B.Sc. Data Science (Duration: 3 Years)

CURRICULUM and SYLLABUS

(For Academic Year 2023-24)

DEPARTMENT OF MATHEMATICS

NETAJI SUBHAS UNIVERSITY, POKHARI, JAMSHEDPUR-831012, JHARKHAND

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

The Program Educational Objectives (PEOs) of the Computer Applications are listed below:

PEO1. To prepare graduates to be successful professionals in industry, government, academia, research, entrepreneurial pursuit and consulting firms

PEO2. To prepare graduates to achieve peer-recognition, as an individual and as a team player, through demonstration of good analytical, design, implementation and interpersonal skills.

PEO3. To prepare graduates to contribute to society as broadly educated, expressive ethical and responsible citizens with proven expertise

PEO4. To prepare graduates to pursue life-long learning to fulfill their goals.

PROGRAMME OUTCOMES (PO'S):

(To be achieved by the student after every semester/year/and at the time of graduation)

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

1. ***Computer knowledge:*** *Apply the knowledge of mathematics, computer Fundamentals to IT applications.*
2. ***Design/Development of solutions:*** *Design solutions for IT applications using latest technologies and develop and implement the solutions using various latest languages.*
3. ***Modern tool usage:*** *Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex IT applications with an understanding of the limitations.*
4. ***Environment and sustainability:*** *Understand the impact of the IT analyst solutions in societal and environmental contexts, and demonstrate the knowledge and need for sustainable development.*
5. ***Ethics:*** *Apply ethical principles and commit to professional ethics and responsibilities*

   and norms of the engineering practice.
6. ***Individual and teamwork:*** *Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.*

PROGRAMME SPECIFIC OUTCOMES (PSO'S):

PSO-1: *Apply mathematical, conceptual knowledge of computing and analytical skills to demonstrate data analytics of real-world applications.*

PSO-2: *Hands-on experience with appropriate data analytics tools to enhance their knowledge in the field of data science.*

PSO-3: *Equipped with creative and technical skills in various domains of Data Handling, Predictive Modelling and Data Visualization.*

B.SC. DATA SCIENCE

SEMESTER- I									
SL. NO	**COURSE CATEGORY**	**COURSE CODE**	**NAME OF THE COURSE**	**L**	**T**	**P**	**C**	**S**	**TCH**
1	CF		English	2	0	0	2	1	2
2	CF		Mathematical Foundations for Data Science	3	1	0	4	0	4
3	PC		Programming in C	3	1	0	4	0	5
4	PC		Data Science Fundamentals	3	0	0	3	1	3
5	PC		Computer Organization	3	0	0	3	0	3
PRACTICAL									
6	PC		C Programming Lab	0	0	2	1	0	2
7	PC		Data Analysis with Excel Lab	0	0	2	1	0	2
			Total	14	2	4	18	2	21
L – Lecture; T – Tutorial; P – Practical; C – Credit; S- Self Study; TCH- Total Contact Hours									

SEMESTER - II									
SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
1			Statistics for Data Science	3	1	0	4	0	4
2			Data Structures and Algorithm	3	0	2	4	0	5
3			Operating Systems	3	0	0	3	1	3
4			Data Base Management System	3	0	0	3	0	3
5			Python for Data Science	3	0	0	3	1	3
PRACTICAL									
6			Database Management System Lab	0	0	2	1	0	2
7			Python Programming Lab	0	0	2	1	0	2
			Total	15	1	6	19	2	22
L – Lecture; T – Tutorial; P – Practical; C – Credit; S- Self Study; TCH- Total Contact Hours									

SEMESTER-III									
SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
1			Computer Networks	3	0	0	3	0	3
2			Artificial Intelligence	3	1	0	4	0	3
3			Data Analytics using R	3	1	0	4	1	4
4			Business Analytics	3	0	0	3	1	3
5			Elective – 1	2	1	2	4	0	5
PRACTICAL									
6			Data Science programming using R	0	0	2	1	0	2
7			Business Analytics Lab	0	0	2	1	0	2
			Total	14	3	6	20	2	22
L – Lecture; T – Tutorial; P – Practical; C – Credit; S- Self Study; TCH- Total Contact Hours									

SEMESTER- IV									
SL. NO	**COURSE CATEGORY**	**COURSE CODE**	**NAME OF THE COURSE**	**L**	**T**	**P**	**C**	**S**	**TCH**
1			Machine Learning	3	0	0	3	1	3
2			Data Security and Privacy	3	0	2	4	0	5
3			Professional Ethics and Life Skills	3	0	0	3	1	5
4			Data Handling and Visualization	3	0	0	3	1	3
5			Elective – II	2	1	2	4	0	5
PRACTICAL									
6			Machine Learning Lab	0	0	2	1	0	2
7			Data Handling and Visualization Lab	0	0	2	1	0	2
			Total	14	1	8	19	3	25
L – Lecture; T – Tutorial; P – Practical; C – Credit; S- Self Study; TCH- Total Contact Hours									

SEMESTER - V									
SL. NO	COURSE CATEGORY	COURSE CODE	NAME OF THE COURSE	L	T	P	C	S	TCH
1			Big Data and Analytics	3	0	0	3	1	4
2			Principles ofDeep Learning	3	0	2	4	0	5
3			Elective – III	2	1	2	4	0	5
4			Elective – IV	2	1	2	4	0	5
PRACTICAL									
5			Big Data and Analytics Lab	0	0	2	1	0	2
6			Mini Project	0	0	2	1	0	2
			Total	10	2	10	17	1	23
L – Lecture; T – Tutorial; P – Practical; C – Credit; S- Self Study; TCH- Total Contact Hours									

SEMESTER-VI									
SL. NO	**COURSE CATEGORY**	**COURSE CODE**	**NAME OF THE COURSE**	**L**	**T**	**P**	**C**	**S**	**TCH**
1			Techniques And Tools for Data Science	3	0	2	4	1	5
2			Elective – V	2	1	2	4	0	5
PRACTICAL									
3			Internship	*	*	*	1	*	0
4			Project Work	0	0	16	8	0	16
			Total	5	1	20	17	1	26
L – Lecture; T – Tutorial; P – Practical; C – Credit; S- Self Study; TCH- Total Contact Hours									

***3 weeks Internship.**

***Internship to be done during the Winter Vacation after the 5th Semester.**

TOTAL CREDITS: 110

LIST OF DEPARTMENTAL ELECTIVES WITH GROUPING - SEMESTER WISE									
SEM	**COURSE CATEGORY**	**COURSE CODE**	**NAME OF THE COURSE**	**L**	**T**	**P**	**C**	**S**	**TCH**
Elective I									
3	DE	CAC0253	Time Series Analysis	2	1	2	4	0	5
3	DE	CAC0254	Data Wrangling Techniques	2	1	2	4	0	5
Elective II									
4	DE	CAC0272	Predictive Modelling and Analytics	2	1	2	4	0	5
4	DE	CAC0273	Statistical Inference for Data Science	2	1	2	4	0	5
Elective III									
5	DE	CAC0359	Social Network Analytics	2	1	2	4	0	5
5	DE	CAC0360	Information Retrieval and Processing	2	1	2	4	0	5
Elective IV									
5	DE	CAC0361	Computer Vision Techniques	2	1	2	4	0	5
5	DE	CAC0362	Digital Image processing using MATLAB	2	1	2	4	0	5
Elective V									
6	DE	CAC0375	Conditional Monitoring Techniques for Data Science	2	1	2	4	0	5
6	DE	CAC0376	IoT Cloud and Data Analytics	2	1	2	4	0	5

SEMESTER-1

COURSE TITLE	ENGLISH			CREDITS	3
COURSE CODE	ELA0101	COURSE CATEGORY	CF	L-T-P-S	3-0-0-0
VERSION 1.0	APPROVAL DETAILS		LEARNING LEVEL		BTL-3

ASSESSMENT SCHEME

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

Course Description	This course has been designed to develop students' language skills and communication needs. It attempts to develop their proficiency through oral communication skills with an application knowledge of grammar and vocabulary. This course teaches students how to communicate accurately, appropriately and fluently in professional and social situations.
Course Objective	1. To acquire self-confidence by which the learner can improve upon their informative listening skills by an enhanced acquisition of the English language 2. To provide an environment to Speak in English at the formal and informal levels and use it for daily conversation, presentation, group discussion and debate 3. To equip the students to read intensively and extensively, short meaningful extracts from literary and non-literary texts and identify various types of connections among statements 4. To enhance the oral communication skills of the students via functions in clusters and respond to daily conversations naturally 5. To equip the learners in develop critical thinking skills and participate in Group activities, task-based activities and respond to hypothetical situations
Course Outcome	Upon completion of this course, the students will be able to 1. Apply the basic knowledge to upgrade from grammatical competence to communicative competence. 2. Develop skills by listening to speeches, lectures, telephone conversations, recorded versions of all the above, and responding non-verbally as well as verbally 3. Develop conscious awareness about the processes of metacognitive skills by considering societal and environmental contexts 4. Apply and analyse the contextual knowledge through reading the passages and participate in group activities and task-based activities 5. Identify his/her choicest field or specialized area through wide reading such as science fiction, crime thriller and so on by applying ethical principles and contributing to society

Prerequisites: Basic English

CO, PO AND PSO MAPPING

CO	PO -1	PO-2	PO-3	PO-4	PO-5	PO-6	PSO-1	PSO-2	PSO-3
CO-1	1	1	-	-	-	-	1	1	-
CO-2	-	-	-	-	-	-	-	-	-

CO-3	**1**	**-**	**2**	**-**	**-**	**2**	**1**	**-**	**2**

CO-4	-	-	-	-	-	**1**	-	-	-
CO-5	-	-	-	**1**	**1**	**2**	-	**1**	**1**

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

MODULE 1: EXTENSIVE READING	**(9L)**
Reading short meaningful extracts from literary and non-literary texts and identifying various types of connections among statements such as reason- result, statement-illustration, cause-effect, result-reason, addition, contradiction/opposite, introduction, furthering, adding, summing up, conclusion - Tracing the texture of texts — Referencing -- Anaphoric and cataphoric references — Identifying relationships between topic sentences and subordinate sentences **Suggested Activities:** Reading leading to making notes—Random note making—Systematizing conventions **Suggested Reading:** 1. Cambridge Academic English, An integrated skills course for EAP by Martin Hewing and Craig Thaine, by Cambridge University Press, 2014 2. Professional Speaking Skills by ArunaKoneru, Oxford Press, 2015	**CO-1 BTL-2**
MODULE 2 – INTENSIVE READING	**(9L)**
Matching discourse functions with corresponding linguistic structures — one function carried out through several structures — one structure fulfilling several functions - Cohesion and cohesive markers — Coherence and grammatical linkers -Reading newspapers at breakfast table — Reading publicity materials – Skimming – Reading quickly for grasping the main idea or point — Scanning — Reading carefully, looking for specific information — Railway timetable — medical prescription — textbooks — cover letters accompanying important documents - Reading and Note making — Purposes of note making -- Various formats of making notes — Short forms and abbreviations — commonly used and personal conventions **Suggested activities:** Non-literary texts for comparison and contrast -- Identifying words, phrases, idioms, phatic communion phrases, formulaic expressions etc. (which suits day to day communication) from reading materials and using them appropriately in one's own use **Suggested sources:** 1. (Listening and Speaking Modules) – Language Lab 2. Professional Speaking Skills by ArunaKoneru, Oxford Press	**CO-2 BTL-3**
MODULE – 3 :CRITICAL THINKING	**(9L)**
Identifying differences and similarities between pairs of pictures, illustrations, diagrams etc. and talking about them by working in pairs and small groups - Defining 'argument' — Components of an argument: reason and conclusion — illustrating arguments — Identifying arguments from a set of statements and identifying their components **Suggested Activities:** Developing critical thinking skills through visuals (print and electronic), Choose the best responses from the statements, Group activities, task-based activities, responses to hypothetical situations **Suggested sources:** 1. Essential English Grammar by Raymond Murphy, Cambridge University Press, 2016 edition	**CO-3 BTL-3**

2. Embark, English for Under Graduates by Steve Hart, Arvind Nair, Veena Bhambhani, Cambridge University Press 2016.	
MODULE – 4 :ORAL COMMUNICATION SKILLS	**(9L)**
Functions in clusters: Cluster 1**.** Inviting, responding with thanks, accepting invitation/declining - invitation with a valid reason, promising to meet on a later occasion, taking leave & bidding farewell 2. Apologizing, explaining reason, promising not to repeat the mistake, reassuring, taking leave - 3. Correcting someone, defending the right point or stance, convincing the other etc. - 4. Greeting, appreciating something good, illustrating the point further, Complimenting - 5. Complaining, defending logically, demanding things to be set right, and producing proof or evidence - Examples in the form of short recorded extracts of direct interactions as well as telephone conversations from various walks of life such as office work, business, advertisement, law court, police, various service providers such as gas agency, door delivery agency and so on **Suggested activities:** Listening to small meaningful chunks of day-to-day communication and responding to them naturally -- Greetings, formulaic expressions etc. Identifying and listing natural ways of functioning in contexts, based on short extracts taken from plays, or dialogues from fiction. **Suggested sources:** 1. Embark, English for Under Graduates by Steve Hart, Arvind Nair, Veena Bhambhani, Cambridge University Press 2016.	**CO-4 BTL -3**
MODULE 5 – FUNCTIONAL GRAMMAR	**(9L)**
Sentence – Parts of Speech – Comparative Adjectives - Pronouns – prepositions – conjunctions – Articles – Non-finite Verbs - tenses – conditionals – question tags – modal verbs – common errors – concord – Reported speech – Active & Passive voice **Suggested Activities:** Exercises related to grammatical aspects and its function in functional English (day to day conversations) **Suggested Sources:** 1. Essential English Grammar by Raymond Murphy, Cambridge University Press, 2016 edition	**CO-5 BTL -1**

TEXT BOOKS	
1.	Sabina Pillai and Agna Fernandez (2018), *Soft Skills & Employability Skills* ,Cambridge University Press.
2	Dolly John(2014), "*English for Life and the Workplace through LSRW&T skills*", Pearson Publications.
REFERENCE BOOKS	
1	Steve Hart et al(2016*), English for Undergraduates* Cambridge University Press
E BOOKS	
1	https://www.britishcouncil.in/english/courses-business
2	http://www.bbc.co.uk/learningenglish/english/features/pronunciation
MOOC	
1	https://www.mooc-list.com/tags/english
2	https://www.mooc-list.com/course/adventures-writing-stanford-online

COURSE TITLE	MATHEMATICAL FOUNDATIONS FOR DATA SCIENCE			CREDITS	4
COURSE CODE	MAA0106	COURSE CATEGORY	CF	L-T-P-S	3-1-0-0
VERSION 1.0	APPROVAL DETAILS	XX ACM, XX.XX.2022		LEARNING LEVEL	BTL-3

ASSESSMENT SCHEME

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

Course Description	Students learn the basics of mathematical foundations for data science. This course introduces the concepts of matrices, calculus, sets and probability theory.
Course Objective	1. To understand the concepts of matrices and calculus in data science 2. To solve problems in sets and foundations in logic. 3. To infer the relations and functions in sets 4. To perform hypothesis testing 5. To apply the concepts of probability in data science
Course Outcome	Upon completion of this course, the students will be able to 1. Interpret the concepts of matrices and calculus in data science 2. Infer problems in sets and foundations in logic. 3. Solve the relations and functions in sets 4. Use hypothesis testing for calculating Type I and Type II errors 5. Relate the concepts of probability in data science

Prerequisites: Basic Maths

CO, PO AND PSO MAPPING

CO	PO -1	PO-2	PO-3	PO-4	PO-5	PO-6	PSO-1	PSO-2	PSO-3
CO-1	3	2	1	2	1	2	3	1	2
CO-2	2	1	2	-	2	1	2	2	1
CO-3	3	2	1	2	1	2	3	1	2
CO-4	2	1	2	1	2	1	2	2	1
CO-5	-	1	1	2	1	2	3	1	1

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

MODULE 1: MATRICES ANDCALCULUS	**(12)**
Matrices as a way of organizing data – Matrices as images –Matrix operations – Identity matrix, inverses and determinants – Vector operations – Dot products -Introduction to Calculus- Applications of Calculus- Calculus Notation- Linear Functions- Derivative- Exponential & Logarithm Rule- Sine and Cosine Functions- Sigmoid Function- Differentiation- Partial Differentiation- Integration	**CO-1 BTL-2**
MODULE 2: SETS AND FOUNDATIONS IN LOGIC	**(12)**

Sets – Complex numbers – Counting and elementary combinations – Cardinality – Proof Methods –Quantified statements – Indirect argument – Mathematical Induction –Logic – Automated reasoning	**CO-2 BTL-3**

MODULE 3: RELATIONS AND FUNCTIONS

3. Relations on sets – Reflexivity, symmetry and transitivity – Functions on general sets – Examples of real functions – Composition of functions – one-to-one, onto and inverse functions – Real functions	**CO-3 BTL-3**
MODULE 4: HYPOTHESIS TESTING	
Hypothesis – Significance level and p-value –Type I and Type II Errors – Confidence interval and margin of errors – Calculating sample size and power – Performing hypothesis test – t-test and t-distribution	**CO-4 BTL-3**
MODULE 5: PROBABILITY THEORY	
Probability Basics – Calculating Simple Probabilities –Rule of Addition – Rule of Multiplication –Bayes Theorem – Expected value – Law of large numbers – Central limit theorem	**CO-5 BTL-3**

TEXT BOOKS	
1.	H. Anton, "Elementary Linear Algebra ", John Wiley, 2014.
2.	Zealure C Holcomb, "Fundamentals of Descriptive Statistics", Khanna Publishers, 2015.
3.	Kandasamy S. Chand," Numerical Methods", S. Chand publisher, 2008.
REFERENCE BOOKS	
1.	Sheldon Axler, "Linear Algebra Done Right", Springer Nature; 3rd ed. 2015.
2.	Peter Goos, David Meintrup, "Statistics with JMP: Graphs, Descriptive Statistics and Probability", Wiley, 2015.
E BOOKS	
1	https://www.britishcouncil.in/english/courses-business
2	http://www.bbc.co.uk/learningenglish/english/features/pronunciation
MOOC	
1.	https://www.coursera.org/learn/datasciencemathskills
2.	https://www.udacity.com/course/intro-to-descriptive-statistics--ud827

COURSE TITLE		**PROGRAMMING IN C**		**CREDITS**	**4**
COURSE CODE	**CAB0106**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**3-1-0-0**
VERSION	**1.0**	**APPROVAL DETAILS**	**XX ACM, XX.XX.2022**	**LEARNING LEVEL**	**BTL-3**

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

Course Description	To introduce computers and programming in C and also explore the power of computational techniques that are currently used by engineers and scientists and to develop programming skills with reasonable complexity.
Course Objective	1. To acquire the basic knowledge in computer hardware, programming languages and Problem-solving techniques. 2. To learn the fundamentals of C programming. 3. To gain knowledge in Functions, arrays and strings in C programming.

	4. To understand the pointers, Structures and Union in C programming 5. To gain Knowledge on Embedded Programming
Course Outcome	Upon completion of this course, the students will be able to 1. Describe the basics of digital computer and programming languages. 2. Demonstrate problem solving techniques using flowchart, algorithm/pseudo code to solve the given problem. 3. Design and Implement C program using Control Statements and Functions. 4. Design and Implement C program using Pointers and File operations. 5. Identify the need for embedded C in real-time applications.
Prerequisites: Programming skills	

CO, PO AND PSO MAPPING

CO	PO -1	PO-2	PO-3	PO-4	PO-5	PO-6	PSO-1	PSO-2	PSO-3
CO-1	3	2	1	2	1	2	3	-	2
CO-2	2	1	2	-	2	1	2	2	-
CO-3	3	2	-	2	1	2	2	-	2
CO-4	2	2	2	1	-	1	2	2	1
CO-5	2	1	2	2	1	2	3	1	-

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

MODULE 1 – PROGRAMMING LANGUAGES AND PROBLEM-SOLVING TECHNIQUES	**(12)**
Introduction – Fundamentals of digital computers - Programming languages - Programming Paradigms – Types of Programming Languages – Language Translators – Problem Solving Techniques: Algorithm – Flow Chart - Pseudo code.	**CO-1 BTL-2**
MODULE: 2 FUNDAMNETALS OF C	**(12)**
Evolution of C - Why C language - Applications of C language - Data Types in C – Operators and Expressions – Input and Output statements in C – Decision Statements – Loop Control Statements	**CO-2 BTL-3**
MODULE: 3 FUNCTIONS, ARRYS AND STRINGS	**(12)**
Functions – Storage Class – Arrays – Strings and standard functions -Pre-processor Statements.	**CO-3 BTL-3**
MODULE: 4 POINTERS, STRUCTURES AND UNION	**(12)**
Pointers – Dynamic Memory allocation – Structure and Union – Files.	**CO-4 BTL-3**
MODULE: 2 INTRODUCTION TO EMBEDDED C	**(12)**
Structure of embedded C program - Data Types - Operators - Statements - Functions - Keil C Compiler.	**CO-5 BTL-3**

TEXT BOOKS

1.	Jeyapoovan T, "Fundamentals of Computing and Programming in C", Vikas Publishing house, 2015.
2.	Mark Siegesmund, "Embedded C Programming", first edition, Elsevier publications, 2014.

REFERENCE BOOKS

1.	Ashok Kamthane, “Computer Programming”, Pearson Education, 7th Edition, Inc 2017.
2.	Yashavant Kanetkar, “Let us C”, 15th edition, BPP publication, 2016.
E BOOKS	

1.	https://en.wikibooks.org/wiki/C_Programming
MOOC	
1	https://onlinecourses.nptel.ac.in/noc18-cs10/preview
2.	https://www.coursera.org/specializations/c-programming

COURSE TITLE		**DATA SCIENCE FUNDAMENTALS**			**CREDITS**	**3**
COURSE CODE		**CAB0107**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**3-0-0-1**
VERSION	**1.0**	**APPROVAL DETAILS**	**XX ACM, XX.XX.2022**		**LEARNING LEVEL**	**BTL-3**

ASSESSMENT SCHEME

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

Course Description	The Course helps the students to learn various methodology to utilize the data analysis methods using Excel and perform various forecasting to improve the business.
Course Objective	1. To learn the fundamental concept of Data analytics and introduction to excel 2. To learn various data visualization tools available in Excel for data analytics 3. To learn and perform various research on data and perform predictive analysis 4. To incorporate various methods of advanced data analytics 5. To learn and implement various forecasting methods using Excel
Course Outcome	Upon completion of this course, the students will be able to 1. Explain the fundamental concept of Data Analytics and work with excel simple examples. 2. Infer various data visualization tool 3. Demonstrate various Data driven technique and perform predictive analysis 4. Perform various advanced data analysis like ANOVA 5. Create and execute several Forecasting methods using Excel

Prerequisites: NIL

CO, PO AND PSO MAPPING

CO	PO -1	PO-2	PO-3	PO-4	PO-5	PO-6	PSO-1	PSO-2	PSO-3
CO-1	3	2	1	2	1	1	2	1	2
CO-2	2	1	2	-	2	2	-	2	1
CO-3	3	-	-	2	1	-	2	1	2

CO-4	**2**	**2**	**2**	**1**	**-**	**2**	**1**	**-**	**1**
CO-5	**2**	**1**	**2**	**2**	**1**	**1**	**2**	**1**	**2**
1: Weakly related, 2: Moderately related and 3: Strongly related									

MODULE 1: INTRODUCTION TO Data Analytics & EXCEL (9)	
Introduction to Data Analytics - application of data modeling in business, databases and types of Data variables - Data analytical techniques – Need of Data Analytics, Introduction to Excel - Understanding Worksheet Basics - Perform Functions with Shortcut Keys - Formulas and Functions.	**CO-1 BTL-2**
MODULE 2: Data Visualization (9)	
Introduction to Data visualization technique – Chart types – Gantt & Milestone Chart–Smart art & Organization chart - Get creative with Icons, 3D models, Digital Inking - Putting Data in perspective with Pivots.	**CO-2 BTL-2**
MODULE 3: DATA-DRIVEN TECHNIQUES (9)	
Summarize Marketing Data: Slicing and Dicing Marketing Data with PivotTables - Using Excel Charts to Summarize Marketing Data - Using Excel Functions to Summarize- Marketing Data - Simple Linear Regression and Correlation - Using Multiple Regression to Forecast Sales - Copernican Principle to Predict Duration of Future Sales Viral Marketing - Text Mining.	**CO-3 BTL-3**
MODULE 4: Advanced Data Analytics with Excel (9)	
Complex Data Analysis using ToolPak: Enabling Analysis ToolPak in Excel - Descriptive Statistics in Excel -ANOVA in Excel - ANOVA: Single Factor - t-Test following ANOVA - ANOVA: Two Factor with Replication - ANOVA: Two Factor without Replication.	**CO-4 BTL-2**
MODULE 5: Forecasting in Excel (9)	
Forecast Sheet - One-click forecasting - Create Forecast Worksheet - Customize Forecast using Options - FORECAST Functions - FORECAST.ETS - FORECAST.ETS.CONFINT - FORECAST.ETS.STAT -What-if Analysis Tools - Scenario Manager - Goal Seek - Data Table - Solver Add-In.	**CO-5 BTL-2**
TEXT BOOKS	
1.	Manisha Nigam, "Advanced Analytics with Excel 2019", BPB 2019.
REFERENCE BOOKS	
1.	Wanyne. L. Winston, 2014 "Market Analytics Data Driven Technique with Microsoft Excel"
2.	David Whigham, 2019, "Business Data Analysis Using Excel", Oxford Publications.
E BOOKS	
1.	Punit Prabhu, 2019, “Data Analytics with Excel”
MOOC	
1.	https://www.coursera.org/learn/excel-data-analysis
2.	https://www.udemy.com/course/data-analytics-in-excel/

COURSE TITLE		**COMPUTER ORGANIZATION**			**CREDITS**	**3**
COURSE CODE		**CAB0108**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**3-0-0-1**
VERSION	**1.0**	**APPROVAL DETAILS**		**XX ACM, XX.XX.20**	**LEARNING LEVEL**	**BTL-3**

			22		

ASSESSMENT SCHEME					
First Periodical Assessment	**Second Periodical Assessment**	**Seminar/ Assignments/ Project**	**Surprise Test / Quiz**	**Attendance**	**ESE**

15%	15%	10 %	5 %	5 %	50%

Course Description	This course is a core course of computer science and engineering and covers the concepts of basic computer organization, Arithmetic Logic operations. The course also provides a broad understanding of computer hardware and Input output devices.
Course Objective	1. To understand the basic architecture 2. To familiarize with arithmetic and logic unit and implementation of different arithmetic operations. 3. To understand the concept of pipelining and parallelism 4. To know the difference types of memory and related performance issues. 5. To understand the concepts of Memory and IO devices.
Course Outcome	Upon completion of this course, the students will be able to 1. Identify the component of the basic computer architecture. 2. Demonstrate binary operations in ALU 3. Demonstrate theoretically the concept of pipelining and parallelism. 4. Appreciate the difference between Cache and Virtual memory and related performance issues. 5. Value the performance difference between and different memory devices and IO.

Prerequisites: Basics of Computers

CO, PO AND PSO MAPPING

CO	PO -1	PO-2	PO-3	PO-4	PO-5	PO-6	PSO-1	PSO-2	PSO-3
CO-1	3	2	1	2	1	2	3	-	2
CO-2	2	1	2	-	2	1	2	2	-
CO-3	3	2	-	2	1	2	2	-	2
CO-4	2	2	2	1	-	1	2	2	1
CO-5	2	1	2	2	1	2	3	1	-

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

MODULE 1: INTRODUCTION (9)

Eight ideas – Components of a computer system – Technology – Performance – Power wall –Uniprocessors to multiprocessors; Instructions – operations and operands – representing instructions – Addressing and addressing modes.

MODULE 2: ARITHMETIC FOR COMPUTERS (9)

ALU - Integer Addition, Integer Subtraction, Dealing/Detecting with Overflow - Designing ALU for MIPS, Multiplication- Multiply Algorithm-Optimized Multiplier- Faster Multiplier, Division-Divide Algorithm-Optimized Divider – Floating Point
Operations-Standard- IEEE Floating-Point Format.

MODULE 3: MIPS & PIPELINING (9)

Basic MIPS implementation – Building data path – Control Implementation scheme – Pipelining – Pipelined data path and control – Handling Data hazards & Control hazards – Exceptions.

MODULE 4 - INSTRUCTION-LEVEL PARALLELISM (9)

Instruction-level-parallelism – Parallel processing challenges – Flynn's classification – Hardware multithreading – Multicore processors.

MODULE 5 – MEMORY AND I/O (9)

Memory hierarchy - Cache Memory - Virtual memory, TLBs - Input/output system, programmed I/O, DMA and interrupts, I/O processors.	
TEXT BOOKS	
1.	David A. Patterson and John L. Hennessy, "Computer organization and design', Morgan Kaufmann / Elsevier, Fifth edition,
REFERENCE BOOKS	
1.	William Stallings, "Computer Organization and Architecture", Tenth Edition, Pearson Education, 2016.
2.	V.Carl Hamacher, Zvonko G. Varanesic and Safat G. Zaky, "Computer Organisation", VI th edition, Mc Graw-Hill Inc, 2012.
3.	Vincent P. Heuring, Harry F. Jordan, "Computer System Architecture", Second Edition, Pearson Education, 2005.
E BOOKS	
1	https://sites.google.com/site/uopcog/ebooks
2	https://inspirit.net.in/books/academic/Computer%20Organisation%20and%20Architecture%208e%20by%20William%20Stallings.pdf
MOOC	
1.	https://www.mooc-list.com/course/computer-architecture-coursera
2.	https://www.mooc-list.com/course/fundamentals-computer-architecture-coursera
3.	http://nptel.ac.in/courses/106102062/
4.	http://nptel.ac.in/courses/106103068/

COURSE TITLE		**C PROGRAMMING LAB**				**CREDITS**	**1**
COURSE CODE		**CAB0134**	**COURSE CATEGORY**		**PC**	**L-T-P-S**	**0-0-2-0**
VERSION	**1.0**	**APPROVAL DETAILS**		**XX ACM, XX.XX.2022**		**LEARNING LEVEL**	**BTL-3**

ASSESSMENT SCHEME

First Periodical Assessment	Second Periodical Assessment	Practical Assessment	ESE
15%	**15%**	**20%**	**50%**

Course Description	To introduce computers and programming in C and also explore the power of computational techniques that are currently used by engineers and scientists and to develop programming skills with reasonable complexity.
Course Objective	1. To acquire the basic knowledge in computer hardware, programming languages and Problem-solving techniques. 2. To learn the fundamentals of C programming. 3. To gain knowledge in Functions, arrays and strings in C programming. 4. To understand the pointers, Structures and Union in C programming 5. To gain Knowledge on Embedded Programming

Course Outcome	Upon completion of this course, the students will be able to 1. Describe the basics of digital computer and programming languages. 2. Demonstrate problem solving techniques using flowchart, algorithm/pseudo code to solve the given problem. 3. Design and Implement C program using Control Statements and Functions. 4. Design and Implement C program using Pointers and File operations. 5. Identify the need for embedded C in real-time applications.

Prerequisites: NIL

CO, PO AND PSO MAPPING

CO	PO -1	PO-2	PO-3	PO-4	PO-5	PO-6	PSO-1	PSO-2	PSO-3
CO-1	3	2	1	2	1	2	3	1	2
CO-2	2	1	2	-	2	1	2	2	1
CO-3	3	2	1	2	1	2	3	1	2
CO-4	2	1	2	1	2	1	2	2	1
CO-5	-	1	1	2	1	2	3	1	1

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

LIST OF PROGRAMS

1. Drawing Flowcharts using E- Chart & Writing pseudo code for the following problems

(i) Greatest of three numbers

(ii) Sum of Nnumbers

(iii) Computation of nCr

2. Fundamentals of C

(i) Program to illustrate arithmetic and logical operators

(ii) Program to read and print data of different types

(iii) Program to calculate area and volume of various geometrical shapes

(iv) Program to compute biggest of three numbers

3. Function, Arrays and Strings

(i) Program to compute Factorial, Fibonacci series and sum of n numbers using recursion

(ii) Program to compute sum and average of N Numbers stored in an array

(iii) Program to sort the given n numbers stored in an array

(iv) Program to search for the given element in an array

4. Pointers, Structures and Union

(i) Program to compute sum of integers stored in a 1-D array using pointers and dynamic memory allocation

(ii) Program to read and print records of a student/payroll database using structures

(iii) Program to simulate file copy

(iv) Program to illustrate sequential access file

(v) Program to illustrate random access file

TEXT BOOKS

1.	JeyapoovanT,"FundamentalsofComputingandProgramminginC",VikasPublishing house, 2015.
2.	Mark Siegesmund, "Embedded C Programming", first edition, Elsevier publications,2014.

REFERENCE BOOKS

1.	Ashok Kamthane, "Computer Programming", Pearson Education, 7th Edition, Inc 2017.
2.	Yashavant Kanetkar, "Let us C", 15th edition, BPP publication, 2016.
3	S.Sathyalakshmi, S.Dinakar, "Computer Programming Practicals – Computer Lab Manual", Dhanam Publication, First Edition, July 2013.

E BOOKS

1.	https://en.wikibooks.org/wiki/C_Programming
MOOC	
1.	https://onlinecourses.nptel.ac.in/noc18-cs10/preview
2.	https://www.coursera.org/specializations/c-programming

COURSE TITLE		**DATA ANALYSIS WITH EXCEL LAB**				**CREDITS**	**1**
COURSE CODE		**CAB0135**	**COURSE CATEGORY**		**PC**	**L-T-P-S**	**0-0-2-0**
VERSION	**1.0**	**APPROVAL DETAILS**		**XX ACM, XX.XX.2022**		**LEARNING LEVEL**	**BTL-3**

ASSESSMENT SCHEME

First Periodical Assessment	Second Periodical Assessment	Practical Assessment	ESE
15 %	15 %	20%	50 %

Course Description	The Practical Course helps the students to learn various technologies to enable the data analysis methods using MS Excel and perform various forecasting to improve the business.
Course Objective	1. To explain the fundamental concept of Data analytics and introduction to excel 2. To comprehend various data visualization tools available in Excel for data analytics 3. To learn and perform various research on data and perform predictive analysis 4. To incorporate various methods of advanced data analytics 5. To implement various forecasting methods using Excel
Course Outcome	Upon completion of this course, the students will be able to 1. Implement the fundamental concepts of Data Analytics and work with MS Excel. 2. Infer various data visualization tool 3. Demonstrate various Data driven technique and perform predictive analysis 4. Perform various advanced data analysis like Cognos Analytics. 5. Create and execute several Forecasting methods using Excel

Prerequisites: NIL

CO, PO AND PSO MAPPING

CO	PO -1	PO-2	PO-3	PO-4	PO-5	PO-6	PSO-1	PSO-2	PSO-3
CO-1	3	2	1	2	1	2	3	1	2
CO-2	2	1	2	-	2	1	2	2	1
CO-3	3	2	1	2	1	2	3	1	2
CO-4	2	1	2	1	2	1	2	2	1
CO-5	-	1	1	2	1	2	3	1	1

	1: Weakly related, 2: Moderately related and 3: Strongly related
LIST OF PROGRAMS	

1. Perform basic spreadsheet tasks including navigation, data entry, and using formulas.
2. Employ data quality techniques to import and clean data in Excel.
3. Create basic charts and pivot charts in Excel.
4. Construct advanced charts and visualizations.
5. Create a CGPA Calculator using Excel and Analyze the result.
6. Perform Data visualization for a Class result and create various Charts.
7. Perform market survey from sample market data from Kaggle and demonstrate the prediction.
8. Analyze data in spreadsheets by using filtering, sorting, look-up functions, and pivot tables.
9. Build dashboards using Excel and Cognos Analytics.
10. Standard Normal Probability Distribution in Excel

TEXT BOOKS	
1.	Manisha Nigam, "Advanced Analytics with Excel 2019", BPB 2019.
2.	Mark Siegesmund, "Embedded C Programming", first edition, Elsevier publications,2014.
REFERENCE BOOKS	
1.	Wanyne. L. Winston, 2014 "Market Analytics Data Driven Technique with Microsoft Excel"
2.	David Whigham, 2019, "Business Data Analysis Using Excel", Oxford Publications.
E BOOKS	
1.	Punit Prabhu, 2019, “Data Analytics with Excel”
MOOC	
1.	https://www.coursera.org/learn/excel-data-analysis
2.	https://www.udemy.com/course/data-analytics-in-excel/

SEMESTER-II

COURSE TITLE		STATISTICS FOR DATA SCIENCE			CREDITS	4
COURSE CODE		MAA0108	COURSE CATEGORY	CF	L-T-P-S	3-1-0-0
VERSION	1.0	APPROVAL DETAILS	XX ACM, XX.XX.2022		LEARNING LEVEL	BTL-3

ASSESSMENT SCHEME

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

Course Description	Students learn the basics of statistical methods. This course introduces the concepts of correlation, regression and types of testing hypothesis.
Course Objective	1. To understand the fundamentals of Statistics Methods 2. To comprehend the concepts of Probability and distribution 3. To interpret simple correlation and Regression analysis 4. To describe sampling inference and testing of hypothesis 5. To gain knowledge on time series and forecasting problems in statistical data
Course Outcome	Upon completion of this course, the students will be able to 1. Deploy concepts of Statistics method to compute averages for statistics data 2. Identify probability value of real-life situation problem by using Probability and distribution concepts 3. Analyze casual relation between two variables by using correlation and regression methods 4. Illustrate significance difference between Null and Alternative Hypothesis for statistical data 5. Recognize the trends between two statistical data by using time series method and solution of forecasting problems.

Prerequisites: NIL

CO, PO AND PSO MAPPING

CO	PO -1	PO-2	PO-3	PO-4	PO-5	PO-6	PSO-1	PSO-2	PSO-3
CO-1	2	2	1	1	1	1	3	1	1
CO-2	2	1	1	1	1	-	3	1	1
CO-3	3	2	1	1	1	1	3	1	1
CO-4	2	1	-	1	1	1	3	-	1
CO-5	3	2	1	1	1	1	3	1	1

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

MODULE 1: STATISTICAL METHODS (12)

Introduction to statistics and Data collection – Summarizing and presenting statistical Data – Measures of central tendency – Measures of variation – Measures of skewness and kurtosis	**CO-1 BTL-2**
MODULE 2: PROBABILITY AND DISTRIBUTION	**(12)**

Introduction – Definition of Probability – Basic concepts – Addition law of probability or Theorem of total probability – conditional probability – Bayes' theorem. Random variable – MGF – Distributions - Binomial - Poisson – Uniform – Normal	**CO-1 BTL-3**
MODULE 3: CORRELATION AND REGRESSION (12)	
Introduction – correlation analysis – simple correlation analysis – Rank correlation –Regression analysis	**CO-1 BTL-3**
MODULE 4: SAMPLING AND LARGE SDAMPLE TEST (12)	
Introduction – Parameters & Statistics – Statistical Inference – Testing of Hypothesis – Null & alternative Hypothesis – LOS- Test of significance of large and small samples – student's t-distribution – Chi – square test – F- distribution.	**CO-1 BTL-3**
MODULE 5: STATISTICAL INFERENCE (12)	
Characteristics of Estimators- Invariance Property of Consistent Estimators- Methods of Estimation- Method of Maximum Likelihood Estimation- Method of Minimum Variance- Confidence Intervals and Confidence Limits- Types of Errors.	**CO-1 BTL-3**

TEXT BOOKS	
1.	Richard I. Levin, David S. Rubin, " Statistics for Management ", Seventh Edition, Prentice – Hall of India, 2017.
2.	T. Veerarajan," Statistics", Third Edition, McGraw hill, 2008.
3.	Dr. B.S.Grewal, "Higher engineering Mathematics", Sixth Edition, Khanna publishers, 2017.
REFERENCE BOOKS	
1	Allen B. Downey, "Think Stats: Exploratory Data Analysis 2nd Edition", O'Reilly publications, 2015.
2	Peter Bruce , Andrew Bruce , Peter Gedeck, "Practical Statistics for Data Scientists", O'Reilly publications, 2020.
E BOOKS	
1	https://greenteapress.com/thinkstats2/html/thinkstats2015.html#sec150
MOOC	
1.	https://www.udemy.com/course/statistics-for-data-science-and-business-analysis/
2.	https://www.coursera.org/specializations/data-science-statistics-machine-learning

COURSE TITLE		**DATA STRUCTURES AND ALGORITHM**		**CREDITS**	**4**
COURSE CODE	**CAB0124**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**3-0-2-0**
VERSION	**1.0**	**APPROVAL DETAILS**	**XX ACM, XX.XX.2022**	**LEARNING LEVEL**	**BTL-3**
ASSESSMENT SCHEME					

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

Course Description	This course describes basic data structures such as stack, lists and linked lists, etc. Also, this course gives insight in nonlinear data structures like graphs, trees and their applications in solving real world problems.
Course Objective	Upon completion of the course the students will be able to, 1. To gain knowledge in designing algorithms to solve problems. 2. To understand the concept of linear and nonlinear data structures. 3. To know the concept of various sorting and searching techniques. 4. To acquire knowledge in graph traversal and searching. 5. To apprehend the greedy approach to solve problems.
Course Outcome	Upon completion of the course the students will be able to, 1. Compute and Analyze algorithms for efficiency using asymptotic notations. 2. Develop knowledge about basic data structures like arrays, linked list, trees. 3. Solve problems by applying suitable data structure. 4. Define graph and illustrate graph traversal. 5. Design and develop projects requiring implementation of the data structure.

Prerequisites: NIL

CO, PO AND PSO MAPPING

CO	PO -1	PO-2	PO-3	PO-4	PO-5	PO-6	PSO-1	PSO-2	PSO-3
CO-1	3	3	3	3	2	1	3	1	2
CO-2	2	3	2	3	3	2	-	2	1
CO-3	3	2	3	3	2	1	3	1	2
CO-4	2	-	3	2	-	2	3	1	1
CO-5	3	3	3	3	2	1	2	2	1

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

MODULE:! INTRODUCTION (6L+6P=12)

Introduction to Data structures - Algorithms - Algorithm Specifications - Performance analysis - Space Complexity - Time Complexity - Asymptotic Notations - Elementary of Data structures - Stack and Queue - Linked lists - Singly Linked List - Doubly linked list - Linked list-based implementation of Stacks.

Practical component:

1. Write a C program using functions to perform the following:
   a) Create a singly linked list of integers.
   b) Delete the given integer from the above linked list.
   c) Display the contents of the linked list before and after deletion.
2. Write a C program using functions to perform the following:
   a) Create a doubly linked list of strings.
   b) Delete the given string from the above linked list.
   c) Display the contents of the linked list before and after deletion.

CO-1 BTL-4

Suggested Readings:
Introduction of Data structures

MODULE 2: TREES AND GRAPHS (6L+6P=12)	
Trees - Dictionaries - Binary search trees - Priority Queues - Heaps - Heap Sort – Sets and Disjoint Set union - Union and Find operations - Graphs - introduction - definitions – Graph representations. **Practical component:** 1. Search for the given element in a matrix. 2. Binary search using recursion. 3. Infix to postfix conversion and evaluation of postfix. **Suggested Readings:** Advances in Binary search trees	**CO-2 BTL-2**
MODULE 3: SORTING AND SEARCHING (6L+6P=12)	
Sorting Algorithms: Basic concepts - Binary search - Finding the maximum and minimum - Merge sort - Quick sort - Performance measure - Randomized sorting algorithms - Selection sort - Strassen's matrix multiplication. **Practical component:** 1. Sort the list of integers using the following sorting methods: a) Merger Sort b) Selection Sort c) Quick Sort Heap sort(	**CO-3 BTL-3**
MODULE 4: ALGORITHM BASICS, BRUTE FORCE, DIVIDE AND CONQUER (6L+6P=12)	
Fundamentals of Algorithmic Problem Solving - Sorting - Searching - Graphs - Analysis Framework- Asymptotic Notations and Basic Efficiency Classes- Analysis of Recursive and Non-recursive algorithms. Brute Force - Travelling Salesman Problem, Knapsack Problem, Assignment Problem. Divide and Conquer Approach - Binary Tree Traversals, Multiplication of large Integers, Strassen's Matrix Multiplication. **Practical component:** 1. Calculate the complexity of algorithms. 2. Solve problems using brute force approach and analyze its complexity 3. Solve problems using divide and conquer approach and analyze its complexity	**CO-2 BTL-2**
MODULE 5: DYNAMIC PROGRAMING	
Dynamic Programming - Warshall's and Floyd's algorithm - Optimal Binary Search Trees - Memory Functions. Representing Graphs - Breadth First Search (BFS) - Depth First Search (DFS) - Single source shortest path - Dijkstra's algorithm - Prim's algorithm - Kruskal's algorithm - Backtracking - n Queen's problem - Hamiltonian Circuit Problem - Subset-Sum Problem - Branch and Bound - Approximation Algorithms - Travelling Salesman Problem, Knapsack Problem. **Practical component:** 1. Solve problem using dynamic programming approach and analyze its complexity 2. Solve problem using Greedy approach and analyze its complexity	**CO-3 BTL-3**

3. Implement Single source shortest path algorithm and Analyze its complexity 4. Implement Approximation algorithms for Traveling salesman problem and analyze its complexity 5. Implement Approximation algorithms for Knapsack problem and analyze its complexity	

TEXT BOOKS	
1.	Anita Goel, "Computer Fundamentals", 2nd Edition, Pearson Education, 2012.
2.	Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Third Edition, Pearson Education, 2017.
REFERENCE BOOKS	
1	Norton Peter, "Introduction to Computers", 4th Edition, TMH, 2001.
2	P. K. Sinha and PritiSinha , "Computer Fundamentals",6th Edition, BPB Publications ,2004.
3	Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, " Introduction to Algorithms", Third Edition, PHI Learning Private Limited, 2012.
E BOOKS	
1	https://books.google.co.in/books?id=zyOYs2EqZDgC&lpg=PP1&pg=PA1#v=onepage&q&f=false
1.	https://www.coursera.org/specializations/introduction-computer-science-programming
2.	https://www.udemy.com/course/computer-fundamentals-k/
3	https://www.coursera.org/learn/analysis-of-algorithms

COURSE TITLE	**OPERAING SYSTEMS**			**CREDITS**	**3**
COURSE CODE	**CAB0125**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**3-0-0-1**
VERSION	**1.0**	**APPROVAL DETAILS**	**XX ACM, XX.XX.2022**	**LEARNING LEVEL**	**BTL-3**

ASSESSMENT SCHEME

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

Course Description	An operating system is a system software that manages computer hardware, software resources and provides common services for computer programs. This course covers the basic and advanced concepts of operating system such as operating system components, CPU scheduling algorithms, Deadlocks and file organization techniques.

Course Objective	1. To describe and explain the fundamental components of a computer operating system. 2. To define, restate, discuss, and explain the policies for CPU scheduling 3. Describe reasons for using interrupts, dispatching, and context switching to support concurrency in an operating system 4. To identify the relationship between the physical hardware and the

	virtual devices maintained by the operating system 5. To compare and contrast different approaches to file organization, recognizing the strengths and weaknesses of each.
Course Outcome	Upon completion of this course, the students will be able to 1. Illustrate the basic functionalities of operating systems. 2. Demonstrate the concepts of process management and deadlocks. 3. Implement different memory allocation techniques. 4. Implement File systems and disk I/O techniques 5. Apply the techniques for accessing remote files.

Prerequisites: NIL

CO, PO AND PSO MAPPING

CO	PO -1	PO-2	PO-3	PO-4	PO-5	PO-6	PSO-1	PSO-2	PSO-3
CO-1	3	2	2	1	1	1	2	1	1
CO-2	3	2	2	-	1	1	2	1	1
CO-3	-	2	2	1	1	1	-	1	1
CO-4	3	2	2	1	1	1	2	1	1
CO-5	3	2	2	1	1	1	2	1	1

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

MODULE: INTRODUCTION	**(9)**
Introduction - Computer System Organization - Computer System Architecture Computer System Structure - Operating System Operations - Process Management - Memory Management - Storage Management - Distributed Systems - Operating System Services - User Operating System Interface - System Calls - Types of System calls - System Programs - Process Concept - Process Scheduling -Operations on Processes - Inter-process Communication. **Suggested Readings:** CPU Scheduling algorithms , Deadlock Prevention and Detection	**CO-1 BTL-3**
MODULE 2: PROCESS MANAGEMENT AND COORDINATION	**(9)**
Process Concept - Operations on Processes - Interprocess Communication Threads - Multithreading Models - Process Scheduling - Scheduling Criteria - Scheduling Algorithms - Thread Scheduling - Multiple-Processor Scheduling - Synchronization - The Critical-Section Problem - Peterson's Solution - Semaphores - Deadlocks - System Model - Deadlock Characterization - Methods for handling Deadlocks - Deadlock Prevention - Deadlock avoidance- Deadlock detection - Recovery from Deadlock. **Suggested Readings:** CPU Scheduling algorithms , Deadlock Prevention and Detection	**CO-2 BTL-3**
MODULE 3: MEMORY MANAGEMENT	**(9)**
Memory - Management Strategies – Swapping - Contiguous Memory allocation - Paging Segmentation - Virtual Memory Management - Demand Paging - Copy on Write - Page Replacement - Allocation of frames - Thrashing - Memory Mapped Files - Allocating Kernel Memory **Suggested Readings:** Virtual Memory Management	**CO-3 BTL-3**

MODULE 4: STORAGE MANAGEMENT	(9)
File Concept - Access Methods - Directory and Disk Structure - File System Structure - File System Implementation - Directory Implementation - Allocation Methods - Free-Space Management - Recovery - Disk Structure - Disk Attachment - Disk Scheduling - Disk Management - Swap Space Management - RAID Structure - Stable Storage Implementation - Tertiary Storage Structure **Suggested Readings:** File Management system, Directory and Disk Structure	**CO-4 BTL-3**
MODULE 5: DISTRIBUTED SYSTEMS	**(9)**
Advantages of Distributed Systems -Types of Network based Operating Systems - Network Structure - Network Topology - Communication Structure - Communication Protocols - Robustness - Design Issues - Naming and Transparency - Remote File Access - Stateful versus Stateless Service - File Replication **Suggested Readings:** Distributed Operating Systems, Distributed File Systems	**CO-5 BTL-3**

TEXT BOOKS	
1.	Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", Tenth Edition, John Wiley & Sons (ASIA) Pvt. Ltd, 2018
REFERENCE BOOKS	
1	Stallings, William. "Operating Systems", Fifth Edition. Pearson Education India, 2006..
E BOOKS	
1	http://www.freebookcentre.net/CompuScience/Free-Operating-Systems-Books-Download.html
1.	https://www.coursera.org/courses?query=operating%20system

COURSE TITLE		**DATABASE MANAGMENR SYSTEMS**			**CREDITS**	**3**
COURSE CODE		**CAB0126**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**3-0-0-0**
VERSION	**1.0**	**APPROVAL DETAILS**	**XX ACM, XX.XX.2022**		**LEARNING LEVEL**	**BTL-3**

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

Course Description	This course gives a detail understanding about the basics of database management system, to develop queries and implement it, to know about form generation and report generation, transaction management, concurrency control during the data base transaction, client server and distributed architectures.

Course Objective	1. To understand the basics of data base system 2. To learn Query Basics and SQL commands 3. To comprehend the concepts of storage structures, form design, usage of report 4. To apprehend the concepts of transaction management and recoverability 5. To gain knowledge on database architecture, directory system and network types.
Course Outcome	Upon completion of this course, the students will be able to 1. Create a normalized database for an organization. 2. Implement and test database queries for any real time databases. 3. Formulate and design forms and reports for database applications. 4. Apply transactional management and concurrency control for a database transaction. 5. Recognize the features of client server architecture, distributed architecture, directory system and network types

Prerequisites: NIL

CO, PO AND PSO MAPPING

CO	PO -1	PO-2	PO-3	PO-4	PO-5	PO-6	PSO-1	PSO-2	PSO-3
CO-1	2	2	1	1	1	1	3	1	1
CO-2	2	2	1	1	-	1	3	1	1
CO-3	2	-	1	1	1	1	3	1	1
CO-4	2	2	1	1	1	1	3	-	1
CO-5	2	2	1	1	1	1	3	1	1

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

MODULE 1: INTRODUCTION TO DATA BASE MANAGEMENT SYSTEM	**(9)**
Advantages and Components of a Database Management Systems - Feasibility Study – Class Diagrams - Data Types - Events - Normal Forms - Integrity - Converting Class Diagrams to Normalized Tables - Data Dictionary.	**CO-1 BTL-3**
MODULE 2: QUERIES AND SUBQUERIES	**(9)**
Query Basics - Computation Using Queries - Subtotals and GROUP BY Command – Queries with Multiple Tables - Subqueries - Joins - DDL & DML - Testing Queries.	**CO-2 BTL-3**
MODULE 3: FILE STORAGE, FORMS AND REPORTS	**(9)**
Storage and File Structure - RAID - File Organization - Indexing and Hashing - B Tree - B Tree Index files - Static and Dynamic Hashing - Effective Design of Forms and Reports - Form Layout - Creating Forms - Graphical Objects - Reports - Procedural Languages - Data on Forms - Programs to Retrieve and Save Data.	**CO-3 BTL-3**
MODULE 4: TRANSACTION & CONCURRENCY CONTROL	**(9)**
Transaction Management – Implementation of Atomicity and Durability – Serializability – Recoverability – Concurrency Control – Dead Lock Handling – Recovery System – Buffer Management.	**CO-4 BTL-3**

MODULE 5: DATABASE ARCHITECTURE & DISTRIBUTED DATABASE	**(6)**
Database – System Architecture – Client Server – Architectures – Parallel System – Network Types – Distributed Database – Homogeneous and Heterogeneous Database – Directory System – Case Study – Oracle – MSSQL	**CO-5 BTL-3**

Server.	
TEXT BOOKS	
1.	A. Silberschatz, H.F. Korth and S. Sudharshan, "Database System Concepts" , Fifth Edition, Tata McGraw Hill, New Delhi, 2006.
2.	G. V. Post, "Database Management Systems Designing and Building Business Application" ,McGraw Hill International edition, 1999.
REFERENCE BOOKS	
1	J. D. Ullman, "Principles of Database Systems", Galgotia Publishers, Second Edition, New Delhi, 1988
2	C.J. Date, An Introduction to Database Systems, Third Edition, Narosa, New Delhi, 1985
E BOOKS	
1	https://www.amazon.com/Database-Management-Systems-Raghu- Ramakrishnan /dp/0072465638
1.	https://www.coursera.org/learn/core-database
2.	https://swayam.gov.in/courses/4598-database-and-content-organisation

COURSE TITLE	**PYTHON FOR DATA SCIENCE**			**CREDITS**	**3**
COURSE CODE	**CAB0127**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**3-1-0-0**
VERSION **1.0**	**APPROVAL DETAILS**	**XX ACM, XX.XX.2022**		**LEARNING LEVEL**	**BTL-3**

ASSESSMENT SCHEME

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

Course Description	This course introduces the need for data science and relevant python function libraries along with Numpy arrays. Especially, python concepts pertaining to data science is covered in this course.
Course Objective	1. To gain knowledge the basic concepts of python programming for data science with relevant Python functions and libraries. 2. To acquire the concepts of user defined modules and packages in python and to have knowledge in the object-oriented programming scenario. 3. To accomplish efficient storage and data operations using NumPy arrays. 4. To handle powerful data operations using Pandas. 5. To perform model building and data analysis with visualization.

Course Outcome	1. Identify the need for data science and solve basic problems using Python built-in data types and their methods. 2. Design an application with user-defined modules and packages using OOP concept 3. Employ efficient storage and data operations using NumPy arrays. 4. Apply powerful data manipulations using Pandas. 5. Perform data preprocessing and visualization using Pandas
Prerequisites: NIL	
CO, PO AND PSO MAPPING	

CO	PO -1	PO-2	PO-3	PO-4	PO-5	PO-6	PSO-1	PSO-2	PSO-3
CO-1	3	2	1	2	1	2	3	1	2
CO-2	2	1	2	-	2	1	2	2	1
CO-3	3	2	1	2	1	2	3	1	2
CO-4	2	1	2	1	2	1	2	2	1
CO-5	-	1	1	2	1	2	3	1	1

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

MODULE 1: INTRODUCTION TO DATA SCIENCE AND PYTHON PROGRAMMING	**(12)**
Introduction to Data Science - Why Python? - Essential Python libraries - Python Introduction- Features, Identifiers, Reserved words, Indentation, Comments, Built-in Data types and their Methods: Strings, List, Tuples, Dictionary, Set - Type Conversion- Operators. Decision Making- Looping- Loop Control statement- Math and Random number functions. User defined functions - function arguments & its types.	**CO-1 BTL-2**
MODULE 2: FILE, EXCEPTION HANDLING AND OOP	**(12)**
User defined Modules and Packages in Python- Files: File manipulations, File and Directory related methods - Python Exception Handling. OOPs Concepts -Class and Objects, Constructors – Data hiding- Data Abstraction- Inheritance.	**CO-2 BTL-2**
MODULE 3: INTRODUCTION TO NUMPY	**(12)**
NumPy Basics: Arrays and Vectorized Computation- The NumPy ndarray- Creating ndarrays- Data Types for ndarrays- Arithmetic with NumPy Arrays- Basic Indexing and Slicing - Boolean Indexing-Transposing Arrays and Swapping Axes. Universal Functions: Fast Element-Wise Array Functions- Mathematical and Statistical Methods-Sorting- Unique and Other Set Logic.	**CO-3 BTL-3**
MODULE 4: DATA MANIPULATION WITH PANDAS	**(12)**
Introduction to pandas Data Structures: Series, DataFrame, Essential Functionality: Dropping Entries- Indexing, Selection, and Filtering- Function Application and Mapping- Sorting and Ranking. Summarizing and Computing Descriptive Statistics- Unique Values, Value Counts, and Membership. Reading and Writing Data in Text Format.	**CO-4 BTL-2**
MODULE 5: DATA CLEANING PREPARATION AND VISUALIZATION	**(12)**
Data Cleaning and Preparation: Handling Missing Data - Data Transformation: Removing Duplicates, Transforming Data Using a Function or Mapping, Replacing Values, Detecting and Filtering Outliers- String Manipulation: Vectorized String Functions in pandas. Plotting with pandas: Line Plots, Bar Plots, Histograms and Density Plots, Scatter or Point Plots.	**CO-5 BTL-2**

TEXT BOOKS

1.	Y. Daniel Liang, "Introduction to Programming using Python", Pearson,2012.
2.	Wes McKinney, "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython", O'Reilly, 2nd Edition,2018.
3.	Jake VanderPlas, "Python Data Science Handbook: Essential Tools for Working with Data", O'Reilly, 2017.

REFERENCE BOOKS

1	Wesley J. Chun, "Core Python Programming", Prentice Hall,2006.

2	Mark Lutz, “Learning Python”, O’Reilly, 4th Edition, 2009.
E BOOKS	

1	https://www.programmer-books.com/introducing-data-science-pdf/
2	https://www.cs.uky.edu/~keen/115/Haltermanpythonbook.pdf
3	http://math.ecnu.edu.cn/~lfzhou/seminar/[Joel_Grus]_Data_Science_from_Scratch_First_Princ.pdf
1.	https://www.edx.org/course/python-basics-for-data-science
2.	https://www.edx.org/course/analyzing-data-with-python

COURSE TITLE	**DATABASE MANAGMENTS SYSTEMS LAB**			**CREDITS**	**1**
COURSE CODE	**CAB0145**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**0-0-2-0**
VERSION **1.0**	**APPROVAL DETAILS**		**XX ACM, XX.XX.2022**	**LEARNING LEVEL**	**BTL-3**

ASSESSMENT SCHEME

First Periodical Assessment	Second Periodical Assessment	Practical Assessment	ESE
15 %	15 %	20%	50 %

Course Description	Students get practical knowledge on designing and creating relational database systems. Understand various advanced queries execution such as relational constraints, joins, set operations, aggregate functions, trigger, views and embedded SQL.
Course Objective	1. To be able to query a database using SQL commands. 2. To be able to Declare and enforce integrity constraints on a database using a state-of-the-art RDBMS. 3. To classify and Implementing Indexing on table. 4. To understand and Implement Programming PL/SQL including stored procedures, stored functions, cursors, packages. 5. To Solve basic issues of simple database applications and construct a real time database application using current techniques.
Course Outcome	Upon completion of this course, the students will be able to 1. Populate and query a database using SQL commands. 2. Declare and enforce integrity constraints on a database using a state-of-the- art RDBMS. 3. Implementing Indexing on table. 4. Programming PL/SQL including stored procedures, stored functions, cursors, packages. 5. Solve basic issues of simple database applications and construct a real time database application using current techniques.

Prerequisites: NIL

CO, PO AND PSO MAPPING

CO	PO -1	PO-2	PO-3	PO-4	PO-5	PO-6	PSO-1	PSO-2	PSO-3
CO-1	2	2	1	1	1	1	3	1	1

CO-2	**2**	**2**	**1**	**1**	**-**	**1**	**3**	**1**	**1**
CO-3	**2**	**-**	**1**	**1**	**1**	**1**	**3**	**1**	**1**
CO-4	**2**	**2**	**1**	**1**	**1**	**1**	**3**	**-**	**1**

CO-5	**2**	**2**	**1**	**1**	**1**	**1**	**3**	**1**	**1**

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

LIST OF PROGRAMS

1. To study Basic SQL commands (create table, use, drop, insert) and execute the following queries using these commands: (CO1)

- Create a table 'Emp' with attributes 'ename','ecity','salary','enumber','eaddress','depttname'.
- Create another table 'Company' with attributes 'cname', ccity','empnumber' in the database 'Employee'.

2. To study the viewing commands (select, update) and execute the following queries using these commands:
   - Find the names of all employees who live in Delhi.
   - Increase the salary of all employees by Rs. 5,000.
   - Find the company names where the number of employees is greater than 10,000.
   - Change the Company City to Gurgaon where the Company name is 'TCS'.
3. To study the commands to modify the structure of table (alter, delete) and execute the following queries using these commands:
   - Add an attribute named 'Designation' to the table 'Emp'.
   - Modify the table 'Emp', Change the datatype of 'salary' attribute to float.
   - Drop the attribute 'depttname' from the table 'emp'.
   - Delete the entries from the table 'Company' where the number of employees are less than 500.
4. To study the commands that involve compound conditions (and, or, in , not in, between , not between , like , not like) and execute the following queries using these commands:
   - Find the names of all employees who live in 'Gurgaon' and whose salary is between Rs. 20,000 and Rs. 30,000.
   - Find the names of all employees whose names begin with either letter 'A' or 'B'.
   - Find the company names where the company city is 'Delhi' and the number of employees is not between 5000 and 10,000.
   - Find the names of all companies that do not end with letter 'A'.
5. To study the aggregate functions (sum, count, max, min, average) and execute the following queries using these commands:
   - Find the sum and average of salaries of all employees in computer science department.
   - Find the number of all employees who live in Delhi.
   - Find the maximum and the minimum salary in the HR department.
6. To study the grouping commands (group by, order by) and execute the following queries using these commands:
   - List all employee names in descending order.
   - Find number of employees in each department where number of employees is greater than 5.
   - List all the department names where average salary of a department is Rs.10,000.
7. To study the commands involving data constraints and execute the following queries using these commands:
   - Alter table 'Emp' and make 'enumber' as the primary key.
   - Alter table 'Company' and add the foreign key constraint.

- Add a check constraint in the table 'Emp' such that salary has the value between 0 and Rs.1,00,000
- Alter table 'Company' and add unique constraint to column cname
- Add a default constraint to column ccity of table company with the value 'Delhi'

8. To study the commands for joins (cross join, inner join, outer join) and execute the following queries using these commands:
   - Retrieve the complete record of an employee and its company from both the table using joins.
   - List all the employees working in the company 'TCS'.
9. To study the various set operations and execute the following queries using these commands:
   - List the enumber of all employees who live in Delhi and whose company is in Gurgaon or if both conditions are true.
   - List the enumber of all employees who live in Delhi but whose company is not in Gurgaon.
10. To study the various scalar functions and string functions (power, square, substring, reverse, upper, lower, concatenation) and execute the following queries using these commands:
    - Reverse the names of all employees.
    - Change the names of company cities to uppercase.
    - Concatenate name and city of the employee.
11. To study the commands involving indexes and execute the following queries:
    - Create an index with attribute ename on the table employee.
    - Create a composite index with attributes cname and ccity on table company.
    - Drop all indexes created on table company.
12. To study the conditional controls and case statement in PL-SQL and execute the following queries:
    - Calculate the average salary from table 'Emp' and print increase the salary if the average salary is less that 10,000.
    - Display the deptno from the employee table using the case statement if the deptname is 'Technical' then deptno is 1, if the deptname is 'HR' then the deptno is 2 else deptno is 3.
13. To study procedures and triggers in PL-SQL and execute the following queries:
    - Create a procedure on table employee to display the details of employee to display the details of employees by providing them value of salaries during execution.
    - Create a trigger on table company for deletion where the whole table is displayed when delete operation is performed.
14. Consider the tables given below. The primary keys are made bold and the data types are specified.

PERSON(driver_id:string , name:string , address:string)

CAR(regno:string , model:string , year:int)

ACCIDENT(report_number:int , accd_date:date , location:string)

OWNS(driver_id:string , regno:string)

PARTICIPATED(driver_id:string , regno:string , report_number:int , damage_amount:int)

a. Create the above tables by properly specifying the primary keys and foreign keys.
b. Enter at least five tuples for each relation.
c. Demonstrate how you

- Update the damage amount for the car with specific regno in the accident with report number 12 to 25000.
- Find the total number of people who owned cars that were involved in accidents in the year 2008.

Find the number of accidents in which cars belonging to a specific model were involved.

TEXT BOOKS	
1.	Abraham Silberschatz, Henry F. Korth and S. Sudarshan- "Database System Concepts", Sixth Edition, McGraw-Hill, 2011.
REFERENCE BOOKS	
1.	Ramez Elmasri and Shamkant B. Navathe, "Fundamental Database Systems", Seventh Edition, Pearson Education,2016

COURSE TITLE	**PYTHON PROGRAMMING LAB**			**CREDITS**	**1**
COURSE CODE	**CAB0146**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**0-0-2-0**
VERSION	**1.0**	**APPROVAL DETAILS**	**XX ACM, XX.XX.2022**	**LEARNING LEVEL**	**BTL-3**

ASSESSMENT SCHEME

First Periodical Assessment	**Second Periodical Assessment**	**Practical Assessment**	**ESE**
15 %	**15 %**	**20%**	**50 %**

Course Description	This course introduces the need for data science and relevant python function libraries along with Numpy arrays. Especially, python concepts pertaining to data science is covered in this course.
Course Objective	1. To gain knowledge the basic concepts of python programming for data science with relevant Python functions and libraries. 2. To acquire the concepts of user defined modules and packages in python. Also, to have knowledge in the object-oriented programming scenario. 3. Accomplish efficient storage and data operations using NumPy arrays. 4. Handle powerful data operations using Pandas. 6. Perform model building and data analysis with visualization.
Course Outcome	Upon completion of this course, the students will be able to 1. Identify the need for data science and solve basic problems using Python built-in data types and their methods. 2. Design an application with user-defined modules and packages using OOP concept 3. Employ efficient storage and data operations using NumPy arrays. 4. Apply powerful data manipulations using Pandas. 6. Do data preprocessing and visualization using Pandas

Prerequisites: NIL

CO, PO AND PSO MAPPING

CO	**PO -1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PSO-1**	**PSO-2**	**PSO-3**

CO-1	**2**	**2**	**1**	**1**	**1**	**1**	**3**	**1**	**1**
CO-2	**2**	**2**	**1**	**1**	**-**	**1**	**3**	**1**	**1**
CO-3	**2**	**-**	**1**	**1**	**1**	**1**	**3**	**1**	**1**
CO-4	**2**	**2**	**1**	**1**	**1**	**1**	**3**	**-**	**1**

CO-5	**2**	**2**	**1**	**1**	**1**	**1**	**3**	**1**	**1**

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

LIST OF PROGRAMS

Introduction

1. Implement basic Python programs for reading input from console.
2. Perform Creation, indexing, slicing, concatenation and repetition operations on Python built-in data types: Strings, List, Tuples, Dictionary, Set
3. Solve problems using decision and looping statements.
4. Apply Python built-in data types: Strings, List, Tuples, Dictionary, Set and their methods to solve any given problem

File Handling

1. Create packages and import modules from packages.
2. Perform File manipulations - open, close, read, write, append and copy from one file to another.
3. Handle Exceptions using Python Built-in Exceptions
4. Solve problems using Class declaration and Object creation.

Numpy

1. Create NumPy arrays from Python Data Structures, Intrinsic NumPy objects and Random Functions.
2. Manipulation of NumPy arrays- Indexing, Slicing, Reshaping, Joining and Splitting.
3. Computation on NumPy arrays using Universal Functions and Mathematical methods.

TEXT BOOKS

1.	Abraham Silberschatz, Henry F. Korth and S. Sudarshan- "Database System Concepts", Sixth Edition, McGraw-Hill, 2011.
2	Wes McKinney, "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython", O'Reilly, 2nd Edition,2018.
3	Jake VanderPlas, "Python Data Science Handbook: Essential Tools for Working with Data", O'Reilly, 2017.

REFERENCE BOOKS

1.	Ramez Elmasri and Shamkant B. Navathe, "Fundamental Database Systems", Seventh Edition, Pearson Education,2016
2	Mark Lutz, "Learning Python", O'Reilly, 4th Edition, 2009.

E BOOKS

1	https://www.programmer-books.com/introducing-data-science-pdf/
2	https://www.cs.uky.edu/~keen/115/Haltermanpythonbook.pdf
3	http://math.ecnu.edu.cn/~lfzhou/seminar/[Joel_Grus]_Data_Science_from_Scratch_First_Princ.pdf

MOOC

1	https://www.edx.org/course/python-basics-for-data-science
2	https://www.edx.org/course/analyzing-data-with-python

SEMESTER -III

COURSE TITLE	COMPUTER NETWORKS			CREDITS	3
COURSE CODE	CAB0212	COURSE CATEGORY	PC	L-T-P-S	3-0-0-1
VERSION 1.0	APPROVAL DETAILS	XX ACM, XX.XX.2022		LEARNING LEVEL	BTL-3

ASSESSMENT SCHEME

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

Course Description	This course gives idea about OSI Protocol suite, World Wide Web: HTTP. This course also gives knowledge in the Multiplexing and Demultiplexing Applications, Link State Routing Algorithm.
Course Objective	1. To understand the OSI protocol suite. 2. To learn the concepts transport layer services and principles. 3. To learn the various Routing Principles. 4. To learn the Error Detection and Correction Techniques. 5. To understand the multimedia Networking Applications.
Course Outcome	Upon completion of this course, the students will be able to 1. Describe the functions of computer networks and various layered architectures. 2. Illustrate the various flow and error control techniques and identify the best method for efficient data transmission. 3. Apply various routing algorithms for a network and determine the optimal path. 4. Implement simple client-server applications using TCP and UDP 5. Differentiate the functions of various application layer protocols and use suitable application.

Prerequisites: NIL

CO, PO AND PSO MAPPING

CO	PO -1	PO-2	PO-3	PO-4	PO-5	PO-6	PSO-1	PSO-2	PSO-3
CO-1	2	2	1	1	1	1	3	1	1
CO-2	2	2	1	1	-	1	3	1	1
CO-3	2	-	1	1	1	1	3	1	1
CO-4	2	2	1	1	1	1	3	-	1
CO-5	2	2	1	1	1	1	3	1	1

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

MODULE :1	**(9)**
Components – Direction of Data flow – networks – Components and Categories – types of Connections – Topologies – Protocols and Standards – ISO / OSI model – Transmission Media – Coaxial Cable – Fiber Optics – Line Coding – Modems.	**CO-1 BTL-2**
MODULE	**(9)**

:2	
Error – detection and correction – Parity – LRC – CRC – Hamming code – Flow Control and Error control- stop and wait – ARQ – selective repeat ARQ- sliding window – HDLC. Ethernet IEEE 802.3 - IEEE 802.11.	**CO-2** **BTL-2**
MODULE :3 **(9)**	
Internetworks – Packet Switching and Datagram approach – IP addressing	**CO-3**

methods – Subnetting –Routing – Distance Vector Routing – Link State Routing – Broadcast and Multicast routing	**BTL-3**
MODULE:4 (9)	
Duties of transport layer – Multiplexing – Demultiplexing – Sockets – User Datagram Protocol (UDP) – Transmission Control Protocol (TCP) – Congestion Control – Quality of services (QOS)	**CO-4** **BTL-4**
MODULE:5 (9)	
Domain Name Space (DNS) – SMTP – FTP – HTTP - WWW -Security: Services - Cryptography – Publickey Cryptosystems.	**CO-5** **BTL-2**

TEXT BOOKS	
1.	Behrouz A. Forouzan, "Data communication and Networking", 5th Ed., Tata McGraw Hill, 2015.
REFERENCE BOOKS	
1	James F. Kurose and Keith W. Ross, "Computer Networking: A Top-Down Approach Featuring the Internet", 5th Ed., Pearson Education, 2013.
2	L.Peterson and Peter S. Davie, "Computer Networks", 5th Ed., Morgan Kaufmann, 2011.
3	Andrew S. Tanenbaum, "Computer Networks", 5th Ed., Prentice Hall, 2011.
4	William Stallings, "Data and Computer Communication", 8th Ed., Pearson, 2007.
E BOOKS	
1	https://resources.saylor.org/wwwresources/archived/site/wp-content/uploads/2012/02/Computer-Networking-Principles-Bonaventure-1-30-31-OTC1.pdf
1.	https://www.coursera.org/learn/fundamentals-network-communications
2.	https://www.udemy.com/computer-networks-course-networking-basics/

COURSE TITLE	**ARTIFICIAL INTELLIGENCE**			**CREDITS**	**4**
COURSE CODE	**CAB0213**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**3-1-0-0**
VERSION	**1.0**	**APPROVAL DETAILS**	**XX ACM, XX.XX.2022**	**LEARNING LEVEL**	**BTL-3**

ASSESSMENT SCHEME

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

Course Description	Artificial Intelligence deals with the designing and building of intelligent agents that receive percepts from the environment and take actions that affect that environment. This course introduces the different search strategies, types of knowledge representation, different type of learning techniques and various expert systems.

Course Objective	1. To Solve problems using informed and uninformed search strategies. 2. To Compare various Knowledge Representation Logic using scripts and frames. 3. To Comprehend and analyze the different types of learning. 4. To Identify the need of Production system and Planning states

	5. To Use expert system tools to realize the concepts and components of expert system.
Course Outcome	Upon completion of this course, the students will be able to 1. Demonstrate fundamental understanding of the history of artificial intelligence (AI) and its foundations. 2. Understand and implement search and adversarial (game) algorithms. 3. Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning. 4. Learn different logic formalisms and decision taking in planning problems. 5. Demonstrate awareness and a fundamental understanding of various applications of AI techniques in intelligent agents, expert systems and artificial neural networks.

Prerequisites: NIL

CO, PO AND PSO MAPPING

CO	PO -1	PO-2	PO-3	PO-4	PO-5	PO-6	PSO-1	PSO-2	PSO-3
CO-1	2	2	1	1	1	1	3	1	1
CO-2	2	2	1	1	-	1	3	1	1
CO-3	2	-	1	1	1	1	3	1	1
CO-4	2	2	1	1	1	1	3	-	1
CO-5	2	2	1	1	1	1	3	1	1

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

MODULE 1: INTRODUCTION	**(9)**
AI problems, foundation of AI and history of AI intelligent agents: Agents and Environments, the concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation.	**CO-1 BTL-3**

MODULE 2: PROBLEM SOLVING	**(9)**
Searching- Searching for solutions, uniformed search strategies – Breadth first search, depth first Search. Search with partial information (Heuristic search) Hill climbing, A* ,AO* Algorithms, Problem reduction, Game Playing-Adversial search, Games, mini-max algorithm, optimal decisions in multiplayer games, Problem in Game playing, Alpha-Beta pruning, Evaluation functions.	**CO-2 BTL-2**

MODULE 3: KNOWLEDGE AND REASONING	**(9)**
Knowledge representation issues, predicate logic- logic programming, semantic nets-frames and inheritance, constraint propagation, representing knowledge using rules, rules-based deduction systems. Reasoning under uncertainty, review of probability, Decision trees, Explanation based learning, Statistical Learning methods, Reinforcement Learning.	**CO-3 BTL-3**

MODULE 4: COMMUNICATING, PERCEIVING,	**(9)**

AND ACTING	
Communication as Action- Syntactic Analysis- Augmented Grammars- Semantic Interpretation- Ambiguity and Disambiguation- Discourse Understanding- Probabilistic Language Models- Information Retrieval- Information Extraction- Machine Translation	**CO-4** **BTL-2**
MODULE 5: EXPERT SYSTEM	**(9)**
Expert System- Architecture and Roles of Expert System-Typical Expert System- MYCIN- XOON-DART-Case Study-Construction of simple reflex agent with sensor and actuator using Arduino.	**CO-5** **BTL-3**

TEXT BOOKS	
1.	S. Russel and P. Norvig, "Artificial Intelligence – A Modern Approach", Second Edition, Pearson Education,2020
2.	David Poole, Alan Mackworth, Randy Goebel," Computational Intelligence: a logical approach", Oxford University Press.1998
3.	
REFERENCE BOOKS	
1	Nils J. Nilsson, "Artificial Intelligence: A new Synthesis", Harcourt Asia Pvt. Ltd., 2000.
2	Janakiraman, K. Sarukesi, 'Foundations of Artificial Intelligence and Expert Systems', Macmillan Series in Computer Science, 2000.
3	W. Patterson, 'Introduction to Artificial Intelligence and Expert Systems', Prentice Hall of India, 2003.
4	Artificial Intelligence with python, Prateek Joshi,2017.
E BOOKS	
1	https://www.pdfdrive.net/artificial-intelligence-a-modern-approach-3rd-edition-e32618455.html
1.	https://www.edx.org/learn/artificial-intelligence
2.	https://www.udacity.com/school-of-ai

COURSE TITLE		**DATA ANALYTICS USING R**			**CREDITS**	**4**
COURSE CODE		**CAB0214**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**3-1-0-0**
VERSION	**1.0**	**APPROVAL DETAILS**	**XX ACM, XX.XX.2022**		**LEARNING LEVEL**	**BTL-3**

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

Course Description	This course emphasizes on practicum of skills for data science using R. Focus is on executing the basic syntax, performing matric operations, creating list, data frames and to exploiting graphs.
Course Objective	1. To execute basic syntax and programs in R. 2. To do the Matrix operations using R. 3. To apply non numeric values in vectors. 4. To know the usage and creating of list and data frames. 5. To draw graph using ggplot2.

Course Outcome	Upon completion of this course, the students will be able to 1. Identify and execute basic syntax and programs in R. 2. Perform the Matrix operations using R built in functions. 3. Apply non numeric values in vectors. 4. Create the list and data frames. 5. Exploit the graph using ggplot2.
Prerequisites: NIL	
CO, PO AND PSO MAPPING	

CO	PO -1	PO-2	PO-3	PO-4	PO-5	PO-6	PSO-1	PSO-2	PSO-3
CO-1	2	2	1	1	1	1	3	1	1
CO-2	2	2	1	1	-	1	3	1	1
CO-3	2	-	1	1	1	1	3	1	1
CO-4	2	2	1	1	1	1	3	-	1
CO-5	2	2	1	1	1	1	3	1	1

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

MODULE 1: OVERVIEW OF R	**(9)**
History and Overview of R- Basic Features of R-Design of the R System- Installation of R- Console and Editor Panes-Comments-InstallingandLoadingRPackages-HelpFilesandFunctionDocumentation- Saving Work and Exiting R- Conventions- R for Basic Math- Arithmetic- Logarithms and Exponentials- E-Notation- Assigning Objects- Vectors- Creating a Vector- Sequences, Repetition, Sorting, and Lengths-Subsetting and Element Extraction- Vector-Oriented Behavior **Practical Component:** Develop the R program for Basic Mathematical computation	**CO-1 BTL-2**
MODULE 2: MATRICES AND ARRAYS (9)	
Defining a Matrix – Defining a Matrix- Filling Direction- Row and Column Bindings- Matrix Dimensions Subsetting- Row, Column, and Diagonal Extractions-Omitting and Overwriting- Matrix Operations and Algebra- Matrix Transpose- Identity Matrix- Matrix Addition and Subtraction- Matrix Multiplication Matrix Inversion-Multidimensional Arrays- Subsets, Extractions, and Replacements **Practical Component**: Create and manipulate data stored in arrays and matrices	**CO-2 BTL-2**
MODULE 3: NON-NUMERIC VALUES	**(9)**
Logical Values- Relational Operators- Characters- Creating a String- Concatenation-Escape Sequences- Substrings and Matching- Factors- Identifying Categories- Defining and Ordering Levels- Combining and Cutting **Practical Component**: To carry out exercises with non-numeric data present the findings with inferences	**CO-3 BTL-3**
MODULE 4: LISTS AND DATA FRAMES	**(9)**
Lists of Objects-Component Access-Naming-Nesting-Data Frames-Adding Data Columns and Combining Data Frames-Logical Record Subsets-Some Special Values- Infinity-NaN-NA-NULL Attributes -Object-Class-Is-DotObject- Checking Functions- As Dot Coercion Functions **Practical Component:** To create and process data using lists and frames.	**CO-4 BTL-4**
MODULE 5: BASIC PLOTTING	**(9)**

Using plotwithCoordinateVectors-GraphicalParameters-AutomaticPlotTypes-Title and Axis Labels- Color Line and Point Appearances-Plotting Region Limits-Adding Points, Lines, and Text to an Existing Plot-ggplot2 Package-Quick Plot with qplot-Setting Appearance Constants with Geoms-- READING AND WRITING FILES- R Ready Data Sets- Contributed Data Sets-Reading in External Data Files-Writing Out Data Files and Plots- Ad Hoc Object Read/Write Operations **Practical Component**: To create simple applications by connecting to data sources and generate different types of graphical representations	**CO-5** **BTL-2**

TEXT BOOKS	
1.	Tilman M.Davies," The Book of R- A First Programming and Statistics" Library of Congress Cataloging-in-Publication Data,2016
REFERENCE BOOKS	

1	Roger D. Peng," R Programming for Data Science" Lean Publishing, 2016.
2	Hadley Wickham, Garrett Grolemund," R for Data Science", OREILLY Publication,2017
3	StevenKeller, "R Programming for Beginners", CreateSpace Independent Publishing Platform 2016.
4	Kun Ren," Learning R Programming", Packt Publishing,2016
E BOOKS	
1	https://web.itu.edu.tr/~tokerem/The_Book_of_R.pdf
1.	Online R Courses | Harvard University
2.	Free R (programming language) Tutorial - R Basics - R Programming Language Introduction | Udemy
3	Introduction to R Online Course | DataCamp

COURSE TITLE	**BUSINESS ANALYTICS**			**CREDITS**	**3**
COURSE CODE	**CAB0215**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**3-0-0-0**
VERSION **1.0**	**APPROVAL DETAILS**	**XX ACM, XX.XX.2022**		**LEARNING LEVEL**	**BTL-3**

ASSESSMENT SCHEME

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

Course Description	In this course students learn about Business Intelligence, Business Data Analytics, data preparation and analytics process.
Course Objective	1. To make students understand the essentials of Business analytics and the corresponding terminologies. 2. To help students to analyze the steps involved in the Business Analytics process 3. To Illustrate competently on the topic of analytics 4. Enable students to Understand & Implement the Clustering algorithm 5. To demonstrate the real time scenario by using Business Analytics Techniques
Course Outcome	Upon completion of this course, the students will be able to 1. Understand the essentials of Business analytics and the corresponding terminologies 2. Analyze the steps involved in the Business Analytics process 3. Illustrate competently on the topic of analytics 4. Understand & Implement the Clustering algorithm 5. Demonstrate the real time scenario (Case study) by using Business Analytics techniques
Prerequisites: NIL	
CO, PO AND PSO MAPPING	

CO	PO -1	PO-2	PO-3	PO-4	PO-5	PO-6	PSO-1	PSO-2	PSO-3
CO-1	2	2	1	1	1	1	3	1	1
CO-2	2	2	1	1	-	1	3	1	1

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

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

MODULE 1: BUSINESS INTELLIGENCE	**(9)**
Introduction - History and Evolution: Effective and Timely decisions, Data Information and Knowledge, Architectural Representation, Role of mathematical Models, Real Time Business Intelligent System.	**CO-1 BTL-3**
MODULE 2: DATA MINING & WAREHOUSING	**(9)**
Data Mining - Introduction to Data Mining, Architecture of Data Mining and How Data mining works (Process) , Functionalities & Classifications of Data Mining, Representation of Input Data, Analysis Methodologies.Data Warehousing - Introduction to Data Warehousing, Data Mart, Online Analytical Processing (OLAP)– Tools, Data Modelling, Difference between OLAP and OLTP, Schema– Star and Snowflake Schemas, ETL Process – Role of ETL	**CO-2 BTL-2**
MODULE 3: DATA PREPARTTION	**(9)**
Data Validation - Introduction to Data Validation, Data Transformation – Standardization and Feature Extraction, Data Reduction – Sampling, Selection, PCA, Data Discretization	**CO-3 BTL-3**
MODULE 4: DATA ANALYTICS PROCESS	**(9)**
Analytics Process - Introduction to analytics process, Types of Analytical Techniques in BI – Descriptive, Predictive, Perspective, Social Media Analytics, Behavioral, Iris Datasets	**CO-4 BTL-2**
MODULE 5: BUSINESS ANALYTICS PROCESS	**(9)**
Operational Intelligence: Technological – Business Activity Monitoring, Complex Event Processing, Business Process Management, Metadata, Root Cause Analysis.	**CO-5 BTL-3**

TEXT BOOKS

1.	Carlo-Vercellis, "Business Intelligence Data Mining and Optimization for Decision-Making", First Edition Link : https://bit.ly/3d6XxOr
2.	Drew Bentely, "Business Intelligence and Analytics" ,@2017 Library Pres., ISBN: 978- 1-9789- 2136- 8 Link : https://www.academia.edu/40285447/Business_Intelligence_and_Analytics
3.	Larissa T.Moss & Shaku Atre,"Business Intelligence Roadmap : The Complete Project Lifecycle For Decision-Support Applications", First Edition, Addison-Wesley Professional,2003
4	Kimball, R., Ross,M.,Thornthwaite,W.,Mundy,J.,andBecker,B.John,"The Data Warehouse Lifecycle Toolkit: Practical Techniques for Building Data Warehouse and Business Intelligence

REFERENCE BOOKS

1	Cindi Howson, "Successful Business Intelligence", Second Edition, McGraw-HillEducation,2013**.**

E BOOKS	
1	R Ramesh Sharda, Dursun Delen, Efraim Turban, "Business Intelligence A Managerial Perspective on Analytics", Third Edition, Pearson Publications. Link : https://bit.ly/2YcuLHK
MOOC	
1.	https://www.coursera.org/learn/business-intelligence-data-analytics (Free Course in Course era)

COURSE TITLE	DATA SCIENCE PROGRAMMING USING R			CREDITS	1
COURSE CODE	CAB0235	COURSE CATEGORY	PC	L-T-P-S	0-0-2-0
VERSION 1.0	APPROVAL DETAILS	XX ACM, XX.XX.2022		LEARNING LEVEL	BTL-3

ASSESSMENT SCHEME

First Periodical Assessment	Second Periodical Assessment	Practical Assessment	ESE
15 %	15 %	20%	50 %

Course Description	This course introduces the need for data science and relevant python function libraries along with Numpy arrays. Especially, python concepts pertaining to data science is covered in this course.
Course Objective	1. To execute basic syntax and programs in R. 2. To do the Matrix operations using R. 3. To apply non numeric values in vectors. 4. To know the usage and creating of list and data frames. 5. To draw graph using ggplot2.
Course Outcome	Upon completion of this course, the students will be able to 1. Identify and execute basic syntax and programs in R. 2. Perform the Matrix operations using R built in functions 3. Apply non-numeric values in vectors 4. Create the list and data frames 5. Exploit the graph using ggplot2.

Prerequisites: NIL

CO, PO AND PSO MAPPING

CO	PO -1	PO-2	PO-3	PO-4	PO-5	PO-6	PSO-1	PSO-2	PSO-3
CO-1	2	2	1	1	1	1	3	1	1
CO-2	2	2	1	1	-	1	3	1	1
CO-3	2	-	1	1	1	1	3	1	1
CO-4	2	2	1	1	1	1	3	-	1
CO-5	2	2	1	1	1	1	3	1	1

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

LIST OF PROGRAMS

1. Write Rscript to diagnose any disease using KNN classification and plot the results.
2. Develop the R program for Basic Mathematical computation
3. Create and manipulate data stored in arrays and matrices.
4. To carry out exercises with non-numeric data present the findings with inferences.
5. To create and process data using lists and frames.
6. To create simple applications by connecting to data sources and generate different types of graphical representations.
7. Implementation of Classification algorithm in R Programming
8. Practical Implementation of Decision Tree using R Tool
9. K-means clustering using R
10. Prediction Using Linear Regression
11. Data Analysis using Time Series Analysis

TEXT BOOKS

1.	Tilman M.Davies,"The Book Of R - A First Programming And Statistics" Library of Congress Cataloging-in-Publication Data,2016.
REFERENCE BOOKS	
1.	Roger D. Peng,"R Programming for Data Science"Lean Publishing, 2016.
2	Hadley Wickham, Garrett Grolemund," R for Data Science",OREILLY Publication,2017
3	Steven Keller, "R Programming for Beginners", CreateSpace Independent Publishing Platform 2016.
4	Kun Ren ,"Learning R Programming", Packt Publishing,2016
E BOOKS	
1	https://web.itu.edu.tr/~tokerem/The_Book_of_R.pdf
MOOC	
1	https://online-learning.harvard.edu/subject/r
2	https://www.datacamp.com/courses/free-introduction-to-r
3	https://www.udemy.com/course/r-basics/

COURSE TITLE		**BUSINESS ANALYTICS LAB**		**CREDITS**	**1**
COURSE CODE		**CAB0236**	**COURSE CATEGORY** **PC**	**L-T-P-S**	**0-0-2-0**
VERSION	**1.0**	**APPROVAL DETAILS**	**XX ACM, XX.XX.2022**	**LEARNING LEVEL**	**BTL-3**

ASSESSMENT SCHEME

First Periodical Assessment	Second Periodical Assessment	Practical Assessment	ESE
15%	15%	20%	50%

Course Description	In this course students learn about Business Intelligence, data mining and warehousing, data preparation and analytics process.
Course Objective	1. To make students understand the essentials of BI & data analytics and the corresponding terminologies. 2. To help students to analyze the steps involved in the BI - Analytics process 3. To Illustrate competently on the topic of analytics 4. Enable students to Understand & Implement the Clustering algorithms 5. To demonstrate the real time scenario by using BI & Analytics Techniques
Course Outcome	Upon completion of this course, the students will be able to 1. Understand the essentials of BI & data analytics and the corresponding terminologies. 2. Analyze the steps involved in the BI - Analytics process 3. Illustrate competently on the topic of analytics 4. Understand & Implement the Clustering algorithms 5. Demonstrate the real time scenario (Case study) by using BI & Analytics techniques.
Prerequisites: NIL	

CO, PO AND PSO MAPPING

CO	PO -1	PO-2	PO-3	PO-4	PO-5	PO-6	PSO-1	PSO-2	PSO-3
CO-1	2	2	1	1	1	1	3	1	1
CO-2	2	2	1	1	-	1	3	1	1
CO-3	2	-	1	1	1	1	3	1	1
CO-4	2	2	1	1	1	1	3	-	1
CO-5	2	2	1	1	1	1	3	1	1

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

LIST OF PROGRAMS

1. Import the legacy data from different sources such as (Excel, SqlServer, Oracle etc.) and load in the target system.
2. Perform the Extraction Transformation and Loading (ETL) process to construct the database in the Sqlserver / Power BI.
3. To get the input from user and perform numerical operations (MAX, MIN, AVG, SUM, SQRT, ROUND) using in R
4. To perform data import/export (.CSV,.XLS,.TXT) operations using data frames in R.
5. To perform data pre-processing operations i) Handling Missing data ii) Min-Max normalization
6. To perform statistical operations (Mean, Median, Mode and Standard deviation) using R.
7. To perform K-Means clustering operation and visualize for iris data set
8. Data Visualization from ETL Process
9. Creating a Cube in SQL server
10. Apply the what – if Analysis for data visualization.
11. Design and generate necessary reports based on the data warehouse data.

TEXT BOOKS

1.	Carlo-Vercellis, "Business Intelligence Data Mining and Optimization for Decision-Making", First Edition Link : https://bit.ly/3d6XxOr

REFERENCE BOOKS

1	Drew Bentely,"BusinessIntelligenceandAnalytics",@2017LibraryPres.,ISBN:978- 1-9789-2136-8 Link: https://www.academia.edu/40285447/Business_Intelligence_and_Analytics
2	Larissa T.Moss & Shaku Atre,"Business Intelligence Roadmap : The Complete Project Lifecycle For Decision-Support Applications", First Edition, Addison-Wesley Professional,2003
3	Carlo-Vercellis, "Business Intelligence Data Mining and Optimization for Decision-Making", First Edition Link : https://bit.ly/3d6XxOr

E BOOKS

1	Ramesh Sharda, Dursun Delen, EfraimTurban,"Business Intelligence A Managerial Perspective on Analytics", Third Edition, Pearson Publications. Link : https://bit.ly/2YcuLHK

MOOC

1	https://www.coursera.org/learn/business-intelligence-data-analytics (Free Course in Course era)

SEMESTER-IV

COURSE TITLE	MACHINE LEARNING			CREDITS	3
COURSE CODE	CAB0226	COURSE CATEGORY	PC	L-T-P-S	3-0-0-0
VERSION 1.0	APPROVAL DETAILS	XX ACM, XX.XX.2022		LEARNING LEVEL	BTL-3

ASSESSMENT SCHEME

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

Course Description	This course provides an introduction to the fundamental methods at the core of modern machine learning. It covers theoretical foundations as well as essential algorithms for supervised and unsupervised learning.
Course Objective	1. To provide fundamentals of machine learning algorithms 2. To understand supervised learning algorithms 3. To learn unsupervised learning algorithms 4. To design Artificial Neural Networks. 5. To relate probabilistic models.
Course Outcome	Upon completion of this course, the students will be able to 1. Identify various machine learning algorithms and terminologies and perform data pre-processing using standard ML library. 2. Infer a predictive model using appropriate supervised learning algorithms to solve any given problem. 3. Comprehend applications using appropriate unsupervised learning algorithms for performing clustering and dimensionality reduction. 4. Solve complex problems using artificial neural networks and kernel machines 5. Relate probabilistic graphical models for suitable applications.

Prerequisites: NIL

CO, PO AND PSO MAPPING

CO	PO -1	PO-2	PO-3	PO-4	PO-5	PO-6	PSO-1	PSO-2	PSO-3
CO-1	2	2	1	1	1	1	3	1	1
CO-2	2	2	1	1	-	1	3	1	1
CO-3	2	-	1	1	1	1	3	1	1
CO-4	2	2	1	1	1	1	3	-	1
CO-5	2	2	1	1	1	1	3	1	1

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

MODULE 1: INTRODUCTION TO MACHINE LEARNING	**(9)**
Introduction - History and Evolution: Effective and Timely decisions, Data Information and Knowledge, Architectural Representation, Role of mathematical Models, Real Time Business Intelligent System.	**CO-1 BTL-3**
MODULE 2: SUPERVISED LEARNING	**(9)**

Regression: Linear Regression – Multivariate Regression- Classification: Linear Discriminant Analysis, Logistic Regression- K-Nearest Neighbor classifier. DecisionTree based methods for classification and Regression- Ensemble methods.	**CO-2** **BTL-2**
MODULE 3: UNSUPERVISED LEARNING	**(9)**

Clustering- K-Means clustering, Hierarchical clustering - The Curse of Dimensionality -Dimensionality Reduction - Principal Component Analysis - Probabilistic PCA- Independent Components analysis	**CO-3** **BTL-3**
MODULE 4: ARTIFICIAL NEURAL NETWORKS AND KERNEL MACHINES (9)	
Perceptron- Multilayer perceptron- Back Propagation – Initialization, Training and Validation Support Vector Machines (SVM) as a linear and non-linear classifier - Limitations of SVM	**CO-4** **BTL-2**
MODULE 5: PROBABILISTIC GRAPHICAL MODELS (9)	
Bayesian Networks - Learning Naive Bayes classifiers-Markov Models – Hidden Markov Models Sampling – Basic sampling methods – Monte Carlo -Reinforcement Learning.	**CO-5** **BTL-3**

TEXT BOOKS	
1.	Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.
2.	Stephen Marsland, "Machine Learning –An Algorithmic Perspective", CRC Press, 2009.
3.	Christopher Bishop, "Pattern Recognition and Machine Learning" Springer, 2011.
REFERENCE BOOKS	
1	Andreas C. Muller, "Introduction to Machine Learning with Python: A Guide for Data Scientists", O'Reilly,2016.
2	Sebastian Raschka, "Python Machine Learning", Packt Publishing, 2015.
E BOOKS	
1	http://pdf.th7.cn/down/files/1603/Mastering%20Machine%20Learning%20with%20scikit-learn.pdf
MOOC	
1.	https://www.udemy.com/machinelearning/
2.	https://in.udacity.com/course/intro-to-machine-learning--ud120

COURSE TITLE	**DATA SECURITY AND PRIVACY**			**CREDITS**	**3**
COURSE CODE	**CAB0227**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**3-0-0-0**
VERSION **1.0**	**APPROVAL DETAILS**	**XX ACM, XX.XX.2022**		**LEARNING LEVEL**	**BTL-3**

ASSESSMENT SCHEME

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

Course Description	This course provides insights on data privacy with respect to data mining, test data management, synthetic data generation etc. It formalizes principles of data privacy that are essential for good anonymization design based on the data format and discipline. The principles outline best practices and reflect on the conflicting relationship between privacy and utility.

Course Objective	1. To a definitive guide to approach anonymization of various data formats. 2. To understand multidimensional, longitudinal, time-series, transaction, and graph data. 3. To emphasize on the protection of confidential data.

	4. To Provide a guideline as to how this can be implemented for a wide range of data at the enterprise level. 5. To elaborate on the security and privacy aspect of the enterprise data.
Course Outcome	Upon completion of this course, the students will be able to 1.Demonstrate techniques in Data privacy 2. Summarize static Data Anonymization 3. Illustrate data mining techniques for privacy preserving 4.Identify various synthetic data generation method 5. Recall different types of acts for privacy preserving

Prerequisites: NIL

CO, PO AND PSO MAPPING

CO	PO -1	PO-2	PO-3	PO-4	PO-5	PO-6	PSO-1	PSO-2	PSO-3
CO-1	2	2	1	1	1	1	3	1	1
CO-2	2	2	1	1	-	1	3	1	1
CO-3	2	-	1	1	1	1	3	1	1
CO-4	2	2	1	1	1	1	3	-	1
CO-5	2	2	1	1	1	1	3	1	1

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

MODULE 1: INTRODUCTION TO DATA PRIVACY (9)	
What is Data Privacy and Why it is important – Use Cases: Need for Sharing Data – Methods of Protecting Data – Importance of Balancing Data Privacy and Utility – Introduction to Anonymization Design Principles – Nature of Data in the Enterprise.	**CO-1 BTL-3**
MODULE 2: STATIC DATA ANONYMIZATION (9)	
Introduction – Classification of Privacy Preserving Methods – Classification of Data in a Multidimensional Dataset – Group Based Anonymization – Threats to Anonymized Data – Threats to Data Structure – Threats by Anonymization Techniques.	**CO-2 BTL-2**
MODULE 3: PRIVACY PRESERVING DATA MINING (9)	
Data Mining: Key Functional Areas of Multidimensional Data – Associate rule Mining – Clustering – Test Data Fundamentals – Utility of Test Data – Privacy Preservation of Test Data – Protecting Explicit Identifier – Protecting Quasi Identifier – Quality of Test Data – Anonymization Design	**CO-3 BTL-3**
MODULE 4: SYNTHETIC DATA GENERATION (9)	
Synthetic Data and Their Use – Privacy and Utility in Synthetic Data – Explicit Identifier – Quasi Identifier – Sensitive Data – How safe are synthetic Data – Testing – Error and Exception Data – Scaling – Regression Testing	**CO-4 BTL-2**
MODULE 5: DYNAMIC DATA PROTECTION AND PRIVACY REGULATION (9)	
Bayesian Networks - Learning Naive Bayes classifiers-Markov Models – Hidden Markov Models Sampling – Basic sampling methods – Monte Carlo -Reinforcement Learning.	**CO-5 BTL-3**

TEXT BOOKS

1.	Nataraj Venkataramanan and Ashwin Shriram, "Data Privacy - Principles and Practice",Chapman and Hall, 1st Edition, 2017

REFERENCE BOOKS

1	Chuck Ballard, Cindy Compert, Tom Jesionowski, Ivan Milman, Bill Plants, Barry Rosen, Harald Smith, "Information Governance Principles and Practices for a Big Data Landscape", Redbooks Publication, 2014.
2	Sebastian Raschka, “Python Machine Learning”, Packt Publishing, 2015.
E BOOKS	

1	https://www.privacyinternational.org/sites/default/files/2018-09/Data%20Protection%20COMPLETE.pdf
MOOC	
1.	https://www.coursera.org/learn/data-security-privacy
2.	https://www.udemy.com/course/data-security-and-privacy-training/

COURSE TITLE	**PROFESSIONAL ETHICS AND LIFE SKILLS**			**CREDITS**	**3**
COURSE CODE	**GEA4216**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**3-0-0-0**
Version	**1.0**	**Approval Details**	**XX ACM, XX.XX.2022**	**LEARNING LEVEL**	**BTL-3**
ASSESSMENT SCHEME					
First Periodical Assessment	**Second Periodical Assessment**	**Seminar/ Assignments/ Project**	**Surprise Test / Quiz**	**Attendance**	**ESE**
15%	**15%**	**10%**	**5%**	**5 %**	**50%**
Course Description	This course is designed with the aim of developing the ethics and human values with the students and teach them how to apply ethics in for betterment of the society.				
Course Objective	1. To understand about ethics and human values 2. To apply the ethics in real world problems 3. To differentiate between safety and risk 4. To transform into responsible human being 5. To analyze the society and work for betterment of society				
Course Outcome	Upon completion of this course, the students will be able to 1. Comprehend the essentials of ethics and human values 2. Enumerate the theories of Engineering ethics and apply to real world scenarios 3. Distinguish between safety and risk and possess the ability to claim appropriate rights 4. Inculcate the life skills and value system for transforming into a responsible human being 5. Analyze and appraise the status of society and formulate schemes for the betterment of the society				
Prerequisites: Nil					

CO, PO AND PSO MAPPING									
CO	**PO - 1**	**PO - 2**	**PO - 3**	**PO - 4**	**PO - 5**	**PO - 6**	**PSO -1**	**PSO - 2**	**PSO -3**
CO-1	**2**	**2**	**1**	**1**	**1**	**1**	**3**	**1**	**1**
CO-2	**2**	**2**	**1**	**1**	**-**	**1**	**3**	**1**	**1**
CO-3	**2**	**-**	**1**	**1**	**1**	**1**	**3**	**1**	**1**
CO-4	**2**	**2**	**1**	**1**	**1**	**1**	**3**	**-**	**1**
CO-5	**2**	**2**	**1**	**1**	**1**	**1**	**3**	**1**	**1**
1: Weakly related, 2: Moderately related and 3: Strongly related									

MODULE 1: HUMAN VALUES	**(9)**
Definition of ethics-Morals values and ethics – integrity-Work ethics- Service Learning-Civic Virtue-Respect for others- Caring-Sharing-Honesty-Courage - Valuing time-Cooperation-Commitment-Empathy-Self-confidence-Character- Spirituality-Introduction to Yoga and meditation for professional excellence and stress management. **Self-Study:** Case study of Discovery failure	**CO-1 BTL-3**
MODULE 2: PROFESSIONAL ETHICS	**(9)**
Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self- interest – Customs and Religion – Uses of Ethical Theories. **Self-study:** Study the Bhopal gas tragedy	**CO-2 BTL-2**
MODULE 3: SAFETY, RESPOSIBILITIES AND RIGHTS	**(9)**
Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination. **Self-study:** Chernobyl explosion, Nuclear and thermal power plant issues	**CO-3 BTL-3**
MODULE 4: LIFE SKILLS	**(9)**
Definition, Relevance, Types of values, changing concepts of values-aims and values of value education- basic etiquette-morals and values in life-dealing with people. Personal values – Self – Strengths (self-confidence, self-assessment, self- reliance, self-discipline, determination, self-restraint, contentment, humility, sympathy and compassion, gratitude, forgiveness) Weaknesses. **Self-study:** Influences - Peer pressure, familial and societal expectations, media	**CO-4 BTL-2**
MODULE 5: SOCIETIES IN PROGRESS	**(9)**
Definition of society; Units of society; Communities – ancient and modern – Agents of change – Sense of survival, security, desire for comfort and ease sense of belonging, social consciousness and responsibility. **Self-study:** Personal value and professional value of Engineers on societies perception	**CO-5 BTL-3**

TEXT BOOKS	
1.	Subramanian R., Professional ethics, Oxford University press, 2010.
2.	Manoharan P.K., Education and Personality Development, APH Publishing Corporation, New Delhi, 2008
REFERENCE BOOKS	
1.	Megan J. Murphy (Editor), Lorna Hecker (Editor), Ethics and Professional Issues in
2.	Andrew Belsey (Editor), Ruth Chadwick (Editor), Ethical Issues in Journalism and the
3.	Warwick Fox (Editor), Ethics and the Built Environment (Professional Ethics).
4.	Ruchika Nath, Value Education, APH Publishing Corporation, New Delhi, 2008.

COURSE TITLE	**DATA HANDLING AND VISUALIZATION**			**CREDITS**	**3**
COURSE CODE	**CAB0287**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**3-0-0-0**
Version	**1.0**	**Approval Details**	**XX ACM, XX.XX.2022**	**LEARNING LEVEL**	**BTL-3**
ASSESSMENT SCHEME					
First Periodical Assessment	**Second Periodical Assessment**	**Seminar/ Assignments/ Project**	**Surprise Test / Quiz**	**Attendance**	**ESE**
15%	**15%**	**10%**	**5%**	**5%**	**50%**
Course Description	Data Handling and Visualization course deals with Data visualization, implementation, and principles of proportions				
Course Objective	1. To explain the basics of Data Visualization 2. To enable students to Implement visualization of distributions 3. To make students to write programs on visualization of time series, proportions & associations 4. To make students to apply visualization on Trends and uncertainty 5. To enable students, understand the principles of proportions				
Course Outcome	Upon completion of this course, the students will be able to 1. Understand basics of Data Visualization 2. Implement visualization of distributions 3. Write programs on visualization of time series, proportions & associations 4. Apply visualization on Trends and uncertainty 5. Explain principles of proportions				
Prerequisites: Nil					

CO, PO AND PSO MAPPING									
CO	**PO - 1**	**PO - 2**	**PO - 3**	**PO - 4**	**PO - 5**	**PO - 6**	**PSO -1**	**PSO -2**	**PSO - 3**
CO-1	**2**	**2**	**1**	**1**	**1**	**1**	**3**	**1**	**1**
CO-2	**2**	**2**	**1**	**1**	**-**	**1**	**3**	**1**	**1**
CO-3	**2**	**-**	**1**	**1**	**1**	**1**	**3**	**1**	**1**
CO-4	**2**	**2**	**1**	**1**	**1**	**1**	**3**	**-**	**1**
CO-5	**2**	**2**	**1**	**1**	**1**	**1**	**3**	**1**	**1**

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

MODULE 1: INTRODUCTION TO VISUALIZATION	**(9)**
Visualizing Data-Mapping Data onto Aesthetics, Aesthetics and Types of Data, Scales Map Data Values onto Aesthetics, Coordinate Systems and Axes- Cartesian Coordinates, Nonlinear Axes, Coordinate Systems with Curved Axes, Color Scales- Color as a Tool to Distinguish, Color to Represent Data Values, Color as a Tool to Highlight, Directory of Visualizations- Amounts, Distributions, Proportions, x–y relationships, Geospatial Data	**CO-1 BTL-3**
MODULE 2: VISUALIZING DISTRIBUTIONS	**(9)**
Visualizing Amounts-Bar Plots, Grouped and Stacked Bars, Dot Plots and Heatmaps, Visualizing Distributions: Histograms and Density Plots- Visualizing a Single Distribution, Visualizing Multiple Distributions at the Same Time, Visualizing Distributions: Empirical Cumulative Distribution Functions and Q-Q Plots- Empirical Cumulative Distribution Functions, Highly Skewed Distributions, Quantile-Quantile Plots, Visualizing Many Distributions at Once-Visualizing Distributions Along the Vertical Axis, Visualizing Distributions Along the Horizontal Axis	**CO-2 BTL-2**
MODULE 3: VISUALIZING ASSOCIATIONS & TIME SERIES	**(9)**
Visualizing Proportions-A Case for Pie Charts, A Case for Side-by-Side Bars, A Case for Stacked Bars and Stacked Densities, Visualizing Proportions Separately as Parts of the Total, Visualizing Nested Proportions- Nested Proportions Gone Wrong, Mosaic Plots and Treemaps, Nested Pies, Parallel Sets. Visualizing Associations Among Two or More Quantitative Variables-Scatterplots, Correlograms, Dimension Reduction, Paired Data. Visualizing Time Series and Other Functions of an Independent Variable-Individual Time Series, Multiple Time Series and Dose–Response Curves, Time Series of Two or More Response Variables	**CO-3 BTL-3**
MODULE 4: VISUALIZING UNCERTIANITY	**(9)**
Visualizing Trends-Smoothing, Showing Trends with a Defined Functional Form, Detrending and Time-Series Decomposition, Visualizing Geospatial Data-Projections, Layers, Choropleth Mapping, Cartograms, Visualizing Uncertainty-Framing Probabilities as Frequencies, Visualizing the Uncertainty of Point Estimates, Visualizing the Uncertainty of Curve Fits, Hypothetical Outcome Plots	**CO-4 BTL-2**
MODULE 5: PRINCIPLE OF PROPORTIONAL INK	**(9)**
The Principle of Proportional Ink-Visualizations Along Linear Axes, Visualizations Along Logarithmic Axes, Direct Area Visualizations, Handling Overlapping Points-Partial Transparency and Jittering, 2D Histograms, Contour Lines, Common Pitfalls of Color Use-Encoding Too Much or Irrelevant Information, Using Nonmonotonic Color Scales to Encode Data Values, Not Designing for Color-Vision Deficiency	**CO-5 BTL-3**

TEXT BOOKS	
1.	Claus Wilke, "Fundamentals of Data Visualization: A Primer on Making Informative and Compelling Figures", 1st edition, O'Reilly Media Inc, 2019.
REFERENCE BOOKS	
1.	Tony Fischetti, Brett Lantz, R: Data Analysis and Visualization, O'Reilly, 2016
	Ossama Embarak, Data Analysis and Visualization Using Python: Analyze Data to Create Visualizations for BI Systems, Apress, 2018
E BOOKS	
1.	https://www.netquest.com/hubfs/docs/ebook-data-visualization-EN.pdf
MOOC	
1.	https://www.coursera.org/learn/data-visualization
2.	https://www.coursera.org/learn/python-for-data-visualization#syllabus

COURSE TITLE	**DATA HANDLING AND VISUALIZATION LAB**			**CREDITS**	**1**
COURSE CODE	**CAB0246**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**0-0-2-0**
Version	**1.0**	**Approval Details**	**XX ACM, XX.XX.2022**	**LEARNING LEVEL**	**BTL-3**

ASSESSMENT SCHEME	
Continuous Internal Assessment	**ESE**
80 %	**20 %**

Course Description	This course focuses on the Data Visualization, Distribution, Visualization of time series, application of Visualization trends and explaining principles of proportions.
Course Objective	1. Make the students understand basics of Data Visualization 2. Make the students Implement visualization of distributions 3. Make the students write programs on visualization of time series, proportions & associations 4. Enable the students to apply visualization on Trends and uncertainty 5. Help students to explain principles of proportions
Course Outcome	Upon completion of this course, the students will be able to 1. Understand basics of Data Visualization 2. Implement visualization of distributions 3. Write programs on visualization of time series, proportions & associations 4. Apply visualization on Trends and uncertainty 5. Explain principles of proportions
Prerequisites: NIL	

CO, PO AND PSO MAPPING									
CO	PO -1	PO -2	PO - 3	PO -4	PO - 5	PO -6	PSO-1	PSO-2	PSO-3
CO-1	3	3	3	3	1	2	1	3	3
CO-2	3	3	3	3	1	2	2	3	3
CO-3	3	3	3	3	1	1	1	3	3
CO-4	2	2	2	2	1	1	1	2	2
CO-5	3	3	3	3	1	1	2	3	3
1: Weakly related, 2: Moderately related and 3: Strongly related									

IST OF EXPERIMENTS
1. Download the House Pricing dataset from Kaggle and map the values to Aesthetics
2. Use different Color scales on the Rainfall Prediction dataset
3. Create different Bar plots for variables in any dataset
4. Show an example of Skewed data and removal of skewedness
5. For a sales dataset do a Time Series visualization
6. Build a Scatterplot and suggest dimension reduction
7. Use Geospatial Data-Projections on dataset.
8. Create visualization on streaming dataset of weather forecasting.
9. Illustrate Partial Transparency and Jittering.
10. Illustrate usage of different color codes.

TEXT BOOKS	
1.	Claus Wilke, "Fundamentals of Data Visualization: A Primer on Making Informative and Compelling Figures", 1st edition, O'Reilly Media Inc, 2019.

REFERENCE BOOKS	
1.	Dr.Chun-hauh Chen, W.K.Hardle, A.Unwin, Handbook of Data Visualization, Springer publication, 2016.
2.	Christian Toninski, Heidrun Schumann, Interactive Visual Data Analysis, CRC press publication,2020

E BOOKS	
1.	https://www.netquest.com/hubfs/docs/ebook-data-visualization-EN.pdf

MOOC	
1.	https://www.coursera.org/learn/data-visualization
2.	https://www.coursera.org/learn/python-for-data-visualization#syllabus

COURSE TITLE	MACHINE LEARNING LAB		CREDITS	2
COURSE CODE	CAB0245	COURSE CATEGORY	PC	L-T-P-S	0-0-2-0
Version	1.0	Approval Details	XX ACM, XX.XX.2022	LEARNING LEVEL	BTL-3

ASSESSMENT SCHEME

Continuous Internal Assessment	ESE
80 %	20 %

Course Description	The course will enable the students to implement machine learning algorithms using python and solve various real time problems.
Course Objective	6. To use Python Libraries/ MATLAB tools for implementing pre-processing algorithms. 7. To solve the problems using Multivariate Linear Regression. 8. To build Logistic Regression, k-Nearest Neighbour / Decision Tree. 9. To use Dimensionality reduction of any CSV/image dataset using Principal Component Analysis. 10. To implement clustering algorithms.
Course Outcome	Upon completion of this course, the students will be able to 1. Implement pre-processing algorithms. 2. Solve the problems using Multivariate Linear Regression. 3. Build Logistic Regression, k-Nearest Neighbour / Decision Tree. 4. Use Dimensionality reduction of any CSV/image dataset using Principal Component Analysis. 5. Implement text segment as 'Positive' or 'Negative' statement using the Naïve Bayes Classifier.

Prerequisites: NIL

CO, PO AND PSO MAPPING

CO	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PSO -1	PSO -2	PSO-3
CO-1	3	3	3	3	1	2	1	3	3
CO-2	3	3	3	3	1	2	2	3	3
CO-3	3	3	3	3	1	1	1	3	3
CO-4	2	2	2	2	1	1	1	2	2
CO-5	3	3	3	3	1	1	2	3	3

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

LIST OF EXPERIMENTS
1. Installation of Python Libraries/ MATLAB tools for Machine Learning 2. Data pre-processing using Python Machine Learning libraries/ MATLAB. 3. Design a model to predict the housing price from Boston Dataset using Multivariate Linear Regression. 4. Build a classifier using Logistic Regression, k-Nearest Neighbour/ Decision Tree to classify whether the given user will purchase a product or not from a social networking dataset. 5. Segment a customer dataset based on the buying behaviour of customers using K-means/Hierarchical clustering. 6. Dimensionality reduction of any CSV/image dataset using Principal Component Analysis. 7. Recognition of MNIST handwritten digits using Artificial Neural Network. 8. Build an email spam classifier using SVM. 9. Classify the given text segment as 'Positive' or 'Negative' statement using the Naïve Bayes Classifier. 10. Predict future stock price of a company using Monte Carlo Simulation.

TEXT BOOKS	
1.	Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.
REFERENCE BOOKS	
1.	Sebastian Raschka, "Python Machine Learning", Packt Publishing, 2015
2.	Stephen Marsland, "Machine Learning – An Algorithmic Perspective", CRC Press, 2009.
E BOOKS	
1.	https://www.pdfdrive.com/introduction-to-machine-learning-with-python-e58337749.html
MOOC	
1.	https://www.coursera.org/learn/machine-learning-with-python
2.	https://www.udemy.com/course/machine-learning-course-with-python/

COURSE TITLE	BIG DATA AND ANALYTICS			CREDITS	3
COURSE CODE	CAB0306	COURSE CATEGORY	PC	L-T-P-S	3-0-0-0
Version	1.0	Approval Details	XX ACM, XX.XX.2022	LEARNING LEVEL	BTL-3
ASSESSMENT SCHEME					
First Periodical Assessment	Second Periodical Assessment	Seminar/ Assignments/ Project	Surprise Test / Quiz	Attendance	ESE
15%	15%	10%	5%	5%	50%

Course Description	Big data analytics is the use of advanced analytic techniques against very large, diverse data sets that include structured, semi-structured and unstructured data, from different sources, and in different sizes from terabytes to zettabytes. Big Data analytics provides various advantages—it can be used for better decision making, preventing fraudulent activities, among other things.
Course Objective	1. To have knowledge on the statistical techniques for Big data Analytics. 2. To acquire understanding in mining data streams. 3. Enable the students to know about clustering techniques. 4. Usage of graph analytics and thus to provide solutions. 5. To learn about Hadoop map, Reduce programming.
Course Outcome	Upon completion of this course, the students will be able to 1. Apply statistical techniques for Big data Analytics. 2. Analyze problems appropriate to mining data streams. 3. Apply the knowledge of clustering techniques in data mining. 4. Use Graph Analytics for Big Data and provide solutions 5. Apply Hadoop map Reduce programming for handing Big Data

Prerequisites: Nil

CO, PO AND PSO MAPPING

CO	PO -1	PO - 2	PO - 3	PO - 4	PO -5	PO - 6	PSO -1	PSO -2	PSO - 3
CO-1	2	2	1	1	1	1	3	1	1
CO-2	2	2	1	1	-	1	3	1	1
CO-3	2	-	1	1	1	1	3	1	1
CO-4	2	2	1	1	1	1	3	-	1
CO-5	2	2	1	1	1	1	3	1	1

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

MODULE 1: INTRODUCTION TO BIG DATA	**(9)**
Evolution of Big data - Best Practices for Big data Analytics - Big data characteristics - Validating - The Promotion of the Value of Big Data - Big Data Use Cases- Characteristics of Big Data Applications - Perception and Quantification of Value -Understanding Big Data Storage - Evolution Of Analytic Scalability - Analytic Processes and Tools - Analysis vs Reporting - Modern Data Analytic Tools - Statistical Concepts: Sampling Distributions - Re-Sampling - Statistical Inference - Prediction Error.	**CO-1 BTL -3**

MODULE 2: DATA ANALYSIS, CLUSTERING AND CLASSIFICATION	**(9)**
Regression Modelling - Multivariate Analysis - Bayesian Modelling - Support Vector and Kernel Methods - Analysis of Time Series: Linear Systems Analysis - Nonlinear Dynamics - Rule Induction. Overview of Clustering - K-means - Use Cases - Overview of the Method - Determining the Number of Clusters - Diagnostics - Reasons to Choose and Cautions. - Classification: Decision Trees - Overview of a Decision Tree - The General Algorithm - Decision Tree Algorithms - Evaluating a Decision Tree - Decision Trees in R - Naïve Bayes - Bayes 'Theorem - Naïve Bayes Classifier.	**CO-2 BTL -2**

MODULE 3: STREAM MEMORY	(9)
Introduction to Streams Concepts – Stream Data Model and Architecture - Stream Computing - Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating Moments – Counting Oneness in a Window – Decaying Window - Real time Analytics Platform (RTAP) Applications - Case Studies - Real Time Sentiment Analysis, Stock Market Predictions.	**CO-3 BTL-3**
MODULE 4: ASSOCIATION AND GRAPH MEMORY	**(9)**
Advanced Analytical Theory and Methods: Association Rules - Overview - Apriori Algorithm - Evaluation of Candidate Rules - Applications of Association Rules - Finding Association& finding similarity - Graph Analytics for Big Data: Graph Analytics - The Graph Model - Representation as Triples - Graphs and Network Organization - Choosing Graph Analytics - Graph Analytics Use Cases - Graph Analytics Algorithms and Solution Approaches - Technical Complexity of Analyzing Graphs- Features of a Graph Analytics Platform.	**CO-4 BTL-2**
MODULE 5: FRAMEWORKS AND VISUALIZATION (9)	
MapReduce – Hadoop, Hive, MapR – Sharding – NoSQL Databases - S3 - Hadoop Distributed File Systems – Visualizations - Visual Data Analysis Techniques - Interaction Techniques; Systems and Analytics Applications - Analytics using Statistical packages-Approaches to modeling in Analytics – correlation, regression, decision trees, classification, association-Intelligence from unstructured information-Text analytics-Understanding of emerging trends and Technologies-Industry challenges and application of Analytics- Analyzing big data with twitter - Big data for E-Commerce Big data for blogs - Review of Basic Data Analytic Methods using R.	**CO-5 BTL-3**

TEXT BOOKS	
1.	David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", 2013. ISBN 10: 0124173195ISBN 13: 9780124173194
2.	Anand Rajaraman and Jeffrey David Ullman, “Mining of Massive Datasets”, CambridgeUniversityPress,2012.ISBN10:1107015359ISBN 13:9781107015357
3.	MichaelBerthold,DavidJ.Hand,“IntelligentDataAnalysis”,Springer,2007.ISBN10: 3540430601 / ISBN 13: 9783540430605
REFERENCE BOOKS	
1.	EMC Education Services, "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", Wiley publishers, 2015. ISBN 10: 111887613X/ ISBN 13: 9781118876138.
2.	Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", Wiley Publishers, 2015. ISBN 10: 1118892704ISBN 13: 9781118892701
3.	Kim H. Pries and Robert Dunnigan, "Big Data Analytics: A Practical Guide for Managers " CRC Press, 2015.ISBN 10: 1482234513ISBN 13: 9781482234510

4.	Jimmy Lin and Chris Dyer, "Data-Intensive Text Processing with MapReduce", Synthesis Lectures on Human Language Technologies", Vol. 3, No. 1, Pages 1-177, Morgan Claypool publishers, 2010. ISBN 10: 1608453421ISBN 13: 9781608453429
5.	Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos, "Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data", McGrawHill Publishing, 2012.
E BOOKS	
1.	https://www.netquest.com/hubfs/docs/ebook-data-visualization-EN.pdf
MOOC	
1.	https://www.edx.org/course/big-data-analytics-2
2.	http://nptel.ac.in/courses/110106072/

COURSE TITLE	**PRINCIPLES OF DEEP LEARNING**			**CREDITS**	**4**
COURSE CODE	**CAB0307**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**3-0-2-1**
Version	**1.0**	**Approval Details**	**XX ACM, XX.XX.2022**	**LEARNING LEVEL**	**BTL-3**

ASSESSMENT SCHEME

First Periodical Assessment	**Second Periodical Assessment**	**Practical Component**	**ESE**
15%	**15%**	**20%**	**50%**

Course Description	This course deals basics of machine learning algorithms. This course helps to learn and design the simple feed forward neural network model. Also, from this course students are abletothedemonstratedeeplearning-basedexperimentsusingreal- world data.
Course Objective	1. To design a simple Neural Networks using Linear Perceptron. 2. To Implement a Convolutional Neural Networks using TensorFlow. 3. To develop an application based on Recurrent Neural Network. 4. To solve the Deep Reinforcement Learning problem. 5. TobuildtheSpeechandTextapplicationsbaseddeepneuralnetwork.
Course Outcome	Upon completion of this course, the students will be able to 1. Design a simple Neural Networks using Linear Perceptron. 2. Implement a Convolutional Neural Networks using TensorFlow. 3. Develop an application based on Recurrent Neural Network. 4. Solve the Deep Reinforcement Learning problem. 5. Buildthe Speech and Text applications based deep neural network.

Prerequisites: - Linear Algebra and Calculus

CO, PO AND PSO MAPPING

CO	PO - 1	PO - 2	PO - 3	PO - 4	PO - 5	PO - 6	PSO -1	PSO - 2	PSO -3
CO-1	2	2	1	1	1	1	3	1	1
CO-2	2	2	1	1	-	1	3	1	1
CO-3	2	-	1	1	1	1	3	1	1
CO-4	2	2	1	1	1	1	3	-	1
CO-5	2	2	1	1	1	1	3	1	1

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

MODULE 1: NEURAL NETWORK	**(9)**
Mechanics of Machine Learning-Neuron-Linear Perceptron-Feed-Forward Neural Networks-Sigmoid, Tanh, and ReLU Neurons- Training Feed-Forward Neural Networks-Fast-Food Problem-Gradient Descent- Delta Rule and Learning Rates. **Practical Component:** 1. Perform image classification and document Classification 2. Perform image localization and detection	**CO-1 BTL-2**
MODULE 2: CONVOLUTIONAL NEURAL NETWORKS	**(9)**
TensorFlow: Creating and Manipulating TensorFlow Variables-TensorFlow Operations-Neurons in Human Vision- Convolutional Layer-Building a Convolutional Network-Visualizing Learning in Convolutional Networks-Learning Lower Dimensional Representations- Principal Component Analysis- Autoencoder Architecture-Implementing an Autoencoder in TensorFlow. **Practical Component:** Normalizing the Data and Preparing the Training/ Validation Datasets using the concept of CNN	**CO-2 BTL-2**
MODULE 3: RECURRENT NEURAL NETWORKS	**(9)**
Recurrent Neural Networks- Challenges with Vanishing Gradients- Long Short-Term Memory (LSTM) Units- TensorFlow Primitives for RNN Models- Implementing a Sentiment Analysis Model- Solving seq2seq Tasks with Recurrent Neural Networks-Memory Augmented Neural Networks: Neural Turing Machines, Attention-Based Memory Access, Differentiable neural Computers (DNC) -Memory Reuse - Temporal Linking- DNC Controller Network – Visualizing – Implementing the DNC in TensorFlow. **Practical Component:** For a sentiment classification dataset use the vanilla RNN network and train the network over the data set.	**CO-3 BTL-3**
MODULE 4: DEEP REINFORCEMENT LEARNING	**(9)**
Deep Reinforcement Learning - Masters Atari Games-Markov Decision Processes- Policy Versus Value Learning, Pole-Cart with Policy Gradients-Q-Learning and Deep Recurrent Networks. **Practical Component:** Perform Tabular data for e.g., sales prediction with categorical data, continuous data, and mixed data, including time series.	**CO-4 BTL-2**
MODULE 5: APPLICATIONS	**(9)**
Applications in Object Recognition and Computer Vision- Unsupervised or generative feature learning- Supervised feature learning and classification- Applications in	**CO-5**

	BTL -2

Multimodal and Multi-task Learning- Multi- modalities: Text and image-Speech and image-multi-task learning within the speech, NLP or image domain **Practical Component:** Implement an application for computer vision with OpenCV.	
TEXT BOOKS	
1.	Nikhil Buduma, Nicholas Locascio, "Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms", O'Reilly Media, 2017. https://www.oreilly.com/ai/free/files/fundamentals-of-deep-learning-sampler.pdf
2.	Li Dengand Dong Yu"Deep Learning Methods and Applications", Foundations and Trends in Signal Processing, 2013. http://link.springer.com/openurl?genre=book&isbn=978-3-319-73004-2
REFERENCE BOOKS	
1.	Ian Goodfellow, Yoshua Bengio, Aaron Courville," Deep Learning (Adaptive Computation and Machine Learning series", MIT Press, 2017.
2.	Sandro Skansi "Introduction to Deep Learning from Logical Calculus to Artificial Intelligence", Springer, 2018.
3.	Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2015.
E BOOKS	
1.	https://www.deeplearningbook.org/
2.	https://pythonmachinelearning.pro/free-ebook-deep-learning-with-python/
3.	https://www.getfreeebooks.com/deep-learning/
MOOC	
1.	https://www.classcentral.com/course/kadenze-creative-applications-of-deep-learning-with-tensorflow-6679
2.	https://in.udacity.com/course/deep-learning--ud730
3.	https://www.edx.org/learn/deep-learning

	BIG DATA AND ANALYTICS LAB			CREDITS	1
COURSE CODE	CAB0334	COURSE CATEGORY	PC	L-T-P-S	0-0-2-0
Version	1.0	Approval Details	XX ACM, XX.XX.2022	LEARNING LEVEL	BTL-3

ASSESSMENT SCHEME

Continuous Internal Assessment	ESE
80 %	20 %

Course Description	Big data analytics is the use of advanced analytic techniques against very large, diverse data sets that include structured, semi-structured and unstructured data, from different sources, and in different sizes from terabytes to zettabytes.
Course Objective	1. To have knowledge on the statistical techniques for Big data Analytics. 2. To acquire understanding in mining data streams. 3. Enable the students to know about clustering techniques. 4. Usage of graph analytics and thus to provide solutions. 5. To learn about Hadoop map, Reduce programming.
Course Outcome	Upon completion of this course, the students will be able to 1. Apply statistical techniques for Big data Analytics. 2. Analyze problems appropriate to mining data streams. 3. Apply the knowledge of clustering techniques in data mining. 4. Use Graph Analytics for Big Data and provide solutions 5. Apply Hadoop map Reduce programming for handing Big Data

Prerequisites: NIL

CO, PO AND PSO MAPPING

CO	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PSO-1	PSO-2	PSO-3
CO-1	3	3	3	3	1	2	1	3	3
CO-2	3	3	3	3	1	2	2	3	3

LIST OF EXPERIMENTS	
1. Study of R Programming. 2. Hypothesis Test using R. 3. K-means Clustering using R 4. Naïve Bayesian Classifier 5. Implementation of Linear Regression 6. Implement Logistic Regression 7. Time-series Analysis 8. Association Rules using R. 9. Map Reduce using Hadoop 10. Implementation of Queries using Mongo DB	
TEXT BOOKS	
1.	David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", 2013.
2.	Arshdeep Bahga, Vijay Madisetti, "Big Data Science & Analytics: A Hands-On Approach", Vpt publisher, 2015.
REFERENCE BOOKS	
1.	EMC Education Services, "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", Wiley publishers, 2015.
2.	Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", Wiley Publishers, 2015
E BOOKS	
1.	https://www.pdfdrive.com/introduction-to-machine-learning-with-python-e58337749.html
MOOC	
1.	https://www.edx.org/course/big-data-analytics-2
2.	http://nptel.ac.in/courses/110106072/

COURSE TITLE	MINI PROJECT			CREDIT	1
COURSE CODE	CAB0331	COURSE CATEGORY	PC	L-T-P-S	0-0-2-0
ASSESSMENT SCHEME					
CIA	80%	ESE	20%		
LEARNING LEVEL		**BTL4**			
CO	**Outcomes**				**PO**
Upon completion of this course, the students will be able to					
1	Identify a real time work for engaging, educating, focusing and energizing people				1,2,3,4,5,6
2	Develop a solution for the problem				1,2,3,4,5,6

3	Develop an application by using relevant data science principles	1,2,3,4,5,6
Mini Project		
Design and develop practical solutions to real life problems related to data science. The subject shouldbeappliedtodevelopeffectivesolutionstovariouscomputingproblems.Submitacomplete report of the project work carried out.		

COURSE TITLE	**TECHNIQUES AND TOOLS FOR DATA SCIENCE**			**CREDITS**	**3**
COURSE CODE	**CAB0318**	**COURSE CATEGORY**	**PC**	**L-T-P-S**	**3-0-0-1**
Version	**1.0**	**Approval Details**	**XX ACM, XX.XX.2022**	**LEARNING LEVEL**	**BTL-3**

ASSESSMENT SCHEME

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

Course Description	This course deals basics of machine learning algorithms. This course helps to learn and design the simple feed forward neural network model. Also, from this course students are able to the demonstrate deep learning-based experiments using real-world data.
Course Objective	1. To gain knowledge on preprocessing the data using WEKA and Excel. 2. To understand how to model a system using Scikit and TensorFlow. 3. To find the solutions using the NLTK tool. 4. To create visualization using Matplotlib and Tableau. 5. To solve the real time problems of data science.
Course Outcome	Upon completion of this course, the students will be able to 1. Cleaning and preprocessing the data using WEKA and Excel. 2. Modeling a system using Scikit and TensorFlow. 3. Find the solutions using NLTK tool. 4. Create visualization using Matplotlib and Tableau. 5. Solve the real time problems of data science.

Prerequisites: - Knowledge in Data science

CO, PO AND PSO MAPPING

CO	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PSO -1	PSO -2	PSO -3
CO-1	2	2	1	1	1	1	3	1	1
CO-2	2	2	1	1	-	1	3	1	1
CO-3	2	-	1	1	1	1	3	1	1

CO-4	**2**	**2**	**1**	**1**	**1**	**1**	**3**	**-**	**1**
CO-5	**2**	**2**	**1**	**1**	**1**	**1**	**3**	**1**	**1**
1: Weakly related, 2: Moderately related and 3: Strongly related									

MODULE 1: CLEANING AND PREPROCESSING	(9)
Introduction- Preprocessing Data -File Conversion - Opening File from A Local File System -OpeningFile from A Web Site - Reading Data from a Database - Preprocessing Window-Building Classifier, Cluster, Association-Attribute Selection-Data Visualization. Excel: Statistical Capabilities-Average, Mean, Stand Deviation, Median, Graphs-Scatter Plot, Bar Graphs.	**CO-1 BTL-2**
MODULE 2: MODELING	**(9)**
Introduction to Scikit learn – Installation basics – fitting and predicting (estimator basics) - Transformers and pre-processors - Pipelines: chaining pre-processors and estimator - Model evaluation - Automatic parameter searches-TensorFlow Fundamentals- basic computation - Installation of TensorFlow - Tensors and NumPy - Loading and Preprocessing data - Linear and Logistic regression with TensorFlow - Training convolutional neural network in TensorFlow - deploying model.	**CO-2 BTL-2**
MODULE 3: APPLICATION	**(9)**
Overview of NLTK- Tool Installation -Tokenize Words and Sentences-POS Tagging & Chunking- Stemming and Lemmatization-WordNet with NLTK-Introduction about jupyter notebook-Notebook Basics-Running Code-Markdown cells-ImportingJupyter Notebook as module-connecting to an existing Ipython kernel using Qt Console	**CO-3 BTL-3**
MODULE 4: VISUALIZATION	**(9)**
Visualization with Matplotlib- Figures and Subplots- Colors, Line Styles, Ticks, Labels, and Legends - Saving Plots to File - Line Plots, Scatter Plots, Density and Contour Plots, Histograms, Three-Dimensional Plotting and Geographic Data with Basemap. Visualization with Tableau: Introduction – Adding Data Sources in Tabeau – Creating Data Visualizations – Aggregate Functions, Calculated Fields, and Parameters – Table Calculations – Maps – Advanced Analytics: Trends, Forecasts, Clusters and other Statistical Tools	**CO-4 BTL-2**
MODULE 5: CASE STUDY	**(9)**
Case Study 1: Data Science and Machine Learning tools for mining insights from the student data. CaseStudy 2: Adaptive Learning based on the analysis of student data.	**CO-5 BTL-2**

TEXT BOOKS

1.	Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn and Tensor Flow" O'Reilly, 2017.
2.	Bharath Ramsundar, Reza Bosagh Zadeh (2018). "TensorFlow for Deep Learning", O'Reilly, 2018.

3.	Statistical Analysis with Excel for Dummies, Joseph Schmuller , John Wiley & Sons, Inc, 2013.
4.	Alexander Loth, "Visual Analytics with Tableau", Wiley Publisher, First Edition, 2019.
REFERENCE BOOKS	
1.	Jake VanderPlas, "Python Data Science Handbook: Essential Tools for Working with Data", O'Reilly, 2017.
E BOOKS	
1.	https://www.cs.auckland.ac.nz/courses/compsci367s1c/tutorials/IntroductionToWeka.pdf
2.	https://readthedocs.org/projects/jupyter-notebook/downloads/pdf/latest/
3.	https://www.tutorialspoint.com/tableau/index.htm
MOOC	
1.	https://www.coursera.org/specializations/data-visualization
2.	https://learning.oreilly.com/library/view/hands-on-machine-learning/9781492032632/
3.	https://campus.datacamp.com/courses/data-analysis-in-excel/exploring-data?ex=2

COURSE TITLE	**INTERNSHIP**			**CREDITS**	**1**
COURSE CODE	**CAB0341**	**COURSE CATEGORY**	**LAB**	**L-T-P-S**	**0-0-2-0**
Version	**1.0**	**Approval Details**	**XX ACM, XX.XX.2022**	**LEARNING LEVEL**	**BTL-3**

ASSESSMENT SCHEME		
Technical report/ Certificate	**Presentation and Vivo- voce**	**ESE**
30 %	**70 %**	**-**

Course Description	This course is mainly focused on improving the skills in addition to classroom learning with industrial experience. The student is expected to apply the concepts, principles and algorithms learnt in the field of computer science with specialization in data science and to gain knowledge in obtaining knowledge in building products/tools/applications addressing the needs of real-world societal issues.
Course Objective	1. To learn critical thinking and problem-solving knowledge in data science. 2. To apply design and develop products/tools/applications to solve the issues in data science 3. To obtain professional behavior and knowledge in data science.
Course Outcome	Upon completion of this course, the students will be able to 1. Develop and test program segments that constitute a software/hardware product. 2. Demonstrate the software cycle principles and improve the project management skills

	3. Appraise the hardware/software product developed in the form of technical presentations, demonstrations and report generation through team work.

Prerequisites: NIL

CO, PO AND PSO MAPPING

CO	PO - 1	PO-2	PO-3	PO-4	PO-5	PO-6	PSO-1	PSO-2	PSO-3
CO-1	-	3	3	3	1	2	3	3	2
CO-2	3	3	3	3	1	2	2	-	3
CO-3	3	3	3	3	3	1	3	3	2
CO-4	-	-	-	-	-	-	-	-	-
CO-5	-	-	-	-	-	-	-	-	-

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

NOTE • A student has to compulsorily attend Summer / Winter internship during 3rd year for a minimum period of one month. • In lieu of Summer / Winter internship, the student is permitted to register for undertaking case study / project work under a teaching faculty of the Institute and carry out the project for minimum period of one month. • In both the cases, the internship report in the prescribed format duly certified by the faculty in-charge shall be submitted to the HoD. • Assessment is based on creativity, applicability to the society, project development skills, team work. • Technical communication, presentation and report writing skills form an essential component in assessment.	**CO1, CO2, CO3 /BTL3**

COURSE TITLE	PROJECT WORK			CREDITS	8
COURSE CODE	CAB0342	COURSE CATEGORY	PC	L-T-P-S	0-0-16-0
CIA	60%			ESE	40%
LEARNING LEVEL	BTL-3				

CO	COURSE OUTCOMES	PO
Upon completion of this course, the students will be able to		
1	Develop practical solutions through analyzing the real time problem and apply the fundamental Knowledge learnt from the previous semesters.	1,2
2	Use research-based knowledge and research methods through modern tools	3,4,5
3	Work as an individual and as a team in solving complex problem.	6
Design and Development of Solution for the identified real time complex problems by applying the gained knowledge in data science.		

REFERENCE BOOKS	
1.	Neil G. Siegel, Engineering Project Management, Wiley, 2019
2.	Steve Tockey, How to Engineer Software: A Model-Based Approach, Wiley, 2019

Weightage of Assessment:

Review / Examination Scheme	Weightage
First Review	10%
Second Review	20%
Third Review	20%
End Semester Viva Voce	50%

A committee shall be constituted by the HoD for the Review

LIST OF ELECTIVES

COURSE TITLE	TIME SERIES ANALYSIS			Credit	3
COURSE CODE	CAC0253	COURSE CATEGORY	DE	L-T-P-S	2-0-2-0
Version	1.0	Approval Details	XX ACM, XX.XX.2022	LEARNING LEVEL	BTL-3

ASSESSMENT SCHEME

First Periodical Assessment	Second Periodical Assessment	Practical Assessment	ESE
15%	15%	50 %	50 %

Course Description	A time series essentially is a series of quantitative values. These values are obtained over time, and often have equal time intervals between them. These intervals can be quite different and may consist of yearly, quarterly, monthly or hourly buckets for instance.
Course Objective	1. To explain the basic concepts in time series analysis and forecasting. 2. To help students understand the use of time series models for forecasting and the limitations of the methods. 3. To make students to criticize and judge time series regression models. 4. To teach how to distinguish the ARIMA modelling of stationary and nonstationary time series. 5. To explain how to compare with multivariate times series and other methods of applications
Course Outcome	Upon completion of this course, the students will be able to 1. Knowledge of basic concepts in time series analysis and forecasting. 2. Understanding the use of time series models for forecasting and the limitations of the methods. 3. Ability to criticize and judge time series regression models. 4. Distinguish the ARIMA modelling of stationary and nonstationary time series. 5. Compare with multivariate times series and other methods of applications

Prerequisites: Nil

CO, PO AND PSO MAPPING

CO	PO -1	PO - 2	PO -3	PO - 4	PO -5	PO - 6	PSO -1	PSO -2	PSO - 3
CO-1	2	2	1	1	1	1	3	1	1
CO-	2	2	1	1	-	1	3	1	1

2									
CO-3	**2**	**-**	**1**	**1**	**1**	**1**	**3**	**1**	**1**
CO-4	**2**	**2**	**1**	**1**	**1**	**1**	**3**	**-**	**1**
CO-5	**2**	**2**	**1**	**1**	**1**	**1**	**3**	**1**	**1**
1: Weakly related, 2: Moderately related and 3: Strongly related									

MODULE 1: INTRODUCTION OF TIMESERIES ANALYSIS (6L+6P)	
Introduction to Time Series and Forecasting -Different types of data-Internal structures of time series-Models for time series analysis-Autocorrelation and Partial autocorrelation. Examples of Time series Nature and uses of forecasting-Forecasting Process-Data for forecasting –Resources for forecasting. **Practical Component:** 1. Time Series Data Cleaning 2. Loading and Handling Times series data 3. Pre-processing Techniques	**CO1/BTL 3**
MODULE 2: STATISTICS BACKGROUND FOR FORECASTING (6L+6P)	
Graphical Displays -Time Series Plots - Plotting Smoothed Data - Numerical Description of Time Series Data - Use of Data Transformations and Adjustments- General Approach to Time Series Modelling and Forecasting- Evaluating and Monitoring Forecasting Model Performance. **Practical Component:** 1. How to Check Stationarity of a Time Series. 2. How to make a Time Series Stationary? 3. Estimating & Eliminating Trend. o Aggregation o Smoothing o Polynomial Fitting 4.Eliminating Trend and Seasonality o Differencing o Decomposition	**CO2/BTL 3**
MODULE 3: TIME SERIES REGRESSION MODEL (6L+6P)	
Introduction – Least Squares Estimation in Linear Regression Models – Statistical Inference in Linear Regression- Prediction of New Observations – Model Adequacy Checking -Variable Selection Methods in Regression – Generalized and Weighted Least Squares- Regression Models for General Time Series Data- Exponential Smoothing-First order and Second order. **Practical Component:** 1.Moving Average time analysis data. 2.Smoothing the Time analysis Data. 3.Check out the Time series Linear and non-linear trends. 4.Create a modelling.	**CO3/BTL 3**
MODULE 4: AUTOREGRESSIVE INTEGRATED MOVING AVERAGE (ARIMA) MODELS (6L+6P)	
Autoregressive Moving Average (ARMA) Models - Stationarity and Invertibility of ARMA Models - Checking for Stationarity using Variogram- Detecting Nonstationary - Autoregressive Integrated Moving Average (ARIMA) Models - Forecasting using ARIMA - Seasonal Data - Seasonal ARIMA Models- Forecasting using Seasonal ARIMA Models Introduction - Finding the "BEST" Model - Example:	**CO4/BTL 3**

Internet Users Data- Model Selection Criteria - Impulse Response Function to Study the Differences in Models - Comparing Impulse Response Functions for Competing Models. **Practical Component:** 1. Modelling time series o Moving average o Exponential smoothing o ARIMA 2. Seasonal autoregressive integrated moving average model (SARIMA)	
MODULE 5: MULTIVARIATE TIME SERIES MODELS AND FORECASTING (6L+6P)	
Multivariate Time Series Models and Forecasting - Multivariate Stationary Process- Vector ARIMA Models - Vector AR (VAR) Models - Neural Networks and Forecasting -Spectral Analysis - Bayesian Methods in Forecasting. **Practical Component**: Dependence Techniques o Multivariate Analysis of Variance and Covariance o Canonical Correlation Analysis o Structural Equation Modelling Inter-Dependence Techniques o Factor Analysis o Cluster Analysis	**CO5/BTL 3**
TEXT BOOKS	
1.	Introduction To Time Series Analysis and Forecasting, 2nd Edition, Wiley Series In Probability And Statistics, By Douglas C. Montgomery, Cheryl L. Jen (2015): ISBN10 1118745116, ISBN139781118745113 https://b-ok.cc/book/2542456/2fa941
2.	Master Time Series Data Processing, Visualization, And Modeling Using Python Dr. Avishek Pal Dr. Pks Prakash (2017). ISBN10 178829419X, ISBN13 9781788294195 https://b-ok.cc/book/3413340/2eb247
3.	Time Series Analysis and Forecasting by Example Søren Bisgaard Murat Kulahci Technical University of Denmark Copyright © 2011 By John Wiley & Sons, Inc. ISBN10 0470540648,ISBN139781118056943https://b-ok.cc/book/1183901/9be7ed
REFERENCE BOOKS	
1.	PeterJ.BrockwellRichardA.DavisIntroductiontoTimeSeriesandForecasting Third Edition. (2016). https://b-ok.cc/book/2802612/149485
2.	Multivariate Time Series Analysis and Applications, William W.S. Wei Department of Statistical Science Temple University, Philadelphia, PA, SA This edition first published 2019 John Wiley & Sons Ltd. https://bok.cc/book/3704316/872fbf
3.	Time Series Analysis by James D Hamilton Copyright © 1994 by prince town university press. https://b-ok.cc/book/3685042/275c71
E BOOKS	

1.	https://www.stat.ipb.ac.id/en/uploads/KS/S2%20-%20ADW/3%20Montgomery%20-%20Introduction%20to%20Time%20Series%20Analysis%20and%20Forecasting.pdf
2.	https://ru.b-ok2.org/terms/?q=forecasting
3.	https://otexts.com/fpp2/
4.	http://home.iitj.ac.in/~parmod/document/introduction%20time%20series.pdf
MOOC	
1.	https://www.coursera.org/learn/practical-time-series-analysis
2.	https://ocw.mit.edu/courses/economics/14-384-time-series-analysis-fall-2013/download-course-materials/
3.	https://swayam.gov.in/nd1_noc19_mg46/preview

COURSE TITLE	**DATA WRANGLING TECHNIQUES**			**CREDITS**	**3**
COURSE CODE	**CAC0254**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**3-0-0-1**
Version	**1.0**	**Approval Details**	**XX ACM, XX.XX.2022**	**LEARNING LEVEL**	**BTL-3**

ASSESSMENT SCHEME

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

Course Description	Dealing with the raw data has no longer been accessible and cannot be utilized should be processed to use efficiently. Data-wrangling which helps to turn non- resourceful (raw) data into valuable data which in turn returns valuable information. Each step in the process of wrangling the data is to the best possible analysis.
Course Objective	1. To Perform data analysis in a literate programming environment 2. To Import and manage structured and unstructured data 3. To Manipulate, transform, and summarize the data 4. To Join disparate data sources and to explore and visualize the data 5. To Develop the functions to the perform basic predictive analytic modeling
Course Outcome	Upon completion of this course, the students will be able to 1. Understand the basics of Data Clean up and work on NoSQL 2. Relate data clean up and test the new dataset 3. Transform and wrangle data 4. Visualize the data using different libraries 5. Scrap data from websites using Beautiful Soap library
Prerequisites: - Basic knowledge of python	

CO, PO AND PSO MAPPING									
CO	**PO - 1**	**PO - 2**	**PO - 3**	**PO - 4**	**PO - 5**	**PO - 6**	**PSO -1**	**PSO -2**	**PSO -3**
CO-1	**2**	**2**	**1**	**1**	**1**	**1**	**3**	**1**	**1**
CO-2	**2**	**2**	**1**	**1**	**-**	**1**	**3**	**1**	**1**
CO-3	**2**	**-**	**1**	**1**	**1**	**1**	**3**	**1**	**1**
CO-4	**2**	**2**	**1**	**1**	**1**	**1**	**3**	**-**	**1**
CO-5	**2**	**2**	**1**	**1**	**1**	**1**	**3**	**1**	**1**

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

MODULE 1: INTRODUCTION TO DATA AND DATA CLEAN UP	**(9)**
Acquiring and Storing Data: Readability, Cleanliness, and Longevity – NoSQL: Installation and usage-Data Cleanup-Investigation, Matching, and Formatting.	**CO-1 BTL-2**
MODULE 2: STANDARDIZING AND SCRIPTING	**(9)**
Normalizing and Standardizing, Determining What Data Cleanup Is Right for Your Project, Scripting Your Cleanup, Testing with New Data, Data Exploration and Analysis- Importing Data, Joining Numerous Datasets	**CO-2 BTL-2**
MODULE 3: Data Wrangling	**(9)**
Handling Missing Data- Data Transformation- String Manipulation, Join, Combine, and Reshape: Hierarchical Indexing Combining and Merging Datasets Reshaping and Pivoting	**CO-3 BTL-3**
MODULE 4: VISUALIZATION OF DATA	**(9)**
Charts, Time-Related Data, Maps, Interactives, Words, matplotlib, Plotting with pandas and seaborn, Other Python Visualization Tools.	**CO-4 BTL-2**
MODULE 5: WEB SCRAPING	**(9)**
Acquiring and Storing Data from the Web- Analyzing a Web Page, Reading a Web Page with Beautiful Soup. Screen Scrapers and Spiders- Browser-Based Parsing, Spidering the Web	**CO-5 BTL-2**

TEXT BOOKS	
1.	Jacqueline Kazil & Katharine Jarmul, "Data Wrangling with Python", O'Reilly Media, Inc, 2016.
2.	Wes McKinney, Python for Data Analysis Data Wrangling with Pandas, NumPy, and IPython, O'Reilly Media, Inc, 2016.
REFERENCE BOOKS	
1.	Jeffrey Heer, Sean Kandel & Connor Carreras, Principles of Data Wrangling: Practical Techniques for Data Preparation, O'Reilly Media, Inc, 2017

2.	Allan Visochek, Practical Data Wrangling: Expert Techniques for Transforming Your Raw Data into a Valuable Source for Analytics, Packt
E BOOKS	

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

COURSE TITLE	**PREDICTIVE MODELLING AND ANALYTICS**			**CREDITS**	**3**
COURSE CODE	**CAC0272**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**3-0-0-0**
Version	**1.0**	**Approval Details**	**XX ACM, XX.XX.2022**	**LEARNING LEVEL**	**BTL-3**

ASSESSMENT SCHEME

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

Course Description	This course is designed with the aim of initiating interest for the predictive modelling and Analytics and teach them how to apply predictive analytics in problems.
Course Objective	1. To gain knowledge about data transformation and analysis 2. To distinguish between regression models and nonlinear regression models 3. To impart the understanding of class predictions and its evaluation criteria 4. To be able to comprehend the classification trees and Rule-Based Models 5. To elaborate on the different factors that affect the performance of the predictive models
Course Outcome	Upon completion of this course, the students will be able to 1. Apply data transformation and enable analysis of the transformed data 2. Enumerate the functionalities of various regression and nonlinear regression models 3. Recognize different class predictions and its evaluation parameters 4. Comprehend the classification models and also other rule-based models 5. Explain the elements of model tuning and training methods
Prerequisites: Nil	

CO, PO AND PSO MAPPING									
CO	**PO - 1**	**PO - 2**	**PO - 3**	**PO - 4**	**PO -5**	**PO - 6**	**PSO -1**	**PSO -2**	**PSO -3**
CO-1	**2**	**2**	**1**	**1**	**1**	**1**	**3**	**1**	**1**
CO-2	**2**	**2**	**1**	**1**	**-**	**1**	**3**	**1**	**1**
CO-3	**2**	**-**	**1**	**1**	**1**	**1**	**3**	**1**	**1**
CO-4	**2**	**2**	**1**	**1**	**1**	**1**	**3**	**-**	**1**
CO-5	**2**	**2**	**1**	**1**	**1**	**1**	**3**	**1**	**1**

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

MODULE 1: PREDICTORS FOR DATA TRANSFORMATION (9)	
Introduction - Why Exploratory Data Analysis is Important - Data Cleanup and Transformation - Dealing with Missing Values - Dealing with Outliers - Adding and Removing Variables - Common Graphs - What is Good Data Visualization? - Data Exploration.	**CO-1 BTL-2**
MODULE 2: PERFORMANCE OF REGRESSION MODELS	**(9)**
Introduction to Linear Regression - Assessing Predictive Accuracy Using Cross-Validation - Multiple Regression - Improving Model Fit - Model Selection - Challenges of Predictive Modeling - How to Build a Model using XLMiner - Reflection on Statistical Techniques.	**CO-2 BTL-2**
MODULE 3: PERFORMANCE OF CLASSIFICATION MODELS	**(9)**
Introduction to Logistic Regression - Building Logistic Regression Model - Multiple Logistic Regression - Cross Validation and Confusion Matrix - Cost Sensitive Classification - Comparing Models Independent of Costs and Cutoffs - Building Logistic Regression Models using XLMiner - The Best Prediction Method.	**CO-3 BTL-3**
MODULE 4: MODEL TUNING AND STATEGIES	**(9)**
Classification with Simple Rules - Learning Rules - Sequential Covering - From Rules to Trees – Entropy - Measuring Entropy - Using Information Gain to Build Trees - Building Trees: ID3 Algorithm - Building Trees: C.45 Algorithm - Evaluation: Leave One Out Cross Validation - Nearest Neighbor - Similarity Functions - Curse of Dimensionality.	**CO-4 BTL-3**
MODULE 5: MEASUREMENT OF ERRORS	**(6)**
Introduction to Trees - Classification Trees - Regression Trees - Bagging, Boosting, Random Forest - Neural Networks - Building Trees with XLMiner - Building Neural Networks using XLMiner - Reflection: Trees & Neural Networks.	**CO-5 BTL-2**

TEXT BOOKS

1.	Applied Predictive Modeling, Max Kuhn (Author), Kjell Johnson, 2013.

REFERENCE BOOKS

1.	Statistical and Machine-Learning Data Mining: Techniques for Better Predictive Modelling and Analysis of Big Data, Bruce Ratner, 2nd Edition.
2.	Predictive Analytics For Dummies (For Dummies Series), Dr. Anasse Bari, Mohamed Chaouchi, Tommy Jung, 2014.

EBOOK

1.	https://www.ic.unicamp.br/~wainer/cursos/1s2021/432/2013_Book_AppliedPredictiveModeling.pdf

2.	https://www.researchgate.net/publication/348264487_Predictive_Analytics_Using_Statistics_and_Big_Data_Concepts_and_Modeling
MOOC	
1.	https://www.coursera.org/courses?query=predictive%20analytics
2.	https://www.coursera.org/courses?query=predictive%20analytics

COURSE TITLE	**STATISTICAL INFERENCE FOR DATA SCIENCE**			**CREDITS**	**4**
COURSE CODE	**CAC0273**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**2-1-2-0**
Version	**1.0**	**Approval Details**	**XX ACM, XX.XX.2022**	**LEARNING LEVEL**	**BTL-3**
ASSESSMENT SCHEME					
First Periodical Assessment	**Second Periodical Assessment**	**Practical Assessment**			**ESE**
15%	**15%**	**20 %**			**50%**
Course Description	This is a course suitable for BSC Data Science students. It gives idea about Standard Deviation, Z-Score, Frequency Table and Histograms. This course also gives knowledge in the Bootstrapping, Hypothesis and Linear Regression techniques.				
Course Objective	1. To learn Mean, Median, Mode, Outliers. 2. To learn the concepts of normalization and sampling methods. 3. To learn the various Hypothesis Tests. 4. To have basic knowledge on regression and prediction techniques. 5. To evaluate different classification models.				
Course Outcome	Upon completion of this course, the students will be able to 1. Perform exploratory analysis on the datasets. 2. Understand the various distribution and sampling. 3. Perform Hypothesis Testing on datasets. 4. Apply statistical inference for Regression. 5. Apply statistical inference for Classification.				
Prerequisites: Python for Data Science/ R for Data Science					

CO, PO AND PSO MAPPING									
CO	**PO - 1**	**PO - 2**	**PO - 3**	**PO - 4**	**PO -5**	**PO - 6**	**PSO -1**	**PSO -2**	**PSO - 3**
CO-1	**2**	**2**	**1**	**1**	**1**	**1**	**3**	**1**	**1**
CO-2	**2**	**2**	**1**	**1**	**-**	**1**	**3**	**1**	**1**
CO-3	**2**	**-**	**1**	**1**	**1**	**1**	**3**	**1**	**1**
CO-4	**2**	**2**	**1**	**1**	**1**	**1**	**3**	**-**	**1**
CO-5	**2**	**2**	**1**	**1**	**1**	**1**	**3**	**1**	**1**
1: Weakly related, 2: Moderately related and 3: Strongly related									

MODULE 1: EXPLORATORY ANALYSIS (6L+6P=12)	
Elements of Structured, Estimates of Location - Mean, Median, Mode, Outliers, Estimates of Variability- Standard Deviation, Z-Score, Frequency Table and Histograms, Correlation. **Practical component:** Rainfall prediction dataset – draw correlation between the features Find the outliers in the Housing Price dataset Book Pages: Chapter 1	**CO-1 BTL-2**
MODULE 2: DATA SAMPLING AND DISTRIBUTION (6L+6P = 12)	
Normalization, Sampling Data-Simple Random sampling, Stratified, Cluster Sampling, Sampling Error/Bias. Bootstrapping, Central Limit Theorem, Confidence intervals, Normal distribution, Binomial distribution, Poisson distribution. **Practical component:** For a given dataset, display a chosen feature using different mean values Display the confidence interval of a chosen feature based on a sample Book Pages: Chapter 2	**CO-2 BTL-2**
MODULE 3: HYPOTHESIS (6L+6P = 12)	
A/B Testing, Hypothesis Tests- null, one-way, two-way, P-value, Type 1 & 2 errors, t-tests, multiple testing, degrees of freedom, ANOVA, Chi-Square Tests, Power and Sample Size. **Practical component:** Perform t-test on a feature in a dataset Create Boxplots for different groups of a feature Book Pages: Chapter 3	**CO-3 BTL-3**
MODULE 4: REGRESSION AND PREDICTION (6L+6P = 12)	

Simple Linear Regression, Multiple Linear Regression, Confidence and Prediction Intervals, Categorical Variables, Multicollinearity, Polynomial Regression **Practical component:** Create a Linear Regression model for a dataset and display the error measures Choose a dataset with categorical data and apply linear regression model Book Pages: Chapter 4	**CO-4 BTL-2**
MODULE 5: CLASSIFICATION	**(6L+6P = 12)**

Naive Bayes, Discriminant Analysis, Logistic Regression, Evaluating Classification Models, Strategies for Imbalanced Data. **Practical component:** Apply Naïve Bayes algorithm on a dataset and estimate the accuracy Apply Logistic Regression algorithm on a dataset and estimate the accuracy Book Pages: Chapter 5	**CO-5 BTL-2**

BOOKS	
1.	Bruce, Peter, and Andrew Bruce. (2017). *Practical statistics for data scientists: 50 essential concepts*, O'Reilly Media, Inc. ISBN: 9781491952962
REFERENCE BOOKS	
1.	Dodge, Yadolah. (2014). *Statistical data analysis and inference*, Elsevier. **ISBN** 9780444880291
2.	Ismay, Chester, and Albert Y. Kim. (2019). *Statistical Inference via Data Science: A Modern Dive into R and the Tidyverse*, CRC Press. ISBN-13 : 978-0367409821
E BOOKS	
1.	https://leanpub.com/LittleInferenceBook
MOOC	
1.	https://www.coursera.org/learn/statistical-inference
2.	https://www.datacamp.com/community/open-courses/statistical-inference-and-data-analysis

COURSE TITLE	**SOCIAL NETWORK ANALYTICS**			**CREDITS**	**3**
COURSE CODE	**CAC0359**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**2-0-2-0**
Version	**1.0**	**Approval Details**	**XX ACM, XX.XX.2022**	**LEARNING LEVEL**	**BTL-3**
ASSESSMENT SCHEME					
First Periodical Assessment	**Second Periodical Assessment**	**Practical Assessment**			**ESE**
15%	**15%**	**20 %**			**50%**
Course Description	This course will enable the students to understand and apply social network concepts and methods, to create visualizations of real-world networks and interpret their structural features.				

Course Objective	1. To gain knowledge on social network analysis 2. To elaborate the web data and semantics in social network applications 3. To model and aggregate the social network data 4. To develop social- semantic applications 5. To evaluate the social network extraction with the help of case studies

Course Outcome	Upon completion of this course, the students will be able to 1. Apprise social network analysis 2. Comprehend the Web data and semantics in social network applications 3. Model and aggregate the social network data 4. Develop social–semantic applications 5. Evaluate the social network extraction with case studies

Prerequisites: Web Technology and Computer Networks

CO, PO AND PSO MAPPING

CO	PO -1	PO - 2	PO - 3	PO - 4	PO -5	PO - 6	PSO -1	PSO -2	PSO - 3
CO-1	2	2	1	1	1	1	3	1	1
CO-2	2	2	1	1	-	1	3	1	1
CO-3	2	-	1	1	1	1	3	1	1
CO-4	2	2	1	1	1	1	3	-	1
CO-5	2	2	1	1	1	1	3	1	1

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

MODULE 1: SOCIAL NETWORK ANALYSIS. (6L+6P)	
Network analysis- Development of Social network analysis- Key concepts and measures in network analysis -The global structure of networks - The macro-structure of social networks - Personal networks. **Practical Component:**To Searching for the keyword Paris using the geographic search of Flickr. **Suggested Readings:**Semantic Web	**CO-1 BTL -2**
MODULE2: WEB SEMANTICS IN SOCIAL NETWORK APPLICATIONS (6L+6P)	
Electronic sources for network analysis - Electronic discussion networks - Blogs and online communities - Web-based networks - Knowledge Representation on the Semantic Web - Ontologies and their role in the Semantic Web Ontology languages for the Semantic Web - The Resource Description Framework (RDF) and RDF Schema - The Web Ontology Language (OWL) - Comparison to the Unified Modelling Language (UML) - Comparison to the Entity/Relationship (E/R) model and the relational model - Comparison to the Extensible Markup Language (XML) and XML Schema. **Practical Component:** Identify the features in web pages that can be used for social network extraction. **Suggested Readings:**Web data and semantics	**CO-2 BTL -2**
MODULE 3: MODELLING AND AGGREGATING SOCIAL NETWORK DATA (6L+6P)	

State-of-the-art in network data representation - Ontological representation of social individuals - Ontological representation of social relationships - Aggregating and reasoning with social network data - Representing identity - On the notion of equality - Determining equality - Reasoning with instance equality -Evaluating smushing **Practical Component** Add data to a Sesame repository using the web interface	**CO-3 BTL -3**

Query data through the web interface of Sesame and display the results. **Suggested Readings:**Sesame repository	
MODULE 4:DEVELOPING SOCIAL-SEMANTIC APPLICATIONS (6L+6P)	
Building Semantic Web applications with social network features - The generic architecture of Semantic Web applications -Sesame – Elmo – GraphUtil - The features of Flink - System design – open academia: distributed, semantic-based publicationmanagement-Thefeaturesofopenacademia-Systemdesign. **Practical Component: (Algorithm Implementation)** Creating and write out a FOAF profile Using Elmo. **Suggested Readings:**ELMO	**CO-4 BTL-3**
MODULE 5: EVALUATION OF SOCIAL NETWORK ANALYSIS (6L+6P)	
Evaluation of web-based social network extraction - Data collection - Preparing the data - Optimizing goodness of fit - Comparison across methods and networks - Predicting the goodness of fit - Evaluation through analysis - Semantic-based Social Network Analysis in the sciences - Data acquisition - Representation, storage and reasoning- Visualization and Analysis– Results - Descriptive analysis - Structural and cognitive effects on scientific performance. **Practical Component: (Algorithm Implementation)** Collect personal and social data using a custom-built online survey system which an online survey offers several advantages compared to a paper questionnaire Draw the Histogram for the number of web pages per individual. **Suggested Readings:**Evaluation of Social network analysis	**CO-5 BTL-3**

TEXT BOOKS	
1.	Peter Mika, Social Networks and the Semantics Web", Springer, 2007 ISBN 978-0-387-71001-3
REFERENCE BOOKS	
1.	Borko Furht, "Handbook of Social Network Technologies and Applications", 1st Edition, Springer, 2010. ISBN 978-1-4419-7142-5
E-BOOK	
1	http://www.asecib.ase.ro/mps/Social%20Networks%20and%20the%20Semantic%20Web%20[2007].pdf
MOOC	
1.	https://www.coursera.org/learn/social-network-analysis

COURSE TITLE	**INFORMATION RETRIEVAL AND PROCESSING**			**CREDITS**	**3**
COURSE CODE	**CAC0360**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**2-0-2- 0**
Version	**1.0**	**Approval Details**	**XX ACM, XX.XX.2022**	**LEARNING LEVEL**	**BTL-3**
ASSESSMENT SCHEME					

First Periodical Assessment	Second Periodical Assessment	Practical Assessment	ESE
15 %	15 %	20 %	50%

Course Description	This course gives an insight about processing the languages, tool and techniques behind it.
Course Objective	1. To Work with the basic components of the grammar 2. To Program the syntax verification process for any grammar 3. To Resolve programmatically the meaning of the sentence 4. To Solve issues related to recurrent network for language models 5. To Design and develop NLP based solutions.
Course Outcome	Upon completion of this course, the students will be able to 1. Understand the basics of Natural language processing. 2. Analyze the text syntactically. 3. Analyze the text content semantically. 4. Implement recurrent network for language models. 5. Implement a sentiment classification and chatbot systems.
Prerequisites: AI, Python Programming	

CO, PO AND PSO MAPPING

CO	PO -1	PO - 2	PO -3	PO -4	PO - 5	PO - 6	PSO -1	PSO -2	PSO - 3
CO-1	2	2	1	1	1	1	3	1	1
CO-2	2	2	1	1	-	1	3	1	1
CO-3	2	-	1	1	1	1	3	1	1
CO-4	2	2	1	1	1	1	3	-	1
CO-5	2	2	1	1	1	1	3	1	1

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

MODULE 1: INTRODUCTION (6L+6P)	
Introduction to NLP, Regular Expressions, Words, Corpora, Text Normalization, Minimum Edit distance, N gram Language Models, Evaluating Language Models **Practical Component:** 1. Convert the text into tokens 2. Find the word frequency 3. Demonstrate a bigram language model 4. Demonstrate a trigram language model 5. Generate regular expression for a given text	**CO-1 BTL-3**
MODULE 2: SYNTACTIC ANALYSIS (6L+6P)	

English Word Classes, The Penn Treebank Part-of-Speech Tagset, Part-of- Speech Tagging, HMM Part of-Speech Tagging, Maximum Entropy Markov Models, Grammar Rules for English, Treebanks, Grammar Equivalence and Normal form, Lexicalized Grammar. **Practical Component:**	**CO-2 BTL -3**

1. Perform Lemmatization 2. Perform Stemming 3. Identify parts-of Speech using Penn Treebank tag set. 4. Implement HMM for POS tagging 5. Build a Chunker	
MODULE 3: SEMANTIC ANALYSIS	**(6L+6P)**
Representation of Sentence Meaning: Computational Desiderata for Representations, Model Theoretic Semantics, First-Order Logic, Event and State Representations, Description Logics, Semantic roles, Semantic role labeling. **Practical Component:** 1. Find the synonym of a word using WordNet 2. Find the antonym of a word 3. Implement semantic role labeling to identify named entities 4. Resolve the ambiguity 5. Translate the text using First-order logic	**CO-3 BTL-3**
MODULE 4: SEQUENCE PARSING WITH RECURRENT NETWORKS	**(6L+6P)**
Simple Recurrent Networks, Applications of RNNs, Deep Networks: Stacked and Bidirectional RNNs, Managing Context in RNNs: LSTMs and GRUs, Words, Characters and Byte-Pairs. **Practical Component:** 1. Implement RNN for sequence labeling 2. Implement POS tagging using LSTM 3. Implement Named Entity Recognizer 4. Word sense disambiguation by LSTM/GRU	**CO-4 BTL-3**
MODULE 5: CASE STUDY	**(6L+6P)**
Sentiment Classification, Dialog Systems and Chatbots **Practical Component:** 1. Develop a Movie review system 2. Create a chatbot for HITS.	**CO-5 BTL-3**

TEXT BOOKS	
1.	Dan Jurafsky and James H. Martin. Speech and Language Processing (3rd ed. draft), 2019.ISBN 978-81-317-1672-4

REFERENCE BOOKS	
1.	Steven Bird, Ewan Klein, and Edward Loper, Natural Language Processing with Python, First Edition, O'reilly, 2009
2.	Yoav Goldberg, University of Toronto, Neural Network Methods for Natural language Processing, Morgan & Claypool, 2017
3.	Christopher D. Manning, and HinrichSchütze. Foundations of statistical natural language processing. First Edition, MIT press, 1999

E BOOKS	
1.	https://www.nltk.org/book/
2.	https://www.cs.vassar.edu/~cs366/docs/Manning_Schuetze_StatisticalNLP.pdf
3.	https://www.nltk.org/genindex.html

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

COURSE TITLE	COMPUTER VISION TECHNIQUES			CREDITS	4
COURSE CODE	CAC0361	COURSE CATEGORY	DE	L-T-P-S	2-0-2-0
Version	1.0	Approval Details	XX ACM, XX.XX.2022	LEARNING LEVEL	BTL-3

ASSESSMENT SCHEME

First Periodical Assessment	Second Periodical Assessment	Practical Assessment	ESE
15 %	15%	20 %	50 %

Course Description	This course will enable the students to study the basics of image processing and apply the morphological algorithms, image segmentation techniques, feature extraction methods and patten classification methods for various real- time applications.
Course Objective	1. To understand the fundamentals of computer vision and perform image operations. 2. To summarize various feature extraction techniques. 3. To Demonstrate various segmentation techniques. 4. To Explain Dense Motion Analysis and estimate motion parameter. 5. To Implement several applications of computer vision using machine and deep learning techniques.
Course Outcome	Upon completion of this course, the students will be able to 1. Explain the fundamentals of computer vision and perform image operations. 2. Explain various feature extraction techniques. 3. Demonstrate various segmentation techniques. 4. Explain Dense Motion Analysis and estimate motion parameter. 5. Implement several applications of computer vision using machine and deep learning techniques.

Prerequisites: Basic knowledge in Linear algebra and vector calculus

CO, PO AND PSO MAPPING

CO	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PSO -1	PSO -2	PSO -3
CO-1	2	2	1	1	1	1	3	1	1
CO-2	2	2	1	1	-	1	3	1	1
CO-3	2	-	1	1	1	1	3	1	1
CO-4	2	2	1	1	1	1	3	-	1
CO-5	2	2	1	1	1	1	3	1	1

1: Weakly related, 2: Moderately related and 3: Strongly related
MODULE 1: FUNDAMENTALS OF COMPUTER VISION AND IMAGE OPERATIONS (6L+6P)

Introduction to computer vision - Geometric primitives: 2D and 3D transformations - 3D to 2D projections - Image formation- Light Models – Camera Geometry – Stereo Vision. Thresholding – Histogram processing – Convolution and Filtering – Image Enhancement – Fourier transform **Practical Component:** Use Python/ MATLAB Apply various intensity transformations functions. Computing and plotting image histograms and use standard image processing toolbox Spatial filters. Implement color image Smoothing and Sharpening.	**CO-1 BTL-2**
MODULE 2: IMAGE FEATURE EXTRACTION (6L+6P)	
Edge detection - Canny, LOG, DOG; Line detection; Corner detection; Orientation Histogram, SIFT, SURF, HOG, Scale-Space Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT. **Practical Component:** Use Python/MATLAB Implement Morphological operations. Implement Morphological Reconstruction. Implement Grayscale Morphology.	**CO-2 BTL-2**
MODULE 3: IMAGE SEGMENTATION (6L+6P)	
Region Growing - Edge Based approaches to segmentation - Graph-Cut - Mean- Shift, MRFs, Texture Segmentation. **Practical Component:** Use Python/ MATLAB Implement Optimum Global Thresholding using Otsu's Method. Implement Image segmentation by Region Growing, Splitting and Merging Implement Image Segmentation by Active Contours using anyone method Snakes and Level Sets.	**CO-3 BTL-3**
MODULE 4: MOTION ANALYSIS (6L+6P)	
Background Subtraction and Modeling, Optical Flow - KLT, Spatio-Temporal Analysis, Dynamic Stereo; Motion parameter estimation. **Practical Component:** Use Python/ MATLAB Implement Boundary Feature Descriptors Implement Topological and Texture Descriptors Implement Scale-Invariant Feature Transform (SIFT)	**CO-4 BTL-3**
MODULE 5: COMPUTER VISION APPLICATIONS (6L+6P)	
Image Classification – Image Retrieval- Object Detection -Image Captioning - Generative Models-Video Classification. **Practical Component:** Use Python/ MATLAB Implement Minimum-Distance Classification Algorithm. Implement Optimum (Bayes) Statistical Classification Algorithm. Implement Deep Convolutional Neural Network.	**CO-5 BTL-3**
TEXT BOOKS	

1.	Reinhard Klette, "Concise Computer Vision: An introduction into theory and Algorithms", Springer-Verlag London, 2014.
2.	R. Shanmugamani, "Deep Learning for Computer Vision", Packt Publishing, Jan 2018.
REFERENCE BOOKS	
	RichardSzeliski,"ComputerVision:AlgorithmsandApplications",SpringerInternational, 2011.
	DavidAforsyth&Jeanponce,"Computervision–AmodernApproach",PrenticeHall ,2002.
E BOOKS	
1.	http://szeliski.org/Book/drafts/SzeliskiBook_20100903_draft.pdf
MOOC	
1.	https://in.udacity.com/course/introduction-to-computer-vision--ud810
2.	https://www.edx.org/course/computer-vision-image-analysis-1

COURSE TITLE	**DIGITAL IMAGE PROCESSING USING MATLAB**			**CREDITS**	**3**
COURSE CODE	**CAC0362**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**2-0-2-0**
Version	**1.0**	**Approval Details**	**XX ACM, XX.XX.2022**	**LEARNING LEVEL**	**BTL-3**
ASSESSMENT SCHEME					
First Periodical Assessment	**Second Periodical Assessment**	**Practical Assessment**			**ESE**
15%	**15%**	**20 %**			**50%**
Course Description	This course will enable the students to understand and apply social network concepts and methods, to create visualizations of real-world networks and interpret their structural features.				
Course Objective	1. To understand the basics and fundamentals of digital image processing such as digitization, sampling, quantization, and operations. 2.To gain knowledge on the various techniques for intensity transformations functionsandspatialfilteringformodifyorenhancementofanimage. 3.To Compute Discrete Fourier Transform and apply Frequency domain filters for image enhancement. 4.To Understand and Apply Color Models in Digital Image Processing. 5.To IllustrateMorphologicaloperationandApplyimagesegmentation				

	techniques for various applications.
Course Outcome	Upon completion of this course, the students will be able to 1. Infer the basics and fundamentals of digital image processing such as digitization, sampling, quantization, and operations. 2. Apply the various techniques for intensity transformations functions and spatial filtering for modify or enhancement of an image. 3. Compute Discrete Fourier Transform and apply Frequency domain filters for image enhancement. 4. Understand and Apply Color Models in Digital Image Processing. 5. Illustrate Morphological operation and Apply image segmentation techniques for various applications.
Prerequisites: Image Visualization	

CO, PO AND PSO MAPPING

CO	PO -1	PO - 2	PO - 3	PO -4	PO - 5	PO -6	PSO -1	PSO -2	PSO - 3
CO-1	2	2	1	1	1	1	3	1	1
CO-2	2	2	1	1	-	1	3	1	1
CO-3	2	-	1	1	1	1	3	1	1
CO-4	2	2	1	1	1	1	3	-	1
CO-5	2	2	1	1	1	1	3	1	1

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

MODULE 1: DIGITAL IMAGE FUNDAMENTALS	**(6L+6P)**
Introduction – Fundamental steps in Image Processing Systems – Image Acquisition – Sampling and Quantization – Pixel Relationships – Mathematical Tools Used in Digital Image Processing. **Practical Component**: Find the representation of image, Reading Images, Writing Images, displaying images, handling image types, and handling operators in images using MATLAB	**CO-1 BTL -2**
MODULE 2: MORPHOLOGICAL IMAGE PROCESSING	**(6L+6P)**
Background - Some Basic Intensity Transformation Functions: Image Negatives, Log Transformations, Power-Law Transformations - Histogram Processing. Fundamentals of Spatial Filtering - Smoothing Spatial Filters - Sharpening Spatial Filters. **Practical Component**: Apply Various intensity transformations functions, Computing and plotting image histograms and use standard image processing toolbox Spatial filters in MATLAB	**CO-2 BTL -2**

MODULE 3: IMAGE SEGMENTATION (6L+6P)	
Background - Sampling and the Fourier Transform of sampled functions - Discrete Fourier Transform (DFT) - Some Properties of the 2-D Discrete Fourier Transform - The Basics of Filtering in the Frequency Domain - Image Smoothing and Sharpening using Frequency Domain Filters - Selective Filtering. **Practical Component**: Compute and visualize the 2-D DFT, implement smoothing and sharpening techniques using lowpass and highpass filters in frequency domain in MATLAB.	**CO-3 BTL-3**
MODULE 4: FEATURE EXTRACTION (6L+6P)	
Color Fundamentals - Color Models: RGB, CMY, CMYK, and HSI Color Models - Pseudocolor Image Processing - Color Transformations - Color Image Smoothing and Sharpening. **Practical Component**: Find the representation of color image, Convert to Other Color Spaces, implement color transformations, and implement color image Smoothing and Sharpening in MATLAB.	**CO-4 BTL-3**
MODULE 5: IMAGE PATTERN CLASSIFICATION (6L+6P)	
Morphological Image Processing: Fundamentals - Erosion and Dilation - Opening and Closing - Some Basic Morphological Algorithms. Image Segmentation: Introduction - Point, Line, and Edge Detection – Segmentation by Region Growing and by Region Splitting and Merging. **Practical Component**: Implement Morphological operations, image segmentation and region-based segmentation in MATLAB.	**CO-5 BTL-3**

TEXT BOOKS	
1.	Rafael C Gonzalez, Richard E Woods, "Digital Image Processing", 4th Edition, Pearson, 2018.

REFERENCE BOOKS	
	Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, Digital Image Processing using MATLAB Pearson Education, Inc., 2011.
	Kenneth R. Castleman, Digital Image Processing Pearson, 2006.
	Anil K.Jain, "Fundamentals of Digital Image Processing", Person Educaiton, 2003.

E BOOKS	
1.	https://www.academia.edu/19746149/Digital_Image_Processing_3rd_Edition_Instructors_Manual_Rafael_C._Gonzalez
2.	https://www.academia.edu/18324189/Digital_image_processing_using_matlab_gonzalez_
3.	https://pdfs.semanticscholar.org/15bd/427a1a5f9bc57a7f67fb1b1fc85c5bb39f46.pdf

MOOC	
1.	https://www.coursera.org/learn/digital
2.	https://www.udemy.com/topic/digital-image-processing/
3.	https://www.edx.org/course/image-processing-and-analysis-for-life-scientists

<table>
<tr><td>COURSE TITLE</td><td colspan="3">CONDITIONAL MONITORING TECHNIQUES FOR DATA SCIENCE</td><td>CREDITS</td><td>3</td></tr>
<tr><td>COURSE CODE</td><td>CAC0375</td><td>COURSE CATEGORY</td><td>DE</td><td>L-T-P-S</td><td>2-0-2-0</td></tr>
<tr><td>Version</td><td>1.0</td><td>Approval Details</td><td>XX ACM, XX.XX.2022</td><td>LEARNING LEVEL</td><td>BTL-3</td></tr>
<tr><td colspan="6">ASSESSMENT SCHEME</td></tr>
<tr><td>First Periodical Assessment</td><td>Second Periodical Assessment</td><td colspan="3">Practical Assessment</td><td>ESE</td></tr>
<tr><td>15%</td><td>15%</td><td colspan="3">20%</td><td>50%</td></tr>
<tr><td>Course Description</td><td colspan="5">This course will enable the students to know that Condition Monitoring is the process of monitoring a parameter of condition in machineries such as Vibration and Temperature in order to look for signs that a fault may be developing, Condition Monitoring is a major component of predictive maintenance and is more efficient than reactive maintenance since faults can generally be avoided.</td></tr>
<tr><td>Course Objective</td><td colspan="5">1.To understand the fundamentals of condition monitoring techniques 2.To infer the conditional monitoring technique to identify the faults 3.To Know the role of Networks in Condition monitoring
4. To relate Transfer Bushings
5. To Investigate the online condition monitoring</td></tr>
<tr><td>Course Outcome</td><td colspan="5">Upon completion of this course, the students will be able to
1.Understand the fundamentals of condition monitoring techniques 2.Apply the conditional monitoring technique to identify the faults 3.Know the role of Networks in Condition monitoring
4. Apply for Transfer Bushings
5. Investigate the online condition monitoring</td></tr>
<tr><td colspan="6">Prerequisites: Web Technology and Computer Networks</td></tr>
<tr><td colspan="6">CO, PO AND PSO MAPPING</td></tr>
</table>

CO	PO - 1	PO - 2	PO - 3	PO - 4	PO -5	PO - 6	PSO -1	PSO -2	PSO - 3
CO-1	2	2	1	1	1	1	3	1	1
CO-2	2	2	1	1	-	1	3	1	1
CO-3	2	-	1	1	1	1	3	1	1
CO-4	2	2	1	1	1	1	3	-	1
CO-5	2	2	1	1	1	1	3	1	1

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

MODULE 1: INTRODUCTION	**(6L+6P)**
Theory of condition Monitoring- Stages of condition Monitoring- Data and Strategies used for condition Monitoring-Data preprocessing Techniques-Data Acquisition System-Fourier Transform-Model Properties-Pseudo model Energies-Fractal Dimension-MFCC- Kurtosis Wavelet Transform- Principal component Analysis **Practical component:** 1. Practice on data preprocessing 2. Experimentation on Data Acquisition	**CO-1 BTL-2**
MODULE2: MULTILAYER PERCEPTRON	**(6L+6P)**
Mathematical Framework-Multifold Cross validation Method-Applications to Cylindrical Shells-Bayesian Approaches to Conditional Monitoring-Neural Networks- Sampling Methods-Fault Identification of Cylindrical Shells. **Practical component:** 1. Implement the Bayesian Approach for structural and health Monitoring 2. Develop the Model based on failure detection for cylindrical shells	**CO-2 BTL-2**
MODULE 3: NETWORK APPROACH TO CONDITION MONITORING	**(6L+6P)**
Committee of Networks-Bayes Optimal Classifier-Bagging-Boosting-Stacking-Evolutionary Committees-Theoretical Background-Theory of committee of Networks-Gaussian Mixture Models and Hidden Markov models for Condition Monitoring-Fuzzy system for Condition Monitoring **Practical component:** 1. Apply the condition monitoring techniques for Machine tool with Gaussian mixture model 2. Analyze the Use of Fuzzy Logic for Condition Monitoring of Motor Driven Machineries	**CO-3 BTL-3**
MODULE 4: ROUGH SETS FOR CONDITION MONITORING	**(6L+6P)**
Rough Sets—Discriminative Methods-Rough set Formulation-Optimized Rough Sets-Application to Transfer Bushings-Condition Monitoring with incomplete Information-Genetic Algorithm-Missing Entry Methodology-Dynamics **Practical component:** 1. Develop the system for On-line Condition Monitoring and Diagnosis for Power Transformers 2. Apply the Genetic algorithms for feature selection in machine condition monitoring	**CO-4 BTL-3**
MODULE 5: CONDITION MONITORING USING SVM	**(6L+6P)**

Features-Feature Extraction-Classification Techniques-Support Vector Machine -Extension Neural Networks-On-line Condition monitoring using ensample learning-Ensample Methods-Learn++ On-line Method-Multi layer perceptron-Experimental Investigation. **Practical component:** 1. Build a Model for On-line Condition monitoring using ensample learning 2. Investigate the On-line Method for conditional monitoring using Multi-layer perceptron	**CO-5 BTL-3**

TEXT BOOKS	
1.	Peter Mika, Social Networks and the Semantics Web", Springer, 2007 ISBN 978-0-387-71001-3
REFERENCE BOOKS	
1.	Borko Furht, "Handbook of Social Network Technologies and Applications", 1st Edition, Springer, 2010. ISBN 978-1-4419-7142-5
E-BOOK	
1	http://www.asecib.ase.ro/mps/Social%20Networks%20and%20the%20Semantic%20Web%20[2007].pdf
MOOC	
1.	https://www.coursera.org/learn/social-network-analysis

COURSE TITLE	**IOT CLOUD AND DATA ANALYTICS**			**CREDITS**	**3**
COURSE CODE	**CAC0376**	**COURSE CATEGORY**	**DE**	**L-T-P-S**	**2-0-2-0**
Version	**1.0**	**Approval Details**	**XX ACM, XX.XX.2022**	**LEARNING LEVEL**	**BTL-4**

ASSESSMENT SCHEME

First Periodical Assessment	**Second Periodical Assessment**	**Practical Assessment**	**ESE**
15%	**15%**	**20 %**	**50%**

Course Description	This is a course suitable for B.Sc Data Science students. It gives idea about definitions of IoT and cloud service models. This course also gives knowledge in the IoT analytics challenges and foundation of Artificial intelligence and IoT.

Course Objective	1. To gain knowledge on the Concepts and definitions of IoT. 2. To learn the concepts of cloud service models. 3. To learn the various principles and foundation of Artificial intelligence and IoT. 4. To learn the IoT analytics challenges. 5. To comprehend the security Threats in IoT.
Course Outcome	Upon completion of this course, the students will be able to 1. Demonstrate the working of IoT. 2. Identify the need of cloud computing for IoT. 3. Apply Machine Learning Algorithms for IoT data. 4. Predict and visualize output using Data Analytic tools. 5. Identify the Vulnerability in connected networks.

Prerequisites: Basic Networking Concepts

CO, PO AND PSO MAPPING

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

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

MODULE 1: INTRODUCTION TO IoT (6L+6P=12)

Introduction to Internet of Things (IoT)- Concepts and definitions of IoT-History of IoT – IoT data vs big data- IoT Analytics lifecycle and Techniques-IoT complete Technology chain- Applications of IoT- Opportunities and challenges in IoT. **Practical component:** Study of IoT simulators. Simulate data collection using IoT simulators (IOTIFY/NETSIM) Study of Hardware platforms Arduino/Raspberry pi/Node MCU Implement sensor data collection using IoT gateways (Arduino/Raspberry pi/Node MCU)	**CO-1 BTL-2**

MODULE 2: IoT and CLOUD (6L+6P = 12)

Cloud computing – Cloud service models – Cloud Deployment models – Need of cloud computing for IoT-Fog Computing Vs Cloud Computing for IoT-IoT Cloud Platforms –Microsoft Azure IoT-Amazon Web Services IoT-IBM WATSON IoT- Google's cloud IoT. **Practical component:** Develop your own Application that stores IoT data in open source IoT cloud platform analytic tools. Study of Streaming IoT data in to Google cloud platform using Qwiklab environment.	**CO-2 BTL-2**
MODULE 3: IoT AND MACHINE LEARNING (6L+6P = 12)	
Principles and foundation of Artificial intelligence and IoT – Machine Learning Paradigms for IoT – Supervised learning for IoT-Linear Regression-Logistic regression-SVM – Decision Tree -Naïve's bayes- Deep Learning for IoT-Neural Network. **Practical component:** Write a program to implement the Linear regression for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets. Build a decision tree classifier for weather prediction dataset. Compute the accuracy of the classifier, considering few test data sets.	**CO-3 BTL-3**
MODULE 4: IoT SECURITY (6L+6P = 12)	
Defining IoT Analytics - IoT Analytics challenges – IoT analytics for the cloud-Microsoft Azure overview– Designing data processing for analytics – Designing visual analysis for IoT Data-Data science for IoT-Feature engineering with IoT data. **Practical component:** Develop application for Smart Traffic that analyse the IoT data and predict the Traffic Jam, Visualize the predicted output using Data Analytics tool.	**CO-4 BTL-4**
MODULE 5: MULTIMEDIA NETWORKING AND NETWORK MANAGEMENT (6L+6P = 12)	
Overview of IoT Security- security Threats in IoT- APIs in IoT-Authentication in IoT-Strategies for securing IoT-Public Key Cryptography. **Practical component:** Implement pen test and identify the vulnerable device in your network using Kali Linux. Implement Password Guess attack after identifying Vulnerable device using Kali Linux.	**CO-5 BTL-4**
TEXT BOOKS	

1.	Rajkumar Buyya, Amir Vahid Dastjerdi. (2016). *Internet of Things: Principles and Paradigms*, Elsevier. **ISBN** 9780128053959,
2.	R. Chandrasekaran. (2015). *Essentials of Cloud computing*, 2nd Edition, Chapman and Hall/CRC. **ISBN**-13: 978-1482205435;
3.	Amita Kapoor. (2019). *Hands on Artificial intelligence for IoT*, 1st Edition, Packt Publishing. **ISBN**: 1788836065.
4.	David Etter. (2016). *IoT Security: Practical Guide Book*, CreateSpace Independent Publishing Platform. **ISBN**-13: 978-1540335012
REFERENCE BOOKS	
1.	John Soldatos. (2016). Building Blocks for IoT Analytics, River Publishers. e-ISBN: 9788793519046
2.	John E. Rossman. (2016). The Amazon way on IoT, Volume 2, John E. Rossman publication. ISBN-13: 9780692739006
E BOOKS	
1.	http://index-of.co.uk/Cloud-Computing books/Essentials%20of%20cloud%20computing%20(2015).pdf
2.	https://www.iottechexpo.com/2018/11/iot/the-iot-analytics-lifecycle-from-generating-data-to-predicting-the-future-losant/
MOOC	
1.	https://www.coursera.org/learn/cloud-iot-platform
2.	https://www.udemy.com/course/iothacking1/