Theano.
- PyTorch.
- Caffe.
- Google ML Kit.

#### **Project work/Assignment: Mention the Type of Project /Assignment proposed for this course**

#### **Project Works:**

#### **1. HANDWRITTEN DIGITS RECOGNITION**

Digits written by humans vary a lot in curves and sizes as they are hand-drawn and everyone's writing is not the same. It is a great way to start artificial intelligence by building a handwritten digits recognition system that can identify the digit drawn by humans.

## **2. CUSTOMER RECOMMENDATION**

E-commerce has benefitted dramatically from AI. The finest example is Amazon and its customer recommendation system. This customer recommendation system has helped the platform in enhancing its income tremendously thanks to better customer experience.

## **3. MOVIE LENS CASE STUDY**

The GroupLens Research Project is a research group in the Department of Computer Science and Engineering at the University of Minnesota. Members of the GroupLens Research Project are involved in many research projects related to the fields of information filtering, collaborative filtering, and recommender systems. The project is led by professors John Riedl and Joseph Konstan. The project began to explore automated collaborative filtering in 1992 but is most well known for its worldwide trial of an automated collaborative filtering system for Usenet news in 1996. Since then the project has expanded its scope to research overall information by filtering solutions, integrating into content-based methods, as well as, improving current collaborative filtering technology.

4. Any other project ideas mutually decided by students-instructor

**After completion of each module, a programming-based Assignment/Assessment will be conducted.**

**A scenario will be given to the student to be developed as a Gaming Application.**

### **Case Studies:**

1. Rolls-Royce and Google Partner to Create Smarter Autonomous Ships based on AI.
2. How the US Retail giant is using AI and Robots to prepare for the 4<sup>th</sup> Industrial Evolution.
3. The amazing ways google uses AI and Satellite Data to prevent Illegal Fishing.
4. AI in china: The Amazing ways Tencent is Driving its Adoption
5. Any other Case Studies mutually decided by students-instructor

At the end of the Semester, Teams will be formed according to Student's Count and will be assigned with a Debate Topic

1. AI Risks.
2. Emerging trends in AI.
3. AI in Future.
4. Any other topic mutually decided by students-instructor

### **Text Book**

1. John V Guttag, "Introduction to Computation and Programming Using Python", Second Edition, Prentice Hall of India, 2013.
2. O'Reilly, "Python for Data Analysis", Second Edition, O'Reilly Media Inc, 2017
3. Stuart Russell, Peter Norvig, "Artificial Intelligence: A Modern Approach", Third Edition, Pearson Edu pdfcation / Prentice Hall of India, 2010.

### **References**

1. Wesley J. Chun, "Core Python Programming - Second Edition", Prentice Hall, 2006.
2. Kenneth A. Lambert, "Fundamentals of Python – First Programs", CENGAGE Publication
3. Denis Rothman, Matthew Lamons, Rahul Kumar, Abhishek Nagaraja, Amir Ziai, Ankit Dixit, "Python: Beginner's guide to Artificial Intelligence", Packt publishing, 2018
4. Prateek Joshi, "Artificial Intelligence with Python", Packt Publishing, 2017

### **Weblinks**

W1. <https://presiuniv.knimbus.com/user#/home>

W2. <https://www.britannica.com/technology/artificial-intelligence>.

Topics relevant to "SKILL DEVELOPMENT: Python for Artificial Intelligence, Hill Climbing, Stimulated Annealing, Constraint Satisfaction Problems (CSP) – Backtracking Search and Adversarial Search, Probabilistic Reasoning, Bayes Theorem, Bayesian Network, Hidden Markov Model, Dempster Shafer Theory, Learning decision trees, Learning in Neural and Belief networks, Learning generative adversarial networks for developing Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout

<b>Catalogue prepared by</b>	Dr. Shankar Rammoorthy, Ms. S.Poornima
<b>Recommended by the Board of Studies on</b>	BOS NO: 1, BOS held on 22/12/2022
<b>Date of Approval by the Academic Council</b>	Academic Council Meeting No. 20, Dated 15/02/2023



Course Code: CSE 5006	Course Title: KNOWLEDGE ENGINEERING AND EXPERT SYSTEM Type of Course: Program Core Theory Only		L- P- C	3	0	3
Version No.	2.0					
Course Pre-requisites	Basic Knowledge on Artificial Intelligence and Discrete Mathematics such as Predicative Logic, Logic rules etc.					
Anti-requisites	NIL					
Course Description	Knowledge engineering is a field within artificial intelligence that develops knowledge-based systems. Such systems are computer programs that contain large amounts of knowledge, rules and reasoning mechanisms to provide solutions to real-world problems. A major form of knowledge-based system is an expert system, one designed to emulate the reasoning processes of an expert practitioner. Topics includes: Introduction to Knowledge Engineering, Knowledge based Systems, Types of Knowledge-based systems, Knowledge acquisition, Knowledge representation and reasoning: Logic rules and representations, Semantic Networks, frames, Life cycle Methodologies, Uncertain Reasoning with confidence factor, Basic Structure and Architecture of Expert System. Tools used in Expert System.					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Knowledge Engineering and Expert Systems and attain Skill Development through Participative Learning techniques.					
Course Outcomes	On successful completion of the course the students shall be able to: CO1.Explain the basic concepts in Knowledge Engineering and types of Knowledge based system. CO2.Discuss the process of acquiring the Knowledge from the human expert. CO3.Apply the logical rules, Semantic Networks and Frames for representing the knowledge. CO4.Life Cycle and Methodologies applied to support the development of Knowledge based Systems. CO5.Explain how expert system deal with uncertainty and describes architecture and tools used.					
Course Content:						
Module 1	Introduction to Knowledge Engineering and Knowledge Base	Assignment	Analysis	10 Sessions		
Topics: Data, Information and Knowledge Skills of a Knowledge Engineering, Engineering, software engineering and knowledge engineering, Knowledge Engineering around the world. Introduction to Knowledge-Based Systems.						
Module 2	Knowledge Acquisition	Assignment	Analysis, Data Collection	5 Sessions		
Topics: Knowledge Engineering life cycle, , Knowledge acquisition - knowledge acquired from a human expert - purpose and types of Interviews in obtaining knowledge.						
Module 3	Knowledge Representation and Reasoning	Problem-Solving	Data analysis task	9 Sessions		

Topics: Using knowledge - Logic, rules and representation- Developing rule-based systems, **Conceptual Networks.**

<b>Module 4</b>	Life Cycle and Methodologies	Assignment	Analysis	<b>9 Sessions</b>
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Topics: Need for methodologies- Blackboard architectures- Problem Solving Methods (PSMs)- **GEMINI, POLITE,** - The Hybrid Methodology (HyM)- Building a well-structured application using Aion BRE.

<b>Module 5</b>	Uncertain Reasoning and Expert System	Assignment	Analysis	<b>10 Sessions</b>
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Topics: Uncertainty – Confidence factor- Expert System – Basic Structure, Architecture – Tools used Constructing Expert System, **Rule-based system.**

#### **Targeted Applications & Tools that can be used:**

After Completion of the course, student may get an opportunity to be a Knowledge engineer to design and develop Knowledge base with reference to Acquisition and to represent it.

Expert System can be developed on real time application ( To highlight a few)

Medical Knowledge Automation, Chemical and Biological Synthesis, Mineral and Oil explorations, Planning and Scheduling. Space Defense, VLSI Design, Air traffic control, Equipment fault Diagnosis. Circuit Diagnosis and So on.

**Tools: Programming tools for building Expert System.**

- OPS 5
- EMYCIN
- KAS
- TEIRESIAS

#### **Project work/Assignment:**

**Case Study Analysis:** To Study, analyze and develop expert system on applications.

#### **Term Assignments:**

- **Comparative analysis on methods in Knowledge representations.**
- **A short survey on techniques used to build Knowledge base.**
- **Recent trends used in developing Expert System.**

#### **Text Book**

T1. "An introduction to knowledge engineering", Simon Kendal, Malcolm creen, Springer, 2007.(with Recent version copyright)

T2. "An Overview of Expert System " William B. Gevarter,Dept. of Commerce,U.S , NBS, Washington,D.C.

#### **References**

R1. "An introduction to knowledge engineering", Peter Smith, Thomson computer press, 1996.

R2. "A guide to an Expert System ", Donald Waterman, Pearson India.

### Weblinks

W1. <https://presiuniv.knimbus.com/user#/home>

W2. <https://www.javatpoint.com/ai-knowledge-engineering>.

**Topics relevant to "SKILL DEVELOPMENT"**: Converting from English to Predicate Logic, and logically prove statements using inference rules like first-order resolution, Uncertain Reasoning and Expert Systems for **skill development** through **participative learning** techniques. This is attained through the assessment components mentioned in the course handout.

<b>Catalogue prepared by</b>	Dr. T.K. Thivakaran.
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<b>Recommended by the Board of Studies on</b>	BOS NO: 1, BOS held on 22/12/2022
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<b>Date of Approval by the Academic Council</b>	Academic Council Meeting No. 20, Dated 15/02/2023
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<b>Course Code:</b> CSE 5007	<b>Course Title: Machine Learning Algorithms</b>					
	<b>Type of Course: Program Core Theory and Laboratory Integrated</b>		<b>L-P-C</b>	2	2	3
<b>Version No.</b>	2.0					
<b>Course Pre-requisites</b>	Basic knowledge of a. Statistics, Calculus, Linear Algebra and Probability. b. Programming Language. c. Data Modeling.					
<b>Anti-requisites</b>	NIL					
<b>Course Description</b>	This course provides a broad introduction to machine learning and statistical pattern recognition. Topics include: supervised learning (generative/discriminative learning, parametric/non-parametric learning, neural networks, support vector machines); unsupervised learning (clustering, dimensionality reduction, kernel methods); learning theory (bias/variance tradeoffs, practical advice); reinforcement learning and adaptive control.					
<b>Course Objective</b>	The objective of the course is to familiarize the learners with the concepts of Machine Learning Algorithms and attain Skill Development through Experiential Learning techniques.					
<b>Course Out Comes</b>	On successful completion of the course the students shall be able to: CO1: Identify the characteristics of datasets and compare the trivial data for various applications. CO2: Understand and apply scaling up machine learning techniques. CO3: To design and implement various machine learning algorithms in a range of real-world applications.					
<b>Course Content:</b>						
<b>Module 1</b>	Machine Learning Model Fundamentals	Assignment	Programming	10 Sessions		
Topics: Data-generating process, Understanding the structure and properties of good datasets, Scaling datasets, including scalar and robust scaling, Selecting training, validation and test sets, including cross-validation, Features of a machine learning model, Learnability, Capacity, including Vapnik-Chervonenkis theory, Bias including underfitting, Variance including overfitting, Regularization with types, cross validation, Defining loss and cost functions.						
<b>Module 2</b>	Clustering and Unsupervised Models	Assignment	Programming	10 Sessions		
Topics: K-Nearest Neighbors(KNN), based on k-dimensional(k-d) trees and ball tress, K-means and K-means++, Clustering Fundamentals, Evaluation of clustering models on the ground truth, Hierarchical clustering algorithms, Spectral clustering, DBSCAN, Clustering as a Mixture of Gaussians.						
<b>Module 3</b>	Semi- Supervised Learning Algorithms	Assignment	Programming	15 Sessions		
Topics: Introduction to Semi- Supervised Learning, Semi-supervised scenario, The different approaches to semi-supervised learning, Generative Gaussian Mixture, contrastive pessimistic likelihood estimation approach, Self-Training, Co-Training,  Advanced Semi-Supervised Classification, Contrastive Pessimistic Likelihood Estimation(CPLE), Semi-supervised Support Vector Machines(S3VM). Transductive Learning via regularized least squares						

<b>Module 4</b>	Graph-Based Semi-Supervised Learning	Assignment	Programming	<b>12 Sessions</b>
Topics: Graph-Based Semi-Supervised Learning, Label propagation, Example of label propagation, Label spreading, Label propagation based on Markov random walks, Manifold Learning. Quadratic cost criterion. Regularization with graph.				
<b>List of Laboratory Tasks:</b> <b>Experiment NO 1:</b> Programming assignment for data cleaning.. <b>Level 1:</b> Programming scenarios which handles missing features, data normalization, data scaling.  <b>Level 2:</b> Programming assignment which helps in feature filtering, selection.  <b>Experiment No. 2:</b> Programming assignment for unsupervised learning  <b>Level 1:</b> Implementation of covariance rule. Implementation of rubner_tavan_network  <b>Level 2:</b> Implementation of sanger_network.  <b>Experiment No. 3:</b> Programming assignment for advanced unsupervised learning  <b>Level 1:</b> Implementation of kNN, K-means. Implementation of fuzzy cmeans.  <b>Level 2:</b> Implementation of spectral clustering.  <b>Experiment No. 4:</b> Programming assignment for supervised learning.  <b>Level 1:</b> Programming assignment on label_propagation, spreading  <b>Experiment No. 5:</b> Programming assignment for supervised learning.  <b>Level 1:</b> Implementing SVM  <b>Level 2:</b> Implementing TSVM  <b>Experiment No. 6:</b> Programming assignment for Graph-Based Supervised learning.  <b>Level 1:</b> Estimating Gaussian mixture in ICA  <b>Level 2:</b> Estimating parameter using PCA.				
<b>Targeted Application &amp; Tools that can be used:</b> <ul style="list-style-type: none"> <li>• Data Mining</li> <li>• Text Mining</li> <li>• Web Mining</li> <li>• Medical Industry</li> </ul> <b>Tools:</b> Anaconda for Python or Google Colab for Python.				
<b>Project work/Assignment: Mention the Type of Project /Assignment proposed for this course</b>				
After completion of each module a programming-based Assignment/Assessment will be conducted. A dataset will be given to the student to practice the learned algorithms On completion of Module 4, student will be asked to develop a Project for analyzing the given dataset.				
<b>Text Book</b> T1. Giuseppe Bonaccorso, “Mastering Machine Learning Algorithms”, Packt. T2. Giuseppe Bonaccorso, “Machine Learning Algorithms”, Packt.				

<b>References</b> R1. Imran Ahmed, “40 Algorithms Every Programmer Should Know”, Packt	
<b>Weblinks</b> W1. <a href="https://presiuniv.knimbus.com/user#/home">https://presiuniv.knimbus.com/user#/home</a> W2. <a href="https://www.javatpoint.com/machine-learning-algorithms">https://www.javatpoint.com/machine-learning-algorithms</a>	
Topics relevant to “SKILL DEVELOPMENT: Machine Learning, Clustering and Unsupervised, Graph-Based Semi-Supervised Learning for developing Skill Development through Experiential Learning techniques. This is attained through assessment component mentioned in course handout	
<b>Catalogue prepared by</b>	Dr. Aditya Saxsena, Ms. Galiveeti Poornima
<b>Recommended by the Board of Studies on</b>	BOS NO: 1, BOS held on 22/12/2022
<b>Date of Approval by the Academic Council</b>	Academic Council Meeting No. 20, Dated 15/02/2023

<b>Course Code:</b> <b>CSE 6001</b>	<b>Course Title: Deep Learning</b>  <b>Type of Course: Program Core Theory and Laboratory Integrated</b>		<b>L-P-C</b>	2	2	3
<b>Version No.</b>	2.0					
<b>Course Pre-requisites</b>	<ul style="list-style-type: none"><li>• Data Mining and Machine Learning fundamentals</li><li>• Basic working knowledge of Statistics and Probability</li><li>• Familiarity with programming languages and hands on coding</li></ul>					
<b>Anti-requisites</b>	NIL					
<b>Course Description</b>	The course introduces the core intuitions behind Deep Learning, an advanced branch of Machine Learning involved in the development and application of Artificial Neural Networks that function by simulating the working principle of human brain. Deep learning algorithms extract layered high-level representations of data in a way that maximizes performance on a given task. The course includes theory and lab components which emphasizes on understanding the implementation and application of deep neural networks in various prominent problem domains like speech recognition, sentiment analysis, recommendations, and computer vision etc. The course facilitates the students to interpret and appreciate the successful application of deep neural nets in various prediction and classification tasks of ML.					
<b>Course Objective</b>	The objective of the course is to familiarize the learners with the concepts of <b>Deep Learning</b> and attain <b>SKILL DEVELOPMENT</b> through <b>Experiential Learning techniques</b>					
<b>Course Out Comes</b>	On successful completion of the course the students shall be able to: CO1: Apply basic concepts of Deep Learning to develop feed forward models CO2: Apply Supervised and Unsupervised Deep Learning techniques to build effective models for prediction or classification tasks CO3: Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains of Machine Learning and Machine vision. CO4: Analyze performance of implemented Deep Neural models					
<b>Course Content:</b>						
<b>Module 1</b>	Introduction to Deep Learning	Assignment	Programming	<b>10 Sessions</b>		
<b>Topics:</b>  Machine Learning in a nutshell, Fundamentals of deep learning and neural networks, Deep Neural Network, Feedforward Neural Network, Perceptron, Activation Functions, Loss Functions, Gradient Descent, Back-propagation, Training Neural Networks Building your Deep Neural Network: Step by Step, <b>Introduction to CNN</b>						
<b>Module 2</b>	Improving Deep Neural Networks	Assignment	Programming	<b>09 Sessions</b>		
<b>Topics:</b>  Hyperparameter tuning, Initialization, Overfitting and Underfitting, Regularization and Optimization, Dropout, Batch Normalization						

<b>Module 3</b>	Deep Supervised Learning Models	Assignment	Programming	<b>10 Sessions</b>
<b>Topics:</b> Convolutional neural network with pooling flattening, Prediction of image using Convolutional Neural Networks, Deep learning in Sequential Data, RNN & LSTM, GRU,				
<b>Module 4</b>	Deep Unsupervised Learning	Assignment	Programming	<b>10 Sessions</b>
<b>Topics:</b> Basics of Deep unsupervised learning, Auto encoders, Recommender systems, computer vision				
<b>List of Laboratory Tasks:</b> <b>Experiment No. 1:</b> Programming assignment to implement a single layer feed forward neural network from scratch (Application: A basic neural network). <b>Level 1:</b> Programming scenario to implement a basic single layer feed-forward neural network perceptron. <b>Level 2:</b> Programming scenario to implement a basic single layer feed-forward neural network with a single hidden layer having ReLU activation function and sigmoid in the output layer. <b>Experiment No. 2:</b> Programming assignment to build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets. <b>Level 1:</b> Programming scenario to use the Backpropagation algorithm to build an ANN and run it on a dataset for few epochs. <b>Level 2:</b> Programming scenario to use the Backpropagation algorithm to build an ANN and run it on a dataset for few epochs and interpret the accuracy, loss and other evaluation parameters. <b>Experiment No. 3:</b> Programming assignment to build a multiple layer neural network with specific model parameters and hyperparameters on a given real life dataset. <b>Level 1:</b> Programming assignment to implement a MLP with <ul style="list-style-type: none"> <li>o possibility to use 2-4 layers</li> <li>o ReLU for the hidden layer</li> <li>o Sigmoid in the output layer</li> <li>o optimization via gradient descent (GD)</li> </ul> <b>Level 2:</b> Programming assignment to implement the neural network and add some more hyperparameters in the perceptron model <ul style="list-style-type: none"> <li>o softmax output layer</li> <li>o optimization via stochastic gradient descent (SGD)</li> <li>o Gradient checking code (!!!)</li> </ul> Generate the confusion matrix				
<b>Experiment No. 4:</b> Programming assignment to implement classification of linearly				



separable Data with a Deep neural network (Application: Binary classification).

**Level 1:** Programming scenarios to build a binary classifier with a deep ANN.

**Level 2:** Programming scenarios to build a binary classifier with a deep ANN

- o Weight initialization with random noise (!!!) (use normal distribution with changing std. deviation for now)
- o implement dropout,  $l_2$  regularization
- o implement a different optimization scheme (RPROP, RMSPROP, ADAGRAD)
- o employ batch normalization

**Experiment No. 5:** Programming assignment to implement a basic Convolution Neural Network.

**Level 1:** Programming scenarios which use the concept of convolution and pooling to implement a CNN.

**Level 2:** Programming scenarios which use the concept of convolution and pooling to implement a CNN and also specify some parameters like number of filters, length of feature detector, stride etc.

**Experiment No. 6:** Programming assignment to perform image segmentation and object detection using CNNs.

**Level 1:** Programming assignment to instantiate a CNN (that uses FullyConnectedLayers) and train the neural network using the training data from MNIST data set.

**Level 2:** Programming assignment to instantiate a CNN (that uses FullyConnectedLayers) and train the neural network using the training data from MNIST data set. Choose appropriate hyper parameters for the training of the neural network. Plot the cost versus training iterations using different mini-batch sizes: 16; 64; 256; 1024. Record the test accuracy in percentage and total training time you spent in seconds. Implement Adam Optimizer. To obtain full marks, the network should be able to achieve a test accuracy of 90% or more across many different random seeds.

**Experiment No. 7:** Programming assignment to employ CNN in image classification from given dataset.

**Level 1:** Programming scenario to instantiate a CNN (with at least one convolutional layer) and train the neural network using the training data from CIFAR10 data. Choose appropriate hyperparameters for the training of the neural network. The network should be able to achieve a test accuracy of at least 50% within 10 training epochs.

**Level 2:** Programming scenario to build a CNN (with more than one convolutional layer) and train the neural network using the training data from CIFAR10 data. Choose appropriate hyperparameters for the training of the neural network. The network should be able to achieve a test accuracy of at least 50% within 10 training epochs. Continue to train further and examine training and testing performance. Report hyperparameters (learning rate, number of hidden layers, number of nodes in each hidden layer, batch size and number of epochs) of the Deep Neural Network. Also, explain the observations.

**Experiment No. 8:** Programming assignment to perform Sentence (text) Classification using Convolutional Neural Networks.

**Level 1:** Programming Scenarios to utilize CNN to categorize text data in given datasets like SST movie reviews.

**Level 2:** Programming Scenarios to utilize CNN to categorize text data in given datasets like SST and MR movie reviews.

**Experiment No. 9:** Programming assignment to apply Recurrent Neural Networks for sentiment analysis of text data.

**Level 1:** Programming scenario to build a model to perform sentiment analysis of IMDB movie reviews using. Reviews are categorized into two polarities: positive and negative.

**Level 2:** Programming scenario to build a model to perform sentiment analysis of IMDB movie reviews. Reviews are categorized into three polarities: positive, negative and neutral.

**Experiment No. 10:** Programming assignment to create a generative model for text, character-by-character using Recurrent neural networks.

**Level 1:** Programming scenario to implement a multi-layer Recurrent Neural Network like LSTM for training/sampling from character-level language models, which takes one text file as input and trains an RNN that learns to predict the next character in a sequence. The RNN can then be used to generate text character by character that will look like the original training data.

**Level 2:** Programming scenario to implement a multi-layer Recurrent Neural Network utilizing both LSTM and GRU in turns for training/sampling from character-level language models, which takes one text file as input and trains an RNN that learns to predict the next character in a sequence. The RNN can then be used to generate text character by character that will look like the original training data. Train the model and use it to generate new text.

**Experiment No. 11:** Programming assignment to implement RNN models for multivariate time series forecasting.

**Level 1:** Programming scenario to implement a many-to-one Recurrent Neural Network for Stock Price forecasting, i.e. trained with a certain number of day's data, the model should predict the stock price of the next day.

**Level 2:** Programming scenario to implement a many-to-one Recurrent Neural Network for Stock Price forecasting, i.e. trained with a certain number of day's data, the model should predict the stock price of the next day. Students are free to use RNN, GRU, or LSTM (or compare between) and any number of layers and architecture. In the testing, plot the ground truth and your predicted values for 100 days.

**Experiment No. 12:** Programming assignment to implement Autoencoders and deep Boltzmann's machines.

**Level 1:** Programming scenario to implement a basic recommender system using deep Boltzmann's machines.

**Level 2:** Programming scenario to build a recommender system with Collaborative filtering algorithm using deep Boltzmann's machines,

**Targeted Application & Tools that can be used:**

Targeted employment sector is not restricted to any single domain. Today, ML and DI have been employed for data analysis and improved business intelligence in every sector. Targeted job profiles include Data Analyst, Data Scientist, Data Engineer, Neuroinformatician, Bioinformatician, Image Recognition, Research Analyst, Full Stack Developer for Deep Learning, Natural Language Process Engineer, Business Analyst etc. Few of the top recruiters are Amazon, NVIDIA, Microsoft, IBM, Accenture, Facebook, Intel, Samsung, Lenovo, Adobe etc., among numerous others.

**Tools:** Neural Designer, AutoML, AutoDL, Keras, TensorFlow, Torch, Google Colaboratory, Spider, Jupiter Notebook

**Project work/Assignment:**

Throughout the progression in each module, students will have to submit scenario based programming Assignments/Experiments as listed in “List of Lab Tasks”. On completion of each module, students will be asked to develop a Mini Project, similar to the following:

- **Music genre classification system**

This is one of the interesting deep learning project ideas. This is an excellent project to nurture and improve one's deep learning skills. The aim is to create a deep learning model that uses neural networks to classify the genre of music automatically. For this project, students will use an FMA (Free Music Archive) dataset. FMA is an interactive library comprising high-quality and legal audio downloads. It is an open-source and easily accessible dataset. However, it is noteworthy that before one can use the model to classify audio files by genre, he/she will have to extract the relevant information from the audio samples (like spectrograms, MFCC, etc.)

- **Image Caption generator**

This is one of the trending deep learning project ideas. This is a Python-based deep learning project that leverages Convolutional Neural Networks and LSTM (a type of Recurrent Neural Network) to build a deep learning model that can generate captions for an image. An Image caption generator combines both computer vision and natural language processing techniques to analyze and identify the context of an image and describe them accordingly in natural human languages (for example, English, Spanish, Danish, etc.). This project will strengthen one's knowledge of CNN and LSTM, and one will learn how to implement them in real-world applications as this.

- **Visual tracking system**

A visual tracking system is designed to track and locate moving object(s) in a given time frame via a camera. It is a handy tool that has numerous applications such as security and surveillance, medical imaging, augmented reality, traffic control, video editing and communication, and human-computer interaction. This system uses a deep learning algorithm to analyze sequential video frames, after which it tracks the movement of target objects between the frames. The two core components of this visual tracking system are Target representation and localization

- **Traffic Signal Classification**

The traffic sign classification project is useful for all autonomous vehicles. Machines are able to identify traffic signs from the image. Students can use the GTSRB dataset that contains 43 different traffic sign classes. This is a

good project to understand image classification.

- **Driver Drowsiness Detection**

The driver drowsiness detection is a project which can detect whether a person is sleeping or not while driving. We can implement a model for drivers and it can also prevent accidents from happening.

- **Autocolouring old Black and white images**

The idea of this project is to make a model that is capable of colorizing old black and white

images to colorful images. Digital artists take a few hours to color the image but now with

Deep Learning, it is possible to color an image within seconds.

### **Text Book**

T1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2017

### **References**

R1. Duda, R.O., Hart, P.E., and Stork, D.G. Pattern Classification. Wiley-Interscience, 2nd Edition. 2013

R2. Theodoridis, S. and Koutroumbas, K. Pattern Recognition. Edition 4, Academic Press, 2015

R3. Russell, S. and Norvig, N. Artificial Intelligence: A Modern Approach. Prentice Hall Series in Artificial Intelligence, 2013

R4. Bishop, C. M. Neural Networks for Pattern Recognition, Oxford University Press, 2008.

### **Weblinks**

W1. <https://presiuniv.knimbus.com/user#/home>

W2. <https://www.ibm.com/in-en/topics/deep-learning#:~:text=Deep%20learning%20is%20a%20subset,from%20large%20amounts%20of%20data.>

**Topics relevant to development of "SKILL DEVELOPMENT":** Real time Data Analysis using Deep learning. for developing **SKILL DEVELOPMENT** through **Experiential Learning** techniques. This is attained through assessment component mentioned in course handout

### **Catalogue prepared by**

Prof.Tapas Guha, Prof.Nappa Lakshmi

### **Recommended by the Board of Studies on**

BOS NO: 1, BOS held on 22/12/2022

### **Date of Approval by the Academic Council**

Academic Council Meeting No. 20, Dated 15/02/2023

<b>Course Code:</b> CSE 6002	<b>Course Title:</b> Natural Language Processing			2	2	3
	<b>Type of Course:</b> Program Core Theory and Laboratory Integrated Course		L- P- C			
<b>Version No.</b>	2.0					
<b>Course Pre-requisites</b>	[1] Basic Algebra [2] Probability [3] Deep learning Familiarity with basics of probability and statistics, and linear algebra would be essential. Prior exposure to Deep learning techniques would be desirable.					
<b>Anti-requisites</b>	NIL					
<b>Course Description</b>	This course introduces a basics of Natural Language Processing methods with specific emphasis on modern applications. The course will cover pre-processing techniques of textual data like stemming, lemmatization, tokenization etc. Different word Vectorization Techniques like Bag of Words, TF-IDF etc. followed by basics of Probability for building language models. Basics of Neural Network, LSTM Recurrent Neural Network, Applications of NLP like Information Extraction, Emotion Extraction from text, sentiment analysis etc.					
<b>Course Objective</b>	The objective of the course is to familiarize the learners with the concepts of <b>Natural Language Processing</b> and attain <b>SKILL DEVELOPMENT</b> through <b>Experiential Learning</b> techniques					
<b>Course Outcomes</b>	<b>On successful completion of this course the students shall be able to:</b> CO1: Understanding the fundamentals of NLP techniques. CO2: Apply Language modelling techniques for predictions. CO3: Apply Deep learning Techniques to build NLP Model CO4: Outline the application of NLP Techniques.					
<b>Course Content:</b>						
<b>Module 1</b>	pre-processing techniques	Assignment	Apply all the pre-processing techniques to the corpus of your choice.	14 Sessions		
Topics: Introduction to Natural Language Processing, terminologies, empirical rules, why NLP is hard, why NLP is useful, Natural Language generation, NLP Processing pipeline, Corpus Cleaning techniques – word tokenization, sentence tokenization, word frequency distribution, stemming, lemmatization, dictionary, Part of Speech Tagging, optical character recognition, Textual Pre-Processing techniques – Stop words removal, regular expression, lower case, text standardization. Punctuation Mark Removal.						
<b>Module 2</b>	Language Model	Assignment	Build n-gram language model for future word predictions.	11 Sessions		
Topics: Word Embeddings techniques- bag of words, Tf-IDF, Word2Vec and optimization. Hidden Markov Models Simple N-gram models. Estimating parameters and smoothing. Negative Sampling Evaluating language models. (Forward and Viterbi algorithms and EM training), Maximum Entropy Models, N-gram and unigram.						
<b>Module 3</b>	Deep Learning techniques for NLP models	Assignment	Build model for spam detection using mail subject as Corpus	11 Sessions		
Topics:						

<b>Introduction to Neural Network, Perceptron, back Propagation, Recurrent Neural network, LSTM, Attention Models, BERT (Bidirectional Encoder Representation from Transformer), Reformer, speech recognition, Document summarization</b>				
<b>Module 4</b>	<b>Application of NLP</b>	<b>Assignment</b>	<b>Paper Review of State-of-the-Art NLP Technique</b>	<b>11 Sessions</b>
<b>Topics:</b> Application of NLP- Lexical semantics and word-sense disambiguation. Named entity recognition and relation extraction. IE using sequence labeling, Emotion Extraction. tExt Summarization.				
<b>Targeted Application &amp; Tools that can be used:</b>  1. Application Area Sentiment Analysis , Text Classification , Chatbots & Virtual Assistants , Text Extraction , Machine Translation , Text Summarization , Market Intelligence , Auto-Correct , Intent Classification , Urgency Detection , Speech Recognition  <b>Professionally Used Software:</b> Anaconda Navigator, Python Packages, NLP toolkit <b>List of Laboratory Task</b>  1. Experiment No. 1: Apply all preprocessing technique to corpus of choice and plot word frequency. 2. Experiment No. 2: Word Embedding using Bag of words 3. Experiment No. 3: Word Embedding using TF-IDF 4. Experiment No. 4: Word Embedding using Word2Vec Continuous Bag of words 5. Experiment No. 5: Word Embedding using Word2Vec Skip gram Model 6. Experiment No. 6: Build language Model using n- gram. 7. Experiment No. 7: Build NLP model using LSTM 8. Experiment No. 8: Build NLP model using BERT 9. Experiment No. 9: Build NLP model using Reformer to show optimization.				
<b>Project work/Assignment:</b> <b>Project Assignment: NIL</b>  <b>Assignment 1: Paper Review of the state of the art NLP Technique</b>				
<b>Text Books</b> T1. Daniel Jurafsky, James H. Martin Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2014. T2. Steven Bird, Ewan Klein and Edward Loper, Natural Language Processing with Pythonll, First Edition, OReilly Media, 2009.				
<b>References</b>  R1. Breck Baldwin, Language Processing with Java and LingPipe Cookbook, Atlantic Publisher, 2015. R2. Richard M Reese, Natural Language Processing with Javall, OReilly Media, 2015. R3. Nitin Indurkha and Fred J. Damerau, Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010. R4. Tanveer Siddiqui, U.S. Tiwary, Natural Language Processing and Information Retrieval, Oxford University Press, 2008.				

<b>Weblinks</b> W1. <a href="https://presiuniv.knimbus.com/user#/home">https://presiuniv.knimbus.com/user#/home</a> W2. <a href="https://www.ibm.com/in-en/topics/natural-language-processing">https://www.ibm.com/in-en/topics/natural-language-processing</a>	
<b>Topics relevant to development of “SKILL DEVELOPMENT”:</b> Information retrieval of Search Engines Information Retrieval. for developing <b>SKILL DEVELOPMENT</b> through <b>Experiential Learning techniques</b> . This is attained through assessment component mentioned in course handout.	
<b>Catalogue prepared by</b>	Ms. Mitali Halder
<b>Recommended by the Board of Studies on</b>	BOS NO: 1, BOS held on 22/12/2022
<b>Date of Approval by the Academic Council</b>	Academic Council Meeting No. 20, Dated 15/02/2023

[Text Wrapping Break]



<b>Course Code:</b> CSE 5009	<b>Course Title:</b> Data Analytics and Visualization			L-P-C	2	2	3
<b>Type of Course:</b> Program Core Theory and Laboratory Integrated Course							
<b>Version No.</b>	2.0						
<b>Course Pre-requisites</b>	Mathematical background in calculus, linear algebra, and probability & statistics, Programming in Python / R						
<b>Anti-requisites</b>	NIL						
<b>Course Description</b>	The Course consists of two parts where first Part covers advanced analytics that covers topics necessary to give businesses greater insight into their data than they could ordinarily, and the Second Part covers data visualization concepts. Primary concepts include machine learning, data mining, predictive analytics, location analytics, big data analytics, and location intelligence. Visualization for Time series, Geolocated data, Correlations, connections, Hierarchies, networks, and interactivity.						
<b>Course Objective</b>	The objective of the course is to familiarize the learners with the concepts of <b>Data Analytics and Visualization</b> and attain <b>EMPLOYABILITY SKILLS</b> through <b>PARTICIPATIVE LEARNING techniques</b>						
<b>Course Out Comes</b>	On successful completion of the course the students shall be able to: CO1: Analyze data by performing Exploratory Data Analysis. CO2: Apply techniques of Machine Learning to build Generalized Predictive Models. CO3: Explain basic concepts of Data Visualization. CO4: Apply principles of Data Visualizations to provide insights from data.						
<b>Course Content:</b>							
<b>Module 1</b>	Data Analytics	Assignment	Analysis, Data Collection	<b>11 Sessions</b>			
<b>Topics:</b> Characteristics and types of data, Types of Analytics, Location Analytics, Working with Geospatial Data, Feature Engineering and Selection, Dimensionality Reduction Techniques, <b>Common challenges faced during analysis</b>							
<b>Module 2</b>	Advanced Analytics	Case Study	Analysis, Data Collection, Programming	<b>13 Sessions</b>			
<b>Topics:</b> Statistical methods for Data Analytics, Advance topics in Supervised and Unsupervised Machine Learning: Cluster Analysis, Hyper-Parameter Tuning, Measuring Performance of the Models, Model Selection, Data Mining techniques.							
<b>Module 3</b>	Introduction to Data Visualization	Assignment	Analysis, Data Collection	<b>9 Sessions</b>			
<b>Topics:</b> <b>Importance of analysis and visualization in the era of data abundance</b> , Fundamentals of Data Visualization, Human Perception, Basic plotting techniques, Interaction concepts, Visualization techniques for Time Oriented data, Introduction to Data Visualization Tools							
<b>Module 4</b>	Application - Data Visualization	Case Study	Analysis, Data Collection, Programming	<b>14 Sessions</b>			
<b>Topics:</b> Designing effective Visualizations, Advanced Visualization Tools, Visualizing Geospatial Data, Document Visualization, Visualization Systems, Evaluating Visualizations, Visualization Benchmarking. <b>Use cases of data visualization.</b>							



### List of Laboratory Tasks:

#### Experiment No 1: Exploratory Data analysis

**Level 1:** Demonstration of Tools to implement EDA

**Level 2:** Use the Dataset to analyze and summarize data, analyze anomalies, analyze Outliers, and Missing Value Treatment

#### Experiment No. 2: Dimensionality Reduction Techniques

**Level 1:** Implement DR Technique(s)

#### Experiment No. 3: Machine Learning Methods

**Level 1:** Implement Supervised Learning Techniques for the given dataset

**Level 2:** Implement Un-Supervised Learning Techniques for the given dataset and Cluster Analysis

#### Experiment No. 4: Measure the Performance of the Models

**Level 1:** Perform Model Selection

**Level 2:** Regularize the model

#### Experiment No. 5: Introduction to Data Visualization Tools

**Level 1:** Implement Basic plotting techniques

#### Experiment No. 6: Time Oriented data

**Level 1:** Visualization techniques for Time Oriented data

#### Experiment No. 7: Trees, Graphs, Networks

**Level 1:** Visualization techniques for Trees, Graphs, Networks

#### Experiment No. 8: Advanced Visualization Tools

**Level 1:** Design effective Visualizations for the given scenario

**Level 2:** Implement Visualizing of Geospatial Data and Document Visualization

#### Experiment No. 9: Analyze Visualization Systems

**Level 1:** Analyze Visualization Systems

### Targeted Application & Tools that can be used:

Data visualization is the graphical representation of information and data. By using visual elements like charts, graphs, and maps, data visualization tools provide an accessible way to see and understand trends, outliers, and patterns in data. In the world of Big Data, data visualization tools and technologies are essential to analyze massive amounts of information and make data-driven decisions.

#### Tools:

1. R Programming
2. Python
3. Tableau
4. SAS

5. Excel
6. RapidMiner
7. IBM Cognos Analytics
8. Microsoft Power BI

### Project work:

After completion of each module a Data analysis or programming based Assignment/Assessment will be conducted.

### Mini Project:

Perform exploratory data analysis on a given dataset and provide insights on the same.

1. **Crunchbase** – Find business information about private and public companies. You can look up how many investments they had, who the founding members are, and if they had any mergers or acquisitions.
2. **Glassdoor Research** – Glassdoor offers data related to employment. You can, for example, figure out how much you can save by retaining employees.
3. **Open Corporates** – Open Corporates is the largest open database of companies and company data in the world. Used by banks and governments, they pride themselves on having the most accurate data.
4. **FBI Uniform Crime Reporting** – The Uniform Crime Reporting compiles statistical crime reports, publications, and data points from thousands of cities, universities, states, and federal law enforcement agencies.
5. **Uppsala Conflict Data Program** – The Uppsala Conflict Data Program (UCDP) provides data on organized crime and civil war around the world.
6. **National Institute on Drug Abuse** – The National Institute on Drug Abuse (NIDA) monitors the prevalence and trends regarding drug abuse in the United States.
7. **DBpedia** – DBpedia aims to make Wikipedia's information easily searchable via SPARQL queries or by downloading their information directly. For instance, you can search for NBA players born in the 80s, in cities with more than 1M inhabitants.
8. **Google Trends** – Google Trends allows you to look at what's going on in the world. It gives you data about what's becoming popular, and how much people are searching for a particular term.
9. **Instagram API** – Facebook allows you to use Instagram's API to quickly access comments, metadata, and metrics.
10. **Comtrade** – Official trade in goods and services data sets managed by the UN COMTRADE database. There are data visualization tools and an API and other extraction tools available.
11. **Datahub – Stock Market** – From gold prices, NASDAQ listings, to S&P 500 companies, you'll find it all on datahub.io
12. **Global Financial Data** – Global Financial Data gives you exactly what it says on the tin; data about the finances of the world. Ranges from real estate, global macro data, to market data.
13. **IMF Data** – The IMF, or International Monetary Fund, is an organization that aims to foster monetary collaboration between countries. You can find data on trade, government finance, and financial development.
14. **The Atlas of Economic Complexity** – The Atlas of Economic Complexity provides data about global trade dynamics over time. Want to know the quantity of textiles China exported to South Korea? Easy.
15. **World Bank** – Not only does the World Bank provide financial data about countries, but it also provides data on education and health.
16. **Financial Times Data** – Here you'll find cold, hard numbers about the different markets in the world. Data include fluctuations in currency, yield rates of bonds, and commodity prices.

### Text Book

- T1. Wilke, Claus O. Fundamentals of data visualization: a primer on making informative and compelling figures. O'Reilly Media, 2019.
- T2. Ward, Grinsten, Keim. Interactive Data Visualization: Foundations, Techniques, and Applications, A K

### References

R1. Mohammed J. Zaki, and Wagner Meira Jr., "Data Mining and Analysis: Fundamental Concepts and Algorithms", Cambridge University Press, 2016

R2. I.H. Witten and E. Frank, Data Mining: Practical Machine learning tools and techniques Morgan Kaufmann publishers; 3<sup>rd</sup> Edition, 2011

### Weblinks

W1. <https://presiuniv.knimbus.com/user#/home>

W2. <https://www.geeksforgeeks.org/short-note-on-data-visualization/>

**Topics relevant to "EMPLOYABILITY SKILLS":** Real time decision-making application development using Data visualization tools for **EMPLOYABILITY SKILLS** through **Participative Learning** techniques. This is attained through assessment component mentioned in course handout.

<b>Catalogue prepared by</b>	Dr.S.Thiruselvan
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<b>Recommended by the Board of Studies on</b>	BOS NO: SoCSE01, BOS held on 22/12/2022
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<b>Date of Approval by the Academic Council</b>	Academic Council Meeting No. 20, Dated 15/02/2023
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<b>Course Code:</b> CSE 5010	<b>Course Title:</b> Robotic Process Automation			<b>L- P- C</b>	3	0	3
	<b>Type of Course:</b> Discipline Elective Theory only						
<b>Version No.</b>	2.0						
<b>Course Pre-requisites</b>	Basic knowledge of computer and internet, Basic programming skill, Logical Thinking.						
<b>Anti-requisites</b>	NIL						
<b>Course Description</b>	The purpose of this course is to enable the students to appreciate the need for Robotic Process Automation and the course offers comprehensive knowledge and professional-level skills focused on developing and deploying software robots using UiPath Platforms. The course is both conceptual and Practical in nature and needs basic knowledge of Computer Programming. The course assumes no prior knowledge of RPA. It begins by refreshing basic programming skills and introducing basic RPA concepts. The course develops skills to identify task which can be automated and develop it with UiPath Studio. The course also enhances the programming abilities through assignments.						
<b>Course Objective</b>	The objective of the course is to familiarize the learners with the concepts of <b>Robotic Process Automation</b> and attain <b>EMPLOYABILITY SKILLS</b> through <b>PARTICIPATIVE LEARNING techniques</b>						
<b>Course Outcomes</b>	On successful completion of the course, the students shall be able to: CO1.Explain the concept of automation. CO2.Describe various programming constructs in RPA. <b>CO3.Identify and understand different simulation drive robots.</b> CO4.Apply automation to various concepts related to AI and ML algorithms.						
<b>Course Content:</b>							
<b>Module 1</b>	Introduction to Programming Concepts and RPA Basics	Assignment	Data Analysis	<b>10 Sessions</b>			
<b>Topics:</b> <b>Programming Concepts Basics-1:</b> Software applications, Introduction to Programming, Data and data structure, Algorithms, Sequence, and Flow, and Software Development Guidelines. <b>Programming Concepts Basics-2:</b> Compiler and execution, Scripting and Macro, Frameworks and Languages, Information Sharing Mechanism, Variables and Arguments, Files and File Types, Access Control. <b>RPA Basics:</b> Automation and RPA, Programming Constructs in RPA, Robots in RPA, RPA in Business and Technology.							
<b>Module 2</b>	RPA Advanced Concepts	Assignment	Build own bots	<b>10 Sessions</b>			
<b>Topics:</b> <b>RPA Advanced Concepts:</b> Setting up the Center of Excellence, RPA Project Methodology, The RPA Journey, RPA in the Emerging Ecosystem. <b>Introduction to UiPath:</b> The Basics of UiPath Studio Installation, The User Interface, the various steps involved in the automation projects, The installation of UiPath extensions. <b>Variables:</b> Variables, Types of Variables, Variables in UiPath, Arguments, Namespaces. <b>Control Flow:</b> Control Flow & Universal Statements, Control Flow Statements in UiPath, Practical Exercise							
<b>Module 3</b>	Simulation of differential drive robots	Assignment	Differential robots	<b>10 Sessions</b>			
Introduction to Gazebo, Installation, Testing Gazebo with ROS interface, Simulation of differential drive robot using ROS technical requirements: Getting Started with Gazebo							

Simulator, Working with TurtleBot2 simulation, Creating a simulation of Chefbot.				
Module 4	Advanced Automation and Orchestrator	Case Study	Data Collection and Team Project	10 Sessions
<b>Topics:</b> <b>Email Automation:</b> Introduction to Email Automation, Email Automation in UiPath Studio, Practice retrieving and sending emails <b>Debugging and Exception Handling:</b> Exception Handling, Debugging Tools, Workflow Designs, Catching errors <b>Project Organization:</b> Project Organization, Process, Library, Robotic Enterprise Framework <b>Orchestrator:</b> Introduction to Orchestrator, Processes, Robots in Orchestrator, Working with Orchestrator <b>Future Trends:</b> Artificial Intelligence, Autonomous things, Digital Assistant, Computing				
<b>Targeted Application &amp; Tools that can be used:</b>  Targeted employment sector is service provider and control monitor like GE, Siemens, TCS etc. Targeted job profiles include digital domain and Service based industry etc.				
<b>Tools:</b> <ul style="list-style-type: none"> <li>UiPath Studio/StudioX</li> </ul>				
<b>Project work:</b>				
Project 1: Sales order entry Robot Project 2: E-Mail auto responder Robot Project 3: Disk Monitoring Robot				
<b>Text Book</b> T1. "Robotic Process Automation using UiPath StudioX", Adeel Javed, Anum Sundrani, Nadia Malik, Sidney Madison Prescott, Apress, 2021				
<b>References</b> R1. "Learning Robotic Process Automation", Alok Mani Tripathi, Packetz, 2018. R2. <a href="https://academy.uipath.com/">https:// academy.uipath.com/</a>				
<b>Weblinks</b> W1. <a href="https://presiuniv.knimbus.com/user#/home">https://presiuniv.knimbus.com/user#/home</a> W2. <a href="https://www.geeksforgeeks.org/robotics-introduction/">https://www.geeksforgeeks.org/robotics-introduction/</a> .				
<b>Topics relevant to development of "EMPLOYABILITY SKILLS":</b> Get introduced to RPA Studio and RPA developer Tools for developing <b>Employability Skills</b> through <b>Participative Learning</b> techniques. This is attained through assessment component mentioned in course handout.				
<b>Catalogue prepared by</b>	Prof. Raghavendra T S Prof. Kukkala Prudhvi Raj			
<b>Recommended by the Board of Studies on</b>	BOS NO: 1, BOS held on 22/12/2022			
<b>Date of Approval by the Academic Council</b>	Academic Council Meeting No. 20, Dated 15/02/2023			

<b>Course Code:</b> CSE 5011	<b>Course Title:</b> Data Science with Cloud Computing			<b>L- P- C</b>	3	0	3
	<b>Type of Course:</b> Discipline Elective Theory Only						
<b>Version No.</b>	2.0						
<b>Course Pre-requisites</b>	Having familiarity with the Basic concepts of Mathematics(Linear Algebra, Calculus) and Statistics (Descriptive Statistics, Inferential Statistics), Programming Knowledge(R, Python, Excel)						
<b>Anti-requisites</b>	NIL						
<b>Course Description</b>	This course introduces a new Transformative, more collaborative way of doing Data Science. It helps in understanding End to End Data pipelines, Ingesting Data in a serverless way and working our way through Data Exploration, Dashboards, and Streaming Data all the way to training and making an operational Machine Learning Model.						
<b>Course Objective</b>	The objective of the course is to familiarize the learners with the concepts of <b>Data Science with Cloud Computing</b> and attain <b>EMPLOYABILITY SKILLS</b> through <b>PARTICIPATIVE LEARNING</b> techniques						
<b>Course Outcomes</b>	On successful completion of the course the students shall be able to: CO1.Define Data Science and its fundamentals and the process in Data Science. CO2.Explain the process of Ingesting Data into the Cloud Platform. CO3.Analyze real-world problems with Accuracy. CO4.Demonstrate the overall organization of Data and Storage.						
<b>Course Content:</b>							
<b>Module 1</b>	<b>Making Better Decisions Based on Data</b>	<b>Assignment</b>	<b>Case Study</b>	<b>10 Sessions</b>			
<b>Topics:</b> Many Similar Decisions, Role of Data Engineers, The Cloud Makes Data Engineers Possible, <b>The NaN value, Series CRUD, Series Indexing,</b> The Cloud Turbocharges Data science, Airline on Time Performance Data, Scheduling Monthly Downloads.							
<b>Module 2</b>	<b>Creating Compelling Dashboards</b>	<b>Assignment</b>	<b>Case Study</b>	<b>10 Sessions</b>			
Topics: Explain your Model with Dashboards, Loading Data into google Cloud SQL, Creating Google cloud Instance, Interacting with Google cloud Platform, <b>Maximum Likelihood Estimation (MLE)</b>							
<b>Module 3</b>	<b>Streaming Data: Publication and Ingest</b>	<b>Assignment</b>	<b>Case Study</b>	<b>10 Sessions</b>			
<b>Topics:</b> Designing the Event Feed, Time Correction, Apache Beam/Cloud Dataflow, Publishing an Event Stream to Cloud Pub/Sub, Real Time Stream processing, Interactive Data Exploration, Exploratory Data Analysis, Loading Flights Data into Big Query, Arrival Delay conditioned on Departure Delay, Evaluating the Model. <b>Time Series Analysis</b>							
<b>Module 4</b>	<b>Cloud Dataproc</b>	<b>Assignment</b>	<b>Case Study</b>	<b>10 Sessions</b>			

<b>Topics:</b> Bayes Classifier on Cloud Dataproc, Map Reduce and Hadoop Eco System, Quantization using Spark SQL, Bayes Classification using Pig	
<b>Targeted Applications &amp; Tools that can be used:</b>  Targeted Industries like Banking, Transport, e-commerce, healthcare and many more are using data science to make optimal Decisions. The usage of data science helps in rising sales. It can explore historic data, make comparisons and analyses of the market and provide recommendations. Target Jobs Data Scientist, Data Architect, Data Engineer, Statistician. <b>Tools:</b> <ul style="list-style-type: none"> <li>• Apache Spark</li> <li>• Jupyter</li> <li>• Weka</li> </ul>	
<b>Project work/Assignment:</b>	
<b>Mini Project:</b>  <b>Walmart Sales Forecasting in Cloud</b> <ul style="list-style-type: none"> <li>• Predict the sales across various departments in each store.</li> <li>• Predict the effect of markdowns on the sales during the holiday seasons.</li> </ul> <b>Term Assignments:</b>  Consider a Dataset on Bird communities that needs to be analyzed. The data has three columns, a date, a common name, and a count of the number of individuals. <ul style="list-style-type: none"> <li>• Count the total number of individuals of each species that were seen in each data file.</li> <li>• Sort based on the total number of individuals.</li> </ul>	
<b>Text Book</b> T1. “Data Science on the Google Cloud Platform: Implementing End-to-End Real-Time Data Pipelines: From Ingest to Machine Learning”-Valiappa Lakshmanan,1 <sup>st</sup> Edition, January 2018. T2. “Data Analysis in The Cloud”- Domenico Talia ,1 <sup>st</sup> Edition, September 2015	
<b>References</b> R1. Doing Data Science, Straight Talk from the Frontline. O’Reilly. 2014.	
<b>Weblinks</b> W1. <a href="https://presiuniv.knimbus.com/user#/home">https://presiuniv.knimbus.com/user#/home</a> W2. <a href="https://www.geeksforgeeks.org/why-cloud-computing-is-important-in-data-science/">https://www.geeksforgeeks.org/why-cloud-computing-is-important-in-data-science/</a>	
<b>Topics relevant to “ EMPLOYABILITY SKILLS ”:</b> Data Extraction, Data wrangling for developing <b>Employability Skills</b> through <b>Participative Learning techniques</b> . This is attained through assessment component as mentioned in course handout.	
<b>Catalogue prepared by</b>	Mrs Sridevi S Mrs Anitha Prem Kumar
<b>Recommended by the Board of Studies on</b>	BOS NO: SoCSE1, BOS held on 22/12/2022

<b>Date of Approval by the Academic Council</b>	Academic Council Meeting No. 20, Dated 15/02/2023
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<b>Course Code:</b> CSE 5012	<b>Course Title: Artificial Intelligence in Cloud Computing</b>  <b>Type of Course: Discipline Elective Theory Only</b>			<b>L- P- C</b>	3	0	3
<b>Version No.</b>	2.0						
<b>Course Pre-requisites</b>	<ul style="list-style-type: none"><li>• Probability and Statistics</li><li>• Knowledge on programming language</li><li>• Familiarity with Fundamentals of AI and Cloud Computing</li></ul>						
<b>Anti-requisites</b>	NIL						
<b>Course Description</b>	This Course is designed to acquire the ability to deliver intelligent solutions to problems in a variety of domains and business applications such as natural language processing, text mining, robotics, reasoning and problem-solving in AI. The inclusion of AI in the cloud can lead to a more effective synthesis of data systems for identifying valuable information. This information can then be applied practically in business operations. AI in cloud computing can provide users with seamless data access. AI uses data to get things done, which makes it well-suited to cloud environments as they can hold large amounts of data. Topics Includes: AI Cloud Services, Applications of AI, AI Chatbots , Types of Chatbots, Applications of Chatbot, Cloud platforms –Google cloud, Microsoft Azure, AWS, Developing AI Application using AWS sage maker						
<b>Course Objective</b>	The objective of the course is to familiarize the learners with the concepts of <b>Artificial Intelligence in Cloud Computing</b> and attain <b>EMPLOYABILITY SKILLS</b> through <b>PARTICIPATIVE LEARNING</b> techniques						
<b>Course Outcomes</b>	On successful completion of the course the students shall be able to: CO1. Gain the knowledge on AI Cloud services. CO2. Understand the various applications of AI CO3. Explain the factors that lead to the growing popularity of chatbots. CO4. Develop the cloud AI application using AWS Sage Maker						
<b>Course Content:</b>							
<b>Module 1</b>	AI Cloud Services	Assignment	Cloud API	<b>10 Sessions</b>			
Topics: Introduction to AI cloud, <b>The AI Hub</b> , <b>AI platform</b> , <b>AI building blocks</b> , why AI cloud, Technologies that support AI platform for business like IBM Watson, Microsoft Cognitive Services or Natural Language application programming interfaces allow abstract complex AI capabilities via simple API calls.							
<b>Module 2</b>	AI applications	Use case study	Speech Recognition	<b>10 Sessions</b>			
Topics: Language Models – Information Retrieval- Information Extraction – Machine Translation – Speech Recognition - <b>Image Analysis and Recognition on the Cloud</b> – Robot – Hardware –Perception – Planning – Moving							
<b>Module 3</b>	AI chatbot	Assignment	Applications of chatbots	<b>8 Sessions</b>			
Topics: Explaining what a chatbot is, Describe common applications of chatbots, Identifying							

factors that drive the growing popularity of chatbots, two main systems in use that bots use to recognize intent and extract entities, Designing a chatbot conversation, Building Chatbots with Python, Developing Goal-Oriented Chatbots with Dialogflow, Building Text Transformers, Training Conversational Chatbots.

<b>Module 4</b>	Cloud-native AI application development	use case study	Create and deploy AI Application using AWS cloud platform	<b>10 Sessions</b>
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Topics: MLOps: Train, test, and deploy Deep Learning models using containers on a cloud server  
 - Hands-on end-to-end cloud AI applications development and deployment using AWS Sage Maker, Training the AI Fashionista to Discern Fashions, Improving Fashionista AI 2.0 - Hands-on AI application development with APIs provided by the main cloud platforms, Object Detection and the Object Detection Hub API

#### Targeted Application & Tools that can be used:

- Google Vertex AI is an integrated suite of machine learning tools and services for building and using ML models with AutoML or custom code. It offers both novices and experts the best workbench for the entire machine learning development lifecycle.

#### Project work:

##### Mini Project: Build a dynamic mobile chatbot powered with AI

1. Create Watson services with IBM Cloud.
2. Update the details in the back-end application.
3. Deploy the back-end application.
4. Set up IBM Cloud Functions.
5. Set up Watson Assistant.
6. Set up IBM Mobile Foundation Server and CLI.
7. Set up Google Cloud Anchors.
8. Configure the Android mobile app.
9. Build and run the Android mobile app.

#### Text Book

T1. Micheal Lanham “Practical AI on the Google Cloud Platform”, O’Reilly Media, 2020

E.Book-[Practical AI on the Google Cloud Platform \(21h.io\)](https://21h.io)

2. Anand Deshpande, Manish Kumar, Vikram Chaudhari , “Hands-On Artificial Intelligence on Google Cloud Platform: Build intelligent applications powered by TensorFlow, Cloud AutoML, BigQuery, and Dialogflow” , Kindle Edition, 2020

#### References

R1. “Cloud Computing: Principles and Paradigms” by Rajkumar Buyya (Editor), James Broberg (Editor), Andrzej M. Goscinski (Editor), WILEY, First Edition, March 29, 2011

R2. Deepak Khemani “Artificial Intelligence”, Tata Mc Graw Hill Education 2013.

R3. Stuart Russel and Peter Norvig “AI – A Modern Approach”, 2nd Edition, Pearson Education 2007.

#### Weblinks

W1.<https://presiuniv.knimbus.com/user#/home>.

W2.<https://www.geeksforgeeks.org/cloud-computing/>.

**Topics relevant to development of “ EMPLOYABILITY SKILLS ”:** Data Scientist using the

Cloud - Data Scientists have to work with a variety of data (structured, semi-structured, unstructured), analytics tools, and programming languages by leveraging the cloud platform for developing <b>Employability Skills</b> through <b>Participative Learning</b> techniques. This is attained through assessment component mentioned in course handout	
<b>Catalogue prepared by</b>	Mrs. Anitha Premkumar & Mrs. Sridevi
<b>Recommended by the Board of Studies on</b>	BOS NO: 1, BOS held on 22/12/2022
<b>Date of Approval by the Academic Council</b>	Academic Council Meeting No. 20, Dated 15/02/2023

<b>Course Code:</b> CSE 5013	<b>Course Title:</b> Soft Computing			<b>L- P- C</b>	3	0	3
	<b>Type of Course:</b> Discipline Elective Theory Only						
<b>Version No.</b>	2.0						
<b>Course Pre-requisites</b>	Calculus, Probability, Linear Algebra and Basic Programming Skills						
<b>Anti-requisites</b>	NIL						
<b>Course Description</b>	Soft computing is an emerging approach in computing that mimics the human mind's remarkable ability to reason and learn in an environment of uncertainty and imprecision. Soft computing is based on biologically inspired methodologies such as genetics, evolution, ant behaviors, particle swarming, human nervous systems, etc. Soft computing is the only solution when we don't have any mathematical modeling of problem-solving (i.e., algorithm), needs a solution to a complex problem in real-time, and easily adapts with changing scenarios and is implemented with parallel computing. It has enormous applications in many application areas such as medical diagnosis, computer vision, handwritten character reconditions, pattern recognition, machine intelligence, weather forecasting, network optimization, VLSI design, etc.						
<b>Course Objective</b>	The objective of the course is to familiarize the learners with the concepts of <b>Soft Computing</b> and attain <b>EMPLOYABILITY SKILLS</b> through <b>Problem Solving Methodologies</b> .						
<b>Course Outcomes</b>	On successful completion of the course the students shall be able to: CO1: Define the concept and applications of Soft Computing. CO2: Discuss Fuzzy logic concepts and its applications. CO3: Demonstrate Artificial Neural Networks concepts and its applications. CO4: Apply Evolutionary algorithms and hybrid soft computing techniques.						
<b>Course Content:</b>							
<b>Module 1</b>	Introduction Soft Computing	Assignment	Analysis	<b>9 Sessions</b>			
<b>Topics:</b> Introduction to Soft Computing: Concept of computing systems, "Soft" computing versus "Hard" computing, Characteristics of Soft computing, Applications of Soft computing techniques, <b>Elements of soft Computing</b> .							
<b>Module 2</b>	Fuzzy Logic	Assignment	Analysis, Data Collection	<b>12 Sessions</b>			
<b>Topics:</b> Fuzzy Logic: Introduction to Fuzzy logic. Fuzzy sets and membership functions. Operations on Fuzzy sets. Fuzzy relations, rules, propositions, implications and inferences. Defuzzification techniques. Fuzzy logic controller design, <b>Predicate logic, Fuzzy decision making</b> .							
<b>Module 3</b>	Neural Networks	Case Study	Analysis, Data Collection	<b>10 Sessions</b>			
<b>Topics:</b> Neural Network: Neural Networks, Supervised and Unsupervised Learning. Single Layer Perceptron, Multilayer Perceptron, Backpropagation Learning, <b>Network rules and various learning activation functions, Introduction to Associative memory, Adaptive resonance theory and self-organizing map, Recent Applications</b> . Neural Networks as Associative Memories: Hopfield Networks, Bidirectional Associative Memory. Topologically Organized Neural Networks: Competitive Learning, Kohonen Maps.							

<b>Module 4</b>	Evolutionary Computing	Assignment	Analysis, Collection	Data	<b>10 Sessions</b>
<b>Topics:</b> Evolutionary Computing: "History of Genetic Algorithm and Optimization working principle, The Schema Theorem, GA operators: Encoding, Crossover, Selection, Mutation, bit wise operation in GA etc. Introduction to ant colony optimization and particle swarm optimization. Integration of genetic algorithm with neural network and fuzzy logic.					
<b>Targeted Application &amp; Tools that can be used:</b>  In recent times, engineers have very well accepted soft computing tools such as Fuzzy Computing, ANN, Neuro-Computing and Evolutionary Computing, etc., for carrying out various numerical simulation studies. In the last two decades, these tools independently and in hybrid forms have been successfully applied to varieties of problems. The main objective is to introduce students to the latest soft computing tools. The training of these tools will be helpful to develop rigorous applications in the engineering domain.					
<b>Tools:</b> <ul style="list-style-type: none"> <li>• MATLAB</li> <li>• PYTHON</li> <li>• C</li> </ul>					
<b>Project work/Assignment:</b>					
<b>Mini Project:</b> <ul style="list-style-type: none"> <li>• Training of known/classified datasets representing some objects/pattern using various ANN learning methods including Perceptron, BPN, Adaline, Associative memory networks, Hopfield, kohonen networks.</li> <li>• Classification of new input feature set/pattern based on training &amp; learning</li> <li>• Applying GA search to optimize the solutions. Implementation of the GA procedure.</li> </ul>					
<b>Text Book</b> T1. Principles of Soft computing, Shivanandam, Deepa S. N Wiley India, 3 <sup>rd</sup> Edition 2019 T2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", Third Edition, Wiley.					
<b>References</b> R1. Kumar S., "Neural Networks - A Classroom Approach", Tata McGraw Hill, 2 <sup>nd</sup> Edition 2017. R2. Eiben A. E. and Smith J. E., "Introduction to Evolutionary Computing", Second Edition, Springer, Natural Computing Series, 2 <sup>nd</sup> Edition, 2015. R3. Fakhreddine O. Karray, and Clarence W. De Silva. Soft computing and intelligent systems design: theory, tools, and applications. Pearson Education, 2009.					
<b>Weblinks</b> W1. <a href="https://presiuniv.knimbus.com/user#/home">https://presiuniv.knimbus.com/user#/home</a> W2. <a href="https://www.geeksforgeeks.org/fuzzy-logic-introduction/">https://www.geeksforgeeks.org/fuzzy-logic-introduction/</a>					
<b>Topics relevant to "EMPLOYABILITY SKILLS":</b> Solving real world problems with uncertainty using Nature Inspired Algorithms for developing Employability Skills through Problem Solving Methodologies. This is attained through assessment component mentioned in course handout					
<b>Catalogue prepared by</b>	Dr.S.Thiruselvan				
<b>Recommended by the Board of Studies on</b>	BOS NO: 1, BOS held on 22/12/2022				
<b>Date of Approval by the Academic</b>	Academic Council Meeting No. 20, Dated 15/02/2023				

Council	
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<b>Course Code:</b> CSE 5014	<b>Course Title:</b> Ontology Engineering for the Semantic Web			L- P- C	3	0	3
	<b>Type of Course:</b> Discipline Elective Theory Only						
<b>Version No.</b>	2.0						
<b>Course Pre-requisites</b>	Basics Programming Skills Basics of XML-Syntax, Schema, Elements, Attributes and Namespaces						
<b>Anti-requisites</b>	NIL						
<b>Course Description</b>	This course presents the basics of semantic web and Ontology engineering. This course consist of the detailed description RDF frameworks. This course is designed with theoretical material on ontology design, Description Logics, and developing ontologies using OWL. The course uses the Protege-OWL environment.						
<b>Course Objective</b>	The objective of the course is to familiarize the learners with the concepts of <b>Ontology Engineering for the Semantic Web</b> and attain <b>EMPLOYABILITY SKILLS</b> through <b>PARTICIPATIVE LEARNING</b> techniques						
<b>Course Outcomes</b>	On successful completion of the course the students shall be able to: CO1. Understand the semantic web basics, architecture and technologies. CO2. Describe the semantic relationships among the data elements using Resource Description Framework (RDF) CO3. Analyze the conventional web with semantic web. CO4. Able to design and implement real-world applications that “discovers” the data and/or other web services via the semantic web						
<b>Course Content:</b>							
<b>Module 1</b>	Introduction	Assignment	Analysis, Data Collection	<b>9 Sessions</b>			
<b>Topics:</b> Introduction to the Syntactic web and Semantic Web, Evolution of the Web, The visual and syntactic web, Levels of Semantics, Metadata for web information, The semantic web architecture and technologies, A <b>Layered Approach</b> , Semantic Modeling -Potential of semantic web solutions and challenges of adoption.							
<b>Module 2</b>	Ontological Engineering	Assignment	Analysis, Data Collection	<b>9 Sessions</b>			
<b>Topics:</b> Ontologies, Taxonomies, Topic Maps, Classifying Ontologies, Terminological aspects: concepts, terms, relations between them, Complex Objects, Subclasses and Sub properties, definitions, Upper Ontologies, Quality, Uses, Types of terminological resources for ontology building, Methods and methodologies for building ontologies, Multilingual Ontologies, methods for Ontology Learning, <b>Constructing Ontologies Manually</b> , <b>Reusing Existing Ontologies</b> , Ontology Evolution, Versioning.							
<b>Module 3</b>	Describing the Web Resources	Assignment	Data analysis task	<b>9 Sessions</b>			
<b>Topics:</b> RDF Overview, The basic elements of RDF, RDF triples, Fundamental rules of RDF Aggregation and distributed information, RDF tools, RDF <b>and RDF Schema in RDF Schema</b> , RDFS, , Need for RDFS, Core elements of RDFS, <b>RDF Schema: Basic Ideas</b> .							
<b>Module 4</b>	Web Ontology Language and Real-world examples	Case Study	Analysis, Data Collection	<b>11 Sessions</b>			
<b>Topics:</b>							

Requirements for Ontology Languages, OWL Sub languages, Description of the OWL Language, Layering of OWL, Examples for OWL, OWL in OWL, **Future Extensions**, Building Classes from Other Classes, Restricting Properties of Classes.

SWOOGLE and FOAF: basics, architecture, usage and examples.

#### **Targeted Application & Tools that can be used:**

**Enterprise applications.** A more concrete example is SAPPHERE (Health care) or Situational Awareness and Preparedness for Public Health Incidences and Reasoning Engines which is a semantics-based health information system capable of tracking and evaluating situations and occurrences that may affect public health.

**Geographic information systems** bring together data from different sources and benefit therefore from ontological metadata which helps to connect the semantics of the data.

**Domain-specific ontologies** are extremely important in biomedical research, which requires named entity disambiguation of various biomedical terms and abbreviations that have the same string of characters but represent different biomedical concepts.

#### **Tools:**

- **Protégé**
- **Neon Toolkit**
- **SWOOP**
- **Vitro**

#### **Project work:**

##### **Mini Project:**

- Ontology-Based Model for the “Ward-round” Process in Healthcare  
To design an ontology-based model that can fix information flow problems in the ward-round process of hospital unit. This can be used to provide relevant information to the domain users according to their needs and demands. The domain users profile and describes their roles, information demands with competencies: skills, qualifications and experiences. The ontology based model will be implemented in OWL language that can be used in an application to support ward-round activities for achieving effective patient’s treatment process.

#### **Text Book/**

1. Grigoris Antoniou, Frank Van, “Semantic Web Primer”, MIT Press, 2008
2. Karin K. Breitman, Marco Antonio Casanova and Walter Truszcowski, “Semantic Web Concepts: Technologies and Applications”, Springer, 2007

#### **References Books**

1. LiyangYu , “Introduction to the Semantic Web and Semantic web services” Chapman & Hall/CRC, Taylor & Francis group, 2007
2. Peter Mika, “Social networks and the Semantic Web”, Springer, 1st edition 2007
3. Robert M. Colomb, “Ontology and the Semantic Web”, Volume 156 ,Frontier in Artificial Intelligence and Applications, IOS Press, 2007
4. Michael C. Daconta, Leo J. Obrst, and Kevin T. Smith, “The Semantic Web: A Guide to the Future of XML, Web Services, and Knowledge Management”, Fourth Edition, Wiley Publishing, 2003.

#### **Weblinks**

W1. <https://presiuniv.knimbus.com/user#/home>.

W2. [https://en.wikipedia.org/wiki/Ontology\\_engineering](https://en.wikipedia.org/wiki/Ontology_engineering).

**Topics relevant to “ONTOLOGY ENGINEERING and “ SEMANTIC WEB”:** Syntactic web and Semantic Web, Multilingual Ontologies, Ontology Development process and Life cycle, RDF triples, Fundamental rules of RDF Aggregation and distributed information, OWL Sub languages for developing **Employability Skills** through **Participative Learning** techniques. This is attained through assessment component



mentioned in course handout.	
<b>Catalogue prepared by</b>	Dr. S. Pravinth raja
<b>Recommended by the Board of Studies on</b>	BOS NO: 1, BOS held on 22/12/2022
<b>Date of Approval by the Academic Council</b>	Academic Council Meeting No. 20, Dated 15/02/2023

<b>Course Code:</b> CSE 6003	<b>Course Title:</b> Big Data Analytics Tools and Techniques <b>Type of Course: Program Core</b> <b>Theory and Lab Integrated Course</b>			<b>L- P- C</b>	2	2	3
<b>Version No.</b>	2.0						
<b>Course Pre-requisites</b>	Relational Database management System: Data, Database, Relational Data, Relational Model, Entity Relational model, SQL Clauses, SQL Queries						
<b>Anti-requisites</b>	NIL						
<b>Course Description</b>	This course is designed to provide the fundamental knowledge to equip students being able to handle real-world big data problems including the three key resources of Big Data: people, organizations and sensor. With the advancement of IT storage, processing, computation and sensing technologies. It helps the students to interpret the operational concepts of computer technology as well as performance enhancement.						
<b>Course Objective</b>	The objective of the course is to familiarize the learners with the concepts of Big Data Analytics Tools and Techniques and attain <b>EMPLOYABILITY SKILLS</b> through <b>EXPERIENTIAL LEARNING</b> techniques						
<b>Course Outcomes</b>	On successful completion of the course the students shall be able to: CO1: Understand managing big data using Hadoop analytical tools and technologies CO2: Understand map-reduce analytics using Hadoop and related tools CO3: Preparing for data summarization, query, and analysis. CO4: Applying data modeling techniques to large data sets CO5: Building a complete business data analytic solution						
<b>Course Content:</b>							
<b>Module 1</b>	Introduction to Hadoop and HDFS	Assignment	Data Collection and Analysis	<b>8 Sessions</b>			
<b>Topics:</b> <b>Meet Hadoop:</b> Data, Data Storage and Analysis, Comparison with Other Systems: Relational Database Management Systems, Grid Computing, Volunteer Computing Hadoop Fundamentals Map Reduce A Weather Dataset: Data Format, Analyzing the Data with Unix Tools, Analyzing the Data with Hadoop: Map and Reduce, Java Map Reduce, Scaling Out: Data Flow, Combiner Functions, Running a Distributed Map Reduce Job, Hadoop Streaming , <b>Characteristics of big data, Challenges in processing big data, Limitations of classical algorithms on big data</b>  <b>The Hadoop Distributed File system:</b> The Design of HDFS, HDFS Concepts: Blocks, Name nodes and Data nodes, HDFS Federation, HDFS High-Availability, The Command-Line Interface, Basic File system Operations, Hadoop File systems Interfaces, The Java Interface, Reading Data from a Hadoop URL, Reading Data Using the File System API, Writing Data, Directories, Querying the File system, Deleting Data, Data Flow: Anatomy of a File Read, Anatomy of a File Write, <b>Using Hadoop archives, limitations.</b>							
<b>Module 2</b>	YARN and Hadoop I/O	Assignment	Data Collection and Analysis	<b>8 Sessions</b>			
<b>Topics:</b> <b>YARN Anatomy of a YARN Application Run:</b> Resource Requests, Application Lifespan, Building YARN Applications, YARN Compared to Map Reduce, Scheduling in YARN: The FIFO Scheduler, The Capacity Scheduler, The Fair Scheduler, Delay Scheduling, Dominant Resource Fairness  <b>Hadoop I/O:</b> Data Integrity in HDFS, Local File System, Checksum File System, Compression and Input Splits, Using Compression in Map Reduce, Serialization, The Writable Interface, Writable Classes, Implementing a Custom Writable, Serialization Frameworks, File-Based Data Structures: Sequence File							

<b>Module 3</b>	Map Reduce Applications	Case Study	Data analysis	<b>8 Sessions</b>
<b>Topics:</b> <b>Developing a Map Reduce Application:</b> The Configuration API, Combining Resources, Variable Expansion, Setting Up the Development Environment, Managing Configuration, Generic Options Parser, Tool, and Tool Runner, Writing a Unit Test with MR Unit: Mapper, Reducer, Running Locally on Test Data, Running a Job in a Local Job Runner, Testing the Driver, Running on a Cluster, Packaging a Job, Launching a Job, The Map Reduce Web UI, Retrieving the Results, Debugging a Job, Hadoop Logs, Tuning a Job, Profiling Tasks, Map Reduce Workflows: Decomposing a Problem into Map Reduce Jobs, Job Control, Apache Oozie  <b>How Map Reduce Works:</b> Anatomy of a Map Reduce Job Run, Job Submission, Job Initialization, Task Assignment, Task Execution, Progress and Status Updates, Job Completion, Failures: Task Failure, Application Master Failure, Node Manager Failure, Resource Manager Failure, Shuffle and Sort: The Map Side, The Reduce Side, Configuration Tuning, Task Execution: The Task Execution Environment, Speculative Execution, Output Committers				
<b>Module 4</b>	Map Reduce Types and Formats, Flume	Case Study	Data analysis	<b>10 Sessions</b>
<b>Topics:</b> <b>Map Reduce Types, Input Formats:</b> Input Splits and Records Text Input, Binary Input, Multiple Inputs, Database Input (and Output) Output Formats: Text Output, Binary Output, Multiple Outputs, Lazy Output, Database Output  <b>Flume</b> Installing Flume, An Example, Transactions and Reliability, Batching, The HDFS Sink, Partitioning and Interceptors, File Formats, Distribution: Agent Tiers, Delivery Guarantees, Sink Groups, Integrating Flume with Applications, Component Catalog				
<b>Module 5</b>	<b>Hive, Pig, Spark Analytical Tools</b>	Case Study	Data analysis	<b>10 Sessions</b>
<b>Topics:</b> <b>Hive</b> Apache Hive with Hive Installation, Hive Data Types, Hive Table partitioning, Hive DDL commands, Hive DML commands, Hive sort by vs order by, Hive Joining tables  <b>Pig</b> Installing and Running Pig, Execution Types, Running Pig Programs, Grunt, Pig Latin Editors, An Example: Generating Examples, Comparison with Databases, Pig Latin: Structure, Statements, Expressions, Types, Data Processing Operators: Loading and Storing Data, Filtering Data, Grouping and Joining Data, Sorting Data, Combining and Splitting Data.  <b>Spark</b> An Example: Spark Applications, Jobs, Stages and Tasks, A Java Example, A Python Example, 20082020 / 31 Resilient Distributed Datasets: Creation, Transformations and Actions, Persistence, Serialization, Shared Variables, Broadcast Variables, Accumulators, Anatomy of a Spark Job Run, Job Submission, DAG Construction, Task Scheduling, Task Execution, Executors and Cluster Managers: Spark on YARN				
<b>List of Laboratory Tasks:</b> <ol style="list-style-type: none"> <li>(i) Perform setting up and Installing Hadoop in its two operating modes: <ul style="list-style-type: none"> <li>Pseudo distributed,</li> <li>Fully distributed.</li> </ul> (ii) Use web based tools to monitor your Hadoop setup.  <b>Level 1:</b> Programming assignment to install the Hadoop environment tools. </li> <li>(i) Implement the following file management tasks in Hadoop: <ul style="list-style-type: none"> <li>Adding files and directories</li> <li>Retrieving files</li> <li>Deleting files</li> </ul> </li> </ol>				

(ii) Benchmark and stress test an Apache Hadoop cluster

**Level 1:** Programming assignment to maintain the Hadoop Distributed File System.

3. Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm.

- Find the number of occurrence of each word appearing in the input file(s)
- Performing a Map Reduce Job for word search count (look for specific keywords in a file)

**Level 1:** Programming scenario to use map reduce programming to perform the analysis.

**Level 2:** Programming assignment to analyze the data for any given data file.

4. Stop word elimination problem:

Input:

- A large textual file containing one sentence per line
- A small file containing a set of stop words (One stop word per line)

Output:

A textual file containing the same sentences of the large input file without the words appearing in the small file.

5. Write a Map Reduce program that mines weather data. Weather sensors collecting data every hour at many locations across the globe gather large volume of log data, which is a good candidate for analysis with Map Reduce, since it is semi structured and record-oriented. Data available at:

<https://github.com/tomwhite/hadoopbook/tree/master/input/ncdc/all>.

- Find average, max and min temperature for each year in NCDC data set?
- Filter the readings of a set based on value of the measurement, Output the line of input files associated with a temperature value greater than 30.0 and store it in a separate file.

**Level 2:** Programming assignment to analyze the social media data for business analytics.

6. For Purchases.txt Dataset , instead of breaking the sales down by store, give us a sales breakdown by product category across all of our stores.

- What is the value of total sales for the following categories?
  - i. Toys
  - ii. Consumer Electronics
- Find the monetary value for the highest individual sale for each separate store  
What are the values for the following stores?
  - i. Reno
  - ii. Toledo
  - iii. Chandler
- Find the total sales value across all the stores, and the total number of sales.

**Level 2:** Programming assignment to analyze and find the maximum sales, minimum sales and average sales in each store.

7. Install and Run Pig then write Pig Latin scripts to sort, group, join, project, and filter your data.

**Level 1:** Programming scenarios to perform the grouping, filtering and Joining.

8. Write a Pig Latin scripts for finding TF-IDF value for book dataset (A corpus of eBooks available at: Project Gutenberg)

**Level 2:** Programming Assignment to analyze the data from the given text file using Pig latin script.

9. Install and Run Hive then use Hive to create, alter, and drop databases, tables, views, functions, and indexes.

**Level 1:** Programming scenario to analyze the data from the given text file to perform SQL operations.

10. Install, Deploy & configure Apache Spark Cluster. Run apache spark applications using Scala.

**Level 1:** Programming scenario to analyze a dataset using spark.

11. Data analytics using Apache Spark on Amazon food dataset, find all the pairs of items frequently reviewed together.

Write a single Spark application that:

- Transposes the original Amazon food dataset, obtaining a Pair RDD of the type:
- Counts the frequencies of all the pairs of products reviewed together;
- Writes on the output folder all the pairs of products that appear more than once and their frequencies. The pairs of products must be sorted by frequency.

**Level 2:** Programming assignment to analyze the data using spark.

**Targeted Application & Tools that can be used:**

- **Business Analytical Applications**
- **Social media Data Analysis**
- **Predictive Analytics**
- **Government Sector for analyzing the data**
- **Improve the business through analytics**

**Tools:** Hadoop Framework tools like map reduce, Hive, Hbase, Spark, Pig, Flume.

**Project work/Assignment:**

After completion of each module a programming based Assignment/Assessment will be conducted. A scenario will be given to the student to be developed as a data analysis application. On completion of Module 5, student will be asked to develop a project for Data Analysis.

**Text Book**

T1. Hadoop: The Definitive Guide Tom White O'Reilley Third Edition, 2012

**References**

R1.SPARK: The Definitive Guide Matei Zaharia and Bill Chambers Oreilly 2018

R2.Apache Flume: Distributed Log Collection for Hadoop . D'Souza and Steve Hoffman Oreilly 2014

**Weblinks**

W1.<https://presiuniv.knimbus.com/user#/home>

W2. [Data Analytics: What It Is, How It's Used, and 4 Basic Techniques \(investopedia.com\)](https://www.investopedia.com/terms/d/data-analytics/)

**Topics relevant to “EMPLOYABILITY SKILLS”:** Real time application development using Hadoop Ecosystem tools. for developing **EMPLOYABILITY SKILLS** through **EXPERIENTIAL LEARNING** techniques. This is attained through assessment component mentioned in course handout

**Catalogue prepared by** Dr. Manujakshi B C, Dr.Senthilkumar S

**Recommended by the Board of Studies on** BOS NO: 1, BOS held on 22/12/2022

**Date of Approval by the Academic Council** Academic Council Meeting No. 20, Dated 15/02/2023

<b>Course Code:</b> CSE 6004	<b>Course Title:</b> Time Series Analysis and Forecasting			<b>L- P- C</b>	3	0	3
	<b>Type of Course:</b> Discipline Elective Theory Only						
<b>Version No.</b>	2.0						
<b>Course Pre-requisites</b>	R,Calculus, Linear Algebra, Probability and Statistics						
<b>Anti-requisites</b>	NIL						
<b>Course Description</b>	The course will provide a basic introduction to time series analysis. This theory based course covers topics in time series analysis and some statistical techniques on forecasting. Time series regression, exploratory data analysis, AR models, Seasonal Models, GARCH Models and Box-Jenkins approach are the major topics covering in this course. R and RStudio will be required for this class.						
<b>Course Objective</b>	The objective of the course is to familiarize the learners with the concepts of <b>Time Series Analysis and Forecasting</b> and attain <b>EMPLOYABILITY SKILLS</b> through <b>PROBLEM SOLVING techniques</b>						
<b>Course Outcomes</b>	On successful completion of the course the students shall be able to CO1.Select appropriate model, to fit parameter values and make concise decisions based on forecasts obtained CO2.Demonstrate an understanding of the principles behind modern forecasting techniques. CO3.Apply concepts to real time series data using packages.						
<b>Course Content:</b>							
<b>Module 1</b>	Introduction	Assignment	Data Analysis task	<b>9 Sessions</b>			
<b>Topics:</b> Background for time series analysis, Examples of Time Series, Objectives of Time Series Analysis, Characteristics of Time Series, Time Series Techniques, Approaches used for time series forecasting, ETS (Error, Trend, Seasonality) models to make forecasts, Decomposition method, Case study on decomposition method, Model forecast theory, Model forecast hands-on, stochastic process.							
<b>Module 2</b>	Time Series Regression and Exploratory Data Analysis	Assignment	Data analysis	<b>10 Sessions</b>			
<b>Topics:</b> Time series pipeline, Classical Regression in the Time Series Context, Exploratory Data Analysis, Stationary Models and the Autocorrelation Function, Detrending and De-seasonalizing Smoothing, Introduction to Time Series Analysis with R,							
<b>Module 3</b>	AR models	Assignment	Data analysis	<b>10 Sessions</b>			
<b>Topics:</b> Models for Stationary Time Series, Models for Non-Stationary Time Series, Identification, Forecasting, ARIMA (Autoregressive, Integrated, Moving Average) models, AR model, and MA model.							
<b>Module 4</b>	Additional models, Spectral Analysis and packages	Case Study	Data analysis	<b>10 Sessions</b>			
<b>Topics:</b> Seasonal Models, Time Series Regression Models, GARCH Models, Seabird Model, Preparing model using ITSM, Time series using astsa, ARIMA models is to use sarima from astsa Preparing model using LSTM for weather forecasting using ARIMA.							

<b>Targeted Application &amp; Tools that can be used:</b> <b>Targeted Applications:</b> Time series analysis on economics, finance, natural sciences, health care and more <b>Tools:</b> <ul style="list-style-type: none"> <li>• R package astsa (Applied Statistical Time Series Analysis)</li> <li>• The package ITSM2000 ( <a href="https://extras.springer.com/">https://extras.springer.com/</a> )</li> </ul>	
<b>Project work:</b>  <b>Mini Project:</b> <b>Choose any suitable real time dataset and build time series forecast models.</b> <b>Example:</b> In the Air Passengers dataset set, go back 12 months in time and build the ARIMA forecast for the next 12 month. Investigate following questions Is the series stationary? If not what sort of differencing is required? What is the order of your best model? What is the AIC of your model? What is the order of the best model predicted by auto_arima() method?	
<b>Text Book</b> T1.Montgomery DC, Jennings CL, Kulahci M. Introduction to time series analysis and forecasting. John Wiley & Sons; 2015 Apr 21. T2.Brockwell & Davis (2016) Introduction to Time Series and Forecasting, 3rd edition, Springer. T3.Shumway & Stoffer (2011) Time Series Analysis and its applications, with examples in R , 3rd edition, Springer.	
<b>References</b> R1.Box GE, Jenkins GM, Reinsel GC, Ljung GM (2015) Time series analysis: forecasting and control. John Wiley & Sons R2.Cryer & Chan (2008) Time Series Analysis with Applications in R, Springer R3.Prado & West (2010) Time Series: Modeling, Computation, and Inference Chapman & Hall	
<b>Weblinks</b> W1. <a href="https://www.coursera.org/courses?query=time%20series%20analysis">https://www.coursera.org/courses?query=time%20series%20analysis</a> W2. <a href="https://www.tableau.com/learn/articles/time-series-forecasting">https://www.tableau.com/learn/articles/time-series-forecasting</a> W3. <a href="https://presiuniv.knimbus.com/user#/home">https://presiuniv.knimbus.com/user#/home</a>	
<b>Topics relevant to development of “EMPLOYABILITY SKILLS”:</b> Information retrieval of Search Engines Information Retrieval for developing <b>Employability Skills</b> through <b>PROBLEM SOLVING</b> techniques. This is attained through assessment component mentioned in course handout	
<b>Catalogue prepared by</b>	Prof. Jobin Thomas, Dr.Jacob A.
<b>Recommended by the Board of Studies on</b>	BOS NO: 1, BOS held on 22/12/2022
<b>Date of Approval by the Academic Council</b>	Academic Council Meeting No. 20, Dated 15/02/2023

<b>Course Code:</b> CSE 6005	<b>Course Title:</b> Intelligent Information Retrieval			L- P- C	3	0	3
	<b>Type of Course:</b> Discipline Elective Theory Only						
<b>Version No.</b>	2.0						
<b>Course Pre-requisites</b>	Core programming and algorithm skills						
<b>Anti-requisites</b>	NIL						
<b>Course Description</b>	This Course studies the theory, design, implementation and evaluation of information retrieval systems. The focus is on the core concepts of Text- based information systems, statistical characteristics of text, representation of information needs and documents. Several important retrieval models, algorithms, and Recommender System. Also examined is how an effective information search and retrieval is interrelated with the organization and description of information to be retrieved. Throughout the course, current literature from the viewpoints of both research and practical retrieval technologies on the World Wide Web will be examined.						
<b>Course Objective</b>	The objective of the course is to familiarize the learners with the concepts of <b>Intelligent Information Retrieval</b> and attain <b>EMPLOYABILITY SKILLS</b> through <b>PARTICIPATIVE LEARNING</b> techniques						
<b>Course Outcomes</b>	On successful completion of the course the students shall be able to: CO1: Define basic concepts of information Retrieval and Recommender System CO2: Evaluate the effectiveness and efficiency of different information retrieval methods CO3: Explain the standard methods for Web indexing and retrieval CO4: Develop Methods for implementing a recommender system						
<b>Course Content:</b>							
<b>Module 1</b>	INTRODUCTION	Assignment	Term Paper	<b>8 Sessions</b>			
<b>Topics:</b> Information Retrieval – Early Developments – The IR Problem - <b>Components of IR Model</b> – <b>User Interaction with IR model</b> - The Users Task – Information versus Data Retrieval – The IR System – The Software Architecture of the IR System – The Retrieval and Ranking Processes – The Web – The e-Publishing Era – How the web changed Search – Practical Issues on the Web – How People Search.							
<b>Module 2</b>	MODELING AND RETRIEVAL EVALUATION	Assignment	Term Paper	<b>12 Sessions</b>			
<b>Topics:</b> Basic IR Models – Boolean Model – TF-IDF (Term Frequency/Inverse Document Frequency) Weighting – Vector Model – Probabilistic Model – Latent Semantic Indexing Model – Neural Network Model – <b>Set Theoretic-Fuzzy, Extended Boolean</b> , Retrieval Evaluation – Retrieval Metrics – Precision and Recall – Reference Collection – User-based Evaluation.							
<b>Module 3</b>	WEB RETRIEVAL AND WEB CRAWLING	Assignment	Term Paper	<b>10 Sessions</b>			



<b>Topics:</b> The Web – Search Engine Architectures – Cluster based Architecture – Distributed Architectures – Search Engine Ranking – Link based Ranking – Simple Ranking Functions – Learning to Rank – Evaluations – Search Engine Ranking – Search Engine User Interaction – Browsing – Applications of a Web Crawler – Taxonomy – Architecture and Implementation – <b>Difference between web scraping and web crawling.</b>				
<b>Module 4</b>	RECOMMENDER SYSTEM	Assignment	Term Paper	<b>10 Sessions</b>
<b>Topics:</b> Recommender Systems Functions – Data and Knowledge Sources – Recommendation Techniques – Basics of Content-based Recommender Systems – High-Level Architecture – Advantages and Drawbacks of Content-based Filtering – Collaborative Filtering – Matrix factorization models – <b>Introduction to user-based recommender systems.</b>				
<b>Targeted Application &amp; Tools that can be used:</b> <ul style="list-style-type: none"> <li>Information Retrieval Applications</li> <li>Machine Learning Applications</li> </ul>				
<b>Tools:</b> <ul style="list-style-type: none"> <li><a href="#">Bow Toolkit</a></li> <li><a href="#">GATE</a></li> <li><a href="#">Lemur</a></li> <li>MG</li> <li>Smart (System for the Mechanical Analysis and Retrieval of Text) Information Retrieval System is an information retrieval system <b>developed at Cornell University</b> in the 1960s.</li> </ul>				
<b>Text Book</b> T1.Ricardo Baeza-Yates and Berthier Ribeiro-Neto, – Modern Information Retrieval: The Concepts and Technology behind Search, Second Edition, ACM Press Books, 2011. Link: <a href="https://people.ischool.berkeley.edu/~hears/irbook/">https://people.ischool.berkeley.edu/~hears/irbook/</a> T2.Ricci, F, Rokach, L. Shapira, B.Kantor, – Recommender Systems Handbook, First Edition, 2011. T3.C. Manning, P. Raghavan, and H. Schütze, –Introduction to Information Retrieval, Cambridge University Press, 2008. Link: <a href="https://nlp.stanford.edu/IR-book/">https://nlp.stanford.edu/IR-book/</a>				
<b>References</b> R1.Mikhail Klassen, Matthew A. Russell, Mining the Social Web,O'Reilly Media, Inc., 3rd Edition (2019) R2.Stefan Buettcher, Charles L. A. Clarke and Gordon V. Cormack, – Information Retrieval: Implementing and Evaluating Search Engines, The MIT Press, 2010. R3.Ceri, S., Bozzon, A., Brambilla, M., Della Valle, E., Fraternali, P. and Quarteroni, S., 2013. Web information retrieval. Springer Science & Business Media.				
<b>Weblinks</b> W1. <a href="https://presiuniv.knimbus.com/user#/home">https://presiuniv.knimbus.com/user#/home</a> W2. <a href="https://www.geeksforgeeks.org/what-is-information-retrieval/">https://www.geeksforgeeks.org/what-is-information-retrieval/</a> .				
<b>Topics relevant to development of “EMPLOYABILITY SKILLS”:</b> Software Development Engineer(Flipkart), Architect, Information Retrieval Officer, Research Scientist – IBM Research, Machine Learning Application Developer and Lead Engineer / Module Lead – Java / Python for developing <b>Employability Skills</b> through <b>Participative Learning</b> techniques. This is attained through assessment component mentioned in course handout				
<b>Catalogue prepared by</b>	Prof. Zafar Ali Khan N, Dr. R Mahalakshmi			

Recommended by the Board of Studies on	BOS NO: 1, BOS held on 22/12/2022
Date of Approval by the Academic Council	Academic Council Meeting No. 20, Dated 15/02/2023

<b>Course Code:</b> CSE 6006	<b>Course Title:</b> AI in Internet of Things			L- P- C	3	0	3
	<b>Type of Course:</b> Discipline Elective Theory Only						
<b>Version No.</b>	2.0						
<b>Course Pre-requisites</b>	Basic knowledge of computer and internet, Basic Python programming, Probability and Linear Algebra						
<b>Anti-requisites</b>	NIL						
<b>Course Description</b>	This course introduces the core principles of the Internet of things and Artificial Intelligence from the basic to intermediate level. This theory-based course emphasizes on understanding the application of AI in IoT. The course will focus on the creative thinking of AI & IoT concepts & technologies.						
<b>Course Objective</b>	The objective of the course is to familiarize the learners with the concepts of <b>AI in Internet of Things</b> and attain <b>EMPLOYABILITY SKILLS</b> through <b>PARTICIPATIVE LEARNING</b> techniques						
<b>Course Outcomes</b>	On successful completion of the course the students shall be able to: CO1.Understand building blocks of Internet of Things and characteristics. CO2.Describe IoT Protocols CO3.Compare and contrast from a range of AI techniques when implementing smart systems. CO4.Identify and Apply techniques in areas of AllIoT.						
<b>Course Content:</b>							
<b>Module 1</b>	Introduction to AI	Assignment	Data Analysis task	<b>10 Sessions</b>			
<b>Topics:</b> Introduction to Artificial Intelligence, Basics of Python, Example programs in Python, Introduction to Machine Learning, Types of Machine Learning Algorithms, Introduction to Linear Algorithm, <b>Introduction to deep learning</b> , Genetic Algorithms, Adversarial Search, Constraint Satisfaction, Propositional Logic & Satisfiability, Uncertainty in AI.							
<b>Module 2</b>	Introduction to IOT	Assignment	Data Collection	<b>10 Sessions</b>			
<b>Topics:</b> Introduction to Internet of Things, What is Microcontrollers?, Difference between Microprocessor and Microcontroller, Introduction to Arduino Boards, Types of Arduino Boards, Installation of Arduino IDE, Usage of Tinker Cad, Types of Sensors, Working Principle, Pin Configuration of Sensors, Demonstrating of Ultrasonic Sensor, IR Sensor, Gas Sensor, and PIR Sensor. Structure of Coding – Embedded C, Demonstrating - the intensity of LED using a potentiometer, Traffic Signal, <b>Tinker cad demonstration for object detection.</b>							
<b>Module 3</b>	AI algorithms for sensors	Assignment	Data Collection	<b>10 Sessions</b>			
<b>Topics:</b> <b>How algorithms are used in sensors</b> , Algorithms of Artificial Intelligence in Sensors-Classification algorithms, Data clustering, Evolutionary algorithms in sensing, Data pattern recognition, Maintenance, and production scheduling, Artificial intelligence in predictive and proactive scheduling, Energy efficient scheduling, Stochastic models in artificial intelligence, Queuing theory-based approach, Project scheduling, Artificial intelligence in assembly line balancing, Disassembly line balancing.							
<b>Module 4</b>	IOT Protocols and Applications of AI in IOT	Case Study	Data Collection	<b>10 Sessions</b>			

**Topics:**

**Connectivity Protocols:** 6LoWPAN, IEEE 802.15.4, Zigbee, Wireless, NFC, RFID.  
**Communication/Transport Protocols:** Bluetooth. **Data Protocols:** Message Queue Telemetry Transport (MQTT), Constrained Application Protocol (CoAP), Advanced Message Queuing Protocol (AMQP), **Data Distribution service**. **Applications of AI in IOT- Case Study: Smart Retail, Drone Traffic Monitoring , Office Buildings.**

**Targeted Application & Tools that can be used:**

Targeted employment sector is service provider and control monitor like GE, Siemens, TCS etc. Targeted job profiles include digital domain and Physical system design engineer, IOT engineer etc.

**Tools:**

- Arduino IDE
- TinkerCad
- NodeMCU
- Tensor Flow and Keras

**Text Book**

T1. "Artificial Intelligence: A Modern Approach", Stuart Russell & Peter Norvig, Prentice-Hall, Third Edition (2009).

T2. "Internet of Things: A hands on approach", Arshdeep Bagha & Vijay Madiseti, Universities Press 2015.

T3. <https://www.tinkercad.com/>

**References**

R1. "The internet of Things: Connecting Objects to web", Hakima Chaouchi, Wiley 2017.

R2. "Prolog: Programming for Artificial Intelligence", I. Bratko, Fourth edition, AddisonWesley Educational Publishers Inc, 2011.

R3. WE. RICH, K. KNIGHT, S. B. NAIR (2017), Artificial Intelligence, McGraw Hill Education, 3rd Edition

**Weblinks**

W1. <https://presiuniv.knimbus.com/user#/home>

W2. <https://techvidvan.com/tutorials/iot-protocols/>.

W3. <https://www.javatpoint.com/iot-internet-of-things>.

**Topics relevant to development of "EMPLOYABILITY SKILLS "**: Get introduced to AI programming and Interfacing of IOT devices. for developing **Employability Skills** through **Participative Learning** techniques. This is attained through assessment component mentioned in course handout.

**Catalogue prepared by**

Prof. Mohammed Mujeer Ulla  
Prof. Preethi

**Recommended by the Board of Studies on**

BOS NO: 1, BOS held on 22/12/2022

**Date of Approval by the Academic Council**

Academic Council Meeting No. 20, Dated 15/02/2023

Course Code: CSE5016	Course Title: Essentials for Machine Learning (ML)  Type of Course: Discipline Elective Theory Only		L- P- C	3	0	3
Version No.	2.0					
Course Pre-requisites	NIL					
Anti-requisites	NIL					
Course Description	Machine learning has been emerged as a promising paradigm in the field of Computer science having applications in a wide variety of fields such as communication networks, bioinformatics, image processing, antenna design etc. Now a day's people from multiple discipline are interested in Machine learning due to its applicability in predicting behaviors of highly complex systems, which is otherwise difficult based on traditional optimization techniques in a time bound fashion. The goal of this course is to provide the mathematical prerequisite for starting any Machine learning course to the students coming from various engineering disciplines. This course does not require any prerequisite. The goal of the course is: <div>1. To introduce basic probability and statistics concepts.</div> <div>2. To introduce basic Linear Algebra concepts.</div> <div>3. To enable the students to understand Machine Learning/Deep learning concepts in future.</div>					
Course Objective	The objective of the course is to familiarize the learners with the concepts of Essentials for Machine Learning (ML) and attain EMPLOYABILITY SKILLS through PARTICIPATIVE LEARNING techniques					
Course Outcomes	On successful completion of this course the students shall be able to: CO1: Understand the basic concepts of Probability and Statistics. CO2: Understand the basic concepts of Linear Algebra. CO3: Peruse courses on Machine learning/Deep learning in future.					
Course Content:						
Module 1	Probability	Assignment	Sample space and Events, Interpretation and axioms of Probability, Conditional Probability, Multiplication and total Probability rules, Independence, Bayes' theorem		08 Sessions	
Topics: Sample space and Events, Interpretation and axioms of Probability, Conditional Probability, Multiplication and total Probability rules, Independence, Bayes' theorem.						
Module 2	Random variables	Assignment	Probability distribution, Probability mass function, Probability density function, Cumulative distribution function, Mean and variance of a random variable, Binomial, Poisson and Normal		08 Sessions	

			random variables, relation between them.	
<b>Topics:</b> Probability distribution, Probability mass function, Probability density function, Cumulative distribution function, Mean and variance of a random variable, Binomial, Poisson and Normal random variables, relation between them.				
<b>Module 3</b>	Introduction to Statistics	Assignment	Pie Chart, Bar chart, Box and whisker plot, Mean, Median, Mode, AM, GM, HM, Quartiles, Deciles, Percentiles, Moments, Skewness, Kurtosis, Measures of Central tendency, Software demonstration.	<b>08 Sessions</b>
<b>Topics:</b> Pie Chart, Bar chart, Box and whisker plot, Mean, Median, Mode, AM, GM, HM, <b>Box Plots, time sequences plots</b> , Measures of Central tendency, Software demonstration.				
<b>Module-4</b>	Estimation of Parameters	Assignment	Point estimation, Sampling distribution, Central Limit Theorem, Unbiased estimators, Method of point estimation, Method of moments, method of maximum likelihood, confidence interval estimates of population parameter, student's t distribution, Testing of hypothesis, Chi square distribution, Degrees of freedom	<b>06 Sessions</b>
<b>Topics:</b> Point estimation, Sampling distribution, Central Limit Theorem, Unbiased estimators, <b>Residual Analysis and model checking</b> , method of maximum likelihood, confidence interval estimates of population parameter, student's t distribution, Testing of hypothesis, Chi square distribution, Degrees of freedom				
<b>Module-5</b>	Linear Algebra	Assignment	Scalar, Vector, Matrices and Tensors, Norms, Span, Eigen Value, Eigen Vector, The trace operator, Determinant, Proximity measure, Example: Principal Component Analysis.	<b>06 Sessions</b>
<b>Topics:</b> Scalar, Vector, Matrices and Tensors, Norms, Span, Eigen Value, Eigen Vector, The trace operator, Determinant, Example: Principal Component Analysis.				
<b>Project work/Assignment:</b> Software demonstration, Probability mass function, Independence, Bayes' theorem, Span, Eigen Value for developing <b>Employability Skills</b> through <b>Participative Learning techniques</b> . This is attained through assessment component mentioned in course handout.				

**REFERENCE MATERIALS:****Text Book(s):**

- T1. Douglas C. Montgomery and George C. Runger, "Applied Statistics and Probability for Engineers", Sixth Edition, Wiley, 2016
- T2. Dimitri P. Bertsekas and John N. Tsitsiklis, "Introduction to probability", MIT press, FALL 2000.
- T3. Murry R Spiegel and Larry J Stephens, "STATISTICS", Fourth Edition, Schaum's outlines, 2008.
- T4. Narsingh Deo, "System simulation with digital computer", PHI.
- T5. G. Strang, "Introduction to Linear Algebra", Fifth Edition, 2016, Wellesley-Cambridge Press, ISBN: 978-09802327-7-6.

**Reference Books:**

- R1. Nils J. Nilsson, "Introduction to Machine Learning" (online Lecture notes on Stanford AI)
- R2. Shai Shalev-Shwartz, and Shai Ben-David, "Understanding Machine Learning", Cambridge University Press, 2017.

**Weblinks**

- W1. <https://presiuniv.knimbus.com/user#/home>
- W2. <https://www.javatpoint.com/machine-learning>

**Topics relevant to "EMPLOYABILITY SKILLS":** Software demonstration, Probability mass function, Independence, Bayes' theorem, Span, Eigen Value for developing **Employability Skills** through **Participative Learning techniques**. This is attained through assessment component as mentioned in course handout

<b>Catalogue prepared by</b>	Dr. Shankar K. Ghosh, Dr. Alamelu Mangai Jothidurai, Dr. M Swapna
<b>Recommended by the Board of Studies on</b>	BOS NO: 1, BOS held on 22/12/2022
<b>Date of Approval by the Academic Council</b>	Academic Council Meeting No. 20, Dated 15/02/2023

<b>Course Code:</b> <b>CSE6011</b>	<b>Course Title:</b> Application of Probability theory in Computer Science		<b>L- P- C</b>	3	0	3
	<b>Type of Course:</b> Theory Course					
<b>Version No.</b>	2.0					
<b>Course Pre-requisites</b>	Basic probability concepts					
<b>Anti-requisites</b>	NIL					
<b>Course Description</b>	For both engineers and researchers in the field of Computer science, it is common to develop models of real-life situations and develop solutions based on those models. In this course, our objective is to give an idea regarding the application of probability theory in the modeling and analyzing different kinds of computer systems. We particularly focus on time complexity analysis of different algorithms, reliability analysis of networks, physical layer security as well as resource allocation in 5G and beyond. The target audience for this course is Masters and Ph.D., students. The student should have basic Probability concepts as a pre-requisite. With a good knowledge of different techniques of applying Probability theory in modeling/analyzing computer systems, the students will be able to develop efficient solutions for complex and challenging real-life problems.					
<b>Course Objective</b>	The objective of the course is to familiarize the learners with the concepts of <b>Application of Probability theory in Computer Science</b> and attain <b>EMPLOYABILITY SKILLS</b> through <b>PROBLEM SOLVING</b> techniques					
<b>Course Outcomes</b>	<b>On successful completion of this course the students shall be able to:</b> CO1: Develop mathematical models for various computer systems. CO2: Apply an appropriate probability concept to analyze the system. CO3: Apply appropriate Reinforcement learning techniques to solve complex real-life problems. CO4: Apply statistical Inference concepts to estimate parameters which are unknown to the model.					
<b>Course Content:</b>						
<b>Module 1</b>	Review on Basic Concepts	Assignment	Basic Probability Concepts	<b>12 Sessions</b>		
<b>Topics:</b> Basic probability concepts, Conditional probability, Expectation, random variables, Law of Large Numbers, well-known distributions, order statistics, and a basic idea of hypothesis testing, Central Limit Theorem. Applications in reliability analysis of VLSI chips, performance analysis of telephone network and binary communication channels, and application in the cognitive radio network.						
<b>Module 2</b>	Stochastic processes	Assignment	Markov process	<b>12 Sessions</b>		
<b>Topics:</b> Markov chain, Random Walks, Generating Functions, Birth-death process, application in modeling the behavior of wireless channels, memory interference problem, performance analysis of medium access protocols, analyzing the time complexity in the implementation of two stacks using a single array.						
<b>Module 3</b>	Reinforcement learning	Assignment	Understanding different Reinforcement learning techniques	<b>12 Sessions</b>		
<b>Topics:</b>						



**Simple Applications of Decision Theory, Model Comparison**, Markov decision process, value and policy iteration, off-policy and on-policy learning techniques (e.g., SARSA, Q-learning), Multi-arm Bandit problem (MAB), modeling resource allocation in 5G as MAB, Hidden Markov model (HMM), application of HMM in physical layer security.

**Targeted Applications & Tools that can be used:**

Markov's inequality  
Chernoff bound

**Project work**

-Performance analysis of the LRU stack model  
-Modeling multiprocessor systems and analyzing the reliability  
-Modeling handovers in wireless networks and performance analysis of handover algorithms.  
-A short survey on Monte Carlo simulation techniques.

**REFERENCE**

**MATERIALS: Text**

**Book(s):**

T1. Kishore S. Trivedi, "Probability and Statistics with Reliability, Queuing, and Computer Science Applications", PHI.

T2. Dimitri P. Bertsekas and John N. Tsitsiklis, "Introduction to Probability", MIT Press, FALL 2000.

T3. Richard S. Sutton and Andrew G. Barto, "Reinforcement Learning: An Introduction", MIT press.

T4. Narsingh Deo, "System simulation with digital computer", PHI

**Reference links:**

R1. <https://open.umn.edu/opentextbooks/textbooks/21>

**Weblinks**

W1. <https://presiuniv.knimbus.com/user#/home>.

W2. <https://www.cuemath.com/data/probability/>.

**Topics relevant to the development of "EMPLOYABILITY SKILLS":** Information retrieval of Search Engines Information Retrieval for developing **EMPLOYABILITY SKILLS** through **PROBLEM SOLVING** techniques. This is attained through assessment component mentioned in course handout

<b>Catalogue prepared by</b>	Dr. Shankar K. Ghosh
<b>Recommended by the Board of Studies on</b>	BOS NO: 1, BOS held on 22/12/2022
<b>Date of Approval by the Academic Council</b>	Academic Council Meeting No. 20, Dated 15/02/2023

<b>Course Code:</b> CSE 5017	<b>Course Title:</b> Machine Vision			<b>L- P- C</b>	3	0	3
	<b>Type of Course:</b> Discipline Elective Theory Only						
<b>Version No.</b>	1.0						
<b>Course Pre-requisites</b>	<b>Basic Mathematics</b> (Linear algebra, vector calculus, and probability), <b>MAT LAB / Open CV</b>						
<b>Anti-requisites</b>	<b>NIL</b>						
<b>Course Description</b>	This course provides an introduction to computer vision including fundamentals of image formation, camera imaging geometry, feature detection and matching, stereo, motion estimation and tracking, image classification and scene understanding. We'll explore methods for depth recovery from stereo images, camera calibration, automated alignment, tracking, boundary detection, and recognition. We'll use both classical machine learning and deep learning to approach these problems. The focus of the course is to develop the intuitions and mathematics of the methods in lecture, and then to learn about the difference between theory and practice in the projects.						
<b>Course Objective</b>	The objective of the course is to familiarize the learners with the concepts of <b>Machine Vision</b> and attain <b>EMPLOYABILITY SKILLS</b> through <b>PROBLEM SOLVING</b> techniques						
<b>Course Outcomes</b>	On successful completion of the course the students shall be able to:  1. Describe Image formation and Camera Models [ Knowledge ]  2. Classify techniques for Local feature extraction and tracking [Comprehension]  3. Apply the different category of calibration methods and dimension reconstruction approach for computer vision[Application]						
<b>Course Content:</b>							
<b>Module 1</b>	Basic Concept of Image Processing	Mini Project	Mapping Facial Features	<b>12 Classes</b>			
Introduction to Image Processing-Basic mathematical concepts: Image enhancement: Grey level transforms, Spatial filtering. Extraction of special features: edge and corner detection. Morphological processing, Image transforms, Discrete Fourier Transform, Fast Fourier Transform. Frequency domain enhancement.							
<b>Module 2</b>	Image Segmentation	Mini Project	Hand gesture recognition	<b>14 Classes</b>			
Image Segmentation Algorithms: contextual, non-contextual segmentation, texture segmentation. Feature Detectors and Descriptors, Feature Matching-Object Recognition, The Use of Motion in Segmentation Optical Flow & Tracking Algorithms, Face detection (Viola Jones), Face Recognition.							
<b>Module 3</b>	Image Dimensions	Mini Project	Surveillance	<b>14 Classes</b>			
2D and 3D feature-based alignment, Pose estimation, Geometric intrinsic calibration, -Camera Models and Calibration: Camera Projection Models – orthographic, affine, perspective, projective models. Projective Geometry, transformation of 2D and 3D, Internal Parameters, Lens Distortion Models							

Calibration Methods – linear, direct, indirect and multi plane methods. Visual servo. Stereo correspondence-Epipolar geometry, Fundamental matrix, Introduction to SLAM (Simultaneous Localization and Mapping).

#### Targeted Application & Tools that can be used:

Computer Vision applications are **used for traffic sign detection, surveillance and recognition**. Vision techniques are applied to segment traffic signs from different traffic scenes (using image segmentation) and algorithms to recognize and classify traffic signs.

#### Tools:

- MAT Lab/Open CV

#### Project work/Assignment:

##### Project Work:

1. Detect the faces of humans by mapping facial features from a video or an image. There are several steps involved in these projects, such as mapping features.
2. Hand gesture recognition is one of the critical topics for human-computer interaction. In this project, there are several tasks which are needed to be performed. This includes the hand region, which is to be extracted from the background, followed by segmenting the palms and fingers to detect finger movements.
3. Count the number of people passing through a specific scene. The applications of this project include civilian surveillance, pedestrian tracking, pedestrian counting, etc.
4. Design, implement and test on several regions on a set of images based on the segmentation algorithms.

#### Text Book

1. R. C. Gonzalez, R. E. Woods, 'Digital Image Processing', Pearson, 2017
2. Introduction to Computer Vision and its Application, Richard Szelinski, 2021

#### References

1. Emanuele Trucco and Alessandro Verri, "Introductory Techniques for 3-D Computer Vision", Prentice Hall, 1998.
- 2 Olivier Faugeras, "Three Dimensional Computer Vision", MIT Press, 1993.
- 3 Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer, 2011.
- 4 Milan Sonka, Vaclav Hlavac and Roger Boyle, "Image Processing, Analysis and Machine Vision", Third Edition, CL Engineering, 2013.
5. Marco Treiber, "An Introduction to Object Recognition Selected Algorithms for a Wide Variety of Applications", Springer, 2010.
6. Forsyth and Ponce, "Computer Vision – A Modern Approach", Second Edition, Prentice Hall, 2011.

Topics relevant to development of "EMPLOYABILITY SKILLS", "IMAGE SEGMENTATION and DIMENSIONS of Image Processing- We compare IMAGE PROCESSING/ COMPUTER VISION jobs with Information Technology service oriented jobs then obviously there is relatively limited scope. But things are changing very fast as time is changing. Scope of image processing/computer vision jobs is increasing day to day.

#### Catalogue prepared by

Dr. R Vignesh and Dr. Arul Murugan Ramu

#### Recommended by the Board of Studies on

BOS NO: 12<sup>th</sup> BOS, held on 04/08/2021

#### Date of Approval by the Academic

Academic Council Meeting No. 16, Dated 23/10/2021



<b>Course Code:</b> CSE 6012	<b>Course Title:</b> Recommender Systems with Machine Learning and AI					
	<b>Type of Course:</b> Discipline Elective		L- P- C	3	0	3
	Theory Only					
<b>Version No.</b>	2.0					
<b>Course Pre-requisites</b>	Basic knowledge of Python and Machine Learning					
<b>Anti-requisites</b>	NIL					
<b>Course Description</b>	This course helps us understand from the early days of collaborative filtering to bleeding-edge applications of deep neural networks and modern machine learning techniques for recommending the best items to every individual user.					
<b>Course Objective</b>	The objective of the course is to familiarize the learners with the concepts of <b>Recommender Systems with Machine Learning and AI</b> and attain <b>EMPLOYABILITY SKILLS</b> through <b>PARTICIPATIVE LEARNING</b> techniques					
<b>Course Outcomes</b>	<b>On successful completion of this course, the students shall be able to:</b> CO1. Define recommender systems CO2. Use content-based filtering using item attributes CO3.Build model-based methods including matrix factorization, SVD. CO4.Apply deep learning, AI, artificial and recursive neural networks, for session based recommendations. CO5. Analyse recommendation algorithms using various case studies.					
<b>Course Content:</b>						
<b>Module 1</b>	Introduction to Recommendation System	Assignment	Seminar	<b>12 Sessions</b>		
<b>Topics:</b> Introduction to Recommendation systems, Architecture of Recommendation systems, Basic models of Recommendation systems, Implicit Ratings, Explicit Ratings, Collaborative Filtering, Content-based Recommendation, <b>Advantages and Disadvantages of Content-based recommendations</b> , Knowledge-Based Recommender Systems, Hybrid Recommendation systems, Demographic Recommendation Systems, Applications of Recommendation systems, <b>Advantages and Disadvantages of recommendation systems</b> .						
<b>Module 2</b>	Content-Based Recommender Systems	Assignment	Mini Project	<b>12 Sessions</b>		
<b>Topics:</b> Introduction, Architecture of content-based recommendation, Basic components of Content-based systems, Learning User profiles and Filtering- KNN, case-based recommendation, Bayes Classifiers, Rule-based Classifiers, <b>Decision tree classifier</b> .						
<b>Module 3</b>	Model-Based Collaborative Filtering	Assignment	Mini project	<b>12 Sessions</b>		
<b>Topics:</b> Introduction to collaborative filtering, Decision and Regression Trees, Rule-based collaborative Filtering-Item-wise vs User-wise models, <b>Item-based collaborative filtering</b> , Naive Bayes Collaborative filtering, Basic matrix Factorization principle, and Singular Value Decomposition.						

<b>Module 4</b>	Hybrid Recommendation Systems	Assignment	Mini project	<b>12 Sessions</b>
<b>Topics:</b> Introduction to Hybrid Recommendation systems, Losses faced by recommendation systems: Bayesian personalized rating (BPR), Weighted approximation rank-pairwise(WARP). Weighted Hybrids, Switching Hybrids, Cascade Hybrids, Meta-Level Hybrids, Mixed hybrids, Advantages and disadvantages of Hybrid Recommendation systems.				
<b>Module 5</b>	Application and Evaluation of RS	Assignment	Seminar	<b>12 Sessions</b>
<b>Topics:</b> Case study on YouTube Recommendation, case study on Netflix Recommendation system, Case study on an restaurant ratings given by the customer, Offline Evaluation, Online Evaluation, Goals of Evaluation design- Accuracy, Coverage, Confidence and Trust, Diversity, Robustness and Stability, Scalability, Training and testing of Ratings, RMSE, MAE, Evaluating Ranking via Correlation, Utility, Receiver Operating Characteristics.				
<b>Targeted Applications &amp; Tools that can be used:</b> <b>Targeted Application: Web application development, AI, Operating systems</b> <b>Tools: Python IDLE, ANACONDA</b> <b>Application Areas:</b> <ul style="list-style-type: none"> <li>E-Commerce Application</li> <li>E-Learning Applications</li> <li>E-Business Services</li> <li>Artificial Intelligence and Machine Learning</li> <li>Enterprise-level/Business Applications</li> </ul> <b>Professionally Used Software: Python, Spyder, Jupyter Notebook, Tensorflow (TFRS), Amazon Personalize.</b>				
<b>Project work</b> <ul style="list-style-type: none"> <li>A scenario will be given to the students to be developed as a series of Program/ Application.</li> </ul> On completion of Module 3 and Module 4, students will be asked to develop a Mini Project using Python.				
<b>Textbooks</b> T1.Frank Kane - Building Recommender Systems with Machine Learning and AI, First Edition,2018 T2. Charu C.Aggarwal – Recommender Systems, Springer Publishing Company,2016.				
<b>References</b> R1. Katarzyna Tarnowska,Lynn Daniel – Recommender System for improving customer Loyalty,Springer,1 <sup>st</sup> edition,2020. R2. EthemAlpaydin, –Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series)  , Third Edition, MIT Press, 2014.				
<b>Weblinks</b> W1.W <a href="https://presiuniv.knimbus.com/user#/home">https://presiuniv.knimbus.com/user#/home</a> W2. <a href="https://www.geeksforgeeks.org/recommendation-system-in-python/">https://www.geeksforgeeks.org/recommendation-system-in-python/</a>				
<b>Topics relevant to the development of “EMPLOYABILITY SKILLS”:</b> Information retrieval of Search Engines Information Retrieval for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout				

<b>Catalogue prepared by</b>	Dr. Blessed Prince P
<b>Recommended by the Board of Studies on</b>	BOS NO: 1, BOS held on 22/12/2022
<b>Date of Approval by the Academic Council</b>	Academic Council Meeting No. 20, Dated 15/02/2023

<b>Course Code:</b> <b>CSE 5001</b>	<b>Course Title: Programming Methodologies using Java</b>  <b>Type of Course: Open Elective Theory Only</b>	<b>L-P-C</b>	3	0	3
<b>Version No.</b>	2.0				
<b>Course Pre-requisites</b>	Basic knowledge of any structured programming: Data types, variables, constants, operators, conditional & control structures, Loops, arrays & functions.				
<b>Anti-requisites</b>	Object Oriented Programming, Java				
<b>Course Description</b>	This course introduces the engineering of computer applications emphasizing modern software engineering principles: object-oriented design, decomposition, encapsulation, abstraction and testing by using Java Programming. This course has theory and lab component which emphasizes on understanding the implementation and application of object-oriented programming paradigm. All along the course, we discuss how OOP allows software engineers to develop complex software by making high-level abstractions starting from very general classes down to more concrete classes. The Programming methodology emphasizes on software engineering principles, following best practices in software development, which enables the student to build real time applications with industry standards.				
<b>Course Objective</b>	The objective of the course is to familiarize the learners with the concepts of <b>Programming Methodologies using Java</b> and attain <b>SKILL DEVELOPMENT</b> through <b>PROBLEM SOLVING</b> techniques				
<b>Course Out Comes</b>	On successful completion of the course the students shall be able to: CO1.Identify and model the objects and their relationship. CO2.Apply the concept of arrays, strings, polymorphism & inheritance for real world scenarios. CO3.Implement interface & packages for building applications CO4.Apply the error handling and multithreading concepts appropriately. CO5.Use collections and generics to create desktop applications. CO6. Create GUI and web-based application.				
<b>Course Content:</b>					
<b>Module 1</b>	INTRODUCTION	Assignment	Programming	<b>8 Sessions</b>	
Introduction to Object Oriented Programming, TOKENS: Data types, Variables, Operators, Control Statements, Command Line Arguments. Common Errors, Comments, <b>Difference between JDK,JRE and JVM</b> , <b>Data types in Java</b> , Pre-conditions and Post-conditions, Decomposition, Importance of Software Engineering.					
CLASSES, OBJECTS, AND METHODS: Defining a class, access specifiers, instantiating objects, reference variable, accessing class members and methods, constructors, method overloading, static members, static methods, inner class, Wrapper class.					
<b>Module 2</b>	Arrays, Strings, Inheritance, and Package	Assignment	Programming	<b>6 Sessions</b>	
Array, Strings, Inheritance, Interface: extending an interface, Implementing interfaces, Package: Package as Access Protection, Defining a Package, Library Packages, <b>Java polymorphism</b> ,					
<b>Module 3</b>	Exception Handling &MultiThreading	Assignment	Programming	<b>8 Sessions</b>	



Exception handling: Introduction to Exceptions, Difference between Exceptions & Errors, Types of Exception. Handling Exceptions: Use of try, catch, finally, throw, throws. User Defined Exceptions and **Exception handling with method overriding.**

Introduction to threads, life cycle of a thread, creating threads, extending the Thread Class, Implementing the “runnable” interface. Thread Priority, Thread synchronization, Intercommunication of Threads

<b>Module 4</b>	Generics, Collection Framework, JAR File	Assignment	Programming	<b>8Sessions</b>
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Generics: Introduction, using wildcard, generic method, generic class hierarchies, erasure. Collections: Introduction to Collections, Classification of Collection, **Interfaces that extends the collection interface.**

<b>Module 5</b>	Graphic Programming & Java Bean, Servlet, JDBC	Assignment	Mini Project	<b>10Sessions</b>
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Swings: Introduction, Swing GUI Components and Layout Managers, Swing Menus. Java Bean: Introduction, Introspection, Persistence, JavaBeans API. Servlet: Lifecycle, Simple Servlet, **Java Applets: Basics of applets, Graphics in applets, Displaying image in the applet, Event handling in the applet, Animation in the applet.**

**List of Laboratory Tasks:**

**Experiment N0 1:** Programming assignment with class, objects and basic control structures.

(Application:

Build a basic menu driven application). RandomGenerator Program, The RollDice Program.

**Level 1:** Programming scenarios which use control structures to solve simple case scenarios.

**Level 2:** Programming assignment which will build menu driven application by identifying the class and its relevant methods.

**Experiment No. 2:** Programming assignment using Arrays and Strings.

**Level 1:** Programming scenarios which build single dimensional and multidimensional array, apply the different methods to operate on strings.

**Level 2:** Programming assignment which will manipulate the data stored in matrices and identify the appropriate usage String methods.

**Experiment No. 3:** Programming assignment using acm.graphics Package, GCanvas, Methods Common to All GObjects, Interfaces and Methods Defined by Them, The Bouncing Ball Program Example, The Geometry of the GLabel Class, The GArc Class.

**Level 1:** Programming scenarios which use the concept the Package and usage of Packages

**Level 2:** Programming assignment which build application which have Packages for different scenarios.

**Experiment No. 4:** Programming assignment using Exception Handling

**Level 1:** Programming assignment on building applications using built in Exceptions.

**Level 2:** Programming assignment on building application using user defined Exceptions.

**Experiment No. 5:** Programming assignment using Multithreading. (E.g.: Building an application which performs different arithmetic operations and sharing the resources using threads)

**Level 1:** Programming scenarios to build a thread, assign priority and use the thread methods to perform operations

**Level 2:** Programming scenarios for building synchronized applications.

**Experiment No. 6:** Programming assignment using Collections, Generics. Music store case study: Managing Large Amounts of Data, Principles of Design, Defining the Song Class, Defining the Album Class, Considering the Data Structures Needed, Reusing Data - Shallow Copy vs. Deep Copy. Jar File: Creating a Jar file.

**Level 1:** Programming scenarios which build applications Using Collections and Generics.

**Level 2:** Programming scenarios which help in understanding the need and scenarios to use Collections

**Experiment No. 7:** Programming assignment to build GUI Applications. Building Online Music Store.

**Level 1:** Programming Scenarios to build GUI for a given scenario using Swings concepts.

**Level 2:** Understanding and application of Swing and Graphics Concepts to build an Application

<p><b>Targeted Application &amp; Tools that can be used:</b> Targeted Employment sector is Software application, product development Companies in IT sector and Non IT Sector. The skills include</p> <ul style="list-style-type: none"> <li>• Platform independent Application Development</li> <li>• Secure Application Development</li> <li>• Data Mining</li> <li>• Operating Systems.</li> <li>• Database Management Systems</li> <li>• Banking software</li> <li>• Automobiles</li> <li>• Mobile Applications</li> </ul> <p><b>Tools:</b> JDK (Java Development Tool kit), Integrated Development Environment (IDE), Apache NetBeans, Eclipse.</p> <p><b>Project work: Mention the Type of Project</b></p> <p><b>A scenario will be given to the student to be developed as a Java Application.</b></p> <p><b>Text Book</b>  T1. Cay S Horstmann and Cary Gornell, “CORE JAVA volume I-Fundamentals”, Pearson.  T2. Cay S Horstmann and Cary Gornell, “CORE JAVA volume II-Advanced Features”, Pearson.</p> <p><b>References</b>  R1. Herbert Schildt, “The Complete Reference Java 2”, Tata McGraw Hill Education.  R2. James W. Cooper, “Java TM Design Patterns – A Tutorial”, Addison-Wesley Publishers.  R3. Jim Keogh, “J2EE Complete reference”, Tata McGrawHill.  R4. Timothy C. Lethbridge and Robert Laganieri, “Object Oriented Software Engineering : Practical Software Development using UML and Java”, Tata McGrawHill.  R5. Sarcar, Vaskaran, “Java Design Patterns – A hands on experience with real world examples”, Apress.</p> <p><b>Weblinks</b>  W1. <a href="https://presiuniv.knimbus.com/user#/home">https://presiuniv.knimbus.com/user#/home</a>  W2. <a href="https://www.w3schools.com/java/java_intro.asp">https://www.w3schools.com/java/java_intro.asp</a>.</p> <p><b>Topics relevant to the development of “SKILL DEVELOPMENT”:</b> Tokens, Arrays, Strings, Inheritance and Package, Exception Handling &amp; Multithreading, Generics, Collection Framework, JAR File, Graphic Programming &amp; Java Bean, Servlet, JDBC, JavaBeans API. Servlet: Lifecycle, Simple Servlet for developing SKILL DEVELOPMENT through PROBLEM SOLVING techniques. This is attained through assessment component mentioned in course handout</p>	
<b>Catalogue prepared by</b>	Dr. Blessed Prince P
<b>Recommended by the Board of Studies on</b>	BOS NO: 1, BOS held on 22/12/2022
<b>Date of Approval by the Academic Council</b>	Academic Council Meeting No. 20, Dated 15/02/2023

Course Code:	Course Title: Human-Computer Interaction			L- P- C	3	0	3
CSE 5002	Type of Course: Open Elective Theory Only						
Version No.	2.0						
Course Pre-requisites	Basic knowledge of HTML and web design						
Anti-requisites	NIL						
Course Description	The Course is intended to introduce students about the key concepts of User Interface Design. It will cover the theory and methods that exist in the field. User Interface Design is an interdisciplinary field that integrates theories and methodologies from computer science, cognitive psychology, design, and many other areas. It stresses the importance of good interfaces and the relationship of interface design to effective human interaction with computers. It helps in categorizing the interfaces based on the processes, methods and programming used. It focuses on applications of emerging fields in user Interface Design.						
Course Objective	The objective of the course is to familiarize the learners with the concepts of <b>Human-Computer Interaction</b> and attain <b>SKILL DEVELOPMENT</b> through <b>Experiential Learning</b> techniques.						
Course Outcomes	On successful completion of the course the students shall be able to: CO1.Identify the factors influencing user interfaces; CO2.Apply guidelines, principles, theories, and methodologies for designing interfaces; CO3.Explain various user interface evaluation methods. CO4.Identify the applications of emerging fields in human-computer interaction						
Course Content:							
Module 1	Importance of User Interface Design	Assignment	Basics	10 Sessions			
<b>Topics:</b> Introduction: Importance of user Interface – definition, the importance of good design. Benefits of good design, <b>Types of user interface design</b> , <b>GUI design</b> , and A brief history of Screen design. Human Perception –Human Thinking, Emotion, Psychology and the design of interactive systems – Cognitive frameworks – Models of interaction, Frameworks, and HCI							
Module 2	Interface Design	Assignment	Designing	10 Sessions			
<b>Topics:</b> <b>Interface design:</b> The software life cycle Usability engineering Iterative design and prototyping, <b>UI design principles</b> -Interaction design – Guidelines – Principles – Theories – The process of design –Prototyping and Construction - Conceptual design – Physical design – The four pillars of design – Development methodologies – Participatory design – Scenarios development – Social impact statement for early design review							
Module 3	Evaluation of interface design	Case Study	Evaluation	8 Sessions			
<b>Topics:</b> <b>Evaluating interface design</b> Evaluating interface design – Evaluation, Goals of evaluation, Expert Reviews, Usability testing and Laboratories,Acceptance Tests, Evaluating during Active Use, Controlled Psychologically Oriented Experiments, Choosing an evaluation method, <b>Different challenges faced during evaluation.</b>							
Module 4	Information Presentation	Assignment	Applications	10 Sessions			

<b>Topics:</b>  <b>Information presentation:</b> Information presentation – Data type by task taxonomy, Challenges for Information Visualization -Information display factors–Analog vs digital presentation-Ubiquitous computing and augmented realities Ubiquitous computing applications research Design Focus: Ambient Wood – augmenting the physical Virtual and augmented reality Design Focus: Shared experience Design Focus: Applications of augmented reality Information and data visualization Design Focus: Getting the size right. Groupware – Goals of collaboration and participation, Design for Diversity <b>Targeted Applications &amp; Tools that can be used:</b>  Targeted employment sector is Developing Mobile Apps and web Applications vendors like Amazon, Flip kart, Snap Deal, Byjus, eBay etc. Targeted job profiles include HCI Specialist, UX Design etc.  <b>Tools:</b> <ul style="list-style-type: none"> <li>• Xampp Server</li> <li>• Any Text Editor like notepad++</li> </ul>	
<b>Case Study Analysis</b>  <b>Case Study Analysis:</b> <ul style="list-style-type: none"> <li>• Students have to choose any of the Application it can be Mobile App or web Applications and they should relate with User Interface Design concepts in term of Guidelines and Principles of Interface Design etc. to evaluate design with respect to user perspective.</li> </ul>	
<b>Text Book</b> T1.Ben Shneiderman and Catherine Plaisant, “Designing the User Interface”. Addison Wesley. T2.Dix A. et al. “Human-Computer Interaction”, Prentice Hall T3.The essential guide to user interface design, Wilbert O Galitz, Wiley Dream Tech.	
<b>References</b> R1.Yvonne Rogers, Helen sharp, Jenny Preece, “Interaction Design: Beyond Human Computer Interaction”, Wiley. R2.The Essentials of Interaction Design, Fourth Edition by Cooper, Reimann, Cronin, & Noessel (2014). R3.Human-Computer Interaction. Alan Dix, Janet Fincay, Gre Goryd, Abowd, Russell Bealg, Pearson Education	
<b>Weblinks</b> W1. <a href="https://presiuniv.knimbus.com/user#/home">https://presiuniv.knimbus.com/user#/home</a> W2. <a href="https://www.javatpoint.com/software-engineering-coding">https://www.javatpoint.com/software-engineering-coding</a> . W3. <a href="https://www.javatpoint.com/gui-testing">https://www.javatpoint.com/gui-testing</a> .	
<b>Topics relevant to the “ SKILL DEVELOPMENT”:</b> Identifying factors which influences User Interface Topics relevant to “Human Values and Professional ethics”: Guidelines for User Interface Design and Data collection for Term Assignments and case studies for developing SKILL DEVELOPMENT through Experiential Learning techniques. This is attained through assessment component mentioned in course handout.	
<b>Catalogue prepared by</b>	Prof. T Ramesh
<b>Recommended by the Board of Studies on</b>	BOS NO: 1, BOS held on 22/12/2022
<b>Date of Approval by the Academic Council</b>	Academic Council Meeting No. 20, Dated 15/02/2023



<b>Course Code:</b> CSE 5003	<b>Course Title:</b> IOT Applications			<b>L- P- C</b>	3	0	3
	<b>Type of Course:</b> Open Elective Theory Only						
<b>Version No.</b>	2.0						
<b>Course Pre-requisites</b>	Fundamentals of computer network, wireless sensor network, communication, internet technology, web technology and information security.						
<b>Anti-requisites</b>	NIL						
<b>Course Description</b>	This course introduces the core principles of Internet of things. This theory based course emphasizes on understanding the applications areas of IOT. The course will focus on creative thinking of IoT concepts & technologies.						
<b>Course Objective</b>	The objective of the course is to familiarize the learners with the concepts of <b>IOT Applications</b> and attain <b>SKILL DEVELOPMENT</b> through <b>Experiential Learning</b> techniques.						
<b>Course Outcomes</b>	On successful completion of the course the students shall be able to: CO1.Understand general concepts of Internet of Things (IoT) CO2.Recognize various devices, sensors and applications CO3.Apply design concept to IoT solutions CO4.Evaluate design issues in IoT applications CO5. Create IoT solutions using sensors, actuators and Devices						
<b>Course Content:</b>							
<b>Module 1</b>	Introduction to IoT	Assignment	Fundamentals	<b>10 Sessions</b>			
<b>Topics:</b> Introduction, Definition & Characteristics of IOT, Physical Design of IoT- Things in IoT, IoT Protocols, Logical design of IoT- IoT functional blocks, IoT Communication Models, IoT Communication APIs, IoT Enabling Technologies- Wireless sensor networks,Big data Analytics, <b>Embedded Devices and System</b> , <b>Advantages and disadvantages of IoT.</b>							
<b>Module 2</b>	IoT Protocols	Assignment	Protocols	<b>10 Sessions</b>			
<b>Topics:</b> <b>Connectivity Protocols:</b> 6LoWPAN, IEEE 802.15.4, Zigbee, Wireless HART, Z-Wave, ISA 100, NFC, RFID. <b>Communication/Transport Protocols:</b> Bluetooth. Data Protocols: Message Queue Telemetry Transport (MQTT), Constrained Application Protocol (CoAP), Advanced Message Queuing Protocol (AMQP), XMPP – Extensible Messaging and Presence Protocol, <b>Data Distribution Service(DDS).</b>							
<b>Module 3</b>	IoT Application building tools	Assignment	Tools	<b>10 Sessions</b>			
<b>Topics:</b> Introduction to Arduino Boards, Types of Arduino Boards, Installation of Arduino IDE, Usage of Tinker Cad, Structure of Coding – Embedded C, Hands-on session in Serial Monitor, Hands-on session in Traffic Signal, Hands-on session in Arduino UNO Board, <b>Hands-on session on gas detector using Arduino</b> , Introduction to WiFi Module (ESP8266), Introduction to Node MCU, Pin Configuration of Node MCU, Installation of Node MCU and Blynk Library files, Introduction to Blynk App Open Source Cloud Environment, demonstrate session in connecting Node MCU with Blynk, demonstrate session in Blinking Inbuilt LED in Node MCU, demonstrate session in Blinking of LED. Sensors and its applications.							
<b>Module 4</b>	Applications of IoT	Assignment	Analysis, Data Collection	<b>10 Sessions</b>			

<b>Topics:</b> <b>Overview of IoT applications:</b> Automotive and Transport, Smart factories, Smart buildings, Smart cities, Smart Utilities, Security and Surveillance, Retail, and Healthcare with suitable examples, <b>Wearables</b> . <b>Building IoT Application:</b> Enabling and facilitating the students to take up existing problems and building the solution.	
<b>Targeted Applications &amp; Tools that can be used:</b>  The targeted employment sector is service providers and control monitors like GE, Siemens, TCS etc. Targeted job profiles include digital domain and Physical system design engineer, IOT engineer, etc.	
<b>Tools:</b> <ul style="list-style-type: none"> <li>• Arduino IDE</li> <li>• TinkerCad</li> <li>• NodeMCU</li> <li>Tensor Flow and Keras</li> </ul>	
<b>Project work</b>	
<b>Mini Project:</b> <ul style="list-style-type: none"> <li>• A mini project to demonstrate use of IOT tools, techniques and protocols to build and smart real time application.</li> </ul>	
<b>Text Book</b> T1. "Internet of Things (A Hands-on-Approach)", by Vijay Madisetti and Arshdeep Bahga, 1st Edition, VPT, 2014 T2. "Industry 4.0: The Industrial Internet of Things", by Alasdair Gilchrist (Apress)	
<b>References</b> R1. "Industrial Internet of Things: Cyber manufacturing Systems" by Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer)	
<b>Weblinks</b> W1. <a href="https://www.udemy.com/internet-of-things-iot-for-beginners-getting-started/">https://www.udemy.com/internet-of-things-iot-for-beginners-getting-started/</a> W2. <a href="http://playground.arduino.cc/Projects/Ideas">http://playground.arduino.cc/Projects/Ideas</a> W3. <a href="http://runtimeprojects.com">http://runtimeprojects.com</a> W4. <a href="https://presiuniv.knimbus.com/user#/home">https://presiuniv.knimbus.com/user#/home</a>	
<b>Topics relevant to development of "SKILL DEVELOPMENT ":</b> Get introduced to AI programming and Interfacing of IOT devices for developing <b>SKILL DEVELOPMENT</b> through <b>Experiential Learning</b> techniques. This is attained through assessment component mentioned in course handout.	
<b>Catalogue prepared by</b>	Prof. Prakash B Metre, Prof. Mohammed Mujeer Ulla
<b>Recommended by the Board of Studies on</b>	BOS NO: 1, BOS held on 22/12/2022
<b>Date of Approval by the Academic Council</b>	Academic Council Meeting No. 20, Dated 15/02/2023



<b>Course Code:</b> CSE 5004	<b>Course Title: Programming Essentials in Python</b>		<b>L- P- C</b>	3	0	3
	<b>Type of Course: Open Elective Theory Based Course</b>					
<b>Version No.</b>	2.0					
<b>Course Pre-requisites</b>	Basic knowledge of Computers and Mathematics					
<b>Anti-requisites</b>	Python programming					
<b>Course Description</b>	This course introduces the core concepts of programming using Python. This course has theory component which emphasizes on understanding and programming right from basics to Visualization in Python. It helps the student to explore data by applying these concepts and also for effective problem solving, visualizing and analyzing.					
<b>Course Objective</b>	The objective of the course is to familiarize the learners with the concepts of Programming Essentials in Python and attain <b>SKILL DEVELOPMENT</b> through <b>Participative Learning</b> techniques.					
<b>Course Outcomes</b>	<b>On successful completion of this course the students shall be able to:</b> CO1.Illustrate the python programming constructs. CO2.Explore Data using Python Numpy and Pandas CO3.Demonstrate Data Visualization using Matplotlib. CO4.Analyze the data using scikit.					
<b>Course Content:</b>						
<b>Module 1</b>	Basics of Python programming	Assignment	Programming	<b>8 Sessions</b>		
<b>Topics:</b> Data types, Operators and expressions, I/O statements, Control structures- Sequential, selective and <b>Iteration logic</b> , Functions- user defined and builtin functions.						
<b>Module 2</b>	Data Exploration using Numpy and Pandas	Assignment	Programming	<b>10 Classes</b>		
<b>Topics:</b> Installation of <b>Numpy</b> , Numpy Basics, Placeholders, Datatypes, Arrays, Basic Statistics, Copying, Slicing & Subsetting, Indexing, Flattening, Reshaping, Resizing, Sorting, Swapping, Dealing with Missing values. <b>PANDAS</b> - the PYTHON Data Analysis Library, Motivation, Installation of PANDAS, PANDAS Data Structure, Series, Dataframe, Loading the Data, Descriptive Statistics, Indexing & ReIndexing, Renaming, Iteration, Sorting, Statistical functions, <b>loc &amp; iloc</b> Groupby Operations, Merging/Joining, Concatenation, Time Series, Working with Categorical Data and Text Data. <b>Pivot table</b>						
<b>Module 3</b>	I/O Tools and Visualization	Assignment	Mini project	<b>10 Sessions</b>		
<b>Topics:</b> <b>I/O API Tools</b> , CSV and Textual files, Reading data in CSV or text files, Using RegExp to parse txt files, Reading txt files into parts, Writing data in CSV, Reading and Writing HTML files, Reading data from XML, Reading and Writing data from excel file, JSON Data, The format HDF5, Pickle-PYTHON Object Serialization, Serialize a PYTHON object with cpickle The <b>Matplotlib library</b> , Installation, A simple interactive chart, Adding elements to the chart, Adding a grid, Adding a legend, Converting the session to an html file, Saving your chart directly as an image, Handling date values, Chart typology, Line charts, Histograms, Bar charts, Horizontal Bar Charts, Multiseries bar charts, Multiseries stacked bar chart, Pie chart.						

<b>Module 4</b>	Sci-kit	Assignment	Mini project	<b>8 Sessions</b>
<b>Topics:</b> <b>The Scikit learn library</b> , Machine learning, Supervised and Unsupervised learning, Supervised learning with Scikit learn, The iris flower dataset, KNN Classifier, Diabetes dataset, Linear Regression-the least square regression, SVMs, SVC, Non linear SVC, Plotting different SVM classifier using iris dataset.				
<b>Targeted Application &amp; Tools that can be used:</b> <b>Targeted Application : Web application development, AI, Operating systems</b> <b>Tools: Python IDLE, ANACONDA</b> <ul style="list-style-type: none"> <li>• <b>Application Areas:</b></li> <li>• Web Development</li> <li>• Game Development</li> <li>• Scientific and Numeric Applications</li> <li>• Artificial Intelligence and Machine Learning</li> <li>• Software Development</li> <li>• Enterprise-level/Business Applications</li> <li>• Education programs and training courses</li> <li>• Operating Systems</li> <li>• Web Scrapping Applications</li> <li>• Image Processing and Graphic Design Applications</li> </ul>				
<b>Professionally Used Software: Python IDLE, Spyder, Jupyter Notebook, Google Colab</b>				
<b>Project work/Assignment:</b> <ul style="list-style-type: none"> <li>• After completion of each module a programming based Assignment/Assessment will be conducted.</li> <li>• A scenario will be given to the students to be developed as a series of Program/Application.</li> </ul> <p>On completion of Module 3 and Module 4, students will be asked to develop a Mini Project using Python.</p>				
<b>Text Book</b> T1. Charles Dierbach, “Introduction to Computer Science Using Python”, Wiley India Edition, 2015.				
<b>References</b> R1. E. Balagurusamy, “Introduction to Computing and Problem-Solving Using Python”, Tata McGraw-Hill, 2016 R2. Y. Daniel Liang, “Introduction to Programming Using Python”, Pearson, 2017 R3. <a href="#">Python Tutor - Visualize Python, Java, C, C++, JavaScript, TypeScript, and Ruby code execution</a>				
<b>Weblinks</b> W1. <a href="https://presiuniv.knimbus.com/user#/home">https://presiuniv.knimbus.com/user#/home</a> W2. <a href="https://practice.geeksforgeeks.org/courses/Python-Foundation">https://practice.geeksforgeeks.org/courses/Python-Foundation</a>				
<b>Topics relevant to “SKILL DEVELOPMENT”:</b> Classification, Clustering and visualization of Charts for developing <b>SKILL DEVELOPMENT</b> through <b>Participative Learning Techniques</b> . This is attained through assessment component mentioned in course handout.				

<b>Catalogue prepared by</b>	Prof. Pallavi M, Prof. Shweta Singh
<b>Recommended by the Board of Studies on</b>	BOS NO: 19, BOS held on 04th Aug 2022
<b>Date of Approval by the Academic Council</b>	Academic Council Meeting No. 18, Dated 03th Aug 2022

<b>Course Code:</b> CSE 5008	<b>Course Title: Programming in Data Science</b> <b>Type of Course: Program Core</b> <b>Theory and Laboratory Integrated</b>		<b>L-P-C</b>	2	2	3
<b>Version No.</b>	2.0					
<b>Course Pre-requisites</b>	Basic knowledge of any structured programming: Data types, variables, constants, operators, conditional & control structures, Loops, arrays & function.					
<b>Anti-requisites</b>	Python, R Programming Language					
<b>Course Description</b>	This course introduces the core concepts of Data Science followed by programming using Python and R. This course has theory and lab component which emphasizes on understanding and programming right from Basics to Visualization in Python and R. It helps the student to explore data by applying these concepts and also for effective problem solving, visualizing and analyzing.					
<b>Course Objective</b>	The objective of the course is to familiarize the learners with the concepts of Programming in Data Science and attain <b>SKILL DEVELOPMENT</b> through <b>EXPERIENTIAL LEARNING</b> techniques					
<b>Course Out Comes</b>	On successful completion of the course the students shall be able to: CO1: Discuss about the process involved in Data Science CO2: Explore Data using Python Numpy and Pandas CO3: Demonstrate Data Visualization using Matplotlib CO4: Explore Data using R and Visualize using R Graphics					
<b>Course Content:</b>						
<b>Module 1</b>	Introduction to Data Science	Assignment	Case Studies	<b>10 Sessions</b>		
<b>Topics:</b> <b>Introduction to Data Science</b> -- The field of Data Science – The various Data Science Disciplines, Connecting the Data Science Disciplines, <b>Features of R</b> , Data Science Techniques and Tools – Types of Data – Measures and Metrics – Descriptive Statistics – Inferential Statistics. <b>Data Science Methodology</b> - From Problem to Approach and From Requirements to Collection, From Understanding to Preparation and From Modeling to Evaluation, From Deployment to Feedback. <b>Data Preprocessing</b> - Data Quality Assessment, Feature Aggregation, Dimensionality Reduction, Feature Encoding. <b>Predictive and descriptive analytics.</b>						
<b>Module 2</b>	Data Exploration using Numpy and Pandas	Assignment	Programming	<b>8 Sessions</b>		
<b>Topics:</b> Introduction to Python World, Motivation, Installation of <b>NUMPY</b> , Numpy Basics, Placeholders, Datatypes, Arrays, Basic Statistics, Copying, Slicing & Subsetting, Indexing, Flattening, Reshaping, Resizing, Sorting, Swapping, Dealing with Missing values. <b>PANDAS</b> - the PYTHON Data Analysis Library, Motivation, Installation of PANDAS, PANDAS Data Structure, Series, Dataframe, Loading the Data, Descriptive Statistics, Indexing & ReIndexing, Renaming, Iteration, Sorting, Statistical functions, <b>for and while loop in R</b> , Window functions, Aggregations. <b>Number of Missing values in single variable.</b> Groupby Operations, Merging/Joining, Concatenation, Time Series, Working with Categorical Data and Text Data.						
<b>Module 3</b>	I/O Tools and Visualization	Assignment	Mini Project	<b>8 Sessions</b>		
<b>Topics:</b> <b>I/O API Tools</b> , CSV and Textual files, Reading data in CSV or text files, Using RegExp to parse txt files, Reading txt files into parts, Writing data in CSV, Reading and Writing HTML files, Reading data from XML, Reading and Writing data from excel file, JSON Data, <b>Data inspection</b> The <b>Matplotlib library</b> , Installation, A simple interactive chart, Adding elements to the chart, Adding a grid, Adding a legend, Converting the session to an html file, Saving your chart directly as an image, Handling date values, Chart typology, Line charts, Histograms, Bar charts, Horizontal Bar Charts, Multiseries bar charts, Pie chart. <b>Preparing time series data.</b>						
<b>Module 4</b>	Introduction to R	Assignment	Programming	<b>10 Sessions</b>		

<p><b>Topics:</b></p> <p><b>R Environment</b>, Using R Studio, Vectors, List, Matrices, Arrays, Data Frames, Factors. Functions - Conditional Functions, User Defined Functions. Reading Data from files, Handling Missing Data, Installing Packages,</p> <p><b>R Graphics</b> – Plot, Line, Scatter Plot, Pie Charts, Bars, Histogram, Box Plots, 3D Pie Charts, 3D Scatter Plot, Visualization with GG Plot.</p> <p><b>R Statistics</b> – Dataset, Max &amp; Min, Mean Median Mode, Subgroup Analyses, Probability Distributions, Pipes in R.</p>
<p><b>List of Laboratory Tasks:</b></p> <p><b>Experiment No 1:</b> Create a Numpy array and perform the following operations on it  <b>Level 1:</b> Basic Statistics, Copying, Slicing &amp; Subsetting, Indexing, Flattening, Reshaping, Resizing,  <b>Level 2:</b> Sorting, Swapping, Dealing with Missing values</p> <p><b>Experiment No. 2:</b> Create a PANDAS Data frame and perform the following operations on it  <b>Level 1:</b> Descriptive Statistics, Indexing &amp; ReIndexing, Renaming, Iteration, Sorting, Dealing with Missing Data  <b>Level 2:</b> Statistical functions, Window functions, Aggregations</p> <p><b>Experiment No. 3:</b> Create a PANDAS Data frame and perform the following operations on it  <b>Level 1:</b> Group by Operations, Merging/Joining, Concatenation,  <b>Level 2:</b> Time Series, Categorical Data and Text Data</p> <p><b>Experiment No. 4:</b> Demonstrate Reading and Writing using IO API tools  <b>Level 1:</b> CSV and EXCEL files, HTML and XML files,  <b>Level 2:</b> HDF5 CPickle</p> <p><b>Experiment No. 5:</b> Using Matplotlib, Visualize the Data  <b>Level 1:</b> Visualize the data using Line Chart, Bar Charts, Pie Chart, Histograms, Bar chart, Horizontal Bar Chart  <b>Level 2:</b> Visualize the data using Multiseries Bar Chart, Multiseries Stacked Bar Chart</p> <p><b>Experiment No. 6:</b> Install R Studio and perform basic operations  <b>Level 1:</b> Vectors, List, Matrices, Arrays, Data Frames, Factors,  <b>Level 2:</b> Functions and handling Missing Data</p> <p><b>Experiment No. 7:</b> Using R graphics perform the following  <b>Level 1:</b> Plot, Line, Scatter Plot, Pie Charts, Bars, Histogram, Box Plots,  <b>Level 2:</b> 3D Pie Charts, 3D Scatter Plot, GG Plot</p> <p><b>Experiment No. 8:</b> Using R Statistics perform the following  <b>Level 1:</b> Max &amp; Min, Mean Median Mode, Subgroup Analyses,  <b>Level 2:</b> Probability Distributions and Pipes</p>
<p><b>Targeted Application &amp; Tools that can be used:</b></p> <ul style="list-style-type: none"> <li>• Data Exploration</li> <li>• Data Visualization</li> <li>• Data Analysis</li> </ul> <p><b>Tools:</b></p> <ul style="list-style-type: none"> <li>• Google Colab</li> <li>• Anaconda</li> <li>• R Studio</li> </ul>
<p><b>Project work</b></p> <ul style="list-style-type: none"> <li>• A scenario will be given to the students to be developed as a series of Program/ Application.</li> <li>• On completion of Module 2 and Module 4, students will be asked to develop a Mini Project using Python and R.</li> </ul>
<p><b>Text Book</b></p> <p>T1. The essentials of Data Science, Knowledge Discovery Using R, Graham J Williams, CRC Press, 2017</p> <p>T2. PYTHON Data Analysis, APRESS Publications, Fabio Nelli, 2015</p>

<b>References</b> R1. Comparative Approaches to using R and PYTHON for Statistical Data Analysis, Information Series Reference, 2018 R2. Practical Data Science CookBook, APRESS Publications, 2018  <b>Weblinks</b> W1. <a href="https://presiuniv.knimbus.com/user#/home">https://presiuniv.knimbus.com/user#/home</a> W2. <a href="https://www.simplilearn.com/data-science-free-course-for-beginners-skillup">https://www.simplilearn.com/data-science-free-course-for-beginners-skillup</a>	
Topics relevant to “ <b>SKILL DEVELOPMENT</b> ”: Data Exploration, Data Analysis and Visualization using Python and R Programming. for <b>Skill Development</b> through <b>Experiential Learning techniques</b> . This is attained through assessment component mentioned in course handout.	
<b>Catalogue prepared by</b>	Dr. R. Kesavamoorthy, Ms. Napalakshmi
<b>Recommended by the Board of Studies on</b>	BOS NO: 1, BOS held on 22/12/2022
<b>Date of Approval by the Academic Council</b>	Academic Council Meeting No. 20, Dated 15/02/2023

<b>Course Code:</b> CSE 5015	<b>Course Title:</b> Data Security and Access Control						
	<b>Type of Course:</b> Discipline Elective Theory Only			<b>L- P- C</b>	3	0	3
<b>Version No.</b>	2.0						
<b>Course Pre-requisites</b>	Basics of Cryptography, Networking						
<b>Anti-requisites</b>	NIL						
<b>Course Description</b>	This course describes fundamental issues and problems in data security and provides technical solutions or facets to the problem of achieving data security. The course also deals with the security of statistical databases, discusses authorization systems, and covers the fundamental ideas of cryptography.						
<b>Course Objective</b>	The objective of the course is to familiarize the learners with the concepts of Data Security and Access Control and attain <b>EMPLOYABILITY SKILLS</b> through <b>Participative Learning</b> techniques.						
<b>Course Outcomes</b>	On successful completion of the course the students shall be able to: CO1: Describe the basic concepts of a Data Security CO2: Apply appropriate techniques for security Algorithms CO3: Explain the Access Controls mechanisms CO4: Simulate data security algorithms for achieving access control						
<b>Course Content:</b>							
<b>Module 1</b>	Fundamentals of Data Security	Assignment	Algorithms	<b>8 Sessions</b>			
<b>Topics:</b> Introduction to Data Security, Confidentiality, Integrity, Availability, Visibility, Automation, Monitoring, Models and Methodology, and <b>The Security Problem in Computing. The Data Encryption Standard</b>							
<b>Module 2</b>	Data Security Techniques	Assignment/ Case Study	Presentation	<b>10 Sessions</b>			
<b>Topics:</b> Introduction, data masking, data erasure, and backup storage, Anti-malware protection, <b>viruses and other malicious code</b> , Security in Key specified model, Security in Characteristic specified model, <b>File Protection Mechanisms</b>							
<b>Module 3</b>	Authorization Mechanisms in Data Security	Assignment/ Case Study	Coding	<b>12 Sessions</b>			
<b>Topics:</b> Introduction, concept of Un-decidability, Authorization Systems with Tractable Safety Problem, Authorization Systems with Tractable Safety Problem, Grammatical Authorization Systems, <b>Threats in Network, Network Security Controls</b>							
<b>Module 4</b>	An Overview of Data Security Tools, Data Security Policies	Assignment/ Case Study	Simulation of DS tools	<b>8 Sessions</b>			

<b>Topics:</b> Introduction to tools available for Data Security, Demonstration of Security features in Linux platform, simulation using more than two computers, demonstration of data leakage during transmission, GDPR (General Data Protection Regulation), Comparative study with India regulation, Data Privacy Act, Role Based Access Control, Organizational <b>Security policies</b> .					
<b>Targeted Applications &amp; Tools that can be used:</b> Anomaly Deduction, Inclusion Prevention Systems, Firewall, Email Security <b>Tools:</b> SAGE Mathematical Library package, VPN					
<b>Assignment:</b>					
<b>Term Assignments:</b> <ol style="list-style-type: none"> <li>1. Implement Cryptographic algorithms using SAGE</li> <li>2. Comparative Study on Various Data Security Tools</li> <li>3. Case Study on GDPR - General Data Protection Regulation</li> <li>4. Identify Data Leakage in LINUX environment using Authorization Mechanisms</li> </ol>					
<b>Text Book</b> T1. Data Privacy and Security, David Solomon, Springer, T2. Principles of Data Security, Ernst L. Leiss, Plenum Press. New York And London					
<b>References</b> R1. Intelligence and Security Informatics for International Security, Chen, Hsinchun, Springer Publication 2006 R2. Certified Information Security Professional (CSIP) web portal					
<b>Weblinks</b> W1. <a href="https://presiuniv.knimbus.com/user#/home">https://presiuniv.knimbus.com/user#/home</a> W2. <a href="https://www.datasunrise.com/professional-info/what-is-access-control/">https://www.datasunrise.com/professional-info/what-is-access-control/</a>					
Topics relevant to "EMPLOYABILITY SKILLS": Email Security, Web Security, GDPR (General Data Protection Regulation), Grammatical Authorization Systems for developing <b>Employability Skills</b> through <b>Participative Learning techniques</b> . This is attained through assessment component mentioned in course handout.					
<b>Catalogue prepared by</b>	Mr. Murthy D H R				
<b>Recommended by the Board of Studies on</b>	BOS NO: 1, BOS held on 22/12/2022				
<b>Date of Approval by the Academic Council</b>	Academic Council Meeting No. 20, Dated 15/02/2023				
<b>Course Code:</b> CSE 6007	<b>Course Title:</b> IOT Data Analytics  <b>Type of Course:</b> Discipline Elective Theory Only	<b>L- P- C</b>	3	0	3
<b>Version No.</b>	2.0				



<b>Course Pre-requisites</b>	Computer networks, Data mining, Data analytics, and Basics of IoT.			
<b>Anti-requisites</b>	<b>NIL</b>			
<b>Course Description</b>	This course helps in understanding the context of analytics in IoT data. Strategies to collect IoT data in order to enable analytics. Skills learnt will enable to understand the tradeoffs in streaming and batch processing. Data science techniques such as machine learning, deep learning, and forecasting are applied on IoT data. This course also teaches how to implement machine learning methods and ARIMA forecasting on IoT data. Deep learning will be described along with a way to get started experimenting with it on AWS.			
<b>Course Objective</b>	The objective of the course is to familiarize the learners with the concepts of IoT Data Analytics and attain <b>EMPLOYABILITY SKILLS</b> through <b>Problem Solving</b> Methodologies.			
<b>Course Outcomes</b>	On successful completion of the course the students shall be able to: CO1: Discuss the challenges of IoT Analytics. CO2: Apply strategies and techniques to collect IoT data. CO3: Apply data science techniques on IoT data			
<b>Course Content:</b>				
<b>Module 1</b>	IoT analytics, challenges, devices and networking protocols	Assignment	Data Analysis task	<b>12 Sessions</b>
<b>Topics:</b> Defining IoT Analytics and Challenges Defining IoT Analytics. IoT analytics challenges, Core <b>IoT Functional Stack</b> , Functional <b>blocks of an IoT ecosystem</b> IoT Devices and Networking Protocols IoT devices Networking basics IoT networking connectivity protocols IoT networking data messaging protocols Message Queue Telemetry Transport (MQTT) Hyper-Text Transport Protocol (HTTP) Data Distribution Service (DDS)				
<b>Module 2</b>	Data - Strategies, Techniques and Exploring IoT Data	Assignment	Analysis, Data Collection	<b>12 Sessions</b>
<b>Topics:</b> Collecting All That Data - Strategies and Techniques Designing data processing for analytics Applying big data technology to storage Apache Spark for data processing Exploring IoT Data Exploring. <b>Data analytics tools</b>				
<b>Module 3</b>	Data Science for IoT Analytics	Case Study	Data analysis task	<b>13 Sessions</b>
<b>Topics:</b> Feature engineering with IoT data Validation methods Understanding the bias-variance trade off Comparing different models to find the best fit Random Forest models Gradient Boosting Machines Anomaly detection, Forecasting, <b>scaling issues.</b>				
<b>Targeted Application &amp; Tools that can be used:</b> Employment opportunities are available in Companies like Hexaware, Episteme, Randstad. Siemens, Accenture etc. as IoT Data Engineer  Tools R Python Microsoft Azure Stream Analytics.				

AWS IoT Analytics. SAP Analytics Cloud. Oracle Stream Analytics and Oracle Edge Analytics.	
<b>Project work</b>	
<b>Mini Project:</b>  Develop a IoT application for real time data analysis of manufacturing sector. The automated IoT Analytics should aid in using real time data to watch out for certain patterns and send alerts to the concerned departments. It should enable smart manufacturing.	
<b>Text Book</b>	
T1. "Analytics for the Internet of things (IoT)", Andrew Minter, Packt, 2017	
<b>References</b>	
R1. WInternet of Things and Big Data Analytics for Smart Generation, Valentina E Balas, Springer	
<b>Weblinks</b>	
W1. <a href="https://presiuniv.knimbus.com/user#/home">https://presiuniv.knimbus.com/user#/home</a> W2. <a href="https://www.orientsoftware.com/blog/iot-data-analytics/">https://www.orientsoftware.com/blog/iot-data-analytics/</a>	
Topics relevant to "EMPLOYABILITY SKILLS": Processing geospatial IoT Data, protocols Message Queue Telemetry Transport (MQTT) Hyper-Text Transport Protocol (HTTP) Constrained Application Protocol (CoAP) Data Distribution Service (DDS), Random Forest models Gradient Boosting Machines Anomaly detection for developing <b>Employability Skills</b> through <b>Problem Solving methodologies</b> . This is attained through assessment component mentioned in course handout.	
<b>Catalogue prepared by</b>	Prof. Shashidhar. V, Prof. S. Deepak Raj
<b>Recommended by the Board of Studies on</b>	BOS NO: 1, BOS held on 22/12/2022
<b>Date of Approval by the Academic Council</b>	Academic Council Meeting No. 20, Dated 15/02/2023

<b>Course Code:</b> CSE 6008	<b>Course Title: Probabilistic graph Models</b>			<b>L- P- C</b>	3	0	3
	<b>Type of Course: Discipline Elective Theory Only</b>						
<b>Version No.</b>	2.0						
<b>Course Pre-requisites</b>	<b>Probability, Probability distributions and graph theory</b> Basic concepts of probability, conditional probability, Standard probability distributions and basic concepts of undirected and directed graphs along with traversal.						
<b>Anti-requisites</b>	<b>NIL</b>						
<b>Course Description</b>	Probabilistic graphical models are used to model stochasticity (uncertainty) in the world and are extremely popular in AI and machine learning. The course will cover two classes of graphical models: Bayesian belief networks (also called directed graphical models) and Markov Random Fields (undirected models). After introducing the two frameworks the course will focus on recent advances in inferences and learning with graphical models, including topics such as loopy belief propagation, variational approximations, conditional Markov random fields and others.						
<b>Course Objective</b>	The objective of the course is to familiarize the learners with the concepts of <b>Probabilistic graph Models</b> and attain <b>EMPLOYABILITY SKILLS</b> through <b>PARTICIPATIVE LEARNING</b> techniques						
<b>Course Outcomes</b>	On successful completion of the course the students shall be able to: CO1: Apply key concepts of Statistics to solve problems. CO2: Analyze the properties of distributions encoded by graphs CO3: Illustrate Inference in graphic models CO4: Illustrate Learning in graphic models						
<b>Course Content:</b>							
<b>Module 1</b>	Fundamentals of Probability and Graph Theory	Assignment	Understanding all standard probability distributions	<b>9 Sessions</b>			
<b>Topics:</b> Fundamentals of Statistics and Probability, Conditional Probability, Conditional Independence, Joint Distributions, Baye’s Theorem, <b>Gaussians rule</b> , Probability Distributions, Fundamentals of Graph Theory - Paths, Cliques, Sub-graphs, Cycles and Loops.							
<b>Module 2</b>	Graphical Models	Assignment	Construction of Markov chain model for real time problems	<b>9 Sessions</b>			
<b>Topics:</b> Directed Models: Bayesian Network; Undirected Models: Markov Random Fields; Parameterization of MRFs, Independencies, <b>Duality and optimality, Non parametric Bayes hierarchical models.</b>							
<b>Module 3</b>	Inference in Graphical Models	Assignment	Study about some problems based on Monte Carlo method	<b>9 Sessions</b>			
<b>Topics:</b> Inference in Graph Models, Variable Elimination; Belief Propagation, Sampling Methods: Markov Chain Monte Carlo, <b>Convexity and optimization</b> , Hidden Markov Model, Viterbi Algorithm.							
<b>Module 4</b>	Learning in Graphical Models	Assignment	Applications of Naïve Bayes Classifier	<b>10 Sessions</b>			

<b>Topics:</b> Learning in Graph Models, Maximum Likelihood Estimation, Naïve Bayes Classifier, Conditional Random Fields, <b>constrained optimization problem</b>
<b>Targeted Application &amp; Tools that can be used:</b>  Targeted employment sector is to acquire knowledge to analyze the given problem to frame Probabilistic graphical models which are a powerful framework for representing complex domains using probability distributions, with numerous applications in machine learning, computer vision, natural language processing and computational biology.  <b>Tools:</b> <ul style="list-style-type: none"> <li>• Python</li> <li>• HUGIN Tool for Learning Bayesian Networks</li> <li>• MATLAB Toolbox for Bayesian net</li> </ul>
<b>Assignment:</b>  <b>Term Assignments:</b> <ul style="list-style-type: none"> <li>• <b>Analysis and Application of Bayesian Network to real time problems</b>   Understanding the given problem, analyze accordingly to apply Bayesian network and convert the problem in a Bayesian Network. The answering the required queries.</li> <li>• <b>A short survey of the Monte Carlo Method</b>   Study and analyze few realistic problems to apply Monte Carlo Technique to answer the solution of the problem.</li> <li>• <b>A short survey of the Markov Chain &amp; Hidden Markov Method</b>   Study and analyze few realistic problems to convert into Markov chain &amp; Hidden Markov to answer the required problem.</li> </ul>
<b>Text books(s)</b> T1. S. Lauritzen. Graphical Models. Oxford University Press, 1996. T2. David J.C. Mackay. Information theory, inference, and learning algorithms. Cambridge, UK: Cambridge University Press 2003.  <b>References(s)</b> R1. <a href="https://towardsdatascience.com/introduction-to-probabilistic-graphical-models-b8e0bf459812">https://towardsdatascience.com/introduction-to-probabilistic-graphical-models-b8e0bf459812</a> .  <b>Weblinks</b> W1. <a href="https://presiuniv.knimbus.com/user#/home">https://presiuniv.knimbus.com/user#/home</a> W2. <a href="https://home.cs.colorado.edu/~mozer/Teaching/syllabi/ProbabilisticModels//">https://home.cs.colorado.edu/~mozer/Teaching/syllabi/ProbabilisticModels//</a>
<b>Topics relevant to development of “EMPLOYABILITY SKILLS”:</b> Conditional Independence , Markov Random Fields; Parameterization of MRFs, Independencies,, Metropolis Hastings Algorithm, Hidden Markov Model, Viterbi Algorithm for developing Employability Skills through Participative Learning techniques. This is attained through assessment component mentioned in course handout

Catalogue prepared by	Dr. M.V Chakradhara Rao
Recommended by the Board of Studies on	BOS NO: 1, BOS held on 22/12/2022
Date of Approval by the Academic Council	Academic Council Meeting No. 20, Dated 15/02/2023

<b>Course Code:</b> CSE 6009	<b>Course Title: ARTIFICIAL NEURAL NETWORK</b>		<b>L- P- C</b>	3	0	3
	<b>Type of Course: Discipline Elective Theory only</b>					
<b>Version No.</b>	2.0					
<b>Course prerequisites</b>	<b>Pre-</b> [1] Basic Algebra [2] Probability [3] Statistics Familiarity with basics of probability and statistics, and linear algebra would be essential. Prior exposure to machine learning techniques would be desirable.					
<b>Anti-requisites</b>	<b>NIL</b>					
<b>Course Description</b>	The objective of this course is to provide students with a basic understanding of the fundamentals and applications of artificial neural networks. The course will cover techniques in Single layer perceptron classifier and feed forwards network for single layer and multilayer. Along with basic concepts of Associative network and Self organizing map.					
<b>Course Objective</b>	The objective of the course is to familiarize the learners with the concepts of <b>ARTIFICIAL NEURAL NETWORK</b> and attain <b>EMPLOYABILITY SKILLS</b> through <b>PROBLEM SOLVING</b> techniques					
<b>Course Outcomes</b>	On successful completion of this course the students shall be able to: CO1: Understand the mathematical foundations of neural network models. CO2: Solve real world problems using neural network systems. CO3: Explain feed forward network for Single layer and multiple layers. CO4: Describe the Knowledge of Associative memories and Self organizing maps.					
<b>Course Content:</b>						
<b>Module 1</b>	Fundamental Concepts of ANN	Assignment	Numerical to observe performance of different learning rule.	09 Sessions		
Topics: Structure of biological neurons relevant to ANNs. Models of ANNs; Feedforward & feedback networks; learning rules; Hebbian learning rule, perception learning rule, delta learning rule, Widrow-Hoff learning rule, <b>Directed Graph , knowledge representation.</b>						
<b>Module 2</b>	Single layer Perception Classifier	Assignment	Build classifier using discrete perceptron algorithm.	12 Sessions		
Topics: Classification model, training & classification using discrete perceptron, algorithm, single layer continuous perceptron networks for linearly separable classifications, <b>back propogation algorithm</b>						
<b>Module 3</b>	Feed forward Networks	Assignment	STEP BY STEP SOLVE BACK PROPAAATION	12 Sessions		
Topics: MULTI LAYER FEED FORWARD NETWORK: Linearly non-separable pattern classification, Delta learning rule for multi-perceptron layer, generalized delta learning rule, error back-propagation training, learning factors, Examples, <b>output representation and decision rule.</b> Single LAYER FEED FORWARDS NETWORK: Basic Concepts, Training & Examples.						
<b>Module 4</b>	ASSOCIATIVE MEMORIES AND SOM	Assignment	Paper Review of State of the Art OPT	10 Sessions		

<b>Topics:</b> Linear Association, Basic Concepts of recurrent Auto associative memory: retrieval algorithm, storage algorithm; By directional associative memory, Architecture, Association encoding & decoding, Stability. UN supervised learning of clusters, winner-take-all learning, separability limitations, two basic feature mapping models, SOM algorithm , properties of feature mapping.	
<b>Targeted Application &amp; Tools that can be used:</b> <b>Application Area:</b> Resource Allocation, Finance and Economics (Risk Analysis and Consumption Assessment), Fraud Detection, Image Segmentation, Dimensionality Reduction, Gene Expression Analysis, Recommender System, Image reconstruction, Large Scale Surveillance. <b>Tools:</b> Anaconda Navigator Python Packages	
<b>Text Books</b> T1. Machine Learning by Tom Mitchell, McGraw-Hill Press T2. Pattern Recognition and Machine Learning by Christopher M. Bishop, Springer, 2006	
<b>References</b> R1. Neural Networks A Classroom Approach– Satish Kumar, McGraw Hill Education (India) Pvt. Ltd, Second Edition. R2. Introduction to Artificial Neural Systems-J.M. Zurada, Jaico Publications 1994. R3. Artificial Neural Networks-B. Yegnanarayana, PHI, New Delhi 1998.	
<b>Weblinks</b> W1. <a href="https://presiuniv.knimbus.com/user#/home">https://presiuniv.knimbus.com/user#/home</a> W2. <a href="https://www.javatpoint.com/artificial-neural-network">https://www.javatpoint.com/artificial-neural-network</a>	
<b>Topics relevant to development of “EMPLOYABILITY SKILLS”:</b> Concept of feed forward network, Hopfield network, self-organizing map for developing Employability Skills through PROBLEM SOLVING techniques. This is attained through assessment component mentioned in course handout.	
<b>Catalogue prepared by</b>	Ms. Mitali Halder
<b>Recommended by the Board of Studies on</b>	BOS NO: 1, BOS held on 22/12/2022
<b>Date of Approval by the Academic Council</b>	Academic Council Meeting No. 20, Dated 15/02/2023

Course Code: CSE 6010	Course Title: Social Network Analysis		3	0	3
	Type of Course: Discipline Elective Theory Only	L- P- C			
Version No.	2.0				
Course Pre-requisites	CSE5016-Essentials for Machine Learning, CSE6011-Application of Probability theory in Computer Science				
Anti-requisites	NIL				
Course Description	The rapid growth of social media has given the mass consumers a powerful tool to create knowledge and propagate opinions. At the same time, social media has created an unprecedented opportunity for companies to engage real-time interactions with consumers. In addition, the size and richness of social media data has provided companies an unusually deep reservoir of consumer insights to transform the business and marketing operations. The social media analytics course will enable students to grasp the analytics tools to leverage social media data. The course will introduce tools such as engagement analytics, sentiment analysis, topic modeling, social network analysis, identification of influencers and evaluation of social media strategy.				
Course Objective	The objective of the course is to familiarize the learners with the concepts of Social Network Analysis and attain EMPLOYABILITY SKILLS through PROBLEM SOLVING techniques				
Course Outcomes	On successful completion of this course the students shall be able to: CO1: Interpret the social network landscape and appreciate the importance of analytics in business. CO2: Apply appropriate native analytics and measurement tools to analyze data in different social platforms CO3: Use Natural Language Processing for efficient mining of web data CO4: Demonstrate meaningful insights with actionable and strategic recommendations.				
Course Content:					
Module 1	Network Science	Quiz/Assignment	Analysis	9 Sessions	
Topics: Introduction to semantic web, limitation of current web, Central Measures, Community Analysis, CPM, Homophily and Triadic Closure, Affiliation Networks, Schelling model of Segregation, Current Social Media landscape, working environment, Getting analyzing and visualizing the data, Getting started with the toolset, Need for SMA, Applications of SMA in different areas. Connecting, Capturing and cleaning of Social Data. Social network analysis of social and behavioral sciences  APIs in nutshell, Introduction to authenticate techniques, Parsing API outputs, Basic cleaning techniques. Exploring GitHub's API, Analyzing GitHub Interest Graphs, Computing Graph Centrality Measures.					
Module 2	Analyzing Social graphs and Sentiment	Quiz	Project Development	10 Sessions	
Topics: Modeling and aggregating social network data, Exploring Facebook's Social Graph API, Open Graph Protocol, Analyzing Social Graph Connections, Mining your posts, Facebook Pages. Exploring Twitter's API, Analyzing Twitter using sentiment analysis, Frequency Analysis, Examining Patterns in Retweets.					
Module 3	Mining web pages	Assignment	Project Development	11 Sessions	



<b>Topics:</b> Scraping, Parsing and Crawling the Web: BFS in Web Crawling, Discovering Semantics by Decoding Syntax: NLP Illustrated Step-by-Step, Sentence Detection in Human Language Data, Document Summarization, Entity-Centric Analysis: A Paradigm Shift, Summarizing Human Language Data, Quality of Analytics for Processing Human Language Data, <b>trust models based on subjective logic</b> Campaigns and Consumer Reaction Analytics on YouTube: Structured and Unstructured, Scope and Process, Getting the data, Data pull, Data processing and Data analysis, <b>Attack spectrum and counter measures.</b>				
<b>Module 4</b>	<b>Recommender Systems and SEO</b>	Quiz	Group Discussion	<b>8 Sessions</b>
<b>Topics:</b> Content-Based Recommendation and Collaborative Filtering, <b>introduction to SEO, Keyword research Process, avoid negative SEO,</b> Search Engines, Google PageRank, IBM HITS, <b>Targeted Application &amp; Tools that can be used:</b> The applications of Social Media Analytics have been seen in industrial sector, sports and games, local governments services, tourism and hospitality services, politics, social issues, disaster management, community development issues, commerce and business applications, fashion industry, agricultural activities, online media, medical and health related services as well as supplier chain services. <b>Tools:</b> Google Colab or Jupyter Notebook(Anaconda). <b>Project work</b> On completion of all Modules, students will be given a Mini Project to build a deep learning model for a given application. Sample mini projects include: <b>Twitter Summaries</b> Twitter is famous for its character-limited posts. We can use this social media platform for an innovative summary-writing project. Consolidate the takeaways from a topic or reading discussed. Students should be able to understand the text, coherently organize the points and capture the central idea with 280 words, which is the character limit on Twitter. <b>Hashtag activism</b> Information and communication technologies provide a tremendous tool for spreading awareness and highlighting issues that may not be adequately represented in the mainstream media. Hashtag activism, in particular is concerned with driving social media traffic to oft-neglected topics. We can devise a project-based activity to teach our students about social justice, human rights, equality etc.				
<b>Text Book(s):</b> <b>T1.Matthew A. Russell, “Mining the Social Web”, O’Reilly, 3<sup>rd</sup> Edition, 2019.</b>				
<b>Reference(s):</b> <b>R1.Marco Bonzanini, “Mastering Social Media Mining with Python”, PacktPub, 2016.</b>				
<b>Weblinks</b> W1. <a href="https://presiuniv.knimbus.com/user#/home">https://presiuniv.knimbus.com/user#/home</a> W2. <a href="https://onlinecourses.nptel.ac.in/noc22_cs117/preview">https://onlinecourses.nptel.ac.in/noc22_cs117/preview</a>				
Topics relevant to “EMPLOYABILITY SKILLS: <b>Recommender Systems and SEO</b> for developing <b>Employability Skills</b> through <b>PROBLEM SOLVING</b> techniques. This is attained through assessment component mentioned in course handout				
<b>Catalogue prepared by</b>	Prof. G Poornima, Dr. Tapas Guha			
<b>Recommended by the Board of Studies on</b>	BOS NO: 1, BOS held on 22/12/2022			
<b>Date of Approval by the Academic</b>	Academic Council Meeting No. 20, Dated 15/02/2023			

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Course Code:	Course Title: Medical Image Processing					
CSE 5020	Type of Course: Discipline Elective Theory and Lab Integrated	L- T-P- C	2	0	2	3
Version No.	2.0					

<b>Course Pre-requisites</b>	<ul style="list-style-type: none"> <li>• Python programming language</li> <li>• Open CV library</li> <li>• Basics of digital image processing</li> </ul>			
<b>Anti-requisites</b>	<b>NIL</b>			
<b>Course Description</b>	The course introduces the basics to advance the implementation of biomedical images such as MRI, CT, X-ray, etc. Here we will be studying about complete basics of thecal image processing and then moving forward we will be learning about the various filters and feature extraction techniques. This course also teaches the segmentation and restoration techniques in depth along with the practical implementation.			
<b>Course Objective</b>	The objective of the course is EMPLOYABILITY SKILLS of student by using PARTICIPATIVE LEARNING techniques.			
<b>Course Outcomes</b>	<p>On successful completion of the course, the students shall be able to:</p> <p><b>CO 1:</b> understand digital image processing using OpenCV and Python programming language.</p> <p><b>CO 2:</b> Demonstrate image enhancements for Filter and feature extraction of statistical measurement.</p> <p><b>CO 3:</b> Implement deep learning techniques for image restoration and segmentation.</p> <p><b>CO 4:</b> Experiment with soft computing techniques for content-based medical image retrieval</p>			
<b>Course Content:</b>				
<b>Module 1</b>	Digital image processing	Assignment	Image processing	<b>10 Sessions</b>
<p><b>Introduction:</b> What is an image, Digital image, Image resolution, and aspect ratio, components of digital image processing, sampling, and quantization, applications areas, vision fundamentals, CAD systems, and research areas of digital image processing.</p> <p><b>Biomedical image processing:</b> various modalities of medical imaging: breast cancer imaging, mammographic imaging, ultrasound imaging, magnetic resonance imaging(MRI), and breast thermography imaging. Problems with medical images, image enhancement, and other modalities of medical imaging.</p>				
<b>Module 2</b>	Filters and feature extraction	Use case study	Feature extraction	<b>10 Sessions</b>
<p><b>Noise reduction filters for medical imaging:</b> sources of noise and filters used for noise reduction, spatial domain filters, frequency domain filters, practical results.</p> <p><b>Feature extraction and statistical measurement:</b> selection of features, shape-related features, Fourier descriptors, text analysis.</p>				

<b>Module 3</b>	<b>Image restoration and segmentation</b>	Assignment	Segmentation	<b>8 Sessions</b>
<p><b>Medical Image restoration:</b> Image resolution, degradation model, estimation of degradation function, blur model, medical image restoration, blur identification, super-resolution method.</p> <p><b>Biomedical image segmentation:</b> Broad classification and applications, point detection, line detection, edge detection methods, histogram-based image segmentation, segmentation using split and merge method, region growing method, watershed method, k-means clustering method, self-similar fractal method, topological derivative-based segmentation, comparison of segmentation methods.</p>				
<b>Module 4</b>	<b>Soft computing techniques and content-based image retrieval</b>	use case study	Content based image retrieval	<b>10 Sessions</b>
<p><b>Soft computing techniques:</b> Fuzzy-based techniques, Neural network-based techniques ,genetic algorithm-based techniques. <b>Content-based image retrieval (CBIR):</b> Visual connect descriptors, shape similarity measure, relevance feedback, distance measure and s, challenges,<b>Content-based medical image retrieval (CBMIR):</b> Challenges in implementation of CBMIR, Practical approaches of CBMIR.</p>				
<p><b>Targeted Application &amp; Tools that can be used:</b></p> <ul style="list-style-type: none"> <li>• Google Collab Pro</li> <li>• Jupyter Notebook with GPU</li> </ul>				
<b>Project work/Assignment:</b>				
<b>Mini project on feature extraction using deep learning algorithm such as CNN.</b>				
<p><b>Text Book</b> T1. G.R Sinha, Bhagwati Charan Patel, " Medical Image Processing Concepts and Applications", Eastern Economy Edition.2020</p>				
<p><b>References</b> R1. Geoff Dougherty California State University, Channel Islands" Digital Image Processing for Medical Applications", Cambridge University Press.2019</p>				
<p><b>Weblinks</b> W1. <a href="https://onlinecourses.nptel.ac.in/noc22_bt34/preview">https://onlinecourses.nptel.ac.in/noc22_bt34/preview</a> W2. <a href="https://www.slideshare.net/AboulEllaHassanien/medical-image-analysis-27297012">https://www.slideshare.net/AboulEllaHassanien/medical-image-analysis-27297012</a></p>				
<p><b>Topics relevant to development of "EMPLOYABILITY SKILLS": Design and development of feature extraction and segmentation algorithm using python programming language.</b></p> <p><b>Topic relevant to HUMAN VALUES &amp; PROFESSIONAL ETHICS": Naming and coding convention for Project Development.</b></p>				
<b>Catalogue prepared by</b>	Dr.Senthilkumar S			

<b>Recommended by the Board of Studies on</b>	BOS NO: SOCSE 2 <sup>nd</sup> BOS held on 10/07/23
<b>Date of Approval by the Academic Council</b>	Academic Council Meeting No 21, Dated XX/XX/XX